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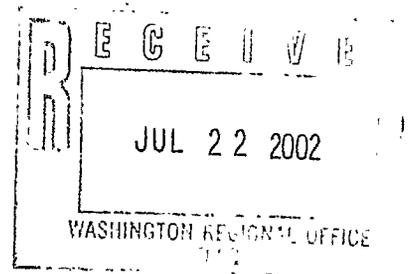
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July 19, 2002

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**RE: ZVI/Molasses Pilot Test Report
Washington, North Carolina**



Dear Mark:

On behalf of Hamilton Beach-Proctor-Silex (HBPS), URS Corporation – North Carolina (URS) is submitting the enclosed copy of the referenced report as required by UIC Permit No. WI0700035. This report, which was prepared by the technology provider, Alpine Field Services (formerly NESCO), in cooperation with URS, describes the pilot test, summarizes the results, and provides conclusions and recommendations for full-scale application of the technology at the HBPS facility in Washington, NC.

According to permit requirements, Radian has also included contaminant plume and potentiometric surface maps. These maps were added at the end of the enclosed report. These maps were prepared in August 2001 as part of groundwater sampling conducted at the site.

The pilot test demonstrated that the in-situ application of zero valent iron (ZVI) and molasses can be safely implemented at the site with limited disruptions to operations or local activities. Analytical results from groundwater samples indicated significant reductions of the contaminant levels in the treatment areas.

URS and HBPS are preparing to initiate development of a corrective action plan (CAP) that will include full-scale application of a ZVI-based in-situ technology to remediate portions of the dissolved phase groundwater contaminant plume. Along with the CAP submittal, we expect to submit a UIC permit application for this full-scale application.

Please call me (919-461-1290) or Jim Narkunas with any additional questions or concerns (919-461-1270).

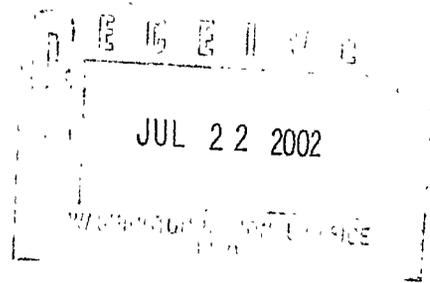
Sincerely,
URS CORPORATION – NORTH CAROLINA

Brett Berra

Enclosure

cc: Michelle Volosin, NCDENR-WaRO
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**Hamilton Beach Proctor-Silex, Inc.
Washington, North Carolina
ZVI Pilot Test Report**

July 2002

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Hamilton Beach ◊ Proctor-Silex, Inc.
Washington, North Carolina
ZVI Pilot Test Report

EXECUTIVE SUMMARY

A pilot test involving the subsurface injection of zero-valent iron (ZVI) and molasses was conducted from 2 October 2001 to 9 April 2002 at the Hamilton Beach◊Proctor-Silex, Inc. (HBPS) facility in Washington, North Carolina. This pilot test was a continuation of a bench study conducted in October of 2000 to evaluate the potential use of ZVI to remediate site contamination.

Chemical contamination at the site is distributed in a shallow groundwater reservoir (Unit A) and a semi-confined aquifer (Unit B). Significant reductions in concentrations of principal site contaminants were observed during the pilot test. Eighty to 90 percent reductions in 1,1,1-trichloroethane (TCA) and trichloroethene (TCE) were obtained in Unit B and 50 to 60 percent reductions were obtained in Unit A.

A strong correlation between concentration changes in wet chemistry parameters and chlorinated solvent concentrations was noted in each unit. Wet chemistry parameters measured during the pilot test can be used as secondary confirmation of the reductive dechlorination process and several positive results were obtained.

- Sustained reductions in oxidation-reduction potential (ORP) resulted in each unit.
- Ferrous iron concentrations increased by 92 percent in Unit B and by 83 percent in Unit A.
- The increase in chloride concentration almost exactly matched the rise in ferrous iron concentration in Unit A.

Rates of degradation for all contaminants and degradation products were calculated using a first order kinetic model, and the time for remediation was estimated for each unit. Calculated rate constants from the pilot test were compared to those obtained from the bench study and excellent agreement was obtained in Unit B. Unit A rate constants were lower than those in the Unit B, however this disparity is explained by the soil types present in this shallow reservoir. Pilot test results indicate that groundwater cleanup goals for chlorinated hydrocarbons may be approached in approximately 1.5 to 2 years. However, because of the limited area of the pilot test and the vast differences in contaminant concentrations and hydrogeologic conditions across the site, a more realistic estimate for the time required to reach North Carolina Groundwater Standards is approximately 2 to 4 years after installation of the in-situ reagents. In addition, this estimate is based on the assumption that the source area has been removed prior to implementation. This time period may be shortened if target groundwater cleanup goals greater than the North Carolina Groundwater Standards are approved in the future for this site.

Objectives of the pilot test included optimization of injection parameters, confirmation of the predicted performance of ZVI, and estimation of the time required to remediate contamination in saturated soils at the site. Pilot objectives were successfully met and system design parameters have been defined.

1.0 Introduction

A pilot test involving the subsurface injection of zero-valent iron (ZVI) and molasses was conducted from 2 October 2001 to 9 April 2002 at the Hamilton Beach-Proctor-Silex, Inc. facility in Washington, North Carolina. The pilot test was scheduled after the results of a laboratory bench test indicated that the contaminants of concern at the site were effectively reduced by ZVI (NESCO, 2001). Pilot testing was performed to evaluate the efficacy of this technology in reducing soil and groundwater contamination under field conditions. The test was conducted according to the conditions specified in Underground Injection Control Permit No. WI0700035. This report describes the pilot test procedures, interprets the test results, and presents conclusions and recommendations.

1.1 Report Organization

The report is organized as follows:

- Section 1 is this introduction, which briefly describes the site history, its hydrogeology, and the results of previous site assessment;
- Section 2 identifies the two test areas and summarizes the technical approach;
- Section 3 discusses the results of soil sampling and analysis;
- Section 4 provides selected details of the ZVI installation;
- Section 5 discusses the results of groundwater sampling and analysis;
- Section 6 interprets the pilot test results;
- Sections 7 and 8 provide conclusions and recommendations; and
- Section 9 lists references.

In order to concentrate on the pilot results, we have placed discussions pertaining to fieldwork and technical details associated with theoretical reaction pathways in appendices. While documenting fieldwork and providing details, such as the amount of iron injected at each location and why molasses was utilized in concert with the iron, are all very important details of the work performed, they are not critical to understanding the pilot results, and for brevity, these details are provided in Appendix A.

Some understanding of the important reactions occurring within the zone of injected iron is essential to interpretation of the results, and a brief description of this is contained in the report. A more-detailed discussion of reaction pathways explaining why certain compounds are formed in preference to others, and a short discussion of first order reaction kinetics is provided in Appendix B.

1.2 Site Description

A detailed description of the site is included in the *Comprehensive Site Assessment Report, Hamilton Beach-Proctor-Silex, Inc., Washington, North Carolina* (Radian Engineering, Inc., 1999). The following description is summarized from that report.

1.2.1 Site History

The Hamilton Beach-Proctor-Silex (HBPS) facility is located at 234 Springs Road, north of the City of Washington, in Beaufort County, North Carolina. The facility and surrounding land parcel are owned by the City of Washington and have been leased by HBPS since 1990 and previously leased by predecessor companies. HBPS no longer uses the facility for manufacturing. A portion of the facility is currently subleased to another manufacturing company.

In 1992, chemicals were initially detected underlying the site. This finding led to several phases of environmental investigation. Based on the site's description and operating history and on the results of the site investigations, it is likely that the chemicals detected in soil and groundwater originated from multiple sources. Current data indicate that soil and groundwater at the site exhibit constituents of both petroleum hydrocarbons and degreasing solvents. The exact sources of the chemicals are unknown but may be one or more of the various above-ground storage tanks (ASTs) and underground storage tanks (USTs) that have been utilized at the site. The nature, volume, and time period of any releases associated with these potential sources is also unknown. The area occupied by these potential sources is located adjacent to the south wall of the plant building, near the southeast corner, and is referred to as the source area.

1.2.2 Site Hydrogeology

The hydrogeology of the site is characterized, in the upper 75 feet, by a shallow groundwater reservoir (Unit A), a surficial confining bed, a semi-confined aquifer (Unit B), a lower (Yorktown) confining bed, and the semi-confined Tertiary limestone (Castle Hayne) aquifer.

Unit A coincides with the complexly interbedded fine sand to clay deposits that comprise the upper 5 to 10 feet of sediments underlying the site. Unit A is not considered to be an aquifer due to the variable permeability, discontinuous nature, and thin saturated thickness of its component deposits. The hydraulic conductivity of deposits comprising Unit A range from 3.6×10^{-2} ft/day to 7.4×10^{-2} ft/day. These measurements represent average values because the intervals tested include interlayered beds of both low permeability clay and more permeable sand. Measurement of hydraulic conductivity at 5.7×10^{-4} ft/day in one location may represent an interval of lower permeability clay deposits comprising Unit A or may represent a section of the confining bed underlying the unit. Based on a textural description of the deposits, the effective porosity is estimated to range from approximately 3 percent for the clay deposits to approximately 20 percent for the sand deposits. Groundwater within Unit A is expected to occur under water table conditions; although, water within an individual sand layer or lens may be confined. The top of Unit A occurs at the water table, which is typically about 3 to 5 feet below ground surface (bgs) at the site. The base of Unit A is approximately 4 to 7 feet bgs and coincides with the top of a shallow confining bed. Therefore, the thickness of

Unit A at the site is typically 4 feet or less.

Silty fine sand deposits form a semi-confined aquifer between the overlying shallow confining bed and the underlying Yorktown confining bed. The aquifer is identified as Unit B to distinguish it from the overlying shallow groundwater reservoir that also occurs within the surficial deposits at the site. The hydraulic conductivity of Unit B is calculated at approximately 3.0 ft/day and the effective porosity is estimated to be approximately 20 percent. The top of Unit B typically occurs about 12 to 16 feet bgs at the site, but may be as shallow as 7 feet bgs where the overlying shallow confining bed is thin. The base of Unit B is approximately 30 to 40 feet bgs and coincides with the top of the Yorktown confining bed. The thickness of Unit B averages about 25 feet, but varies considerably across the site ranging from about 15 feet to 35 feet. The clay deposits of the Yorktown Formation comprise the Yorktown confining bed overlying the Tertiary limestone aquifer. Based on a textural description of the deposits, the hydraulic conductivity of the Yorktown confining bed is estimated to be low to very low, on the order of 10^{-3} ft/day, or less.

Groundwater in Unit A flows toward and discharges into the drainage ditch that borders the site on the east and south. Groundwater in Unit B flows in the opposite direction toward the north and northwest. The average linear groundwater flow velocity in the more permeable beds in Unit A ranges from 0.01 to 0.04 feet/day. The linear groundwater flow velocity in Unit B is estimated to average 0.05 feet/day; however, flow within more permeable deposits comprising Unit B may approach 0.1 ft/day. The range of velocity values is considered representative for the site, but does not take into account inherent small-scale differences in gradient, porosity, and hydraulic conductivity that occur within the units.

1.2.3 Assessment Results

Soil and water at the site contain fuel, chlorinated and non-chlorinated volatile organic compounds, and semivolatile organic compounds that are consistent with the storage and use of petroleum products and degreasing solvents. The principal chemicals detected at the site are certain volatile organic compounds (VOCs), including trichloroethene (TCE) and 1,1,1-trichloroethane (TCA). Certain semivolatile organic compounds (SVOCs) are detected less frequently, at lower concentrations, and over a smaller area.

Soil in the source area exceeds action levels for TPH and for several VOCs and SVOCs. The source area is located adjacent to the former solvent AST, encompasses an area approximately 90 feet by 150 feet in size, and is known to extend beneath a portion of the plant building. Chemicals detected in soil outside the source area are presumed to represent transport by groundwater and subsequent adsorption onto the soil.

Groundwater underlying the site exceeds action levels for certain, predominantly, chlorinated VOCs. Groundwater also exceeds action levels for certain SVOCs; however, the extent of the semivolatile organics is limited to Unit A in the immediate source area. A dissolved VOC plume, originating at the source area, is present in both hydrogeologic

Unit A and Unit B. Within Unit A, the plume extends from the source area toward the south and discharges to a drainage ditch as evidenced by the presence of similar volatile organics, at significantly lower concentrations, in the surface water. A lobe of the plume extends to the area east of the employee parking lot. The existence of this lobe may be due to preferential chemical migration through a former, now buried, drainage ditch. Within Unit B, the plume extends from the source area toward the northwest. The plume underlies the plant building and the leading edge is located about 700 feet from the source area and approximately 150 feet from Springs Road. A lobe of the plume extends from the source area, against the hydraulic gradient, to the south. Two former roof drains that extend from the plant building to the ditch in this general area may influence the position of the lobe. No analytes were detected at concentrations that exceed action levels in samples from off-site monitoring points. The Yorktown confining bed retards vertical migration of the plume as no VOCs were detected in a sample collected from beneath the Yorktown confining bed underlying the source area.

2.0 Objectives and Technical Approach

The pilot test was conducted to evaluate the feasibility of using ZVI and molasses to remediate groundwater quality at the site. In that regard, the test had the following objectives:

- Determine the optimal slurry density (pounds of iron powder per gallon of slurry) and the injection volumetric flow rate appropriate for subsurface conditions at the site;
- Determine the practical limits for the volume of slurry to be applied at each injection point;
- Determine the hydraulic fracture geometry;
- Confirm suitability of ZVI for cleanup of groundwater contamination, and,
- Monitor the transient changes in contaminant concentrations to estimate kinetic rates and the approximate time required for remediation.

Testing was performed at two locations (Figure 1) to evaluate the technology separately in Hydrogeologic Unit B and Hydrogeologic Unit A. The technical approach is described in detail in Appendix A. In general, the following steps were taken at each of the two locations:

- Soil samples were collected from the unit, visually inspected and chemically analyzed to identify soil type and to determine the chemical concentration and distribution in soil before reagent injection;
- Temporary groundwater sampling implants were installed in the unit, implants were developed, and sampled and analyzed at various times, to determine chemical concentration and distribution in groundwater before and after reagent injection;
- ZVI and molasses were injected into the hydrogeologic unit.

Plans for the pilot test injection and monitoring networks for Unit B and Unit A are shown in Figure 2 and Figure 3, respectively.

3.0 Results of Soil Sampling and Analysis

As indicated in Section 2, the first task performed was to advance a continuous soil core within the test area to a selected depth. The targeted depth of soil sampling was based on historical data from the *Comprehensive Site Assessment Report*. The purpose of this sampling was to determine how contaminants of concern were distributed throughout the formation as a function of depth. This information was critical to placement of ZVI and to installation of temporary implants.

As detailed in Appendix A, cores were logged and sub-samples were taken every 2 feet for laboratory analysis using EPA SW 846 Method 8260B. Area specific results are provided in the following sections.

3.1 Unit B Test Location

Previous investigation work suggested that this unit consists of silty fine grained sand, semi-confined by Unit A silty clays above and the Yorktown clays below. A continuous soil boring was advanced to a depth of 34 feet bgs near implant number B-M6 to vertically profile contaminants. The majority of soil types logged at this location were silty clays, which does not match previous soil samples taken from this formation. A sand lens was noted at a depth of 21 feet to 24 feet bgs and shell fragments were encountered at 34 feet bgs.

Samples of the core were taken every 2 feet and submitted for analysis of VOCs. Analytical results indicate a significant concentration of contaminants was present at a depth of approximately 18 feet, reached a maximum at 28 feet, and had dropped off dramatically at a depth of 30 feet. Based on these results, implants were installed at a depth of approximately 28 feet bgs with a 5-foot section of screen. These analytical results and the soil log can be found in Appendix C.

3.2 Unit A Test Location

Two soil borings were advanced at this test location. The first (SB-A1) was located at the approximate center of the test area slightly upgradient of implant A-M6 and was advanced to a depth of 16 feet bgs. The second was located in the vicinity of implant A-M2 and was advanced to a depth of 12 feet bgs. Soil types logged at these locations were very comparable to those noted historically, consisting of interbedded silty clays and fine silty sands.

As above, core samples were taken at 2-foot intervals and submitted for analysis of VOCs. Inspection of the analytical results shows that significant contamination begins at a depth of 6 feet to 8 feet, rapidly increases to a maximum at approximately 10 feet, and then begins to decline, quickly tailing out at a depth of from 14 feet to 16 feet bgs. Based on these results, temporary implants were installed at a depth of approximately 10 feet bgs with a 5-foot section of screen. These analytical results and soil logs can be found in Appendix C.

4.0 ZVI Installation

Historically, zero-valent iron has most often been used to form a permeable reactive wall or barrier by digging a trench across a groundwater contaminant plume and filling it with iron powder. As groundwater seeps through, contaminants react with the iron forming various degradation products. Fairly regular concentration gradients exist within the structure, and when properly designed, contaminated water enters on the upgradient side and clean water emerges on the downgradient side. The two key parameters in wall design are residence time and contaminant degradation rate. Residence time is a function of groundwater velocity, and the rate of degradation is a function of the specific contaminant. In general, the more highly chlorinated the compound, the more rapidly it degrades.

The pilot installation performed at the Washington site is a fundamentally different system from conventional reactive barriers, and therefore, performance of a small-scale installation is not expected to mirror that of a conventional barrier. As shown in Figures 2 and 3, test area layout of injection points and monitoring point locations was similar in both units. However, Unit A employed only three injection points and Unit B contained six. Within each grid, injection points were symmetrically located using a triangular grid pattern with 8-foot center-to-center spacing. Eight to nine monitor points were scattered throughout the grid area at various distances from injection well locations. Just as soil-sampling results were used to guide installation of temporary implants, these same results also guided injection of iron. For example, within Unit A, soil-sampling results indicated that significant contamination began at a depth of approximately 6 to 8 feet and extended to a depth of 12 feet bgs. As a result, iron was installed at various depths within this 6 to 12-foot zone.

As described in Appendix A, iron was injected in Unit B at seven depth intervals of roughly 2 feet each. At a typical point, the injection rod was driven to a depth of 29 or 30 feet, approximately 110 gallons of iron slurry was forced into the formation under pressure, then the rod was withdrawn 2 feet and another 110 gallons of slurry was injected. This process was repeated until the upper depth of contamination was reached. Targeted injection depths at adjacent wells were slightly staggered, so the iron would be more randomly distributed throughout the volume of treated soils. The injected slurry contained about 1.0 pounds of iron powder per gallon. Therefore, 4200 to 4500 pounds of iron powder was installed within this test area.

The procedure at Unit A was slightly different, due to the shallow injection depths required and soil types present. At each injection point, two injection rods were installed, one at the shallow depth (5 or 6 feet bgs) and the second at 9 or 10 feet bgs. Slurry was injected from the top down. For example, the initial injection would occur at 5 feet and then the injection rod was advanced to a depth of 7 feet and a second injection performed. Then, injections were continued using the second rod installed to a depth of 9 feet. Upon completion of the 9-foot injection, the injection rod was advanced 2 feet in depth and the final injection completed. This procedure was followed at injection points A-I1 and A-I2. At A-I3, the depths were staggered with respect to the other two, with injections

being performed at depths of 6 feet, 8 feet, and 10 feet bgs. The injected slurry contained about 1.0 pounds of iron powder per gallon. Therefore, 1100 to 1300 pounds of iron powder was installed within this test area.

Just prior to injection of the slurry, the injection rod was raised approximately 6 inches to open up a small space. This small void space could be imagined as a tiny vessel subjected to rapidly increasing pressures. At some point, the vessel fails and slurry begins to stream outward into the formation. The slurry will always follow the path of least resistance, and as a consequence, its path is nearly impossible to predict. Installed shapes will range from localized globs to thin fingers or seams meandering through the formation, depending on the lithology in the immediate vicinity of the injection well and the volume of slurry injected. If one could view a cross-section of the formation, the injection regime is intended to create a three-dimensional network of iron dispersed randomly throughout the treated volume. Ideally, no matter where we look within this space, contact with iron is imminent.

Clearly, it would have been advantageous to install sampling implants within the injection point borehole immediately after completion of iron injection. Then, there would be a high probability of iron in the immediate vicinity of the implant, and an equally high potential for detection of degradation products. Upon evaluation of this approach, however, it was decided that this might provide a biased view of performance. Therefore, implants were installed at discrete locations scattered around within the pilot test area to provide a more robust design and a more realistic understanding of localized performance. A detailed description of implant installation, the number and location of implants in each test area, and the depth of installation are provided in Appendix A.

Two implants, spaced about 20 feet apart, were installed approximately 25 feet downgradient of each test area to be used as controls. The idea was to place them so they would be independent of injection activities. In addition, these implants were utilized to monitor for acrylamide, a constituent of the injected slurry, as required by the UIC Permit.

An agricultural feed grade molasses was obtained from Blount Fertilizer Company, a local vendor in Bethel, NC. It was diluted with sufficient clean water to prepare a ten-percent solution by volume and was then injected in each test area. Molasses injections were performed at exactly the same points and at depths corresponding to those of ZVI injection. This procedure was designed to install molasses within the same pathways or seams that the iron had taken during its installation, almost as if it had been mixed with the polymer during injection of the ZVI. Approximately 600 gallons of molasses solution were injected in the Unit A test area, and 2400 gallons were injected in the Unit B test area.

The molasses used was essentially a pure sugar source that also contained a variety of nutrients beneficial to bacterial growth, including trace amounts of iron, sulfate, and ammonium phosphate. It was a high energy, easily metabolized "bug candy" designed to

promote nearly instant bacterial growth. Three desirable affects were intended to have resulted from this stimulation of the indigenous microbial population.

- Background dissolved oxygen should be rapidly consumed, driving the microcosm into an anaerobic condition.
- Dramatic fermentation is triggered that produces large amounts of dissolved hydrogen and other useful byproducts such as acetates, esters, and lactates. Two common fermentation processes of benefit are methanogenesis and halorespiration.
- The presence of dissolved hydrogen and other fermentation byproducts supports the mineralization of chlorinated solvents through bacterial reductive dechlorination.

A more detailed description of the molasses injections and a specification sheet supplied by Blount Fertilizer is provided in Appendix A.

5.0 Results of Groundwater Sampling and Analysis

As detailed in Appendix A, the temporary implants were sampled at various times from October 2001 to April 2002. Initial samples were used to establish baseline values and to evaluate the magnitude of variability within the test area. Subsequent samples were needed to quantify transient effects resulting from injection of iron slurries and molasses, and to monitor changes due to reductive dechlorination of contaminants. The following analytical methods were utilized throughout the pilot project:

- VOCs USEPA SW846 Method 8260B
- pH USEPA SW846 Method 9040 (used in the lab and field)
- D.O. USEPA Method 360.1 (Dissolved Oxygen)
- ORP Standard Methods 2580 (used in the lab and field) - Oxidation-Reduction Potential
- Iron (Fe^{+2}) Standard Methods 3500-Fe Phenanthroline Method
- Iron (Fe^{+2}) Hach Method 8146 (phenanthroline field method)
- Chloride Hach Method 8325 (ISE method)
- Acrylamide USEPA SW846 Method 8032A

A problem with the primary VOC calibration standard (8260B) was discovered in November which had caused a high bias in analytical values for the gasses, including chloromethane, chloroethane, trichlorofluoromethane, and vinyl chloride. The problem came to light as a result of routine quality assurance/quality control activities and was corrected in December. Upon review of all affected data, it appeared that the reported analytical results for these compounds were elevated by a factor of ten. Consequently, the results were adjusted by this factor and flagged in the data tables. All flagged values should be treated as estimated.

There were no specific testing procedures utilized for detection or measurement of changes in dissolved hydrogen or in the complex and tightly linked groups of interacting microorganisms. However, D.O. and ORP can be used to determine if conditions are supportive of biological degradation of site contaminants. Also, since many of the fermentation byproducts are volatile, they could be detected and identified using Method 8260B. Within a few days, following injection of molasses, vigorous activity was noted in groundwater samples from each test unit. Significant amounts of alcohols and esters, including acetates and lactates were found in the majority of implants. Groundwater also became heavily carbonated for several weeks.

Initial activity was striking and continued for several weeks. Activity began to subside after about one month, although low-level fermentation continued to persist for at least 3 months. In Unit A, this activity continued for over five months. The extended activity in this unit may have been due to drought conditions experienced in the late fall and early winter months.

Testing for acrylamide was performed twice during the project in accord with the UIC Permit. No acrylamide was detected in either the Unit A or Unit B acrylamide

monitoring implants. The laboratory report detailing this work is included in Appendix D.

5.1 Unit B Test Location

5.1.1 Wet Chemistry Parameters

Five wet chemistry parameters were monitored, including iron (Fe^{+2}), pH, chloride, ORP, and dissolved oxygen (D.O.). Implant numbers B-10 and B-11 are the control monitor points in this test area. Except for a small decrease in pH, parameter values were very stable in the control monitor points. In the case of pH, a decrease was noted in every implant.

Iron was determined in the field during each sampling event and again about one day later in the laboratory. The field determination was performed because dissolved iron is not stable and there was a concern that a low bias might occur in the laboratory data. The Hach procedure used in the field, while very good when iron concentrations are less than 10 to 15 ppm, is extremely difficult to use when levels are high. Unfortunately, baseline values were high in this unit, and a wide disparity between the field and laboratory measurements was immediately manifested. Due to field test limitations, the field values reported are very likely of low data quality and will not be discussed further.

Based on laboratory measurements, significant increases over baseline values for Fe^{+2} were noted in 7 out of 9 experimental implants. Implant numbers B-4 and B-5 showed an initial drop followed by a rebound back to baseline values. Other implants initially exhibited increases, maximizing after two weeks and then falling off to a final value much higher than baseline. In some cases (B-3, 6 & 7) steady increases were noted over the 70-day project. On average, ferrous iron increased in the 9 experimental implants from a baseline of 105 ppm to a final value of 202 ppm, which represents a 92 percent increase.

Baseline chloride values were surprisingly high with the average over all of the experimental implants being 719 ppm. Overall, a 23 percent reduction in chloride occurred during the project, as the final value on average was 554 ppm. Transient increases were noted in several of the implants initially, however these increases were short lived and subsequently subsided in all but two implants (B-6 and B-9).

Very low stability is also noted with pH and ORP. Field ORP measurements appear to be of better quality based on consistency with other indicators and control values. A sustained reduction in the ORP is tracked by the field results. Groundwater pH is extremely fragile so it is best to measure this parameter in the field. Laboratory measurements were also performed about one day later for comparison and in general, good agreement was observed. Groundwater pH declined in every implant and resulted in slightly acidic conditions.

D.O. measurements were only performed in the field. Baseline values were fairly consistent at about 1 ppm and very little change was measured over the course of the project.

Wet chemistry results are tabulated in Appendix E.

5.1.2 Chlorinated Hydrocarbons

Tabulated groundwater results are presented in normal concentration units (ppb) and on a molar basis ($\mu\text{gm-moles/L}$). Values tabulated using conventional units (ppb) are included in Appendix F. Molar based units are useful for mass balance or in stoichiometric calculations and these results are also provided in Appendix F.

Ideally, we would like to have very little variance between implant concentrations for any chemical within the test area. In practice, this is never the case, although baseline concentrations within the test area proved to be reasonably uniform. Differences between the experimental implants seldom exceeded an order of magnitude and were most often within one standard deviation of the mean value. The following are representative of baseline values in the unit:

<u>Chemical</u>	<u>Range (ppb)</u>	<u>Mean</u>	<u>STDev</u>	<u>% RSD</u>
1,1-DCA	23,932 to 80,745	48,276	14,943	31
TCE	620 to 21,105	6,264	3,523	56
1,1-DCE	7,248 to 24,566	15,192	4,589	30
TCA	1,208 to 156,820	44,430	45,429	101

1,1-DCA = 1,1-Dichloroethane

1,1-DCE = 1,1-Dichloroethene

Most of the variability evident in the TCA data was caused by one value, 1,208, which is easily an order of magnitude below the next lowest value.

Concentrations generally exhibited in control implants remained constant throughout the project, whereas significant changes occurred in all nine experimental implants. For example, on average, TCE concentration dropped from 6,284 ppb to 433 ppb over the 70-day period, which corresponds to roughly a 93 percent reduction. TCA was reduced from an average of 44,430 ppb to 7,476 ppb, equating to an 83 percent decline.

Behavior of daughter products did not follow any particular pattern but varied from implant to implant. In many cases, cis-DCE and 1,1-DCA levels dropped initially only to then rise to some maximum and then begin to fall once again. At other implants, such as B-3, these chemicals tended to decline throughout the project. Vinyl chloride, being the most toxic daughter product, was of particular interest as it was anticipated that concentrations might sharply rise for some period to time. Although modest transient increases were observed at selected implants, no persistent increases were noted. Plots of concentration (ppb) versus time (days) were prepared in order to more easily view the

dynamic changes of contaminants at each implant. Plots associated with this test area can be seen in Appendix G.

5.2 Unit A Test Location

Due to the nature of this formation, static groundwater levels in this shallow unit are somewhat erratic and closely tied to seasonal precipitation. In October, groundwater was encountered at roughly 4 feet bgs and was above the top of the implant screen. As drought conditions in the fall worsened, groundwater levels dropped to a depth at or near the bottom of the implants and samples taken in the later part of October and into December were very poor. In fact, in some cases, no sample could be obtained during this period. Conditions improved in the winter and by February, groundwater had risen to the October values and sample quality had dramatically improved. It is very likely that drought conditions and the associated falling water table were responsible for much of the scatter in reported analytical values from this unit in the early months. As a result, values obtained for VOCs and all wet chemistry parameters during this initial time period are suspect and are shaded in the tabular results. For purposes of the following discussions, initial values coincide with the November 26 to 27 sampling event or the February 12 sampling event.

5.2.1 Wet Chemistry Parameters

Implant numbers A-9 and A-10 were used for control monitoring and results mirrored those of Unit B in that parameters remained very stable for all but pH where a slight decrease was noted in A-9 and an increase was observed in A-10. No clear trend is evident in this unit as some implants increased while others decreased, although conditions after nearly six months of monitoring remained slightly acidic.

Baseline values for iron were low, however concentrations rapidly rose and, once again, there was very poor agreement between field data and laboratory results. Viewing the laboratory data, significant increases in iron concentrations were observed in 7 out of 8 experimental implants. On average, iron concentrations in these seven implants increased from a baseline of 44.8 ppm to a final value of 128.3 ppm, giving a net average increase of 83.5 ppm at each implant.

D.O. levels dropped in every experimental implant during this same time period. In addition, field measurements indicate a sustained decrease in ORP has occurred throughout the test area. These are good indicators that anaerobic processes are taking place.

Unlike the situation in Unit B, initial chloride concentrations were low enough to allow measurement of the modest increases expected from reductive dechlorination of contaminants. In six out of eight experimental implants, significant increases in the chloride concentrations were observed. At implant A-8, chloride dropped and no significant change occurred at implant A-6. Considering the same seven as implants as above (A-1 through A-7), the average chloride concentration increased from 52.7 ppm to

114.3 ppm, giving a net increase of 62.3 ppm at each implant. Comparing this average rise to that of ferrous iron on a molar basis, this represents 119 percent of the increase in iron. This is virtually a one to one correspondence between the chloride and ferrous iron, precisely what is expected due to reductive dechlorination using ZVI.

Wet chemistry results for this unit are tabulated in Appendix E.

5.2.2 Chlorinated Hydrocarbons

As before, tabulated groundwater results are presented in normal concentration units (ppb) and on a molar basis ($\mu\text{gm-moles/L}$). Conventional units (ppb) are provided in Appendix H and those results in molar-based values are also included in Appendix H.

In spite of the erratic behavior of groundwater during the late fall and the apparent instability noted, differences between the experimental implants were comparable to those measured in Unit B. The following are representative of initial values in the unit:

<u>Chemical</u>	<u>Range (ppb)</u>	<u>Mean</u>	<u>STDev</u>	<u>%RSD</u>
1,1-DCA	202 to 466	392	99.2	25.3
TCE	128 to 1,242	644	383	59.5
1,1-DCE	321 to 421	379	33.1	8.7
TCA	54 to 263	157	70.3	44.7

In contrast, control implant concentrations were very different from one another with TCE at 1500 ppb in A-10, while A-9 contained only 80 ppb. Viewed separately, contaminant levels remained very stable in each of the control implants, providing a reasonable standard to evaluate relative change over time at other implants.

Contaminant concentrations are 50 to 100 times lower within this test area than those in Unit B. As a result, relative changes will not be as dramatic. TCE and TCA concentrations were significantly reduced in seven of the eight experimental implants. Implant A-3 remained relatively flat, rising at first then returning to its initial concentration. The other seven implants exhibited reductions in TCE of 50 percent to 95 percent with an average reduction of 70 percent. TCA, in these same implants, was reduced by about 58 percent, on average.

Appendix I contains plots of contaminant concentration (ppb) versus time (days) for implants in this test area.

6.0 Interpretation of Results

6.1 ZVI Installation Parameters

Questions concerning optimal injection flow rate and volume of slurry injected are related to cost for full scale implementation and have very little to do with cleanup of contamination. Clearly, the faster the material can be installed, the less time is required and cost is reduced. Every site is unique and so no universal rule is applicable and, very often, the first few days of injections are devoted to learning what limitations site soils will impose. At the Washington site, contamination is located in a shallow formation, characterized by silty and clayey soils complexly interbedded with fine grained sand lenses and is also present in a lower unit that consists of fine grained silty sands.

When pressure-injecting materials into the subsurface, it is unrealistic to think that a uniform distribution of material around the injection point results. Further, it is very difficult to control the path material will take, once a fracture or separation in the formation is initiated. In silts and clays, an irregularly shaped seam is typically formed whose thickness can vary considerably. We might have a pancake-shaped seam of iron slurry, perhaps 1 or 2-inches thick, emanating outward from the injection point. On the other hand, the seam may have followed a narrow path and run for some distance from the injection point in a random direction. One thing is certain; the path followed will be the path of least resistance. Such fractures or seams tend toward the surface, so at some point, as material is injected, slurry will break through to the surface and the injection must be stopped. The volume of material that can be injected will depend on soil conditions and is a strong function of depth. In general, the deeper one injects, the more material can be installed and the greater the effective radius of influence.

Injections in Unit A were quite shallow, starting at only a few feet below grade. There was a concern that this would not be feasible, as it is very difficult to maintain a seal around the injection point during shallow injections and material may leak from around the injection rod. In silts and clays, injections should be performed from the top down. This means they must start at the shallowest depth and the injection rod must be advanced to lower depths as the injection proceeds. When starting at a shallow depth, the seal around the rod is inevitably compromised as soon as an attempt is made to push it downward. During the pilot work, it was determined that slurry could be successfully injected at the shallow depths required in Unit A. Initial injections were not problematic, however, as injection proceeded and the rod was advanced to lower depths, leakage from around the injection point occurred. This problem was overcome by installing a pair of rods separated by about 2 feet. The rods were installed at different depths so that each rod was only needed for two injections.

The second concern with shallow injections has to do with the volume of slurry that can be injected before breakthrough to the surface occurs. The effective "radius of influence" is a direct function of the volume of slurry injected. As the volume diminishes, the injection point spacing must be reduced to achieve the desired result. Overall, it appeared that 75 to 125 gallons of slurry could be injected at the test location in Unit A at a rate of

approximately 35 gallons per minute without serious leakage. Also, it was determined that if leakage occurred early on, a reduction in the injection rate frequently enabled installation of additional material. Presuming a 1 to 2-inch seam, the effective radius of influence will be from 5 to 8 feet. Since about 100 pounds of iron was injected every 2 feet in depth, the average density will be about 0.64 lbs-iron/ft³ of formation. The iron powder used possesses roughly 1.62 m² of surface area per gm of material, so an estimated 470 m² of surface is available per ft³ of formation.

In flowing sands and sandy soils, a good deal of radial mixing occurs as material moves out from the injection point. Although seams are a strong likelihood, it is also possible to get a more globular injection. In general, this behavior results in a more uniform distribution than that obtained in heavy soils. In addition, injections can be performed from the bottom up, which means that the injection rod can be driven to the lowest targeted depth and then withdrawn as the injection proceeds. As the rod is withdrawn, sand flows back into the borehole, effectively isolating the lower seam from the well and ensuring that slurry from the next injection will not typically communicate with the lower material. This technique was used for installation of iron in Unit B.

As injections targeted depths from 17 feet to 30 feet bgs, and injections began at the lower depth, a larger effective radius of influence was expected to be attained in Unit B. During the pilot work, iron slurry was injected easily at a rate of 35 to 40 gallons per minute and total volumes up to 200 gallons were installed without mishap. At this rate, since 7 injections were performed at each well location, over 1400 gallons of slurry would be installed at each location. The Unit B pilot test area was inside the building and injection wells were installed through the concrete floor. Because of this, it was impossible to know if slurry was leaking to the surface under the floor, so higher volumes were not attempted.

For purposes of the pilot demonstration, injections were limited to approximately 125 gallons of slurry at each targeted depth location in the Unit B test area. Accounting for radial mixing, it was estimated that this volume resulted in an effective radius of influence of about 4.5 feet. As iron was injected every 2 feet in depth, this should have resulted in a density of approximately 0.75 lbs-iron per ft³ of formation or about 553 m² of surface area per ft³.

6.2 Reaction Pathways

Chlorinated alkanes (such as TCA and DCA) and alkenes (such as TCE and DCE) are present in Units A and B. In general, reaction types available for chemical (abiotic) degradation of these compounds include addition, substitution, and elimination. Reductive dechlorination, as commonly described, is a substitution reaction in that a chlorine atom is replaced by hydrogen on the molecule. For example, TCE would react, losing a chlorine atom and gaining a hydrogen atom to form DCE, which could further react to form vinyl chloride (VC). As a result, it is easy to see that intermediate degradation products, like cis-DCE, are constantly being produced while also being degraded. In this stepwise reaction sequence, one atom of iron is oxidized for every atom

of chlorine removed. As a result, as contaminant concentrations decline, the level of ferrous iron and chloride should be on the rise.

Elimination reactions are also well documented and typically involve the loss of two halogen atoms or a hydrogen-halide from across adjacent carbon atoms, forming a carbon-carbon double bond. An example of this is the formation of DCE from TCA. Lastly, metallic iron is commercially important as a catalyst in reduction of certain chemicals, and it is well known that hydrogen gas is formed when finely divided or activated metal powders are contacted with water. This hydrogen can be utilized in additional (hydrogenation) reactions. This type of reaction would necessarily involve alkenes, as the hydrogen would add across the carbon-carbon double bond forming an alkane. For example, hydrogen could add to cis-DCE, forming 1,2-DCA.

As a result, dynamic behavior of the intermediate reaction products can be a very complex mix of several different mechanisms that are sometimes difficult to predict. Rates of reaction vary widely, depending on local geochemistry, the amount of catalyst (iron) present, on the chemical in question, and on the various products being produced. One rule of thumb is that the more heavily chlorinated chemicals tend to degrade more rapidly than less chlorinated daughters. This very often results in transient increases of chemicals like cis-DCE or VC in groundwater while principal contaminants, like TCE, decline. At some point, the rate of formation of these intermediate compounds falls off sufficiently that their levels also begin to decline.

For simplicity's sake, first order kinetic models are most often used to model degradation over time and to predict the time required to approach groundwater standards. A more detailed description of reaction pathways and first order kinetic models can be found in Appendix B.

6.3 Molasses Injections

As stated in Section 5, vigorous fermentation was observed at nearly every implant in each unit within a few days following injection of molasses. Known metabolic byproducts of anaerobic activity persisted for a few months after installation of the molasses solution. Although no attempt was made to directly measure the contribution of biodegradation to the overall reduction occurring in groundwater contaminant concentrations, there is strong evidence of a significant contribution to reduction of daughter products, in particular vinyl chloride and chloroethane. It is well documented that chemical dechlorination using ZVI alone results in rapid increases in daughter products such as vinyl chloride and chloroethane. Except for minor increases, observed early in the pilot test, no significant or sustained increases occurred in either test unit. In fact, as the test progressed, concentrations for these compounds slowly fell within the test areas. Although not confirmed, this was very likely due to biological activity.

6.4 Unit B Test Location

In complex mixtures of chemicals, the clearest picture is obtained from the top of the chain. As very little perchloroethene (PCE) or 1,1,1,2-tetrachloroethane is present at the site, no significant amounts of TCE or TCA are being formed through chemical reaction and concentrations should begin to decline early on. Inspection of plots, associated with each of the implants, clearly indicate fairly regular declines in TCE and TCA concentrations over time in the majority of experimental implants. In addition, transient increases in daughter product concentrations are frequently seen. First order degradation rates were calculated for the five principal contaminants at the site using data from eight of the implants and calculated results are shown in the following table.

Implant ID	First Order Reaction Rate - k (day ⁻¹)					Theoretical Fe Demand (ppm)	Available Fe (C ^f -C ⁰)
	TCE	TCA	cis-DCE	1,1-DCE	1,1-DCA		
B-M2	-0.0462	-0.0105	-0.0129			13.6	75
B-M3	-0.0218	-0.0125	0.00924	-0.0252	-0.0136	38.3	150
B-M4	-0.0398	-0.0136	-0.01195	-0.0152	-0.00729	40.1	Neg.
B-M5	-0.0306	-0.0100	-0.0128	-0.0233	-0.00757	25.2	Neg.
B-M6	-0.0125	-0.0235	-0.0110	-0.0155	-0.00333	22.1	413
B-M7	-0.0307	-0.0336	-0.0082	-0.0162	-0.0085	16.7	142
B-M8	-0.0195	-0.0484	-0.0132	-0.0157	-0.0128	39.5	60
B-M9	-0.047	-0.0122	-0.0089	-0.01995	-0.0123	10.3	7
Average	-0.0310	-0.0205	-0.011	-0.0187	-0.0093		
Standard Deviation	0.0127	0.0139	0.002	0.0041	0.00371		
% Std Deviation	40.9	67.7	18.1	22.1	40		
Bench k	-0.0862	-0.2947	-0.0305	-0.0577	-0.0217		

A fair amount of variance is present in the data, however this is to be expected in light of the installation protocol. In addition to calculation of first order rate constants (k), estimations of the amount of iron required to support the observed changes were calculated for each implant. Calculated values were then converted to ppm, so a direct comparison to raw final iron values would be possible. These estimated values are tabulated as theoretical iron demand. The available iron values were calculated by subtracting the baseline value from the final value. Overall, the observed increased iron concentrations meet or exceed the "theoretical demand" at all but two or three of the implants.

In spite of the complexity of reactions that may be at work, there is a relationship between the fall in TCE, for example, and localized increases in cis-DCE. Stoichiometric estimates were performed for each implant and very good agreement was obtained at several of the implants. The most important result is that even where close agreement is not observed, no result is so far from expected values as to be inconsistent with proposed degradation pathways.

Chloride values were difficult to interpret as a general decline was observed over the project and baseline values were surprisingly high, making measurement of the modest changes difficult, at best. It is possible that the elevated ionic strength seen in Unit B groundwater coupled with slightly acidic conditions is causing low-level corrosion of the iron. Chloride may well be responsible for some of this corrosion, producing the excess iron observed at most implants.

At first blush, it would appear that average reaction rate constants obtained during the bench study are significantly higher than those calculated from the pilot data. To directly compare values, they must first be adjusted to account for the difference in available surface area per unit volume. When this correction is made, rate constants observed during the pilot turn out to be very comparable to those from the bench work for every compound except TCA.

As mentioned in the results section, no significant or sustained increase in vinyl chloride was observed in any implant. Apparently, the overall rate of degradation is sufficiently high to account for its rate of formation from other chemicals present in the formation.

Lastly, calculations were performed to predict the period of time required to reduce site contaminant levels to North Carolina Groundwater standards. Using the average value for TCE (6284 ppb), it is estimated that 250 days will be required to meet the 2.8 ppb standard at the test location utilized in the pilot test. Looking at the highest baseline value measured (21,105 ppb); it is estimated that 280 days would be required to meet the groundwater standard at the test location utilized in the pilot test. It is unlikely that TCE will control site closure, as other contaminants will persist after the TCE has ceased to be a problem. 1,1-DCE may provide a better indicator of overall performance as it degrades more slowly than TCE and the groundwater standard is low (7 ppb). Using the highest baseline concentration, it is estimated that 440 days may be required to reach the standard. As a result, it is likely that 1.5 to 2 years will be required to achieve state groundwater standards at the test location utilized in this unit.

6.5 Unit A Test Location

Although plots of contaminant concentrations over time depict all of the data, the first two months of data is suspect due to drought conditions experienced in the fall and early winter. As a result, all calculations and discussion are based on data derived from the last five sampling events.

The most important implants are numbers A-4, 5, and 6 as these are located within the estimated radius of influence of all three injection points. Of these, performance at implants A-4 and A-6 is the most impressive. Implants A-1 and A-5 also track reasonable performance and average reductions of TCE and TCA over seven of the eight experimental implants is nearly 60 percent. Transient increases in daughter product concentrations consistent with reductive dechlorination of parent compounds are evident at implants A-1, A-4 and A-6.

Data from six of the implants was used to calculate first order rate constants for comparison with values obtained from Unit B. Average values are as follows:

TCE $k = -0.0139$,
TCA $k = -0.0205$, and
DCA $k = -0.00712$.

Values for TCE and TCA were one-half to one-third of those observed at Unit B, while the value for DCA is very comparable to that obtained in Unit B. The largest difference between the two units is soil type. Unit A is characterized by silts and clays, while Unit B consists of fine-grained sands. Heavy soils are far less permeable and tend to contain a lot more adsorbed chemicals than sands. As a result, the soils act like a low-level source, which tends to flatten the observed rates of contaminant reduction.

Ferrous iron concentrations increased in seven of the eight experimental implants with average values being 44.8 ppm initially and then rising to 128.3 ppm over the project. This gives an average increase per implant of 83.5 ppm, which easily accounts for estimated iron demand due to contaminant degradation. Using the same seven implants, average chloride concentration rose by 62.3 ppm over initial values. This increase in chloride equates to 119 percent of that required to support the observed iron rise. The values are essentially identical, providing strong experimental confirmation of proposed degradation pathways.

Field ORP measurements in this unit exhibited a sustained reduction in potential. This parameter is commonly used as an indicator for evaluating the propensity for aerobic versus anaerobic biological processes to occur and to assess the relative efficiency of other electron transfer reactions to occur, such as sulfate reduction and reductive dechlorination of solvents in groundwater. Field readings have fallen by nearly an order of magnitude from baseline values measured in October and are now and have been well below literature values to support reductive dechlorination.

As for Unit B, rate constants were used to estimate the time required to achieve groundwater standards. Using worst-case values for TCE, it is estimated that 440 days may be required to reach this goal in the test area location. As before, TCE will not likely control and an additional period of time may be required for final closure.

As in Unit B, the apparent rate of degradation for vinyl chloride is such that no buildup of this compound is expected to occur.

7.0 Conclusions

- **Injection of iron powder is a viable approach for treatment of chlorinated chemicals in site groundwater.**

Results obtained from performance monitoring in Unit B were consistent with expected trends. Concentrations of principal contaminants were dramatically reduced over the 70-day project period, tracking a 93 percent reduction in TCE and an 83 percent reduction in TCA. Concurrently, a sustained reduction in ORP and a 92 percent increase in ferrous iron were observed. Excellent agreement between reductions in TCE/TCA and the associated rise in daughter product levels was noted in several of the experimental implants.

Data from eight implants was used to calculate first order reaction rate constants. Very good agreement between average pilot values and Bench Study values resulted, once pilot values were normalized in accord with ZVI surface area. This agreement is a major achievement, providing confirmation of kinetic degradation modeling originally developed in the Bench Study. Rate constants were utilized to estimate the time required for remediation of contamination in Unit B. Calculated estimates indicate a period of from one to two years may be required to approach North Carolina Groundwater Standards.

Results observed in Unit A are very similar to those seen in Unit B, except that they are not quite so dramatic. One reason for this is that contaminant concentrations in this unit are lower by two orders of magnitude. However, as in Unit B, TCE was reduced by roughly 60 percent and TCA fell by 58 percent over the first few months in 2002. At the same time, ferrous iron and chloride increased by 186 percent and 217 percent respectively, and sustained reductions in ORP and D.O. were observed. The rise in chloride is a nearly perfect match to the rise in iron on a molar basis and reasonable agreement was noted between the fall in principal contaminants and the rise in daughter products at key implants.

First order kinetic reaction rate constants for the test location in Unit A were calculated and compared to Unit B values. Unit A values appear to be approximately one-half of those measured in Unit B, however this is explained by soil types present in Unit A. It is expected that as levels in the dissolved phase fall, contaminants previously bound to silt and clay particles, will desorb into the groundwater. The net effect of this process is to flatten the observed rate of reduction. As in Unit B, rate constants were used to estimate the time required for remediation. Although calculations indicate that a period of approximately two years may be required, a more realistic estimate of the time needed to approach North Carolina Groundwater Standards in this unit and in Unit B, may be two to four years. This time period may be shortened if target groundwater cleanup goals greater than the North Carolina Groundwater Standards are approved in the future for this site.

The estimated periods of time to cleanup solvent contaminated groundwater, within Units A and B at the site, are based upon the following assumptions:

1. Iron will be injected throughout each plume;
2. Calculations were based upon results obtained within the test areas only and the vast differences in contaminant concentrations and hydrogeologic conditions across the site may adversely affect the time required;
3. Some form of source treatment will be performed prior to or concurrently with installation of ZVI; and
4. Key design parameters needed for full-scale implementation have been determined.

Very little latitude exists in the treatment parameters of Unit A. Design will be driven by soil conditions, the sensitivity of groundwater to seasonal rainfall, the shallow depth of contamination, and the limited volume of slurry that can be successfully injected at each location. It is evident from pilot injections that the effective radius of influence is limited to 4 or 5 feet, because it will be impractical to inject more than 75 to 100 gallons of slurry at each point. As a result, injection grid spacing cannot be more than 10 feet without running the risk of poor performance and extended cleanup times.

There are two means of affecting the rate of reduction, both of which increase the available ZVI surface area per cubic foot. The first is to increase the slurry density and the second is to install slurry at smaller depth intervals. For example, 2 pounds of iron could be mixed per gallon of slurry, and it could be injected every foot in depth, quadrupling the amount of iron theoretically installed at each borehole. It is probably unrealistic to inject at every foot in depth, but a heavier slurry can be used.

Lastly, reductive dechlorination using conventional iron powder is most effective when iron is installed within the contaminated aquifer. It is less effective when groundwater is not present, as demonstrated during drought conditions experienced in late October through December. It may be that this issue will turn out to be of little significance as lack of groundwater should not be an issue for more than a fraction of the year.

Based on performance noted in Unit B, an average iron density equivalent to about 500 to 600 square meters (iron surface) per cubic foot should be targeted. Some economy can be obtained in this unit as the grid spacing can be increased to 15 to 20 feet. This represents more than a 50 percent reduction in the number of boreholes over that employed per unit area during the pilot work. This increase in grid spacing is possible due to the large volume that can be injected at each point. To achieve a 7 plus foot effective radius of influence, roughly 250 gallons of slurry must be installed at each of the seven targeted depths, for a total of 1750 gallons per borehole. It may be possible to inject larger volumes and further increase the grid spacing, as test injections performed during the pilot study easily supported planned injections of over 1500 gallons per borehole.

Not only did Unit B readily accept large volume injections, but rapid injection flow rates were used throughout the pilot without problem. A maximum of 40 gallons per minute

could be provided by the pump utilized for the pilot work, and this flow rate was consistently used during the test installation. As a result, injection design will incorporate a grid spacing of 15 feet and injection flow rate of 40 gallons per minute.

It does not appear to be necessary to increase the slurry density as good performance was noted using 1 pound of iron per gallon. Although slurry density could probably be reduced slightly without risking significant falloff in kinetic rate, the cost savings is small. As a result, no change in slurry density is suggested.

- **It is not likely that vinyl chloride concentrations will rise significantly during cleanup or that it will adversely affect the time required for remediation.**

During the Bench Study, it was noted that a general rise in vinyl chloride could occur as principal contaminants degrade by reductive dechlorination pathways. This is a problem frequently encountered with funnel and gate type installations on the downgradient side. Once again, it should be emphasized that the proposed injection scheme does not perform like a funnel and gate system and pilot results do not indicate that significant accumulation of vinyl chloride will occur. In fact, pilot results suggest that a gradual decline will take place as cleanup progresses, leaving little, if any, residual vinyl chloride after other chemicals have been degraded. This is a very positive result as its rate of degradation is slow and the North Carolina groundwater standard is quite low.

As noted in Section 6, this result is not consistent with only abiotic degradation processes at play and strongly suggests that biological degradation is also occurring. This was the idea behind injection of molasses in concert with ZVI, and the results suggest it was very effective.

8.0 Recommendations

- **Finalize a technical approach to effect cleanup of chlorinated solvent contamination in site soils and groundwater.**

As it is apparent that chlorinated chemical contaminants in Units A and B can be addressed using ZVI and that subsurface injection can be used successfully to install the iron, it is recommended that ZVI be installed throughout the groundwater plumes in Units A and B. This approach will ensure site closure in the shortest period of time. Other options are available, including, source treatment and injection of barrier walls on the south and north sides of the building to protect against off-site migration. Clearly, use of barrier walls relies on groundwater movement to carry contaminants through the wall and a much longer period if time is needed for closure. On the other hand, the installation cost for a barrier wall system is less than treatment throughout the plume.

The other factor that may have a significant impact on cost and the time for remediation is selection of the iron product.

- **Product selection.**

A new product, specially designed for cleanup of chlorinated solvent contamination, incorporating ZVI and activated carbon is recommended for remediation of site contaminants.

Zero valent iron powder is available in a variety of forms, each possessing unique properties. The iron utilized for the pilot work is cast iron that was ground and screened to meet certain specifications. It has a modest surface area per gram ($1.8 \text{ m}^2/\text{gm}$), and contains a significant amount of fine material.

It is well known that many of the dechlorination reactions take place on the metal surface and some work has been done to investigate performance of different iron products. The obvious presumption is that more surface area is better and, in fact, enhanced performance is obtained from micro or nano-scale powders. Micro and nano-scale products typically have surface areas that are 10 to 50 times larger than ground products. Corresponding rates of dechlorination are somewhat less than might be expected, but 3 to 5 fold increases are common.

A specially designed catalyst, for cleanup of chlorinated solvent contamination in soil and groundwater, has been recently developed by Remediation Products, Incorporated (RPI), a Colorado company. This new catalyst combines adsorbent properties with zero valent iron.

RPI has discovered a process that impregnates activated carbon with metallic iron. Because the iron is deposited within the network of pores, at virtually an atomic-scale, the effective surface area of zero valent iron is well above any other available product. In

fact, it is estimated to be over 10 times higher than that of nano-scale iron dust and from 100 to 1000 times the area of ground powders on a gram for gram basis.

Activated carbon, widely used in the wastewater treatment industry for decades, can quickly adsorb chlorinated chemicals. As a result, immediate reductions in groundwater contaminant levels are realized. Furthermore, as reductive dechlorination progresses, toxic daughter products are also trapped by the carbon, so transient appearance of these compounds is mitigated and groundwater is protected throughout the treatment process.

The optimum use of this catalyst is in saturated zones, but it is nearly as effective in vadose zone soils. One reason for this is that the activated carbon is able to adsorb contaminants from the soil vapor. Once adsorbed, the chemical is then in close contact with iron metal so treatment can progress within the carbon matrix, just as if it were in groundwater. Described below are the advantages and disadvantages of both the iron powders and the RPI catalyst:

Advantages of Iron Powders

1. The pilot investigation was performed using ground cast iron and projected performance is based on sound data.
2. Another advantage of ground cast iron powders is that they are relatively cheap and available from many vendors.
3. Use of nano-scale iron powder can significantly improve overall efficiency. Although it is more expensive, less material is required.

Disadvantages of iron powders

1. Iron powder is heavy and difficult to install (very labor intensive).
2. Thixotropic agents such as guar gum or polyacrylamide are required to prepare stable iron slurries.
3. Extended periods of time may be required to reach groundwater standards.

Advantages of the RPI Catalyst

1. Based on outside data, large reductions in groundwater contaminant levels can be quickly achieved, and in fact, it may be possible to approach North Carolina Standards in a brief period of time.
2. Rapid degradation of adsorbed chemicals takes place within the catalyst matrix and no significant rebound is observed.
3. The catalyst is superior to iron powder for treatment of vadose zone soils.
4. The material is inert, non-toxic, and insoluble in water.
5. The material is easily installed and does not require the use of thixotropic agents.

Considering site conditions and groundwater fluctuations inherent within Unit A, RPI's product appears to be ideally suited to treatment of this zone. In addition, since the

presumed source is located within this unit, installation of this product will likely eliminate further leakage of chemicals into the lower aquifer, almost immediately.

Disadvantages of the RPI Catalyst

1. This is a new product and, as a result, performance data is not broadly based.

- **For optimal performance, molasses may be required.**

The ultimate time required to reach groundwater cleanup standards may be highly dependant on residual level of vinyl chloride after other targeted solvents have been degraded. As molasses injection catalyzes the biodegradation of this compound and causes its concentration to decline rather than to increase, it should be included in the treatment scheme. However, the decision to include molasses will depend on product selection. The RPI catalyst contains carbon, and carbon is well known to promote bacterial growth. As a result, it is likely that the catalyst itself can initiate the desired fermentation processes and very little, if any, molasses would be needed. Also, daughter products tend to be bound to the catalyst during the treatment process and do not show up as a groundwater contaminant, again negating the need for molasses.

If ZVI alone is chosen, the use of molasses is strongly recommended. Since pilot test results indicate that molasses injections are effective for only three to six months, it is likely that two or three molasses injection events would need to be included in the treatment design.

- **Prepare cost estimates for options defined above.**

Before sound decision-making can take place, cost estimates must be prepared for each of the approach options and incorporating the various products, including RPI's catalyst, as well as cast iron powders and nano-scale iron dust.

- **Prepare a Corrective Action Plan.**

Once selection of a technical approach has occurred, a Corrective Action Plan must be prepared detailing the approach and a schedule for full-scale implementation.

9.0 References

Radian Engineering, Inc., *Comprehensive Site Assessment Report, Hamilton Beach-Proctor-Silex, Inc., Washington, North Carolina*, 1999.

NESCO Inc., *Bench Study to Evaluate the Use of Zero-Valent Iron for Remediation of Solvent Contamination at the Hamilton Beach-Proctor Silex Site in Washington, North Carolina*, 2001.

Stewart, Niel, *Dehalogenation Studies of Different Types and Forms of Zero Valent Iron*, presented at the ACS National Meeting in Orlando, FL April 2002.

Wiedemeier, Todd H., Rifai, Hanadi S., Newell, Charles J., and Wilson, John T. *Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface*. John Wiley & Sons 1999.

Maskarinec, M.P. *Stability of Volatile Organics in Environmental Water Samples: Storage and Preservation*. Oak Ridge National Laboratories, Final Report, August 1989. ORNL/TM-11300

Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*. John Wiley & Sons 1981.

McQuillin, Francis J., Parker, David G., and Stephenson, Richard G. *Transition Metal Organometallics for Organic Synthesis*. Cambridge University Press 1991.

Cary, Francis A., Sundberg, Richard J. *Advanced Organic Chemistry* 2nd Edition, Plenum Press 1984.



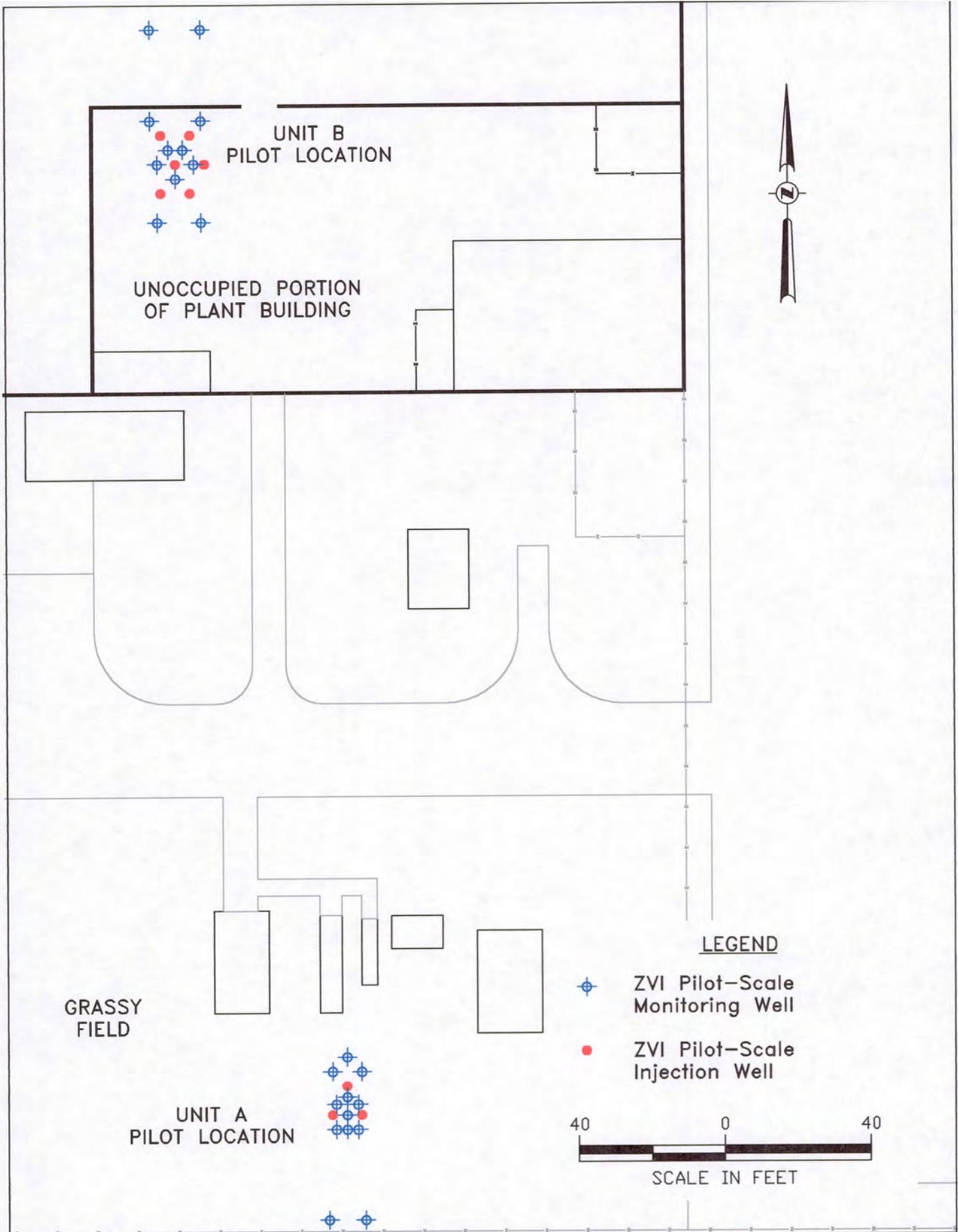


Figure 1. ZVI Pilot-Scale Test
 Hamilton Beach Proctor Silex, Washington, North Carolina UNITAB

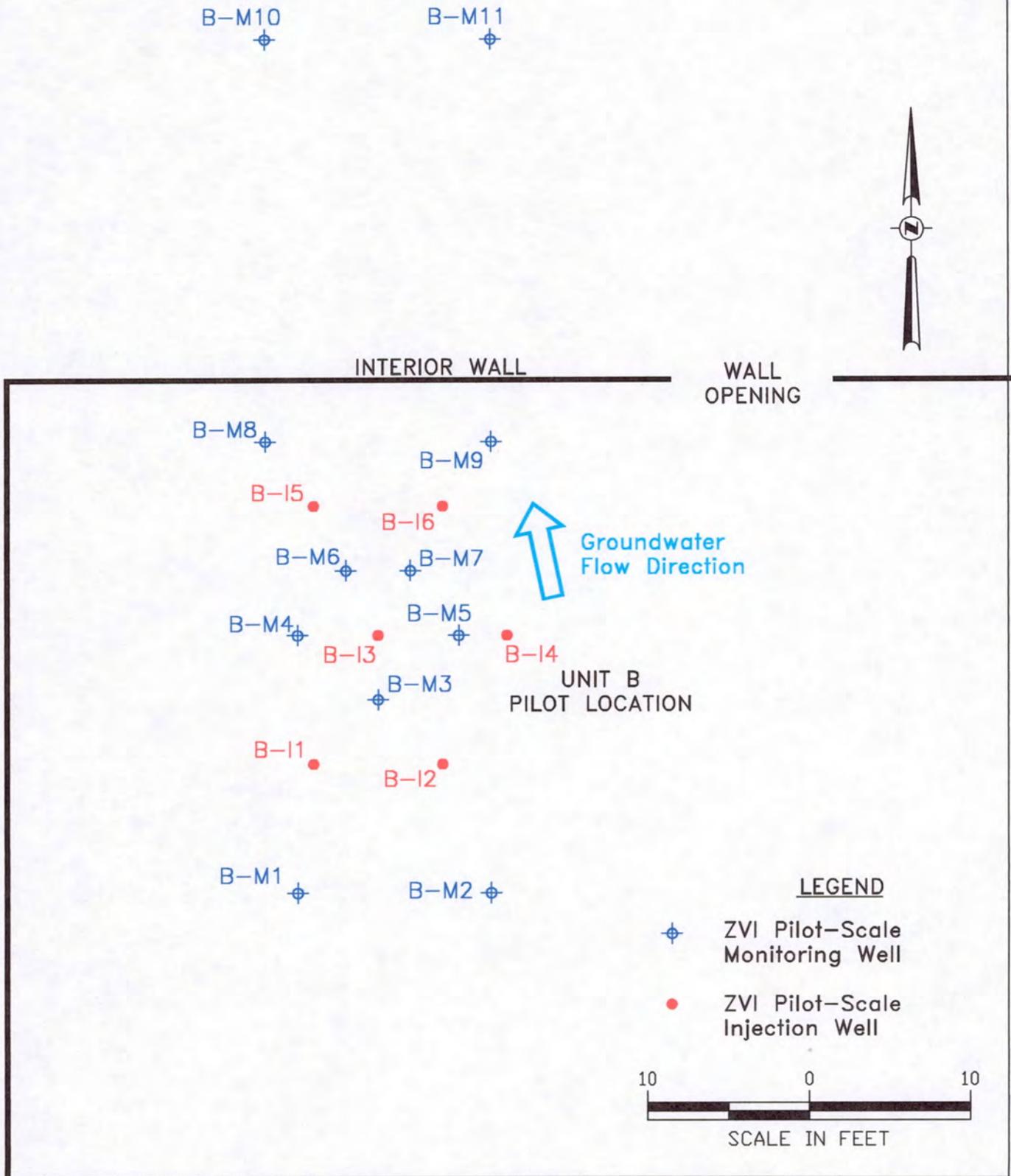
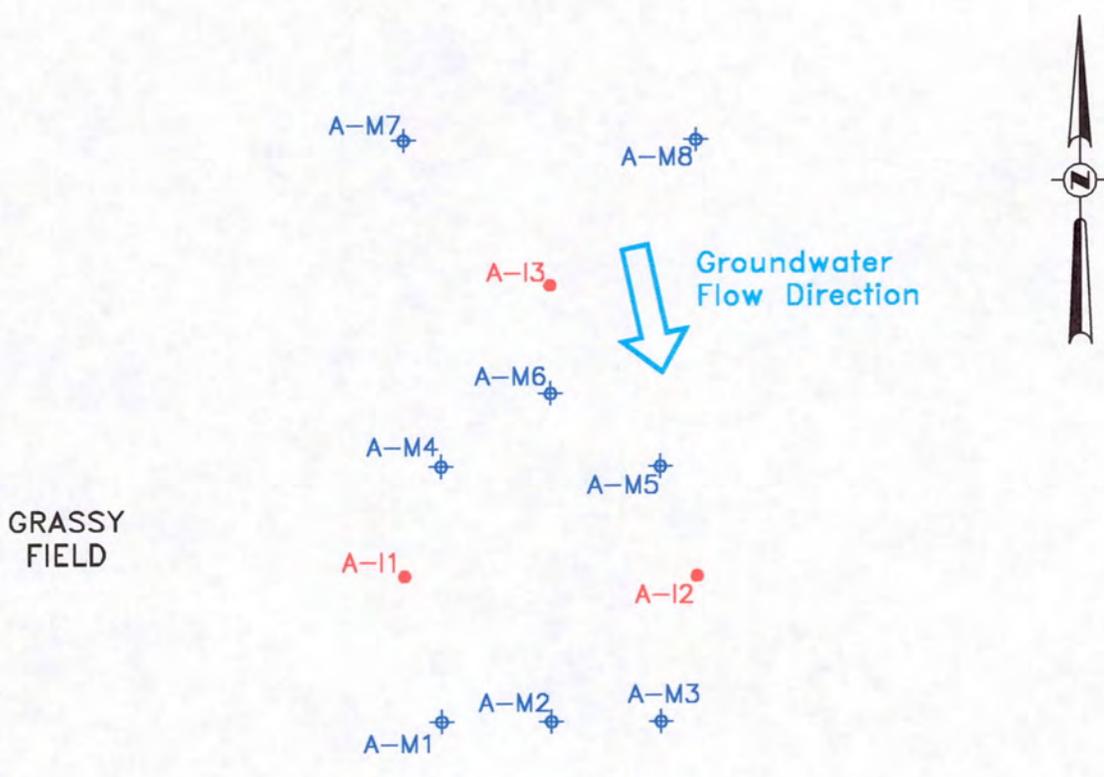


Figure 2. ZVI Pilot-Scale Test, Unit B Grid Layout
 Hamilton Beach Proctor Silex, Washington, North Carolina

UNITB-GRID



LEGEND

- ⊕ ZVI Pilot-Scale Monitoring Well
- ZVI Pilot-Scale Injection Well

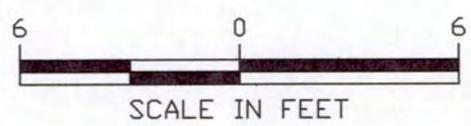


Figure 3. ZVI Pilot-Scale Test, Unit A Grid Layout Hamilton Beach ⊕ Proctor Silex, Washington, North Carolina. UNITA-GRID



Appendix A Description of Fieldwork

INTRODUCTION

This Appendix provides a general description of fieldwork performed by Alpine Field Services (formerly NESCO, Inc.) and URS Corporation (URS, formerly Radian Engineering) at the Hamilton Beach Proctor-Silex (HBPS) facility in Washington, North Carolina, from October 2001 to April 2002. The work involved pilot installation of zero-valent iron (ZVI) to evaluate the feasibility of reducing soil and groundwater contamination using this technology. The site is characterized as having a source area presumed to be located near the former ASTs, on the south side of the building. This area is a shallow unit consisting of silty clays. A second area of contamination exists in a sandy formation underlying the shallow silty clays. To be consistent with previous reports, the shallow zone will be referred to as "Unit A," and the deeper area will be referred to as "Unit B." To ensure that ZVI would be applicable across the site, two separate locations were chosen for testing purposes, targeting both units.

The purpose of this Appendix is to document the fieldwork performed.

FIELDWORK

Mobilization

Prior to commencement of fieldwork, HBPS, URS and Alpine Field Services agreed upon the two test locations. At the end of August 2001, Alpine Field Services mobilized equipment to the HBPS site. At this time, the mobile laboratory was sited, and the rest of the equipment was placed in a storage area. In expectance of the issuance of the Underground Injection Control (UIC) permit (issued October 2, 2002), personnel returned to the site on October 1, 2001. On October 1st and 2nd, Alpine Field Services and URS completed the following tasks:

- Site layout was performed by URS;
- A suitable water supply was provided by HBPS Plant Services and Alpine Field Services set up bulk-mixing equipment nearby;
- Injection equipment was made ready for operation;
- Site orientation was provided to Alpine Field Services personnel;
- Site-specific health and safety procedures were discussed with personnel; and
- Copies of the site-specific health and safety plan prepared by Alpine Field Services were distributed to HBPS and URS.

Utility location was performed by HBPS prior to mobilization.

Preliminary Investigation Work

Because the pilot installation of ZVI was to be performed within very small test areas and a number of temporary groundwater monitoring points were planned at each of the two locations, a limited site investigation was performed at each location prior to ZVI installation. This investigation work consisted of soil sampling, installation and sampling of temporary groundwater sampling implants, and testing of baseline samples for volatile organic compounds (VOCs) and a series of wet chemistry parameters. These wet chemistry parameters included pH, oxidation-reduction potential (ORP), ferrous iron (Fe^{+2}), and chloride.

Soil Sampling

Since contaminants must be in contact with ZVI for reduction to take place, it is necessary to know where contamination begins and how contaminant concentrations vary as a function of depth. It is also important to identify soil types within the affected formation and estimate the depth of groundwater at each test location.

The test area for Unit A measured approximately 15 feet by 20 feet and encompassed three injection points. (See Figure 3.) The test area for Unit B measured 20 feet by 30 feet and encompassed six injection points. (See Figure 2.) Planned injection points were located using a triangular grid pattern with 8-foot centers. At the approximate center of each grid, a soil boring was advanced and a continuous core taken. In addition, a second soil core, located up gradient from the center point, was taken in Unit A. The depth of sampling at each test area was based on historical data and was chosen to develop a detailed picture of the vertical distribution of contamination. Soil cores were logged, and samples were taken every 2 feet for submittal to the onsite lab. See Appendix C for soil logs.

Soil sampling in test area Unit A was advanced to 16 feet in the center location and to 12 feet in the up gradient location. The sampling revealed silty clays to sandy clays of low to medium plasticity. Groundwater was encountered at approximately 6 to 7 feet bgs.

The soil boring at test area Unit B was advanced to 34 feet bgs. The soils encountered here were silty clays of low plasticity to interbedded clays and sands of low to medium plasticity. Moist soils were encountered at a depth of approximately 5 feet and static groundwater was measured in the area (MW-204) at that same depth.

Installation of Temporary Implants

Eight implants were installed in Unit A and nine in Unit B. At the request of the State of North Carolina, two additional implants were installed in both units. They were located 25 feet from the furthest down gradient implants to test for the presence of acrylamide, a constituent of the injected slurry. In essence, implants are "micro" monitoring wells and are installed in a manner similar to conventional monitoring wells. The implant consists of a length of ½-inch I.D. polyethylene tubing, perforated at one end by drilling small holes through the tubing at regular intervals. Typically, perforations extend over a 3 to 5-foot

length and, once completed, are comparable to slotted well screen. Well completion normally includes placement of silica sand around the implant to create a sand-pack extending above the perforated length and then sealing the implant with bentonite.

Implant installation is very quick and easily accomplished using direct push hydraulically powered drilling rigs. An expendable point is affixed to the drill rod and the rod driven to the targeted depth. A threaded stud is inserted into the perforated end of the tubing and then slid down the drill rod, stud first. Once at the bottom, the tubing is turned to thread the stud into the expendable point. Silica sand can be poured down the drill rod or alternatively installed into the open borehole after removal of the drill rod.

To sample the well, a small diameter (3/16-inch) tube is inserted into the implant and connected to a peristaltic pump. As with conventional monitoring wells, it is best to purge the implants prior to sampling. Due to the small size of the implant, very little water is purged (typically around 20 ml to 100 ml). Sampling of an implant normally takes no more than a few minutes.

Implants were installed at 10 feet below ground surface (bgs) in Unit A and 28 feet bgs in Unit B. The purpose of scattering the implants across the test grid was to enable discrete “grab samples” of groundwater to be taken from narrow depth zones. It was determined that performance monitoring at discrete depth intervals, rather than a composite over a 15 to 20-foot screened interval, would provide more insight into the actual ZVI placement and the efficiency of the resulting installation.

Baseline Testing

As previously described, a continuous soil core was advanced at each test area, and a number of implants were installed. Samples of the soil core were taken every 2 feet and analyzed for VOCs. This data was used to determine the targeted depths for installation of ZVI and for placement of temporary groundwater sampling implants.

Prior to injection of ZVI in a test area, all implants within the area were purged and sampled. As detailed earlier, the samples were analyzed for a series of wet chemistry parameters and for VOCs. The purpose of this testing was to establish the state of contamination and water quality before any materials were injected into the formation.

Injection of ZVI

ZVI Properties

The iron used in the construction of reactive walls or barriers is a powder manufactured from various types of commercial steel or cast iron. It is manufactured by grinding raw materials to meet a desired specification and may also be activated to enhance its reactivity. The material selected for use at the site is a specially prepared, highly active form of iron powder. It is ground from cast iron and then screened to produce a 60 to 120-mesh material with a bulk density of roughly 190 pounds per cubic foot. In order to eliminate “sharp” edges,

which shorten the lifetime of injection equipment, additional milling is then performed. Product specifications, including particle size analysis and an industry-standard test for the determination of surface area using the BET equation derived by Brunauer, Emmett, and Teller, are attached to this appendix.

Why Viscous Slurries?

The key to injecting ZVI is to prepare a stable suspension or slurry from the dry powder. The first thing noticed when dealing with iron powder is that it is heavy. As a result, it is difficult to prepare a slurry and maintain it in suspension long enough to complete subsurface injection. Consequently, good mixing is essential to prevent the iron from simply settling out of the slurry. All systems will have some form of a mixing tank or tub, a pump to transfer the mixed slurry, and some type of interface that adapts the high-pressure discharge hose to the injection pipe. Alpine Field Services uses standard drill rod for temporary injection wells.

Keeping the iron powder suspended while in the mixing tank is relatively simple; however, once the mixer is shut off, suspended solids begin to settle out. The rate of this settling is primarily a function of viscosity, particle density, and particle shape. Although the mixing is not interrupted during injection, settling begins as soon as the slurry is pumped out of the mixing tank. Clearly, the rate of settling needs to be as low as possible, since this allows the most flexibility during installation of the iron. The bulk density of ZVI cannot be changed; however, some control can be exerted over particle shape. A spherical shape was found to be optimal. For this reason, the product specified included additional milling to remove sharp edges and produce a more rounded particle shape.

The second fluid property that can be controlled is viscosity. As viscosity increases, settling velocity decreases, all else being equal. A number of thickeners or “thixotropic agents” are commercially available and guar gum is commonly used for this purpose. One downside of thick gooey slurries is that the ZVI is essentially encapsulated in the goo, and once installed, groundwater flow may circumvent the slurry, flowing around the iron. This is an undesirable condition, which often requires the addition of enzyme breakers to “break” or reduce the fluid viscosity. Such breakers are normally used in concert with guar gum.

Both guar gum and a high molecular weight, anionic polyacrylamide resin (acrylamide polymer) were evaluated during the Bench Study and the anionic resin proved to be superior to guar. Another advantage of this material was that a very small amount has a large effect on viscosity. In fact, the desired viscosity was achieved by mixing approximately 10 pounds of polymer into 750 gallons of water. This represents approximately a 0.15 weight percent solution or about 1500 ppm of polymer. Because the polymer is anionic, its viscous properties are not stable and rapidly disintegrate once injected into groundwater. The reason for this instability is that all groundwater contains some dissolved solids or salts, and a large percentage of these salts are calcium and magnesium-based. The dissolved calcium and magnesium ions bond to the anionic polymer strands forming insoluble salts that precipitate from the slurry. This process is extremely rapid, so within minutes, the encapsulation is

removed and contaminants come into contact with ZVI. As a result, no enzyme breakers are needed with the acrylamide polymer.

Description of the Injection Process

Roughly 30 minutes of mixing is required for the polymer to dissolve and the viscosity to fully develop. For efficiency, polymer solutions were premixed in a tank placed close to the water supply. As needed, holding tanks on the injection pump trailer were filled from this tank using high volume transfer pumps. The tank was equipped with an electric mixer powered by a generator and fresh water was dispensed from the site emergency water supply. The "polymer premixing" equipment was set-up in the east parking lot, immediately adjacent to the emergency water supply. The HBPS plant has been shut down, and the parking lot where the mixing tank was staged was in a vacant parking lot where there was no traffic. As a result, the area was well removed from plant personnel and traffic, and therefore did not cause any traffic or personnel-related safety hazards.

The injection pump trailer was equipped with a positive displacement pump capable of delivering up to 40 gallons per minute at a pressure in excess of 1000 pounds per square inch (psi). Process tanks located on the trailer included a 330-gallon ZVI slurry-mixing tank and a 330-gallon holding tank for premixed polymer. Pump suction was directly connected to the slurry-mixing tank, and the polymer solution was transferred into this tank from the holding tank using a gas-driven, high-volume pump.

A volume of polymer solution was transferred into the ZVI slurry-mixing tank, the mixer was started, and a measured amount of iron powder was slowly added to the tank. Previously, a small diameter (1.25-inch OD) drill rod was driven to the targeted depth, and an injection head was threaded securely onto the rod. The injection head was configured with a valve and quick-connect coupling to facilitate rapid connection to the injection pump discharge hose. Initially, the valve on the injection head was closed and the injection tip on the drill rod was sealed at the bottom with an expendable point. Once the slurry was mixed, the pump was engaged, the injection head valve was opened, and the discharge line was pressured up. The injection rod was then pulled up slightly to shed the expendable point. Pressure was allowed to build until a fracture or fissure was created in the formation and slurry began to flow out into the formation. The fracture or fissure propagated outward from the point of the injection as additional slurry was pumped into the injection well.

After injection of the batch, fresh polymer solution was transferred into the slurry tank, mixed and then injected to flush the system of residual iron powder. The pump was disengaged, and the injection head valve was closed. A fresh batch of slurry was prepared, the injection rod was advanced to the next depth, and the process was repeated.

When slurry was injected into the formation, a fair amount of backpressure was present that dissipated over a period of time. As a result, the injection well was not removed immediately after injection of slurry. Rather, it was allowed to sit for a time to allow this transient pressure to dissipate. Residual pressure in the formation was easily checked by simply opening the injection head valve. Once residual pressure dissipated, the rod was safely removed, and the borehole was sealed with bentonite.

Injections at Test Areas

Injection of ZVI was started in the test area in Unit A (see Figure 3). A slurry was prepared that contained 0.8 to 1 pound of iron per gallon of polymer/water solution. Approximately 100 pounds of iron were injected at each injection depth. Two injection points were installed for each of the three injection locations in Unit A. Injections began at injection location A-I2, with one injection well set at 5 feet below ground surface (bgs) and the second at 9 feet bgs. The iron slurry was injected at the 5-foot location, then the rod was pushed down to 7 feet bgs and a second injection was performed. Connections were now made to the second injection well and slurry was injected at 9 feet bgs. Then the rod was pushed down to 11 feet bgs and a second injection was performed. The next injection was performed at injection location A-I3. Here, the wells were set at 6 feet bgs and 8 feet bgs. An initial injection was performed at the 6 feet injection well. Then the second well was used for injection of slurry at 8 feet bgs. The well was then pushed down to 10 feet bgs and a third injection performed. The final injection in Unit A occurred at injection location A-I1 where the injections were performed at the same depths and following the same procedure as at injection location A-I2.

In general, injections in this area went very well. The formation seemed to accept the slurry, with only a small amount of seepage or breakthrough occurring. The seepage or breakthrough patterns we saw gave us a good idea of how the iron was moving into and throughout the formation. In location A-I1, communication was seen in implants A-M1, A-M2, A-M4, A-M6, A-M5, and the suspected former utility trench (trench). (Note: This trench is seen as a slight indentation in the grass running east west in Unit A. The trench is located along implants A-M1 through A-M3.) In location A-I2, communication was seen in implants A-M1, A-M2, A-M5 and A-M6. In location A-I3, communication was seen in implants A-M5, A-M6, and A-M7. It was interesting to note that these pathways to the surface did not seem to connect with implants A-M8 and A-M3. Overall, around 1100 pounds of iron powder were installed in the Unit A test grid.

ZVI was next injected in the Unit B test grid. (See Figure 2.) In this grid, injections were performed in reverse order by pushing to depth, performing an injection and then raising the rod in 2-foot increments. This injection procedure could be used because of the sandy soil conditions present. The rod was driven to depth; slurry injected, then as the rod was raised, the formation collapsed in behind the raised point, effectively sealing off the lower injection pathway.

Seven injections were performed at each of six locations within the formation for a total of 42 injections. As in Unit A, the slurry density was 0.8 to 1 pound of iron per gallon of polymer/water solution. At three of the locations, well rod was pushed to 30 feet, an injection was performed, and the subsequent injections occurred at depths of 28, 26, 24, 22, 20 and 18 feet bgs. To interlace the injections, the other three injection wells were pushed to 29 feet bgs, an injection performed, and the subsequent injections occurred at depths of 27, 25, 23, 21, 19, and 17 feet bgs. Approximately 100 pounds of iron was injected at each targeted depth, resulting in approximately 4200 to 4500 total pounds of iron installed in the Unit B test grid.

From the moment injections began in Unit B, groundwater began to seep from every implant throughout the test grid. It was clear that the injections were pressurizing the formation and communicating throughout the entire grid. Because of this fact, the response appeared to be fairly symmetrical at each injection point and equated to a uniform distribution of iron throughout the entire test grid.

Final ZVI Placement

As described above, the slurry tends to flow outward from the injection point along fractures or fissures that are relatively thin, flat seams oriented horizontally with respect to the ground surface. Once a fracture is initiated, fluid will always follow the path of least resistance. As a result, it is difficult, if not impossible, to control how fissures propagate throughout the formation. Experience has demonstrated that, as these seams move out within the formation, they tend to migrate toward the surface. So if enough fluid is pumped into the ground, it will eventually break through to the surface. In addition, it is safe to say that the seams can take on a variety of shapes from irregular pancakes to thin fingers emanating from the injection point.

The objective in the pilot was to create a three-dimensional network of iron interlaced throughout the affected formation, such that it was unlikely that any contaminants would move through the installation without contacting the iron. To this end, injection points were located fairly close to one another, and targeted injection depths were offset. For example in Unit A, injections were performed at 5, 7, 9 and 11 feet at injection points A-I1 and A-I2, and at adjacent point A-I3, injections were performed at 6, 8 and 10 feet. The idea was to allow some overlap to occur and to create seams of iron that were not separated by more than a foot or two. It was clear from seepage and leakage at implants that vertical connections were formed between horizontal seams emanating from other injection wells, thus supporting the notion that a network was created and the iron was not simply located in thin, parallel seams.

Injection of Molasses

Molasses was obtained from a local vendor, Blount Fertilizer Company, in Bethel, NC. From our past experience, Alpine Field Services has found that feed-grade molasses frequently contains significant amounts of calcium and cannot be mixed with the polymer without almost immediate loss of viscosity. Since the exact composition of the molasses being used was unknown initially, to avoid this potential problem, Alpine Field Services chose to inject the molasses after all the iron had been installed.

The molasses was diluted with sufficient clean water to prepare a ten-percent solution by volume. This solution was injected in each test area at depths corresponding to the depths of ZVI injection. Approximately 600 gallons of molasses solution were injected in Unit A, and 2400 gallons were injected in Unit B.

In Unit A, the molasses was injected at location A-I2 in the same manner as the iron. In fact, the two injection points that were used for the iron were still in the ground at A-I2, and one

molasses injection occurred at 7 feet bgs and the other at 11 feet bgs. At location A-I3, molasses was again injected in the same two locations as were used for the iron, one at 6 feet bgs and the other at 10 feet bgs. The final injection location, A-I1, followed the same injection pattern as the one used at A-I2. In Unit A, seepage or breakthrough was noted in all the implants with the exception of A-M8. There was also seepage into the trench and to the west of the Unit A injection area.

In Unit B, instead of injecting molasses in B-I5, a location was picked that was in the center of the grid and up gradient, at a location roughly on line with implants B-M1 and B-M2. Here, the injection well was driven to depth (approximately 28 feet bgs), an injection performed, and the well was then raised in 4-foot increments with an injection at each increment. All other molasses injection locations in Unit B were in the same locations as those for injecting the iron. A "top down" injection pattern was used, spaced at 4-foot intervals within the formation. As with the iron injections in Unit B, communication between implants was immediately observed. The injections pressurized the formation, and a uniform spread of injection material was seen flowing from implants throughout the grid. It appeared that injected molasses, much like the iron, uniformly flowed throughout the injection grid.

The molasses used for the pilot study was an agricultural feed-grade material. Essentially it was a pure sugar source that also contained a variety of nutrients beneficial to bacterial growth. It was a high energy, easily metabolized "bug candy" designed to promote nearly instant bacterial growth. Molasses is incorporated into the treatment scheme for two reasons:

- Background dissolved oxygen will be rapidly consumed driving the microcosm into an anaerobic condition.
- The presence of a carbon substrate stimulates the mineralization of chlorinated solvents through reductive dechlorination and by co-metabolism.

Performance Monitoring

Original Monitoring Plan

Baseline values were determined prior to installation of the iron to provide initial conditions needed for kinetic modeling of the reductive dechlorination process. Samples were tested for volatile organic compounds using Method 8260 B and also for pH, chloride, ferrous iron, ORP and DO. A mobile laboratory was present onsite during the injection phase to perform these analyses.

Temporary implants were sampled approximately 48 hours after placement of the iron, and analyzed for the parameters described above.

Four additional sampling events were planned for the ten-week period following the pilot installation. URS performed the sampling events over this time period, packed samples in ice and shipped them to Alpine Field Services for analysis, in accord with established chain-of-custody procedure.

Additional Sampling

The sampling of Unit B proceeded in line with the original monitoring plan. In Unit A, however, sampling was extended for four months because of drought conditions encountered onsite. After the beginning of 2002, weather conditions improved, and three additional sampling events took place in February, March and April of 2002.

Soil Sampling – Unit A

10/3/01

Soil Sampling – Unit B

10/6/01

Unit A – Sampling Dates

A-M1 10/4/01, 10/9/01, 10/10/01, 10/17/01, 11/8/01, 11/27/01, 12/17/01, 2/12/02, 3/12/02 and 4/9/02

A-M2 10/4/01, 10/9/01, 10/10/01, 11/8/01, 11/27/01, 12/17/01, 2/12/02, 3/12/02, and 4/9/02

A-M3 10/4/01, 10/9/01, 10/10/01, 10/17/01, 11/8/01, 11/27/01, 2/12/02, 3/12/02, and 4/9/02

A-M4

A-M5

A-M6

A-M7

A-M8

A-M9 10/4/01, 10/9/01, 10/10/01, 11/8/01, 2/12/02, 3/12/02 and 4/9/02

A-M10

Unit B – Sampling Dates

B-M1 10/7/01, 10/9/01, 10/10/01, 10/17/01, 11/8/01, 11/27/01, 2/12/02, 3/12/02, and 4/9/02

B-M2

B-M3

B-M4

B-M5

B-M6

B-M7

B-M8

B-M9

B-M10 10/7/01, 10/9/01, 10/10/01, 11/8/01, 2/12/02, 3/12/02, and 4/9/02

B-M11



May 15, 2002

Nesco
 ATTN: Scott Noland
 6870 N. Broadway
 Unit H
 Denver, CO 80221

FAX: 303-487-1083

303-216-0575

SUBJECT:

Dear Scott:

Our laboratory performed the surface test on two different lots of Cast Iron Aggregate Size 60/120 with Fines.
 The following are those results along with the 5-minute rotaps of each. Results are % retained.

<u>SIEVE SIZE</u>	<u>CROSS SAMPLE OF OLDEST INVENTORY</u>	<u>CROSS SAMPLE OF MORE CURRENT INVENTORY</u>
40	0	0
70	14	7
80	10	19
100	13	18
120	14	16
200	27	24
325	16	12
Pan	6	4
BET Multipoint Surface Area	1.61 sq. m/g	3.41 sq. m/g
Single Point Surface Area	1.52 sq. m/g	3.25 sq. m/g

Very truly yours,

Norcen P. Warrens

NPW/mc

Peerless Metal Powders & Abrasive

124 South Military • Detroit, Michigan 48209
 (313) 841-5400 Fax (313) 841-0240

FN : 053 70300082 33 08-23-2000

BULK

PM AG PRODUCTS

EASY FLO 68

----- GUARANTEED ANALYSIS -----

Crude Protein	Not Less Than	2.7 %
Moisture		
Not More Than	31.8 %	
Total Sugars Invert	Not Less Than	
ss Than	43.0 %	

INGREDIENTS

CANE MOLASSES, SULFURIC ACID, PROPIONIC ACID, AMMONIUM HYDROXIDE, SORBIC ACID, BENZOIC ACID, PHOSPHORIC ACID, PROPYL PARABEN, METHYL PARABEN, BUTYLATED HYDROXYANISOLE, PROPYLENE GLYCOL, ARTIFICIAL FLAVOR.

FEEDING DIRECTIONS:

1. Mix into livestock and poultry feeds to control dustiness and fines, use as a source of energy and for improved palatability.

2. Use at a level from 5% to 12% of the finished feed. Because of management decisions and practices beyond our control, seller makes no expressed or implied warranties other than the guaranteed analysis. No agent of PM Ag Products is authorized to make other expressed or implied warranties.

PM AG PRODUCT

S

C/O DUNDALK MARINE TERMINAL
2700 BR

OPENING HWY.

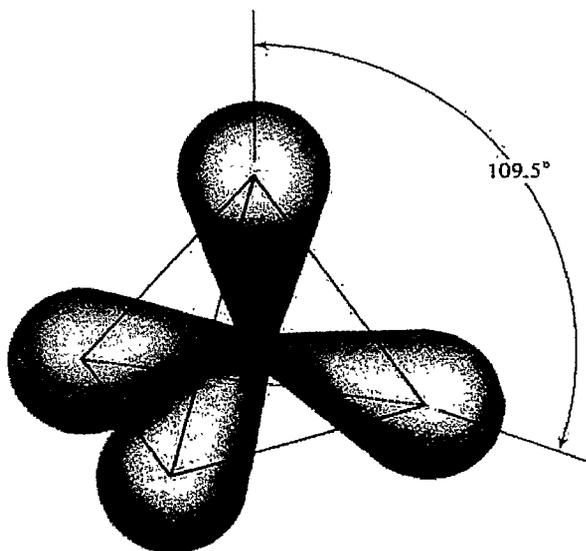
DUNDALK, MD 21222



Appendix B Chlorinated Solvent Abiotic Degradation Mechanisms

Molecular Orbital Background

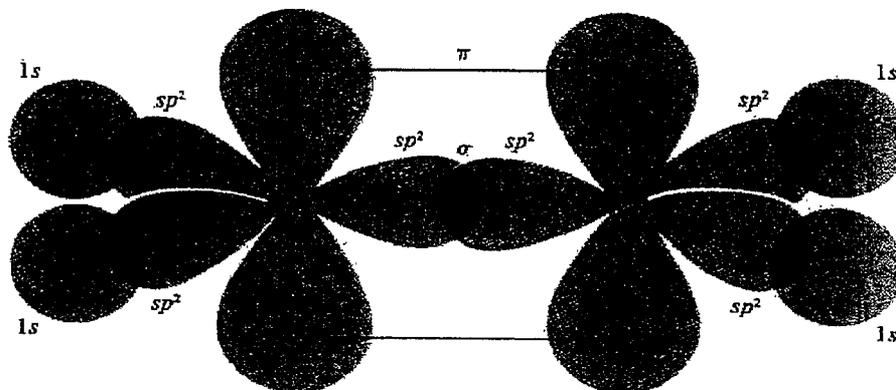
The electronic configuration of carbon in its ground state ($1s^2, 2s^2, 2p^2$) precludes a simple explanation of the bonding in organic compounds. Linus Pauling suggested that the four valence orbitals ($2s, 2p_x, 2p_y, 2p_z$) were replaced by a set of four equivalent hybrid orbitals, which he designated as sp^3 . The probability distribution for these hybridized orbitals is distorted, with the region of highest probability concentrated on one side of the nucleus, as shown in the following figure.



Orbital hybridization has two important consequences. First, four bonds, rather than two may be formed to carbon and second, the distorted orbitals provide for more efficient overlap. The mathematical description of hybridization predicts tetrahedral geometry and, for example, methane is a perfect tetrahedron with each H-C-H angle equal to 109.5° . This type of bond is called a sigma bond and accounts for much of the chemistry found in saturated organic compounds including site contaminants such as 1,1,1-TCA, and 1,1-DCA.

The situation in two-carbon olefins is analogous in that each carbon bears three ligands bonded by hybridized sigma bonds. The simplest example is ethylene and is depicted in the figure below. In this molecule one ligand is the adjacent carbon atom and the other two are hydrogen. As shown, one of the bonds between the two carbons is a sigma bond and the second bond formed results from overlap of the non-hybridized p orbitals on each carbon atom. This is called a pi bond and it is easily seen that the overlap here is not as efficient as that found in sigma bonds. Also, the molecular orbital geometry is slightly altered as the six sigma bonds are coplanar and orthogonal to the remaining 2p orbitals forming the pi bond. The sigma bonds in this type of system are designated as sp^2 hybridization. Consequently the

electron distribution in a pi bond is concentrated above and below the plane of the sigma framework. Compounds such as TCE, DCE, and VC possess this type of structure.



Surface Interaction

The above discussion on sigma and pi bonds is extremely important when attempting to understand the role played by ZVI during degradation of site contaminants. It is widely held that the reaction takes place on the metal surface and atoms in the surface of a metal crystal will differ from those in the body of the crystal in that "residual combining power" will be directed out, away from the crystal surface. It is significant that both alkenes and hydrogen react exothermically and reversibly with many catalytic metals.

Essentially, molecules can bind to transition metals in two orientations; they may be "side-on", or "end-on". When considering ligand-metal binding, sigma and pi bonds may be involved in either orientation, however "side-on" binding is favored with unsaturated compounds such as TCE. This is due to the ability of the orthogonal p orbitals to overlap with d orbitals in the metal. Unsaturated compounds such as TCA do not have this ability, so must bind through their sigma bonds and no particular orientation is favored. Also, it is important to keep in mind that conduction (d-shell) electrons in a transition metal are not localized or held to any one single metal atom. Rather, they tend to be delocalized and are able to move around freely and are thus readily available to be shared with an approaching molecule.

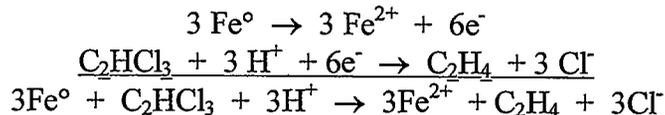
Lastly, chlorine is very electronegative. This means that it has a high affinity for electrons and is able to carry the resulting negative charge without becoming activated or unstable. As a result, electrons can be drawn from the metal surface into the chlorine atoms contained in, for example, 1,1,1-TCA and result in an electrostatic bond with the metal. The orientation for such a bond would be "end-on", as all three chlorines would then be involved.

Regardless of the type of bond or the orientation, binding of the chlorinated compound with the iron surface is the first step in its degradation.

Reaction Mechanisms

In general, reaction types available for chemical (abiotic) degradation of these compounds include addition, substitution, and elimination. Reductive dechlorination, as commonly

described, is a substitution reaction in that a chlorine atom is replaced by hydrogen on the molecule. For example, TCE would react, losing one chlorine and gaining hydrogen to form DCE, which could further react to form vinyl chloride (VC). As a result, it is easy to see that intermediate degradation products, like cis-DCE, are constantly being produced while also being degraded. In this stepwise reaction sequence, one atom of iron is oxidized for every atom of chlorine removed as shown by the following stoichiometry for degradation of TCE to ethene:



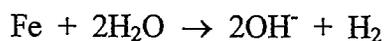
As a result, as contaminant concentrations decline, the level of ferrous iron and chloride should be on the rise.

As stated in the previous section, TCE will bind to the ZVI surface in a "side-on" orientation, resulting in a fairly strong complex. As it approaches the metal, electrons are drawn from the metal and an electron rich distribution is formed across the pi bond. This delocalized negative charge activates the complex and enables susceptibility to acid attack. As the hydronium ion interacts with the pi bond, the p orbitals are partially hybridized, so the transition state exhibits more sigma than pi bond character. In all probability, this transition state forms slowly and is the rate-limiting step. Formation of the transition state weakens the pi bond overlap with the iron, therefore as bond breaking and bond formation is occurring, a natural inclination to reform the pi bond exists. The problem is that as this process takes place, one of the iron atoms participating in the original complex is oxidized, losing two electrons in the process, and becomes dissolved. As a result, the complex must move to a new atom of iron in order to form, and this is not always possible. The net effect of this is that intermediate daughter products, including cis-DCE and VC are sometimes desorbed from the surface, showing up as contaminants in the groundwater.

Considering TCE as an example, three different isomers including 1,1-DCE, cis-DCE, and trans-DCE, can be formed by removal of one chlorine atom. Looking only at thermodynamic properties, the trans-DCE isomer should be favored. In reality, cis-DCE is the principal compound formed due to the limitations imposed by the initial metal-ligand binding. As expected, all three isomers are indeed formed, but the trans-DCE and 1,1-DCE are only formed in trace amounts.

The previous discussion pertained to substitution reactions; however, the transition state described will be identical to that formed during associated elimination reactions. Elimination reactions widely occur and may involve the loss of two halogen atoms, a hydrogen (metal catalyzed β -elimination), or a hydrogen-halide from across adjacent carbon atoms, forming a carbon-carbon double bond. An example of this is the formation of DCE from TCA. Energetically, this is a very favorable reaction as no oxidation of the iron takes place and pi bond overlap can occur as the olefin is formed. Another interesting feature of this reaction is that it is base catalyzed. This is important as hydroxyl anion (OH^-) is formed as a byproduct of acid attack during dechlorination (by substitution).

Lastly, metallic iron is commercially important as a catalyst in reduction of certain chemicals and it is well known that hydrogen gas is formed when finely divided or activated metal powders are contacted with water, in accord with the following reaction.



The hydrogen formed can also bind to the metal. Only sigma bonds are possible when hydrogen binds to the metal; however the hydrogen is activated in the process. This hydrogen can be utilized in addition (hydrogenation) reactions. As above, this reaction begins with the binding of an unsaturated compound (like DCE) to the metal surface. Should an olefin be bound to ZVI in the vicinity of an "activated-hydrogen" complex, it is very likely that hydrogen will add across the carbon-carbon double bond, and an alkane would rapidly desorb from the surface. An example of this would be the formation of 1,2-DCA from cis-DCE.

The importance of these various reactions can be appreciated when it is realized that both ethene and ethane (in the ratio of about 2:1) are ultimately formed during reaction of TCE with ZVI. This only seems possible if hydrogenation is taking place to a significant extent at some point along the way. Also chloroacetylenes have been shown to form from TCE by elimination reactions catalyzed by ZVI. As a result, the dynamic behavior of the intermediate reaction products can be a very complex mix of several different mechanisms that are sometimes difficult to predict. This is especially true when a mix of various alkanes and alkenes are present as site contaminants. Rates of reaction vary widely, depending on local geochemistry, the amount of catalyst (iron) present, on the chemical in question, and on the various products being produced.

The true kinetic model, even when dealing with a single contaminant will be dependent on ZVI surface area (the concentration of active sites), concentration of acid, and contaminants, rates of binding, rate of transition state formation, and rates of degradation/formation of the various intermediate chemicals. For simplicity's sake, first order kinetic models are most often used to model degradation over time and to predict the time required to approach site cleanup standards. A more detailed mathematical description of first order kinetic models is attached to this appendix.

FIRST ORDER KINETIC MODEL

The purpose of kinetic modeling is to enable calculation of future performance and to predict, for example, at what point in time TCA levels will be below the established cleanup goal. As a result, the model provides some insight into how rapidly or slowly any given contaminant is degraded and what daughter products are produced in the process. First order kinetics says that the rate of change of concentration at any point in time is simply equal to the product of a constant (the rate constant) and the concentration existing at that time. In other words, the rate of degradation will be faster when contaminant levels are high and slow down as the level drops. Expressed in mathematical terms, we have:

$$\text{Rate of Change} = d[\text{TCA}]/dt = -k[\text{TCA}]$$

Where: [TCA] represents the concentration of TCA at time t, and
k is the rate constant.

This equation can easily be solved by separation of variables as follows:

$$d[\text{TCA}]/dt = -k[\text{TCA}]$$

$$\frac{d[\text{TCA}]}{[\text{TCA}]} = -kdt$$

and finally

$$-k \int dt = \int 1/[\text{TCA}] d[\text{TCA}]$$

The resulting solution is a natural log function in the following form:

$$\ln [\text{TCA}] = kt - \ln [\text{TCA}]^0$$

Where

$\ln [\text{TCA}]$ - is the natural log of the TCA concentration at time t;

$\ln [\text{TCA}]^0$ - is the natural log of the initial TCA concentration;

t = time

Since the initial concentration is not a changing variable, the natural log of this number is a constant. The above equation is then recognizable as an equation of a straight line, $y = mx + b$. The intercept (b), is given by the log of the initial concentration, and slope (m) is the first order rate constant.



**Hamilton Beach Pilot
Unit A
Soil Sampling Results**

Sample ID. No.	HB-AS1	HB-AS1
Depth	12 - 14'	14 - 16'
Date	10/3/01	10/3/01
Units	ug/kg	ug/kg
Analyte		
Chloromethane	ND (1)	ND (1)
Chloroethane	ND (1)	ND (1)
Trichlorofluoromethane	ND (1)	ND (1)
Vinyl Chloride	2 (1)	ND (1)
1,1-Dichloroethene	4.3 (1)	ND (1)
Acetone	8.6 (1)	21 (1)
Methylene Chloride	ND (1)	3 (1)
Methyl Ethyl Ketone	64 (1)	3.3 (1)
cis-Dichloroethene	2 (1)	ND (1)
1,1-Dichloroethane	4.3 (1)	ND (1)
1,2-Dichloroethane	ND (1)	ND (1)
Chloroform	ND (1)	ND (1)
1,1,1-Trichloroethane	ND (1)	ND (1)
Trichloroethene	ND (1)	2.6 (1)
Toluene	ND (1)	ND (1)
Tetrachloroethene	ND (1)	ND (1)
Surrogates (% Recovery)		
Dibromofluoromethane	104	126
d8-Toluene	93	100
p-Bromofluorobenzene	90	96

ND=not detected

**Hamilton Beach Pilot
Unit A
Soil Sampling Results**

Sample ID. No.	HB-AS2													
Depth	0 - 2'		2 - 4'		4 - 6'		6'		6 - 8'		8 - 10'		10 - 12'	
Date	10/3/01		10/3/01		10/3/01		10/3/01		10/3/01		10/3/01		10/3/01	
Units	ug/kg		ug/kg											
Analyte														
Chloromethane	ND	(1)	ND	(1)										
Chloroethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	103	(1)	119	(1)	34	(1)
Trichlorofluoromethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	16	(1)	33	(1)	4.5	(1)
Vinyl Chloride	ND	(1)	ND	(1)	ND	(1)	ND	(1)	2.8	(1)	8.1	(1)	5.3	(1)
1,1-Dichloroethane	ND	(1)	1.2	(1)	25	(1)	13	(1)	192	(1)	286	(1)	119	(1)
Acetone	ND	(1)	2.4	(1)	6.7	(1)	ND	(1)	ND	(1)	ND	(1)	58	(1)
Methylene Chloride	ND	(1)	2.9	(1)										
Methyl Ethyl Ketone	ND	(1)	657	(1)										
cis-Dichloroethene	ND	(1)	ND	(1)	2.5	(1)	2.4	(1)	16	(1)	23	(1)	15	(1)
1,1-Dichloroethane	ND	(1)	2.3	(1)	17	(1)	14	(1)	170	(1)	175	(1)	61	(1)
1,2-Dichloroethane	ND	(1)	ND	(1)										
Chloroform	ND	(1)	ND	(1)										
1,1,1-Trichloroethane	ND	(1)	ND	(1)	22	(1)	14	(1)	187	(1)	250	(1)	42	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)										
Trichloroethene	ND	(1)	4.0	(1)	87	(1)	52	(1)	413	(1)	577	(1)	393	(1)
Toluene	ND	(1)	ND	(1)										
Tetrachloroethene	ND	(1)	ND	(1)	12	(1)	4.4	(1)	47	(1)	72	(1)	20	(1)
Surrogates (% Recovery)														
Dibromofluoromethane	100		105		114		100		119		118		102	
d8-Toluene	98		98		95		98		95		96		95	
p-Bromofluorobenzene	96		95		90		96		94		92		96	

ND=not detected

**Hamilton Beach Pilot
Unit B
Soil Sampling Results**

Sample ID. No.	HB-BS1		HB-BS1		HB-BS1									
Depth	0 - 2'		2 - 4'		4 - 6'		6 - 8'		8 - 10'		10 - 12'		12 - 14'	
Date	10/6/01		10/6/01		10/6/01		10/6/01		10/6/01		10/6/01		10/6/01	
Units	ug/kg		ug/kg		ug/kg									
Analyte														
Chloromethane	ND	(1)	ND	(1)	ND	(1)								
Chloroethane	ND	(1)	ND	(1)	ND	(1)								
Trichlorofluoromethane	ND	(1)	ND	(1)	ND	(1)								
Vinyl Chloride	ND	(1)	ND	(1)	6.5	(1)								
1,1-Dichloroethene	ND	(1)	1.1	(1)	2.3	(1)	ND	(1)	ND	(1)	3.1	(1)	4.9	(1)
Acetone	11	(1)	22	(1)	22	(1)	16	(1)	7.6	(1)	9.3	(1)	17	(1)
Methylene Chloride	ND	(1)	7.9	(1)	12	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Methyl Ethyl Ketone	2.3	(1)	5.6	(1)	6.1	(1)	3.1	(1)	2.2	(1)	1.9	(1)	3.8	(1)
cis-Dichloroethene	ND	(1)	1.1	(1)	9.2	(1)	2.9	(1)	2.6	(1)	16	(1)	25	(1)
1,1-Dichloroethane	ND	(1)	ND	(1)	1.5	(1)	ND	(1)	ND	(1)	7.7	(1)	5.7	(1)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)								
Chloroform	ND	(1)	ND	(1)	ND	(1)								
1,1,1-Trichloroethane	ND	(1)	ND	(1)	ND	(1)								
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)								
Trichloroethene	ND	(1)	5.4	(1)	4.9	(1)	ND	(1)	1.5	(1)	4	(1)	6.5	(1)
Toluene	ND	(1)	1.5	(1)	2.6	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	ND	(1)	ND	(1)	ND	(1)								
Surrogates (% Recovery)														
Dibromofluoromethane	4		115		117		132		123		142		115	
d8-Toluene	94		94		92		100		95		97		95	
p-Bromofluorobenzene	98		95		95		97		105		101		96	

E=estimate
ND=not detected

**Hamilton Beach Pilot
Unit B
Soil Sampling Results**

Sample ID. No.	HB-BS1		HB-BS1		HB-BS1		HB-BS1		HB-BS1		HB-BS1		HB-BS1	
Depth	14 - 16'		18 - 20'		20 - 22'		22 - 24'		26 - 28'		28'		28 - 30'	
Date	10/6/01		10/6/01		10/6/01		10/6/01		10/6/01		10/6/01		10/6/01	
Units	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
Analyte														
Chloromethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	391	(1)	ND	(20)
Chloroethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	484	(1)	ND	(1)	ND	(20)
Trichlorofluoromethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(20)
Vinyl Chloride	12	(1)	22	(1)	127	(1)	523	(1)	1439	(1) E	1713	(1) E	ND	(20)
1,1-Dichloroethene	6.8	(1)	36	(1)	211	(1)	1148	(1) E	275	(1)	580	(1)	26	(20)
Acetone	12	(1)	17	(1)	47	(1)	107	(1)	158	(1)	178	(1)	624	(20)
Methylene Chloride	ND	(1)	ND	(1)	1.4	(1)	16	(1)	12	(1)	13	(1)	ND	(20)
Methyl Ethyl Ketone	5.2	(1)	12	(1)	57	(1)	76	(1)	44	(1)	62	(1)	123	(20)
cis-Dichloroethene	33	(1)	123	(1)	434	(1)	1705	(1) E	1411	(1) E	1547	(1)	272	(20)
1,1-Dichloroethane	7.2	(1)	212	(1)	696	(1)	1980	(1) E	3221	(1) E	3447	(1) E	851	(20)
1,2-Dichloroethane	ND	(1)	7.3	(1)	20	(1)	93	(1)	246	(1)	301	(1)	86	(20)
Chloroform	ND	(1)	ND	(1)	ND	(1)	6.3	(1)	ND	(1)	3.2	(1)	ND	(20)
1,1,1-Trichloroethane	ND	(1)	ND	(1)	1.5	(1)	1436	(1) E	25	(1)	1337	(1)	ND	(20)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(20)
Trichloroethene	10	(1)	11	(1)	14	(1)	612	(1)	1398	(1) E	1857	(1)	21	(20)
Toluene	ND	(1)	1.3	(1)	9.9	(1)	72	(1)	152	(1)	204	(1)	76	(20)
Tetrachloroethene	ND	(1)	ND	(1)	ND	(1)	1.8	(1)	2	(1)	4.1	(1)	ND	(20)
Surrogates (% Recovery)														
Dibromofluoromethane	140		122		117		116		110		107		114	
d8-Toluene	92		96		93		92		94		91		105	
p-Bromofluorobenzene	89		101		95		89		94		89		110	

E=estimate
ND=not detected

FIELD DRILLING OPERATIONS

Boring/Well No. HB-AS1

Sampling Interval Continuous

Location Washington, NC

Drill Rig/Operator NESCO

Project Name Hamilton Beach/Proctor-Silex

Method DPT

Date: Started/Completed 10/3/01

Static Water Level NA

Recorded by C. Kennedy

Strati- graphy/ Lithology	Depth (ft)	Sample Interval	Sample ID	SPT Blow Count	Sample Description USCS ASTM D-2487	Remarks
	--	0 - 2'			Med. gray silt	
	--	2' - 4.5'			Lt. gray mottled silty clay	
5	----	4.5' - 5'			Lt. brown fine sand	damp
	--	5' - 11.5'			Lt. gray mottled clay, little coarse sand	Moist
10	----	11.5' - 12'			Med. gray fine sand	Wet
	--	12' - 14'			Dark gray clay	Wet
	--	14' - 15.5'			Dark brown clay	Wet
15	----	15.5' - 16'			Med. gray silty sand, End of boring @ 16'	
	--					
	--					
20	----					
	--					
	--					
25	----					
	--					
	--					
30	----					

Notes:

FIELD DRILLING OPERATIONS

Boring/Well No. HB-SA2

Sampling Interval Continuous

Location Washington, NC

Drill Rig/Operator NESCO

Project Name Hamilton Beach v Proctor-Silex

Method DPT

Date: Started/Completed 10/3/01

Static Water Level NA

Recorded by C. Kennedy

Strati- graphy/ Lithology	Depth (ft)	Sample Interval	Sample ID	SPT Blow Count	Sample Description USCS ASTM D-2487	Remarks
	--					
	--	0 - 2'			Med. gray silt	
	--					
	--	2' - 6'			Lt. to med. gray mottled silty clay	
5	----					
	--					
	--	6' - 7'			Lt. gray clayey sand	Moist
	--					
	--	7' - 10'			Lt. gray clay	Wet
10	----					
	--					
	--	10' - 12'			Med. gray clay	Wet
	--				End of boring @12'	
	--					
	--					
15	----					
	--					
	--					
	--					
20	----					
	--					
	--					
	--					
25	----					
	--					
	--					
	--					
30	----					

Notes:

FIELD DRILLING OPERATIONS

Boring/Well No. HB-SB1 (B-M6)

Sampling Interval Continuous

Location Washington, NC

Drill Rig/Operator NESCO

Project Name Hamilton Beach/Proctor-Silex

Method DPT

Date: Started/Completed 10/6/01

Static Water Level NA

Recorded by C. Kennedy

Strati- graphy/ Lithology	Depth (ft)	Sample Interval	Sample ID	SPT Blow Count	Sample Description USCS ASTM D-2487	Remarks
	--	0 - 0.5'			Concrete	
	--	0.5' - 3'			Orange sand (fill)	
5	---	3' - 6'			Med. to dark gray silty clay	
	--	6' - 8'			Lt. gray silty clay	
	--	8' - 9'			Lt. gray silty clay, little sand	
10	---	9' - 13'			Lt. to med. gray clay, stiff, some mottling	Moist
	--	13' - 15'			Lt. to med. gray clay	Wet
15	---	15' - 16'			Dark gray silty clay, stiff	
	--	16' - 18'			No recovery	
	--	18' - 20'			Lt. gray fine sandy clay	Moist
20	---	20' - 21'			Med. gray clay	Wet
	--	21' - 24'			Med gray clayey fine sand	Wet
25	---	24 - 26			Med. gray sandy clay, some shell fragments	Wet
	--	26' - 28'			Med to dk. gray clayey sand, few shells	Wet
	--	28' - 30'			Med. to dk. gray silty clay, shell fragments	Damp
30	---					

Notes: Well is screened from 17' - 26'



NESCO

January 30, 2002

Brett Berra
Radian Engineering
1600 Perimeter Park drive
Morrisville, NC 27560

Subject: Acrylamide Monitoring Results for the Hamilton Beach/Proctor Silex Site in
Washington, NC

NESCO, Inc.
6870 North Broadway, Unit H
Denver, Colorado 80221
Telephone 303-487-1001

Telefax 303-487-1083
Toll Free 1-877-987-1001

www.nesco-usa.com

Dear Brett:

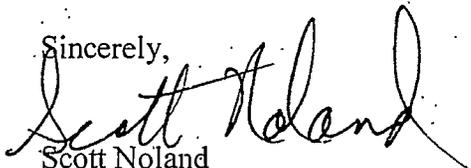
In accord with North Carolina's request to monitor for acrylamide downgradient of the pilot installations of iron powder at the subject site, NESCO has completed method development and subsequent analysis of groundwater samples taken on November 27 and December 17 of last year. Laboratory results, provided in the following report, were obtained using USEPA Method 8031.

One task associated with method development is to evaluate the method detection limit (MDL). Seven replicates were analyzed and the data used to calculate this parameter within a 95 percent confidence interval. Calculation resulted in an MDL of 3 ug/L, based on extraction of 25 ml sample aliquots. In the event that future monitoring is required, NESCO believes that the MDL can be reduced by extraction of a larger sample. One factor that may limit the success of this technique is the presence of numerous matrix interferences but an MDL less than 0.5 ppb should be achievable.

As shown, no acrylamide was detected in any of the samples. Associated quality assurance data for the November sampling event is very good and indicates acceptable method performance. Based on this early success, the laboratory control sample (LCS) spiking level was reduced to approximately ten times the MDL (true values shown on the table are based on the extract concentration, which is five times the sample value) for the December sampling event. It is very likely that this low spike level was responsible for the somewhat erratic quality control results obtained in December.

Please call if you have any questions.

Sincerely,



Scott Noland
Director of Remediation
NESCO, Inc.

**Acrylamide Monitoring Results
Hamilton Beach/Proctor Silex
Treatability Study**

Sample ID	Prep Blank	Prep Blank
Date Sampled	11/27/01	12/17/01
Units	µg/L	µg/L
Acrylamide	ND (3)	ND (3)
Surrogate (%)	107	128

Unit A

Sample ID	A-M9	A-M10	A-M9	A-M10
Date Sampled	11/27/01	11/27/01	12/17/01	12/17/01
Units	µg/L	µg/L	µg/L	µg/L
Acrylamide	ND (3)	ND (3)	ND (3)	ND (3)
Surrogate (%)	102	94	130	130

Unit A

Unit B

Sample ID	B-M10	B-M11	B-M10	B-M11
Date Sampled	11/27/01	11/27/01	12/17/01	12/17/01
Units	µg/L	µg/L	µg/L	µg/L
Acrylamide	ND (3)	ND (3)	ND (3)	ND (3)
Surrogate (%)	102	104	126	105

Unit B

**Acrylamide Monitoring Results
Hamilton Beach/Proctor Silex
Treatability Study
Quality Control/Quality Assurance**

Units: mg/L

Sample ID	Spike Result	Sample Result	Spike TV	Re (%)	RPD (%)
<u>Sampling Date – 11/27/01</u>					
LCS	0.883	----	1.0	88	
LCSD	0.973	----	1.0	97	9.7
A-M10-MS	0.132	ND (0.003)	0.16	82	
A-M10-MSD	0.131	ND (0.003)	0.16	82	0.8
<u>Sampling Date – 12/17/01</u>					
LCS	0.112	----	0.16	70	
LCSD	0.069	----	0.16	43	47.5
B-M11-MS	0.099	ND (0.003)	0.16	62	
B-M11-MSD	0.148	ND (0.003)	0.16	93	39.7



**Hamilton Beach
Water Quality Data
ZVI - Pilot Study**

**Unit "A" Ferrous
Iron Values (mg/L)**

	Lab 10/4/01	Field	Lab 10/9/01	Field	Lab 10/17/01	Field	Lab 11/8/01	Field	Lab 11/27/01	Field	Lab 12/17/01	Field	Lab 2/12/02	Field	Lab 3/12/02	Field	Lab 4/9/02	Field
	(BL)																	
HB - A - M1	2.8	NS	352e	NS	284	50	129	40	91	25	NA	28	150	12	227	25	192	25
HB - A - M2	5.7	NS	253e	NS	NS	50	74	20	51	15	NA	24	89	10	112	17.5	96	20
HB - A - M3	1.3	NS	219e	NS	83	IV	14	10	19	20	NS	20	57	18	87	25	96	35
HB - A - M4	1.9	NS	934e	NS	1028	IV	249	40	39	40	NS	32	51	20	200	35	182	35
HB - A - M5	1.7	NS	210	NS	96	50	18	20	13	15	NS	14	62	10	175	40	93	30
HB - A - M6	1.6	NS	32e	NS	150	IV	163	40	25	30	NS	28	63	10	47	20	37	21
HB - A - M7	4.9	NS	82e	NS	104	IV	95	40	35	30	NS	26	115	10	167	35	202	35
HB - A - M8	3.2	NS	265e	NS	166	IV	146	17.5	85	25	NS	21	13	15	27	25	17	20
HB - A - M9	0.7	NS	1.7	NS	NS	NS	ND (0.2)	5	NS	1	NS	1.2	ND (0.1)	2	ND (0.1)	2	ND (0.1)	2
HB - A - M10	0.7	NS	ND (0.2)	NS	NS	NS	0.7	1	NS	2	NS	3.6	ND (0.1)	2	ND (0.1)	1	0.1 (0.1)	1

**Unit "B" Ferrous
Iron Values (mg/L)**

	Lab 10/7/01	Field	Lab 10/10/01	Field	Lab 10/17/01	Field	Lab 11/7/01	Field	Lab 11/26/01	Field	Lab 12/17/01	Field
	(BL)											
HB - B - M1	59	NS	87	NS	165	20	109	20	111	17.5	150	30
HB - B - M2	77	NS	96	NS	164	100	134	100	115	100	152	100
HB - B - M3	147	NS	169	NS	274	100	218	125	181	150	297	160
HB - B - M4	117	NS	52	NS	111	50	100	75	76	75	102	80
HB - B - M5	126	NS	67	NS	138	100	135	100	116	75	121	70
HB - B - M6	118	NS	146	NS	125	100	239	150	304	200	531	180
HB - B - M7	109	NS	104	NS	137	100	298	175	261	150	251	160
HB - B - M8	100	NS	128	NS	164	100	132	100	127	100	160	110
HB - B - M9	94	NS	73	NS	261	150	125	75	94	100	101	80
HB - B - M10	63	NS	37	NS	NS	NS	48	75	37	20	48	26
HB - B - M11	143	NS	114	NS	NS	NS	168	125	162	20	142	20

(BL) = Groundwater levels were erratic during this period.
 ND=not detected
 IV = Insufficient Volume
 NS = Not Sampled/No Sample
 NA = Not analyzed for Fe
 e = This number is estimated due to interference from molasses injections.

**Hamilton Beach
Water Quality Data
ZVI - Pilot Study**

**Unit "A" Chloride
Values (mg/L)**

	10/4/01	10/9/01	10/17/01	11/8/01	11/27/01	2/12/02	3/12/02	4/9/02
	(BL)							
HB - A - M1	24	2494	64	39	49	80	79	69
HB - A - M2	22	3066	NS	35	50	69	117	102
HB - A - M3	22	1145	270	28	26	96	127	122
HB - A - M4	24	8894	599	53	64	206	243	228
HB - A - M5	27	917	140	43	48	77	113	86
HB - A - M6	26	5672	184	90	53	58	73	49
HB - A - M7	27	4170	149	52	54	115	137	144
HB - A - M8	26	112	176	68	80	28	49	32
HB - A - M9	9	12	NS	4.3	NS	6	4	5
HB - A - M10	8	11	NS	5.5	NS	5	5	5

**Unit "B" Chloride
Values (mg/L)**

	10/7/01	10/10/01	10/17/01	11/7/01	11/26/01	12/17/01
	(BL)					
HB - B - M1	1010	892	1229	425	763	522
HB - B - M2	602	904	930	496	692	576
HB - B - M3	847	814	777	523	631	510
HB - B - M4	783	784	569	434	565	413
HB - B - M5	983	1164	913	616	722	562
HB - B - M6	675	1097	807	549	1154	845
HB - B - M7	531	693	523	453	534	436
HB - B - M8	412	1097	626	538	692	413
HB - B - M9	624	964	766	518	760	711
HB - B - M10	510	626	NS	356	567	394
HB - B - M11	801	1028	NS	652	841	653

(BL) = Groundwater levels were erratic during this period.
NS=Not Sampled/No Sample

Hamilton Beach Water Quality Data ZVI - Pilot Study

Unit "A" ORP Values (mv)

	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	
	10/4/01		10/9/01		10/17/01		11/8/01		11/27/01		12/17/01		2/12/02		3/12/02		4/9/02		
	(BL)																		
HB - A - M1	396	183	186	148	227	165	418	203	470	IV	NA	IV	-140	IV	400	88	390	74	
HB - A - M2	380	177	197	140	NS	-51	376	-30	406	-89	NA	IV	-60	IV	349	12	342	10	
HB - A - M3	457	215	269	184	-217	31	463	-89	497	IV	NS	-60	-259	IV	345	36	351	7	
HB - A - M4	426	228	82	IV	-287	121	-167	IV	54	122	NS	-78	-56	IV	235	19	286	24	
HB - A - M5	457	230	192	155	-273	170	346	IV	442	IV	NS	-63	46	IV	355	47	309	45	
HB - A - M6	451	266	129	155	-234	195	359	IV	428	IV	NS	-67	-213	IV	342	1	283	-14	
HB - A - M7	416	203	160	182	-204	143	418	IV	447	IV	NS	-20	85	IV	296	23	289	36	
HB - A - M8	355	43	237	125	-255	-4	370	2	317	-38	NS	-135	50	IV	353	47	244	43	
HB - A - M9	464	190	404	206	NS	NS	387	183	NS	NS	NS	NS	513	IV	360	220	552	186	
HB - A - M10	487	210	538	230	NS	NS	513	200	NS	NS	NS	NS	543	IV	564	272	592	240	

Unit "B" ORP Values (mv)

	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field
	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
	(BL)											
HB - B - M1	120	NS	244	-2	-20	-4	193	-9	246	-41	162	-49
HB - B - M2	215	NS	179	-29	24	-29	296	114	320	-95	368	-107
HB - B - M3	242	NS	314	110	124	-52	192	-173	274	-151	147	-138
HB - B - M4	132	NS	186	-3	-96	-73	252	-137	308	-109	338	-166
HB - B - M5	170	NS	156	-28	-33	-68	271	-144	302	-123	243	-141
HB - B - M6	269	NS	145	-33	-93	-45	148	-179	197	-90	241	-111
HB - B - M7	259	NS	222	4	-84	-39	152	-160	232	-119	177	-128
HB - B - M8	302	NS	159	5	-91	-69	151	-185	224	-151	143	-139
HB - B - M9	129	NS	198	-23	-69	-123	132	-120	217	-162	209	-111
HB - B - M10	142	NS	198	NS	NS	NS	224	-97	223	-97	222	-143
HB - B - M11	240	NS	198	NS	NS	NS	319	-73	311	-12	324	-57

⊘ = Groundwater levels were erratic during this period.

IV = Insufficient Volume

NS = Not Sampled/No Sample

NA = Not analyzed for ORP

Hamilton Beach Water Quality Data ZVI - Pilot Study

Unit "A" pH Values

	Lab 10/4/01	Field	Lab 10/9/01	Field	Lab 10/17/01	Field	Lab 11/8/01	Field	Lab 11/27/01	Field	Lab 12/17/01	Field	Lab 2/12/02	Field	Lab 3/12/02	Field	Lab 4/9/02	Field
	(BL)																	
HB - A - M1	NA	4.9	5.2	5.1	NA	4.2	4.4	3.8	4.5	IV	NA	IV	5.0	NA	4.8	5.2	4.8	4.8
HB - A - M2	NA	5.2	5.0	5.1	NA	4.2	4.2	3.7	4.4	3.6	NA	IV	5.5	NA	5.6	5.5	5.8	5.7
HB - A - M3	NA	4.8	4.6	4.8	NA	4.0	3.9	IV	4.2	IV	NS	3.3	4.9	NA	4.8	5.3	4.8	4.8
HB - A - M4	NA	4.8	5.4	IV	NA	4.0	4.4	IV	4.4	3.7	NS	3.2	5.0	NA	5.7	5.2	5.7	5.5
HB - A - M5	NA	4.7	5.4	4.9	NA	4.1	4.3	IV	4.5	IV	NS	3.1	5.5	NA	5.0	5.2	5.3	5.4
HB - A - M6	NA	5.0	5.2	4.9	NA	3.7	4.3	IV	4.3	IV	NS	3.2	5.9	NA	5.3	5.2	5.7	5.6
HB - A - M7	NA	4.5	4.8	4.6	NA	4.3	4.3	IV	4.4	IV	NS	3.1	5.0	NA	4.9	4.7	5.0	4.9
HB - A - M8	NA	4.8	4.9	4.8	NA	4.0	4.4	3.9	4.7	4.4	NS	3.2	5.4	NA	5.1	5.0	5.5	5.7
HB - A - M9	NA	4.6	4.8	4.2	NA	NS	4.8	4.3	NS	NS	NS	NS	4.9	NA	4.4	4.7	4.9	5.0
HB - A - M10	NA	4.7	4.9	4.2	NA	NS	4.6	4.4	NS	NS	NS	NS	6.4	NA	4.3	4.8	4.2	4.4
MW-204													5.3					

Unit "B" pH Values

	Lab 10/7/01	Field	Lab 10/10/01	Field	Lab 10/17/01	Field	Lab 11/7/01	Field	Lab 11/27/01	Field	Lab 12/17/01	Field
	(BL)											
HB - B - M1	6.2	NS	6.0	6.0	NA	5.4	5.0	4.7	5.5	4.9	6.0	5.1
HB - B - M2	5.4	NS	6.1	5.8	NA	5.6	5.4	5.1	5.1	4.8	5.1	4.1
HB - B - M3	5.1	NS	4.9	5.0	NA	5.1	5.1	5.0	5.3	5.1	5.4	4.5
HB - B - M4	6.0	NS	6.2	6.0	NA	5.7	4.8	4.5	4.9	4.6	4.9	4.1
HB - B - M5	5.4	NS	6.2	6.2	NA	5.7	5.1	4.9	5.3	4.9	5.6	4.5
HB - B - M6	5.2	NS	5.9	6.1	NA	5.4	5.3	5.5	5.5	5.5	5.7	5.1
HB - B - M7	5.0	NS	5.7	5.7	NA	4.8	5.1	5.1	5.0	4.9	5.3	4.5
HB - B - M8	4.7	NS	5.5	5.7	NA	5.1	5.4	5.4	5.3	5.1	5.1	4.6
HB - B - M9	5.8	NS	5.9	NA	NA	5.4	5.4	5.4	5.7	5.5	6.0	5.1
HB - B - M10	6.2	NS	6.1	NS	NA	NS	5.9	5.8	6.2	5.9	6.1	5.4
HB - B - M11	5.1	NS	5.9	NS	NA	NS	5.1	5.2	5.2	5.0	5.3	4.6

(BL) = Groundwater levels were erratic during this period.

IV = Insufficient Volume

NS = Not Sampled/No Sample

NA = Not analyzed for pH

**Hamilton Beach
Water Quality Data
ZVI - Pilot Study**

Unit "A" DO Values (mg/L)	10/4/01	10/9/01	10/17/01	11/8/01	11/27/01	12/17/01	2/13/02	3/12/02	4/9/02
Field Measurement									
HB - A - M1	4.11	3.90	IV	IV	IV	IV	3.14	3.26	1.64
HB - A - M2	3.32	3.80	1.02	2.62	2.48	IV	2.53	2.98	2
HB - A - M3	4.33	4.38	IV	IV	IV	2.75	2.52	3.48	1.82
HB - A - M4	4.05	IV	IV	IV	IV	IV	3.53	3.64	1.65
HB - A - M5	3.59	4.16	IV	IV	IV	IV	2.97	3.09	1.57
HB - A - M6	3.60	3.68	IV	IV	IV	IV	2.32	3.24	1.5
HB - A - M7	2.94	4.80	IV	IV	IV	IV	2.89	3.10	1.77
HB - A - M8	3.17	2.47	IV	2.36	IV	IV	2.39	2.94	1.62
HB - A - M9	4.72	4.05	NS	4.9	NS	NS	5.35	6.43	4.63
HB - A - M10	3.56	3.86	NS	3.97	NS	NS	5.10	5.95	3.51

Unit "B" DO Values (mg/L)	10/10/01	10/17/01	11/7/01	11/27/01	12/17/01
Field Measurement					
HB - B - M1	1.43	1.40	1.29	1.22	1.50
HB - B - M2	1.57	1.07	1.3	1.16	1.29
HB - B - M3	1.65	0.85	1.08	1.07	1.18
HB - B - M4	1.22	1.13	0.97	1.18	1.33
HB - B - M5	1.58	1.07	1.31	1.23	1.45
HB - B - M6	1.04	1.10	1.02	1.03	1.30
HB - B - M7	0.78	1.14	0.84	1.47	1.06
HB - B - M8	0.06	1.16	0.96	1.36	1.29
HB - B - M9	0.64	0.99	1.16	0.98	1.67
HB - B - M10	NS	NS	1.52	1.14	1.50
HB - B - M11	NS	NS	1.36	1.12	1.33

IV = Insufficient Volume
NS = Not Sampled/No Sample



**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M1		HB-B-M1		HB-B-M1		HB-B-M1		HB-B-M1		HB-B-M1	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(100)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(200)*	ND	(20)
Chloroethane*	ND	(100)*	38	(10)*	95	(10)*	64	(100)*	113	(200)*	162	(20)
Trichlorofluoromethane*	ND	(100)*	ND	(10)*	ND	(10)*	54	(100)*	67	(200)*	ND	(20)
Vinyl Chloride*	390	(100)*	387	(10)*	426	(10)*	191	(100)*	233	(200)*	206	(20)
1,1-Dichloroethene	15287	(100)	10200	(100)	8934	(10) E	9350	(100)	11236	(200)	4614	(200)
Acetone	3636	(100)	596	(10)	1362	(100)	1890	(100)	1428	(200)	1038	(20)
Methylene Chloride	ND	(100)	50	(10)	67	(10)	ND	(100)	ND	(200)	48	(20)
Methyl Ethyl Ketone	1235	(100)	ND	(10)	ND	(10)	481	(100)	ND	(200)	968	(20)
cis-Dichloroethene	7214	(100)	8370	(10)	7631	(10)	6357	(100)	9026	(200)	9426	(200)
1,1-Dichloroethane	80745	(500)	49140	(100)	39000	(100)	45736	(100)	69598	(200)	50144	(200)
1,2-Dichloroethane	1989	(100)	1606	(10)	2041	(10)	1905	(100)	2218	(200)	1630	(20)
Chloroform	105	(100)	64	(10)	75	(10)	ND	(100)	ND	(200)	48	(20)
1,1,1-Trichloroethane	156820	(500)	79880	(100)	48500	(100)	70855	(100) E	143712	(200)	64686	(200)
1,2-Dichloropropane	ND	(100)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(20)
Trichloroethene	21105	(100)	17870	(100)	15440	(10) E	16012	(100)	25910	(200)	13114	(200)
Toluene	974	(100)	632	(10)	703	(10)	770	(100)	1060	(200)	638	(20)
Tetrachloroethene	ND	(100)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(20)
Surrogates (% Recovery)												
Dibromofluoromethane	123		95		112		108		118		103	
d8-Toluene	100		102		96		100		109		100	
p-Bromofluorobenzene	104		100		107		102		112		101	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M2		HB-B-M2		HB-B-M2		HB-B-M2		HB-B-M2		HB-B-M2	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(1)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(100)*	ND	(10)
Chloroethane*	12	(1)*	47	(10)*	40	(10)*	37	(100)*	ND	(100)*	15	(10)
Trichlorofluoromethane*	ND	(1)*	ND	(10)*	ND	(10)*	58	(100)*	29	(100)*	ND	(10)
Vinyl Chloride*	563	(100)*	322	(10)*	376	(10)*	377	(100)*	459	(100)*	357	(10)
1,1-Dichloroethene	14081	(100)	7980	(100)	7997	(10) E	10914	(100)	12206	(100)	7944	(100)
Acetone	2329	(100)	563	(10)	1090	(100)	1512	(100)	658	(100)	444	(10)
Methylene Chloride	50	(1)	44	(10)	49	(10)	ND	(100)	115	(100)	44	(10)
Methyl Ethyl Ketone	2049	(100)	2480	(100)	ND	(10)	987	(100)	ND	(100)	845	(10)
cis-Dichloroethene	24893	(100)	18640	(100)	17641	(10) E	29842	(100)	23292	(100)	18030	(100)
1,1-Dichloroethane	23932	(100)	24090	(100)	21232	(10) E	26250	(100)	29844	(100)	25654	(100)
1,2-Dichloroethane	725	(100)	881	(10)	1051	(10)	860	(100)	953	(100)	873	(10)
Chloroform	26	(1)	ND	(10)	25	(10)	ND	(100)	ND	(100)	24	(10)
1,1,1-Trichloroethane	17794	(100)	15280	(100)	11118	(10) E	13715	(100)	17875	(100)	14644	(100)
1,2-Dichloropropane	ND	(1)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Trichloroethene	620	(100)	7250	(100)	4131	(10)	1245	(100)	610	(100)	319	(10)
Toluene	208	(1)	301	(10)	356	(10)	558	(100)	434	(100)	347	(10)
Tetrachloroethene	ND	(1)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	102		105		113		106		111		94	
d8-Toluene	99		101		98		99		112		96	
p-Bromofluorobenzene	95		99		109		100		111		111	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M3		HB-B-M3		HB-B-M3		HB-B-M3		HB-B-M3		HB-B-M3	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(1)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(100)*	ND	(10)
Chloroethane*	19	(1)*	9.9	(10)*	21	(10)*	43	(100)*	50	(100)*	48	(10)
Trichlorofluoromethane*	ND	(1)*	ND	(10)*	3.8	(10)*	49	(100)*	30	(100)*	ND	(10)
Vinyl Chloride*	616	(100)*	560	(10)*	340	(10)*	263	(100)*	237	(100)*	127	(10)
1,1-Dichloroethene	24566	(100)	12750	(100)	9471	(10) E	10663	(100)	9094	(100)	4018	(100)
Acetone	4467	(100)	435	(10)	1062	(10)	7095	(100)	801	(100)	309	(10)
Methylene Chloride	72	(1)	62	(10)	55	(10)	ND	(100)	ND	(100)	25	(10)
Methyl Ethyl Ketone	10600	(100)	1493	(10)	ND	(10)	ND	(100)	ND	(100)	560	(10)
cis-Dichloroethene	29721	(100)	20160	(100)	16100	(10) E	15159	(100)	14824	(100)	9270	(100)
1,1-Dichloroethane	42581	(100)	29570	(100)	23517	(10) E	23348	(100)	21870	(100)	16573	(100)
1,2-Dichloroethane	1334	(100)	1014	(10)	1092	(10)	774	(100)	810	(100)	621	(10)
Chloroform	ND	(1)	43	(10)	45	(10)	ND	(100)	ND	(100)	16	(10)
1,1,1-Trichloroethane	55039	(100)	47520	(100)	24924	(10) E	24639	(100)	27021	(100)	14291	(100)
1,2-Dichloropropane	ND	(1)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Trichloroethene	2121	(100)	2580	(100)	1825	(10)	1041	(100)	1021	(100)	503	(10)
Toluene	895	(100)	483	(10)	429	(10)	487	(100)	495	(100)	318	(10)
Tetrachloroethene	2.2	(1)	ND	(10)	12	(10)	ND	(100)	ND	(100)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	121		98		109		106		111		94	
d8-Toluene	103		108		97		98		112		96	
p-Bromofluorobenzene	106		102		115		101		113		113	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M4		HB-B-M4		HB-B-M4		HB-B-M4		HB-B-M4		HB-B-M4	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(10)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(100)*	ND	(10)
Chloroethane*	18	(10)*	46	(10)*	28	(10)*	39	(100)*	73	(100)*	45	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	ND	(10)*	50	(100)*	30	(100)*	ND	(10)
Vinyl Chloride*	571	(100)*	427	(10)*	434	(10)*	480	(100)*	436	(100)*	256	(10)
1,1-Dichloroethene	14546	(100)	5290	(100)	6560	(10) E	10861	(100)	10807	(100)	5160	(100)
Acetone	1783	(10)	784	(10)	657	(10)	2308	(100)	2350	(100)	393	(10)
Methylene Chloride	57	(10)	37	(10)	41	(10)	ND	(100)	ND	(100)	43	(10)
Methyl Ethyl Ketone	4044	(100)	4147	(10)	ND	(10)	578	(100)	ND	(100)	614	(10)
cis-Dichloroethene	17924	(100)	10530	(100)	11502	(10) E	16852	(100)	19913	(100)	15682	(100)
1,1-Dichloroethane	51644	(100)	40500	(100)	24566	(10) E	31259	(100)	38094	(100)	30688	(100)
1,2-Dichloroethane	1042	(10)	1056	(10)	1055	(10)	830	(100)	1040	(100)	820	(10)
Chloroform	ND	(10)	22	(10)	40	(10)	ND	(100)	ND	(100)	13	(10)
1,1,1-Trichloroethane	44627	(100)	17140	(100)	16125	(10) E	16005	(100)	17408	(100)	6851	(100)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Trichloroethene	8632	(100)	7470	(100)	4770	(10)	2578	(100)	2085	(100)	365	(10)
Toluene	785	(100)	372	(10)	338	(10)	514	(100)	518	(100)	312	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	127		100		110		104		112		97	
d8-Toluene	106		99		99		100		113		96	
p-Bromofluorobenzene	105		101		113		100		113		112	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M5		HB-B-M5		HB-B-M5		HB-B-M5		HB-B-M5		HB-B-M5	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(10)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(100)*	ND	(10)
Chloroethane*	21	(10)*	71	(10)*	60	(10)*	19	(100)*	19	(100)*	27	(10)
Trichlorofluoromethane*	ND	(10)*	84	(10)*	617	(10)*	56	(100)*	32	(100)*	ND	(10)
Vinyl Chloride*	606	(10)*	301	(10)*	392	(10)*	343	(100)*	362	(100)*	269	(10)
1,1-Dichloroethene	17842	(100)	3710	(100)	6102	(10) E	11184	(100)	13560	(100)	8505	(100)
Acetone	1089	(10)	ND	(10)	594	(10)	2362	(100)	6663	(100)	601	(10)
Methylene Chloride	288	(100)	40	(10)	56	(10)	ND	(100)	ND	(100)	45	(10)
Methyl Ethyl Ketone	2002	(10)	463	(10)	ND	(10)	1289	(100)	ND	(100)	954	(10)
cis-Dichloroethene	33180	(100)	13500	(100)	15782	(10) E	21231	(100)	23764	(100)	18397	(100)
1,1-Dichloroethane	42655	(100)	37280	(100)	29082	(10) E	28133	(100)	31928	(100)	24629	(100)
1,2-Dichloroethane	1141	(10)	1115	(10)	1383	(10)	908	(100)	1046	(100)	832	(10)
Chloroform	56	(10)	ND	(10)	28	(10)	ND	(100)	ND	(100)	24	(10)
1,1,1-Trichloroethane	26644	(100)	6300	(100)	11127	(10) E	14862	(100)	17640	(100)	12978	(100)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Trichloroethene	972	(10)	3170	(100)	2190	(10)	582	(100)	654	(100)	395	(10)
Toluene	738	(100)	329	(10)	399	(10)	502	(100)	576	(100)	399	(10)
Tetrachloroethene	ND	(10)	11	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	124		99		109		105		113		95	
d8-Toluene	104		102		98		100		112		95	
p-Bromofluorobenzene	103		102		114		99		113		111	
Bromochloromethane												

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M6		HB-B-M6		HB-B-M6		HB-B-M6		HB-B-M6		HB-B-M6	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(10)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(100)*	ND	(10)
Chloroethane*	26	(10)*	21	(10)*	40	(10)*	158	(100)*	253	(100)*	303	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	ND	(10)*	52	(100)*	33	(100)*	ND	(10)
Vinyl Chloride*	721	(100)*	183	(10)*	410	(10)*	176	(100)*	260	(100)*	353	(10)
1,1-Dichloroethene	15252	(100)	3490	(100)	3436	(10)	3172	(100)	4352	(100)	3195	(100)
Acetone	2168	(100)	691	(10)	463	(10)	1552	(100)	833	(100)	554	(10)
Methylene Chloride	94	(10)	32	(10)	54	(10)	ND	(100)	ND	(100)	35	(10)
Methyl Ethyl Ketone	2147	(100)	1109	(10)	ND	(10)	ND	(100)	1167	(100)	724	(10)
cis-Dichloroethene	18842	(100)	7710	(100)	16256	(10) E	8207	(100)	10195	(100)	8878	(100)
1,1-Dichloroethane	62038	(100)	29580	(100)	29979	(10) E	18279	(100)	25200	(100)	24780	(100)
1,2-Dichloroethane	1792	(10)	898	(10)	1415	(10)	608	(100)	739	(100)	755	(10)
Chloroform	90	(10)	24	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
1,1,1-Trichloroethane	48113	(100)	15230	(100)	4020	(10)	4800	(100)	4269	(100)	1932	(10)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Trichloroethene	10937	(100)	5440	(100)	2211	(10)	1497	(100)	1615	(100)	947	(10)
Toluene	908	(100)	214	(10)	398	(10)	304	(100)	2014	(100)	232	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	126		100		114		105		115		95	
d8-Toluene	104		101		97		100		109		96	
p-Bromofluorobenzene	105		102		116		98		110		111	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M7		HB-B-M7		HB-B-M7		HB-B-M7		HB-B-M7		HB-B-M7	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(10)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(100)*	ND	(10)
Chloroethane*	11	(10)*	25	(10)*	18	(10)*	29	(100)*	48	(100)*	58	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	ND	(10)*	47	(100)*	ND	(100)*	ND	(10)
Vinyl Chloride*	683	(10)*	312	(10)*	273	(10)*	331	(100)*	312	(100)*	220	(10)
1,1-Dichloroethene	12235	(100)	4730	(100)	3687	(10)	6128	(100)	5809	(100)	3940	(100)
Acetone	1581	(100)	471	(10)	836	(10)	1260	(100)	ND	(100)	255	(10)
Methylene Chloride	265	(100)	38	(10)	34	(10)	ND	(100)	ND	(100)	26	(10)
Methyl Ethyl Ketone	1729	(100)	790	(10)	ND	(10)	482	(100)	ND	(100)	ND	(10)
cis-Dichloroethene	23708	(100)	12720	(100)	12050	(10) E	11664	(100)	12357	(100)	10484	(100)
1,1-Dichloroethane	32750	(100)	22950	(100)	14790	(10) E	17484	(100)	19570	(100)	16514	(100)
1,2-Dichloroethane	906	(10)	639	(10)	707	(10)	458	(100)	512	(100)	464	(10)
Chloroform	47	(10)	16	(10)	22	(10)	ND	(100)	ND	(100)	ND	(10)
1,1,1-Trichloroethane	18126	(100)	5450	(100)	3547	(10)	497	(100)	349	(100)	472	(10)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Trichloroethene	4080	(10)	3490	(100)	2165	(10)	1207	(100)	676	(100)	343	(10)
Toluene	679	(100)	224	(10)	215	(10)	420	(100)	834	(100)	187	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(100)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	127		102		118		103		110		95	
d8-Toluene	105		100		98		99		108		96	
p-Bromofluorobenzene	108		101		113		98		111		111	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M8		HB-B-M8		HB-B-M8		HB-B-M8		HB-B-M8		HB-B-M8	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(10)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(200)*	ND	(10)
Chloroethane*	13	(10)*	2.7	(10)*	24	(10)*	72	(100)*	78	(200)*	60	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	ND	(10)*	52	(100)*	63	(200)*	ND	(200)
Vinyl Chloride*	710	(10)*	450	(10)*	465	(10)*	307	(100)*	322	(200)*	202	(10)
1,1-Dichloroethene	14772	(100)	8060	(100)	7030	(10) E	5801	(100)	5222	(200)	2414	(10)
Acetone	1688	(100)	540	(10)	788	(10)	766	(100)	ND	(200)	211	(10)
Methylene Chloride	297	(100)	51	(10)	60	(10)	ND	(100)	ND	(200)	43	(10)
Methyl Ethyl Ketone	1209	(100)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
cis-Dichloroethene	15655	(100)	11040	(100)	11223	(10) E	14279	(100)	16270	(200)	12510	(200)
1,1-Dichloroethane	45146	(100)	40790	(100)	36753	(10) E	47388	(100)	52226	(200)	40448	(200)
1,2-Dichloroethane	1252	(10)	1577	(10)	1760	(10)	1280	(100)	1274	(200)	997	(10)
Chloroform	68	(10)	60	(10)	48	(10)	ND	(100)	ND	(200)	ND	(10)
1,1,1-Trichloroethane	31504	(100)	38220	(100)	19371	(10) E	5185	(100)	2412	(200)	1169	(10)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
Trichloroethene	10630	(100)	12920	(100)	9881	(10) E	5367	(100)	3366	(200)	3223	(10)
Toluene	833	(10)	498	(10)	498	(10)	604	(100)	594	(200)	399	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	130		109		118		104		113		94	
d8-Toluene	107		99		98		99		109		96	
p-Bromofluorobenzene	107		110		113		97		109		108	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M9		HB-B-M9		HB-B-M9		HB-B-M9		HB-B-M9		HB-B-M9	
Date Sampled	10/7/01		10/10/01		10/17/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte												
Chloromethane*	ND	(10)*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(200)*	ND	(10)
Chloroethane*	34	(10)*	71	(10)*	43	(10)*	81	(100)*	91	(200)*	62	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	ND	(10)*	52	(100)*	ND	(200)*	ND	(10)
Vinyl Chloride*	763	(10)*	511	(10)*	168	(10)*	467	(100)*	546	(200)*	396	(10)
1,1-Dichloroethene	7248	(100)	4520	(100)	3040	(10)	6231	(100)	6694	(200)	4490	(200)
Acetone	2551	(100)	697	(10)	441	(10)	1316	(100)	ND	(200)	398	(10)
Methylene Chloride	63	(10)	47	(10)	32	(10)	ND	(100)	ND	(200)	52	(10)
Methyl Ethyl Ketone	1354	(100)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
cis-Dichloroethene	23043	(100)	18270	(100)	15460	(100)	19329	(100)	25102	(200)	21016	(200)
1,1-Dichloroethane	47941	(100)	45980	(100)	30750	(100)	38759	(100)	51554	(200)	40302	(200)
1,2-Dichloroethane	1165	(10)	1250	(10)	886	(10)	1116	(100)	1450	(200)	1266	(10)
Chloroform	20	(10)	ND	(10)	18	(10)	ND	(100)	ND	(200)	ND	(10)
1,1,1-Trichloroethane	1208	(10)	204	(10)	5628	(10)	183	(100)	ND	(200)	92	(10)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	14	(10)
Trichloroethene	3451	(100)	4470	(100)	2805	(10)	669	(100)	322	(200)	157	(10)
Toluene	891	(100)	402	(10)	186	(10)	639	(100)	812	(200)	499	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
Surrogates (% Recovery)												
Dibromofluoromethane	125		114		115		106		112		97	
d8-Toluene	103		102		98		98		108		97	
p-Bromofluorobenzene	104		104		117		98		108		108	
Bromochloromethane												

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M10		HB-B-M10		HB-B-M10		HB-B-M10		HB-B-M10	
Date Sampled	10/7/01		10/10/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte										
Chloromethane*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(200)*	ND	(10)
Chloroethane*	144	(100)*	62	(10)*	64	(100)*	92	(200)*	52	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	49	(100)*	ND	(200)*	ND	(10)
Vinyl Chloride*	750	(10)*	425	(10)*	350	(100)*	396	(200)*	262	(10)
1,1-Dichloroethene	5579	(100)	3670	(100)	5626	(100)	5596	(200)	4144	(200)
Acetone	1918	(100)	797	(10)	10589	(100)	1092	(200)	721	(10)
Methylene Chloride	141	(100)	40	(10)	ND	(100)	ND	(200)	40	(10)
Methyl Ethyl Ketone	790	(100)	ND	(10)	1610	(100)	ND	(200)	ND	(10)
cis-Dichloroethene	19777	(100)	15500	(100)	15243	(100)	19342	(200)	15372	(200)
1,1-Dichloroethane	56166	(100)	42050	(100)	38241	(100)	53250	(200)	38410	(200)
1,2-Dichloroethane	1495	(10)	1185	(10)	1180	(100)	1516	(200)	1162	(10)
Chloroform	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
1,1,1-Trichloroethane	21	(10)	24	(10)	127	(100)	ND	(200)	39	(10)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(100)	ND	(200)	13	(10)
Trichloroethene	971	(10)	980	(10)	1313	(100)	870	(200)	996	(200)
Toluene	683	(100)	320	(10)	620	(100)	696	(200)	348	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
Surrogates (% Recovery)										
Dibromofluoromethane	122		101		106		113		98	
d8-Toluene	104		100		99		110		97	
p-Bromofluorobenzene	104		100		99		111		108	
Bromochloromethane										

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

**Hamilton Beach Pilot
Unit B
Groundwater Sampling Results**

Sample ID. No.	HB-B-M11		HB-B-M11		HB-B-M11		HB-B-M11		HB-B-M11	
Date Sampled	10/7/01		10/10/01		11/7/01		11/26/01		12/17/01	
Sample Type	BL		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L		ug/L	
Analyte										
Chloromethane*	ND	(10)*	ND	(10)*	ND	(100)*	ND	(200)*	ND	(10)
Chloroethane*	24	(10)*	50	(10)*	29	(100)*	31	(200)*	22	(10)
Trichlorofluoromethane*	ND	(10)*	ND	(10)*	51	(100)*	ND	(200)*	ND	(200)
Vinyl Chloride*	505	(10)*	234	(10)*	177	(100)*	182	(200)*	149	(10)
1,1-Dichloroethene	13499	(100)	5403	(10) E	10435	(100)	10854	(200)	7216	(200)
Acetone	2061	(100)	537	(10)	3059	(100)	ND	(200)	917	(10)
Methylene Chloride	104	(10)	55	(10)	ND	(100)	ND	(200)	58	(10)
Methyl Ethyl Ketone	3222	(100)	ND	(10)	1391	(100)	ND	(200)	1409	(10)
cis-Dichloroethene	37347	(100)	17031	(10) E	25506	(100)	31334	(200)	24860	(200)
1,1-Dichloroethane	45436	(100)	19331	(10) E	30613	(100)	38774	(200)	29952	(200)
1,2-Dichloroethane	1353	(10)	1127	(10)	1118	(100)	1320	(200)	1079	(10)
Chloroform	31	(10)	14	(10)	ND	(100)	ND	(200)	14	(10)
1,1,1-Trichloroethane	4762	(100)	1962	(10)	3934	(100)	3440	(200)	2226	(200)
1,2-Dichloropropane	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
Trichloroethene	354	(10)	290	(10)	278	(100)	256	(200)	150	(10)
Toluene	819	(100)	366	(10)	649	(100)	758	(200)	405	(10)
Tetrachloroethene	ND	(10)	ND	(10)	ND	(100)	ND	(200)	ND	(10)
Surrogates (% Recovery)										
Dibromofluoromethane	120		100		106		117		94	
d8-Toluene	103		97		100		110		97	
p-Bromofluorobenzene	104		106		101		110		108	

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

ND=not detected

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M1	HB-B-M1	HB-B-M1	HB-B-M1	HB-B-M1	HB-B-M1
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	ND	0.58	1.46	1.00	1.76	2.51
Trichlorofluoromethane*	137.37	ND	ND	ND	0.40	0.49	ND
Vinyl Chloride*	62.5	6.24	6.20	6.82	3.05	3.73	3.30
1,1-Dichloroethene	96.94	157.70	105.22	92.16	96.45	115.91	47.60
Acetone	59.07	61.55	10.09	23.06	32.00	24.17	17.57
Methylene Chloride	85.93	ND	0.58	0.78	ND	ND	0.56
Methyl Ethyl Ketone	72.11	17.13	ND	ND	6.67	ND	13.42
cis-Dichloroethene	96.94	74.42	86.34	78.72	65.58	93.11	97.24
1,1-Dichloroethane	98.96	815.94	496.56	394.10	462.17	703.29	506.71
1,2-Dichloroethane	98.96	20.10	16.23	20.62	19.25	22.41	16.47
Chloroform	120.37	0.87	0.53	0.62	ND	ND	0.40
1,1,1-Trichloroethane	133.41	1175.47	598.76	363.54	531.11	1077.22	484.87
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	160.63	136.01	117.51	121.87	197.20	99.81
Toluene	93.13	10.46	6.79	7.55	8.27	11.38	6.85
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		123	95	112	108	118	103
d8-Toluene		100	102	96	100	109	100
p-Bromofluorobenzene		104	100	107	102	112	101

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M2	HB-B-M2	HB-B-M2	HB-B-M2	HB-B-M2	HB-B-M2
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.18	0.72	0.62	0.57	ND	0.23
Trichlorofluoromethane*	137.37	ND	ND	ND	0.42	0.21	ND
Vinyl Chloride*	62.5	9.01	5.16	6.01	6.04	7.34	5.71
1,1-Dichloroethene	96.94	145.25	82.32	82.49	112.59	125.91	81.95
Acetone	59.07	39.43	9.53	18.45	25.60	11.14	7.52
Methylene Chloride	85.93	0.58	0.51	0.57	ND	1.34	0.51
Methyl Ethyl Ketone	72.11	28.41	ND	ND	13.69	ND	11.72
cis-Dichloroethene	96.94	256.79	192.28	181.98	307.84	240.27	185.99
1,1-Dichloroethane	98.96	241.84	243.43	214.55	265.26	301.58	259.24
1,2-Dichloroethane	98.96	7.33	8.90	10.62	8.69	9.63	8.82
Chloroform	120.37	0.22	ND	0.21	ND	ND	0.20
1,1,1-Trichloroethane	133.41	133.38	114.53	83.34	102.80	133.99	109.77
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	4.72	55.18	31.44	9.48	4.64	2.43
Toluene	93.13	2.23	3.23	3.82	5.99	4.66	3.73
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		102	105	113	106	111	94
d8-Toluene		99	101	98	99	112	96
p-Bromofluorobenzene		95	99	109	100	111	111

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

**Hamilton Beach Pilot
Unit B - Molar Units**

Sample ID. No.		HB-B-M3	HB-B-M3	HB-B-M3	HB-B-M3	HB-B-M3	HB-B-M3
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.30	0.15	0.33	0.67	0.78	0.74
Trichlorofluoromethane*	137.37	ND	ND	0.03	0.36	0.22	ND
Vinyl Chloride*	62.5	9.86	8.95	5.44	4.20	3.79	2.03
1,1-Dichloroethene	96.94	253.41	131.52	97.70	110.00	93.81	41.45
Acetone	59.07	75.62	7.36	17.98	120.11	13.56	5.23
Methylene Chloride	85.93	ND	0.72	0.64	ND	ND	0.29
Methyl Ethyl Ketone	72.11	147.00	20.70	ND	ND	ND	7.77
cis-Dichloroethene	96.94	306.59	207.96	166.08	156.38	152.92	95.63
1,1-Dichloroethane	98.96	430.28	298.81	237.64	235.93	221.00	167.47
1,2-Dichloroethane	98.96	ND	10.25	11.03	7.82	8.19	6.28
Chloroform	120.37	ND	0.36	0.37	ND	ND	0.13
1,1,1-Trichloroethane	133.41	412.56	356.20	186.82	184.69	202.54	107.12
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	16.14	19.64	13.89	7.92	7.77	3.83
Toluene	93.13	9.61	5.19	4.61	5.23	5.32	3.41
Tetrachloroethene	165.83	0.01	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		121	98	109	106	111	94
d8-Toluene		103	108	97	98	112	96
p-Bromofluorobenzene		106	102	115	101	113	113

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

**Hamilton Beach Pilot
Unit B - Molar Units**

Sample ID. No.		HB-B-M4	HB-B-M4	HB-B-M4	HB-B-M4	HB-B-M4	HB-B-M4
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.27	0.71	0.43	0.60	1.12	0.70
Trichlorofluoromethane*	137.37	ND	ND	ND	0.37	0.22	ND
Vinyl Chloride*	62.5	9.14	6.83	6.94	7.68	6.97	4.10
1,1-Dichloroethene	96.94	150.05	54.57	67.67	112.04	111.48	53.23
Acetone	59.07	30.18	13.27	11.12	39.07	39.78	6.65
Methylene Chloride	85.93	0.66	0.43	0.48	ND	ND	0.50
Methyl Ethyl Ketone	72.11	56.08	57.51	ND	8.02	ND	8.51
cis-Dichloroethene	96.94	184.90	108.62	118.65	173.84	205.42	161.77
1,1-Dichloroethane	98.96	521.87	409.26	248.24	315.88	384.94	310.11
1,2-Dichloroethane	98.96	10.53	10.67	10.66	8.39	10.51	8.29
Chloroform	120.37	ND	0.18	0.33	ND	ND	0.11
1,1,1-Trichloroethane	133.41	334.51	128.48	120.87	119.97	130.48	51.35
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	65.70	56.85	36.30	19.62	15.87	2.78
Toluene	93.13	8.43	3.99	3.63	5.52	5.56	3.35
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		127	100	110	104	112	97
d8-Toluene		106	99	99	100	113	96
p-Bromofluorobenzene		105	101	113	100	113	112

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

**Hamilton Beach Pilot
Unit B - Molar Units**

Sample ID. No.		HB-B-M5	HB-B-M5	HB-B-M5	HB-B-M5	HB-B-M5	HB-B-M5
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.32	1.10	0.93	0.30	0.29	0.42
Trichlorofluoromethane*	137.37	ND	0.61	4.49	0.41	0.23	ND
Vinyl Chloride*	62.5	9.69	4.81	6.28	5.49	5.79	4.30
1,1-Dichloroethene	96.94	184.05	38.27	62.95	115.37	139.88	87.73
Acetone	59.07	18.44	ND	10.06	39.99	112.80	10.17
Methylene Chloride	85.93	3.35	0.47	0.65	ND	ND	0.52
Methyl Ethyl Ketone	72.11	27.76	6.42	ND	17.88	ND	13.23
cis-Dichloroethene	96.94	342.27	139.26	162.80	219.01	245.14	189.78
1,1-Dichloroethane	98.96	431.03	376.72	293.88	284.29	322.64	248.88
1,2-Dichloroethane	98.96	11.53	11.27	13.98	9.18	10.57	8.41
Chloroform	120.37	0.47	ND	0.23	ND	ND	0.20
1,1,1-Trichloroethane	133.41	199.72	47.22	83.40	111.40	132.22	97.28
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	7.40	24.13	16.67	4.43	4.98	3.01
Toluene	93.13	7.92	3.53	4.28	5.39	6.18	4.28
Tetrachloroethene	165.83	ND	0.07	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		124	99	109	105	113	95
d8-Toluene		104	102	98	100	112	95
p-Bromofluorobenzene		103	102	114	99	113	111

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M6	HB-B-M6	HB-B-M6	HB-B-M6	HB-B-M6	HB-B-M6
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.4	0.3	0.6	2.4	3.9	4.7
Trichlorofluoromethane*	137.37	ND	ND	ND	0.4	0.2	ND
Vinyl Chloride*	62.5	12	2.9	6.6	2.8	4.2	5.6
1,1-Dichloroethene	96.94	157	36	35	33	45	33
Acetone	59.07	37	12	7.8	26	14.1	9.4
Methylene Chloride	85.93	1.1	0.4	0.6	ND	ND	0.4
Methyl Ethyl Ketone	72.11	30	15	ND	ND	16	10
cis-Dichloroethene	96.94	194	80	168	85	105	92
1,1-Dichloroethane	98.96	627	299	303	185	255	250
1,2-Dichloroethane	98.96	18	9.1	14	6.1	7.5	7.6
Chloroform	120.37	0.7	0.2	ND	ND	ND	ND
1,1,1-Trichloroethane	133.41	361	114	30	36	32	14
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	83	41	17	11	12	7.2
Toluene	93.13	10	2.3	4.3	3.3	22	2.5
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		126	100	114	105	115	95
d8-Toluene		104	101	97	100	109	96
p-Bromofluorobenzene		105	102	116	98	110	111

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M7	HB-B-M7	HB-B-M7	HB-B-M7	HB-B-M7	HB-B-M7
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.2	0.4	0.3	0.4	0.8	0.9
Trichlorofluoromethane*	137.37	ND	ND	ND	0.3	ND	ND
Vinyl Chloride*	62.5	11	5.0	4.4	5.3	5.0	3.5
1,1-Dichloroethene	96.94	126	49	38	63	60	41
Acetone	59.07	27	8.0	14	21.3	ND	4.3
Methylene Chloride	85.93	3.1	0.4	0.4	ND	ND	0.3
Methyl Ethyl Ketone	72.11	24	11	ND	6.7	ND	ND
cis-Dichloroethene	96.94	245	131	124	120	127	108
1,1-Dichloroethane	98.96	331	232	149	177	198	167
1,2-Dichloroethane	98.96	9.2	6.5	7.1	4.6	5.2	4.7
Chloroform	120.37	0.4	0.1	0.2	ND	ND	ND
1,1,1-Trichloroethane	133.41	136	41	27	3.7	2.6	3.5
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	31	27	16	9.2	5.1	2.6
Toluene	93.13	7.3	2.4	2.3	4.5	9.0	2.0
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		127	102	118	103	110	95
d8-Toluene		105	100	98	99	108	96
p-Bromofluorobenzene		108	101	113	98	111	111

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M8	HB-B-M8	HB-B-M8	HB-B-M8	HB-B-M8	HB-B-M8
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.2	0.0	0.4	1.1	1.2	0.9
Trichlorofluoromethane*	137.37	ND	ND	ND	0.4	0.5	ND
Vinyl Chloride*	62.5	11	7.2	7.4	4.9	5.1	3.2
1,1-Dichloroethene	96.94	152	83	73	60	54	25
Acetone	59.07	29	9.1	13.3	13.0	ND	3.6
Methylene Chloride	85.93	3.5	0.6	0.7	ND	ND	0.5
Methyl Ethyl Ketone	72.11	17	ND	ND	ND	ND	ND
cis-Dichloroethene	96.94	161	114	116	147	168	129
1,1-Dichloroethane	98.96	456	412	371	479	528	409
1,2-Dichloroethane	98.96	13	16	18	13	13	10
Chloroform	120.37	0.6	0.5	0.4	ND	ND	ND
1,1,1-Trichloroethane	133.41	236	286	145	39	18	8.8
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	81	98	75	41	26	25
Toluene	93.13	8.9	5.3	5.3	6.5	6.4	4.3
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		130	109	118	104	113	94
d8-Toluene		107	99	98	99	109	96
p-Bromofluorobenzene		107	110	113	97	109	108

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M9	HB-B-M9	HB-B-M9	HB-B-M9	HB-B-M9	HB-B-M9
Date Sampled		10/07/01	10/10/01	10/17/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	1/0/1900	MT	MT	MT
Units		10 ⁻⁶					
Analyte	MW						
Chloromethane*	50.49	ND	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.5	1.1	0.7	1.3	1.4	1.0
Trichlorofluoromethane*	137.37	ND	ND	ND	ND	ND	ND
Vinyl Chloride*	62.5	12	8.2	2.7	7.5	8.7	6.3
1,1-Dichloroethene	96.94	75	47	31	64	69	46
Acetone	59.07	43	12	7.5	22.3	ND	ND
Methylene Chloride	85.93	0.7	0.5	0.4	ND	ND	ND
Methyl Ethyl Ketone	72.11	19	ND	ND	ND	ND	ND
cis-Dichloroethene	96.94	238	188	159	199	259	217
1,1-Dichloroethane	98.96	484	465	311	392	521	407
1,2-Dichloroethane	98.96	12	13	9.0	11.3	15	13
Chloroform	120.37	0.2	ND	0.1	ND	ND	ND
1,1,1-Trichloroethane	133.41	9.1	1.5	42	1	ND	ND
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	ND
Trichloroethene	131.39	26	34	21	5	2.5	1.2
Toluene	93.13	9.6	4.3	2.0	6.9	8.7	5.4
Tetrachloroethene	165.83	ND	ND	ND	ND	ND	ND
Surrogates (% Recovery)							
Dibromofluoromethane		125	114	115	106	112	97
d8-Toluene		103	102	98	98	108	97
p-Bromofluorobenzene		104	104	117	98	108	108

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

Hamilton Beach Pilot Unit B - Molar Units

Sample ID. No.		HB-B-M10	HB-B-M10	HB-B-M10	HB-B-M10	HB-B-M10
Date Sampled		10/07/01	10/10/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT
Units		10 ⁻⁶				
Analyte	MW					
Chloromethane*	50.49	ND	ND	ND	ND	ND
Chloroethane*	64.52	2.2	1.0	1.0	1.4	0.8
Trichlorofluoromethane*	137.37	ND	ND	0.4	ND	ND
Vinyl Chloride*	62.5	12	6.8	5.6	6.3	4.2
1,1-Dichloroethene	96.94	58	38	58	58	43
Acetone	59.07	32	13	179	18	12
Methylene Chloride	85.93	1.6	0.5	ND	ND	0.5
Methyl Ethyl Ketone	72.11	11	ND	22	ND	ND
cis-Dichloroethene	96.94	204	160	157	200	159
1,1-Dichloroethane	98.96	568	425	386	538	388
1,2-Dichloroethane	98.96	15	12	12	15	12
Chloroform	120.37	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	133.41	0.2	0.2	1.0	ND	0.3
1,2-Dichloropropane	112.99	ND	ND	ND	ND	0.1
Trichloroethene	131.39	7.4	7.5	10	6.6	7.6
Toluene	93.13	7.3	3.4	6.7	7.5	3.7
Tetrachloroethene	165.83	ND	ND	ND	ND	ND
Surrogates (% Recovery)						
Dibromofluoromethane		122	101	106	113	98
d8-Toluene		104	100	99	110	97
p-Bromofluorobenzene		104	100	99	111	108

ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW=molecular weight

**Hamilton Beach Pilot
Unit B - Molar Units**

Sample ID. No.		HB-B-M11	HB-B-M11	HB-B-M11	HB-B-M11	HB-B-M11
Date Sampled		10/07/01	10/10/01	11/07/01	11/26/01	12/17/01
Sample Type		BL	MT	MT	MT	MT
Units		10 ⁻⁶				
Analyte	MW					
Chloromethane*	50.49	ND	ND	ND	ND	ND
Chloroethane*	64.52	0.4	0.8	0.5	0.5	0.3
Trichlorofluoromethane*	137.37	ND	ND	0.4	ND	ND
Vinyl Chloride*	62.5	8.1	3.7	2.8	2.9	2.4
1,1-Dichloroethene	96.94	139	56	108	112	74
Acetone	59.07	35	9.1	52	ND	16
Methylene Chloride	85.93	1.2	0.6	ND	ND	0.7
Methyl Ethyl Ketone	72.11	45	ND	19	ND	20
cis-Dichloroethene	96.94	385	176	263	323	256
1,1-Dichloroethane	98.96	459	195	309	392	303
1,2-Dichloroethane	98.96	14	11	11	13	11
Chloroform	120.37	0.3	0.1	ND	ND	0.1
1,1,1-Trichloroethane	133.41	36	15	29	26	17
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND
Trichloroethene	131.39	2.7	2.2	2.1	1.9	1.1
Toluene	93.13	8.8	3.9	7.0	8.1	4.3
Tetrachloroethene	165.83	ND	ND	ND	ND	ND
Surrogates (% Recovery)						
Dibromofluoromethane		120	100	106	117	94
d8-Toluene		103	97	100	110	97
p-Bromofluorobenzene		104	106	101	110	108

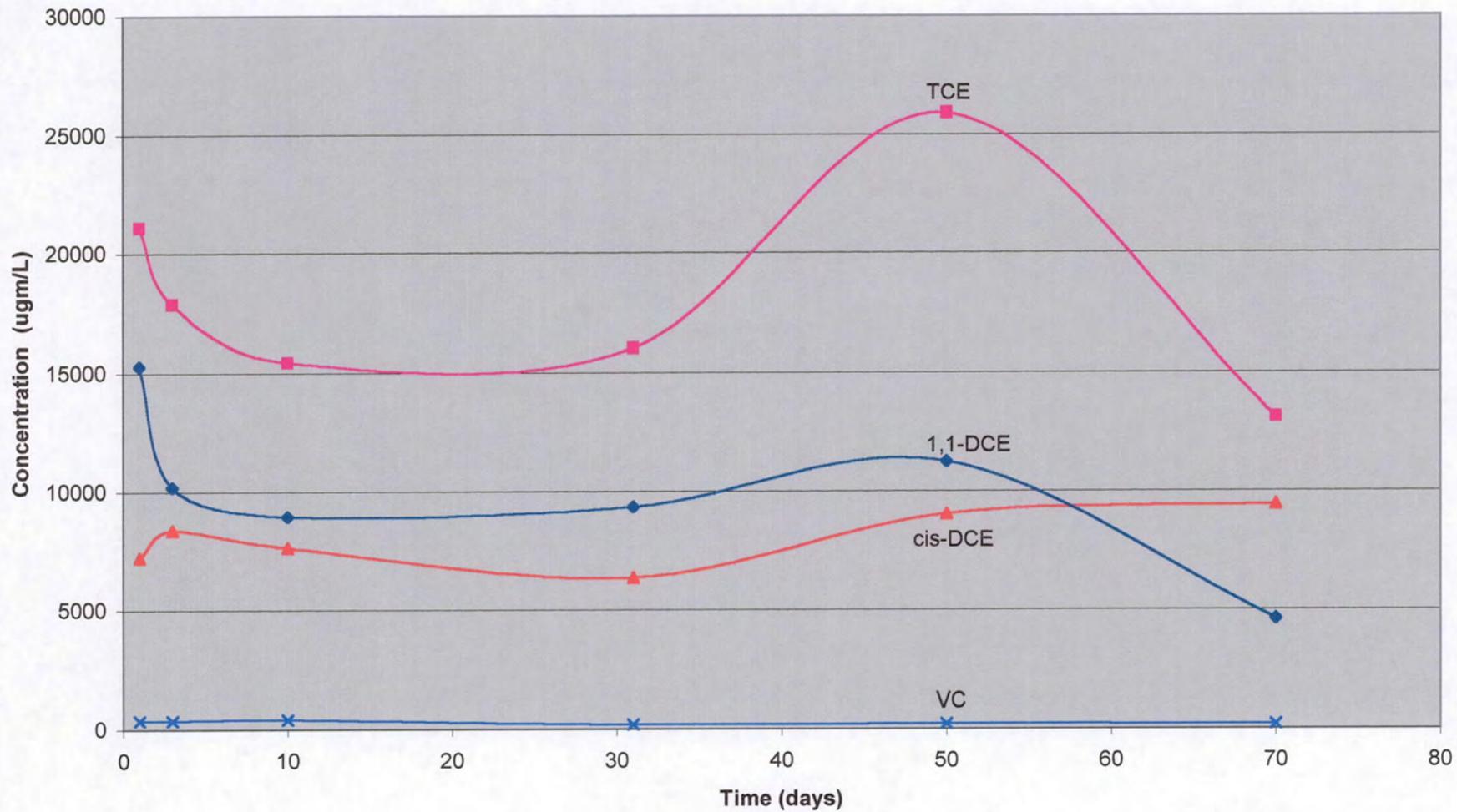
ND=not detected

*=Values through 11/26/01 for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

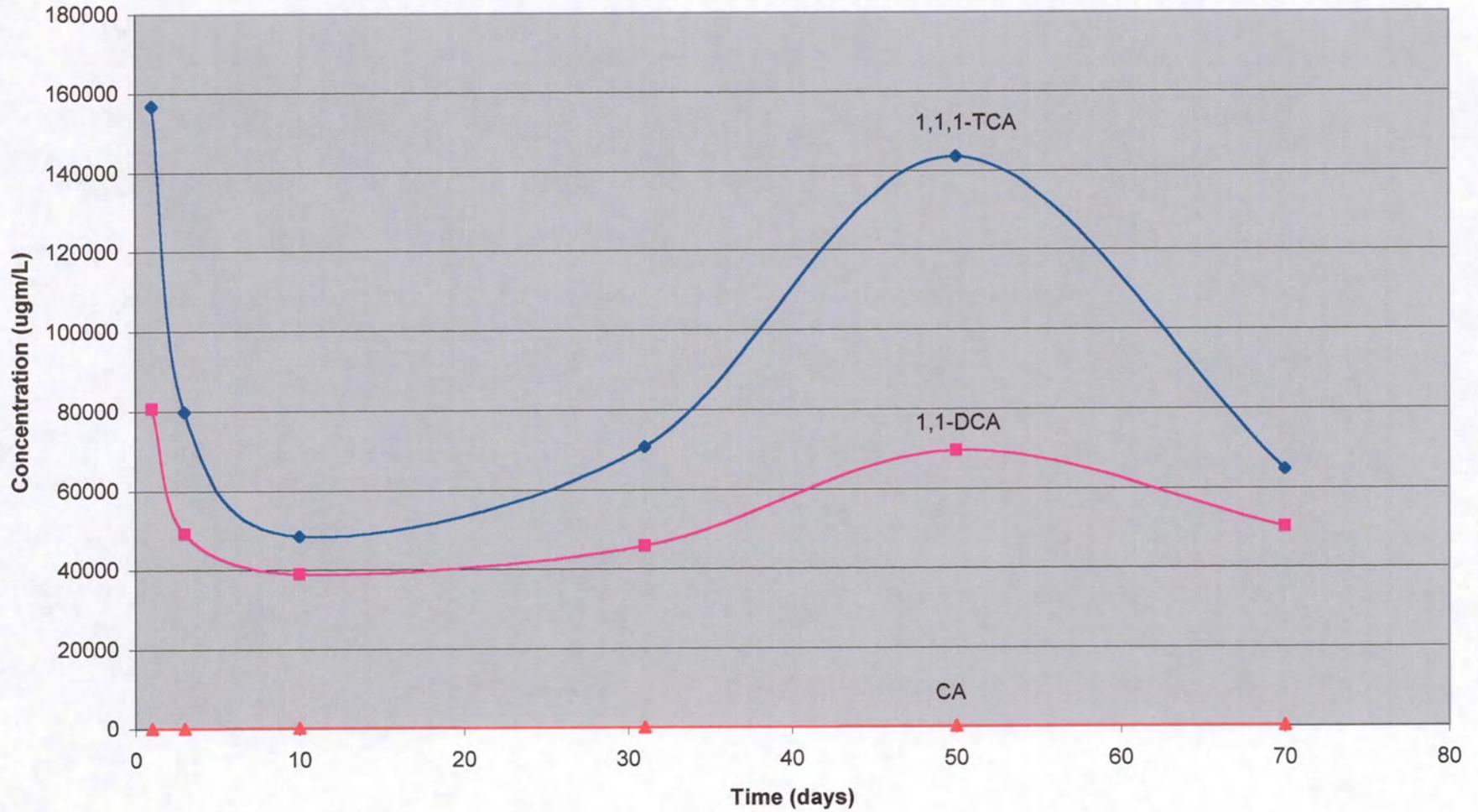
MW=molecular weight



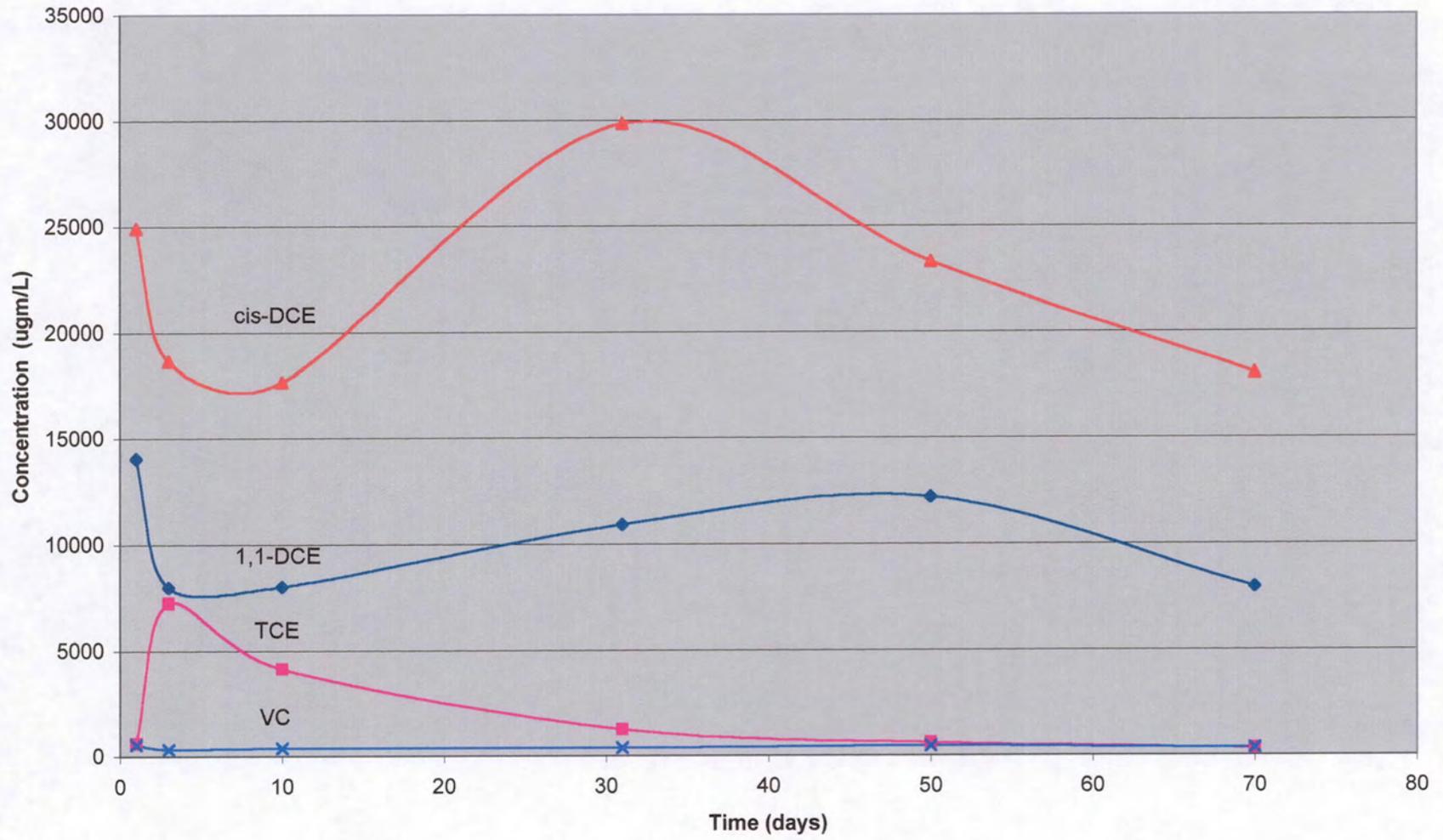
Hamilton Beach Pilot
Implant B-M1 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



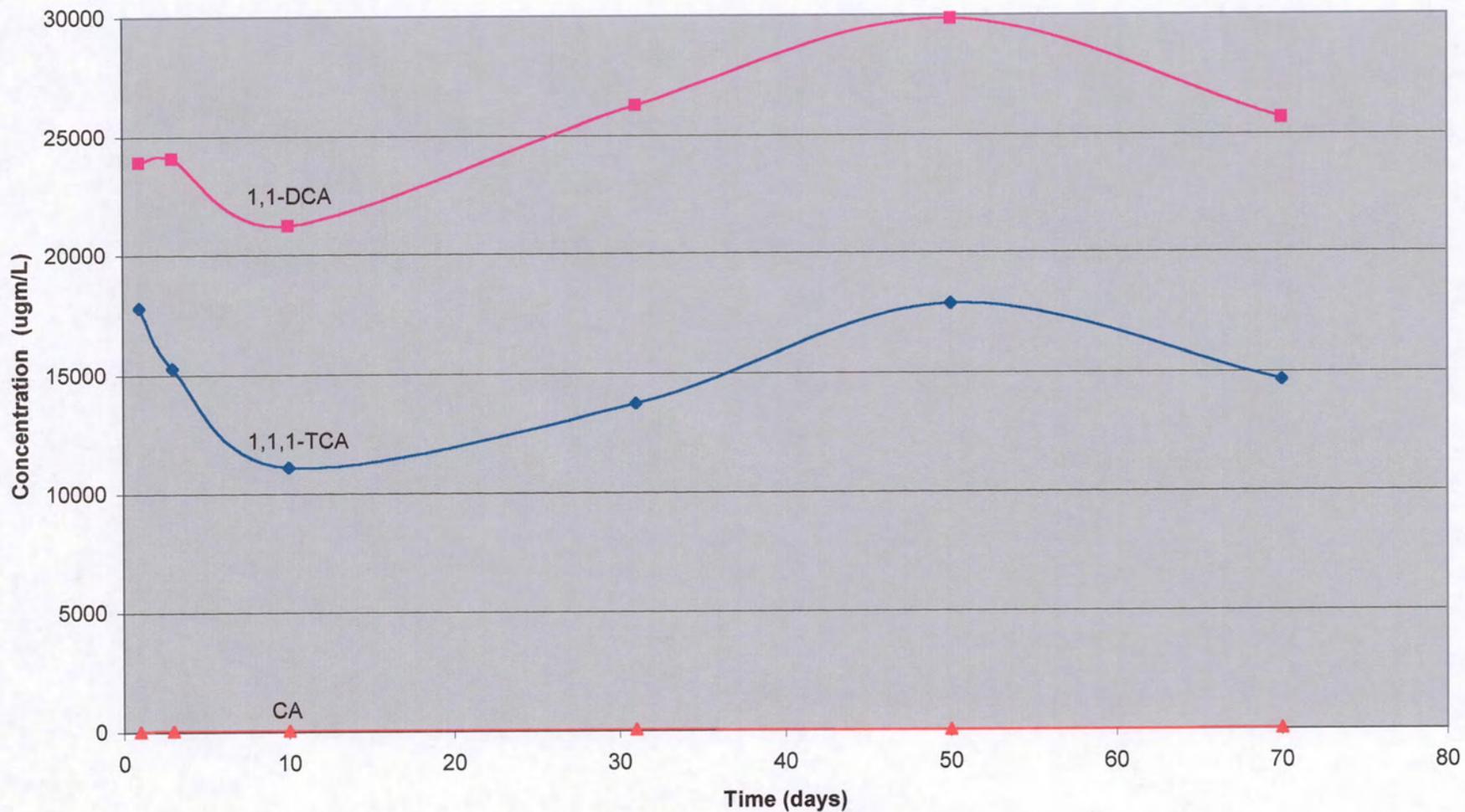
**Hamilton Beach Pilot
Implant B-M1- Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA**



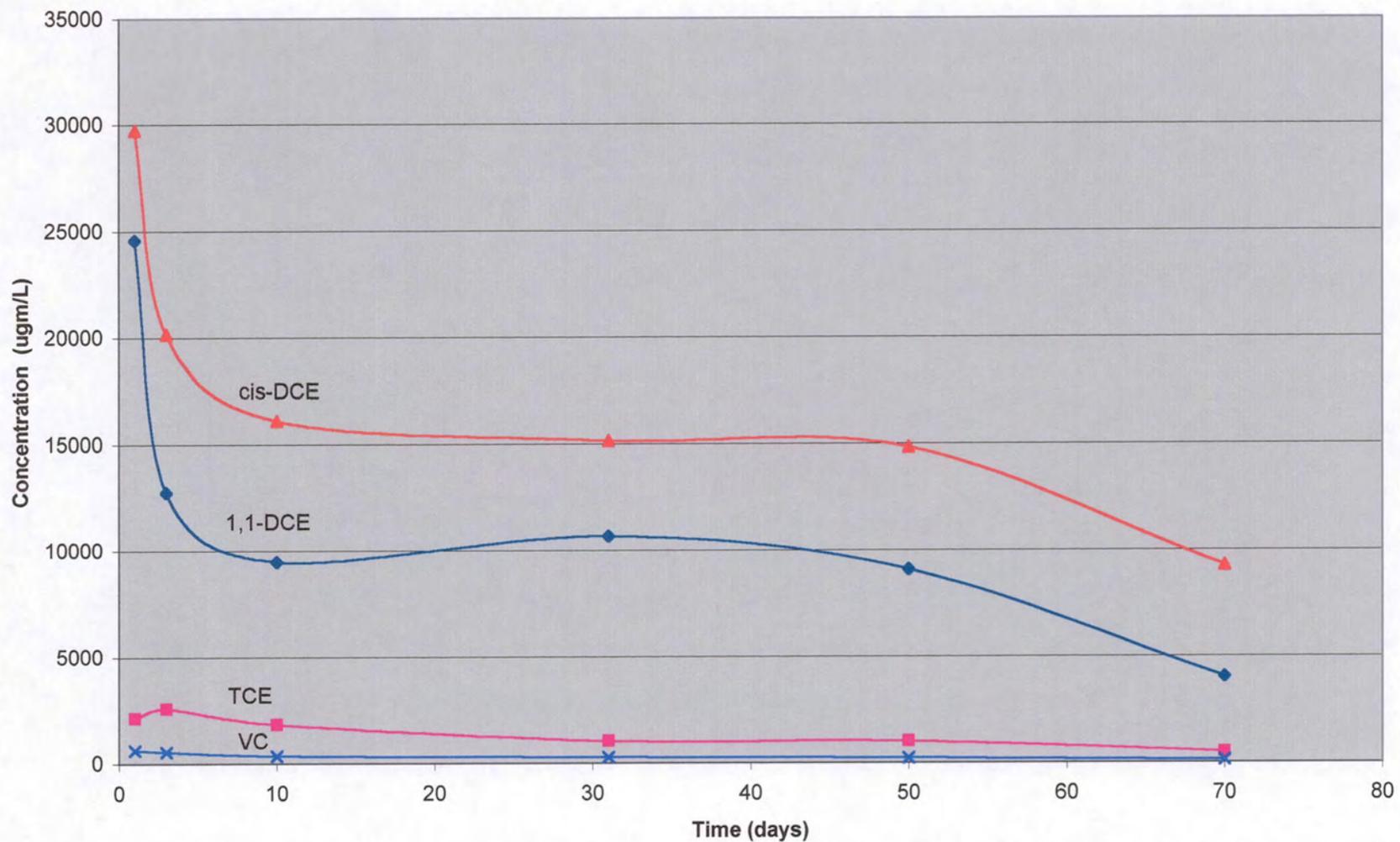
Hamilton Beach Pilot
Implant B-M2 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



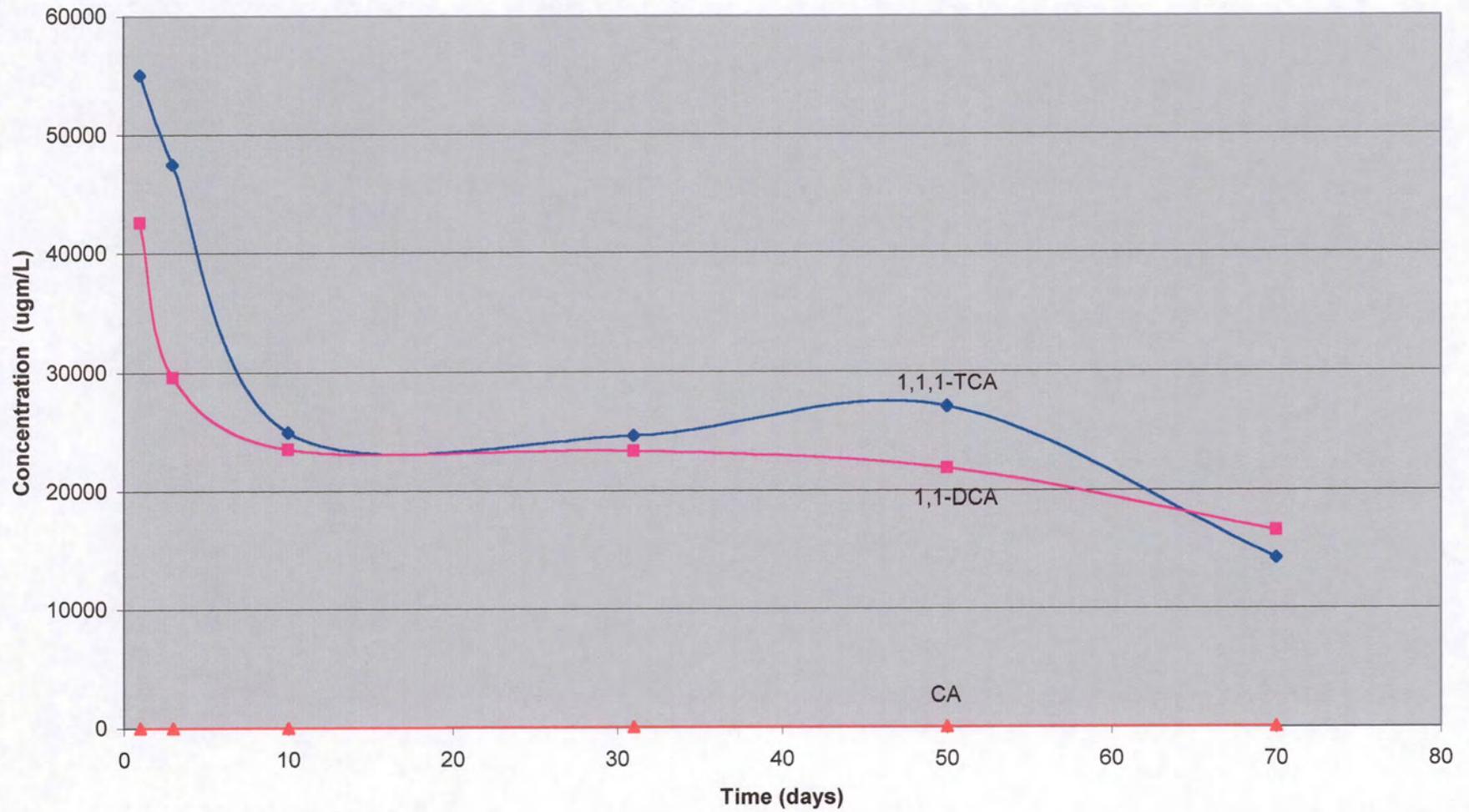
Hamilton Beach Pilot
Implant B-M2 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



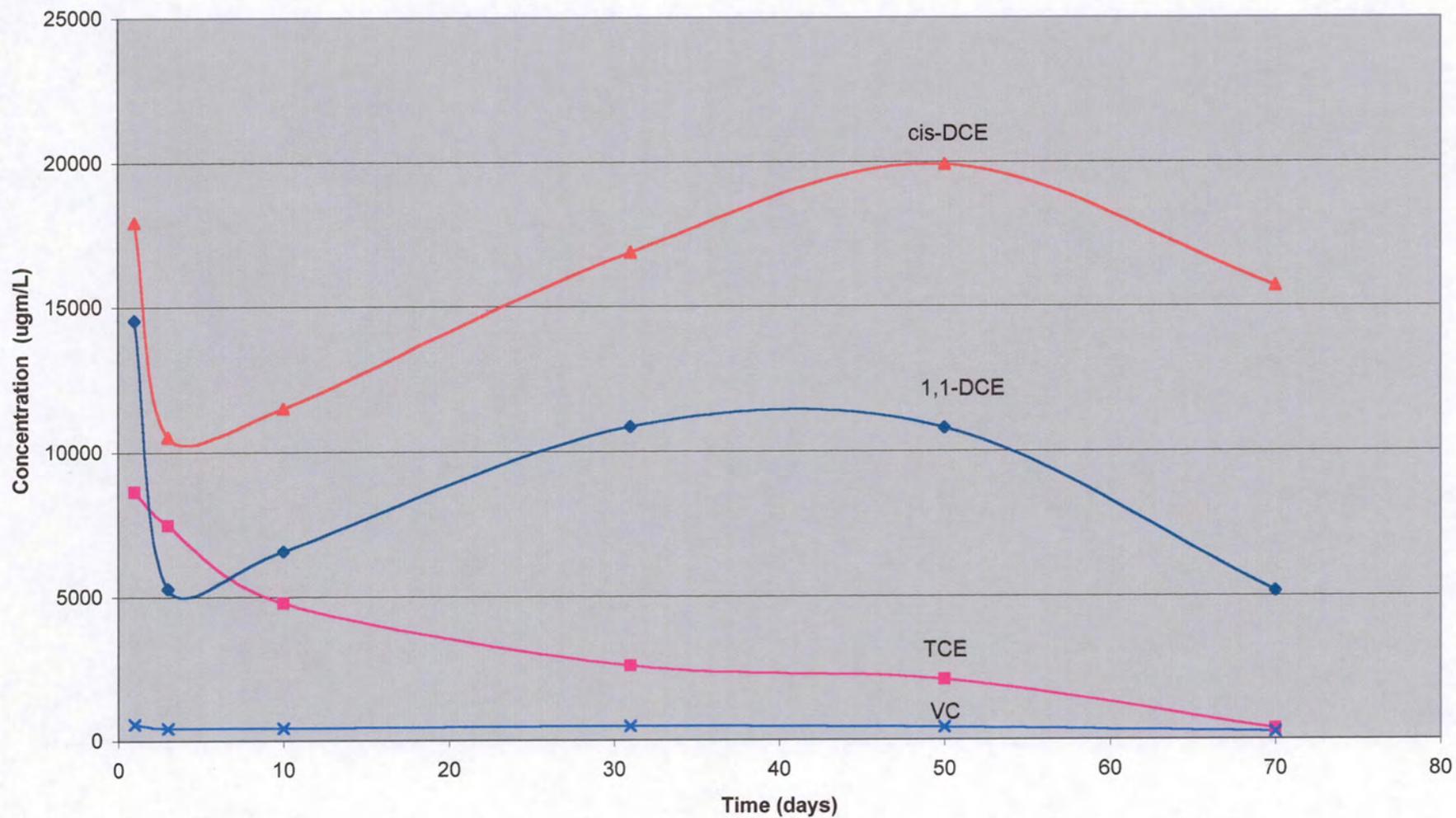
Hamilton Beach Pilot
Implant B-M3 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



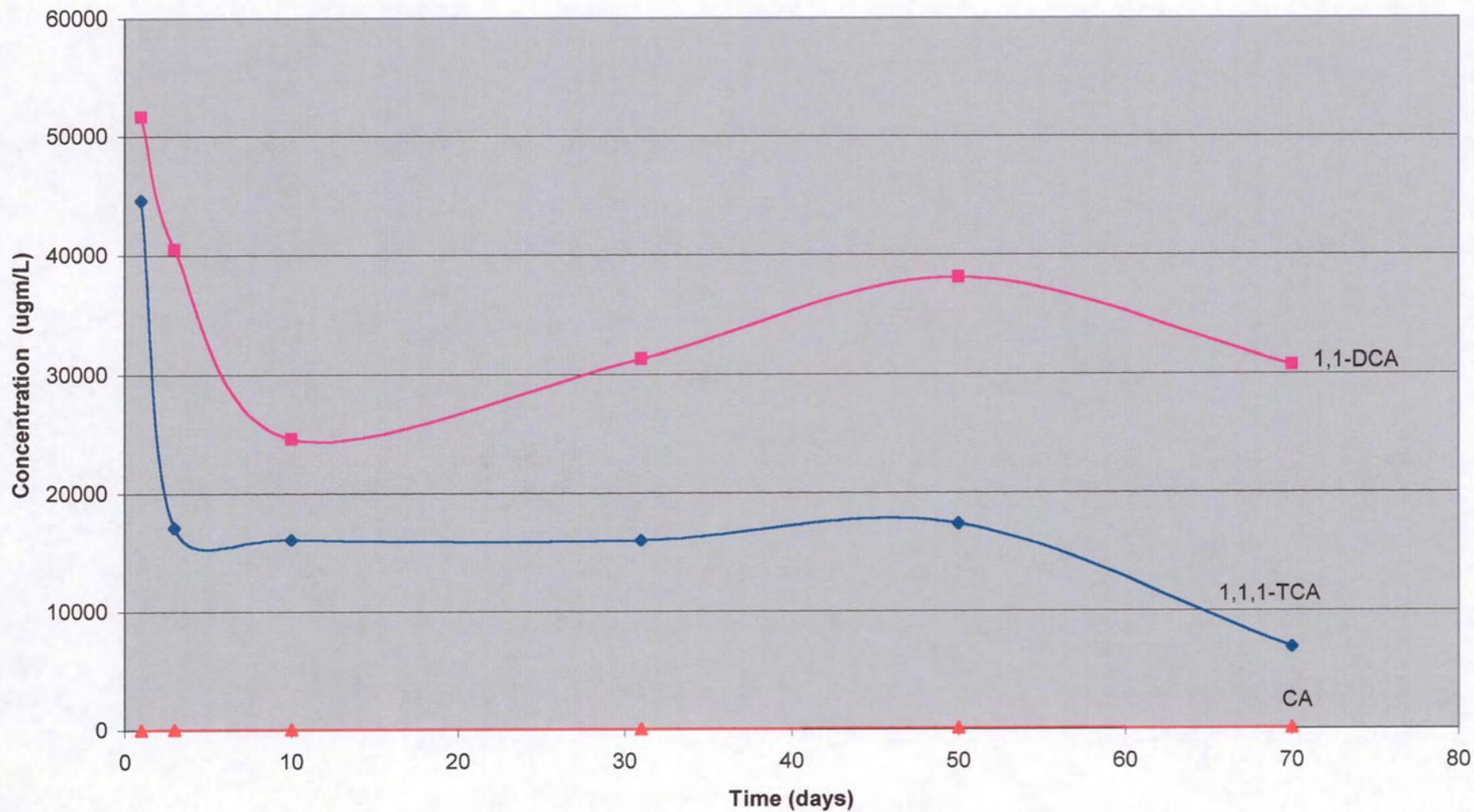
Hamilton Beach Pilot
Implant B-M3 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



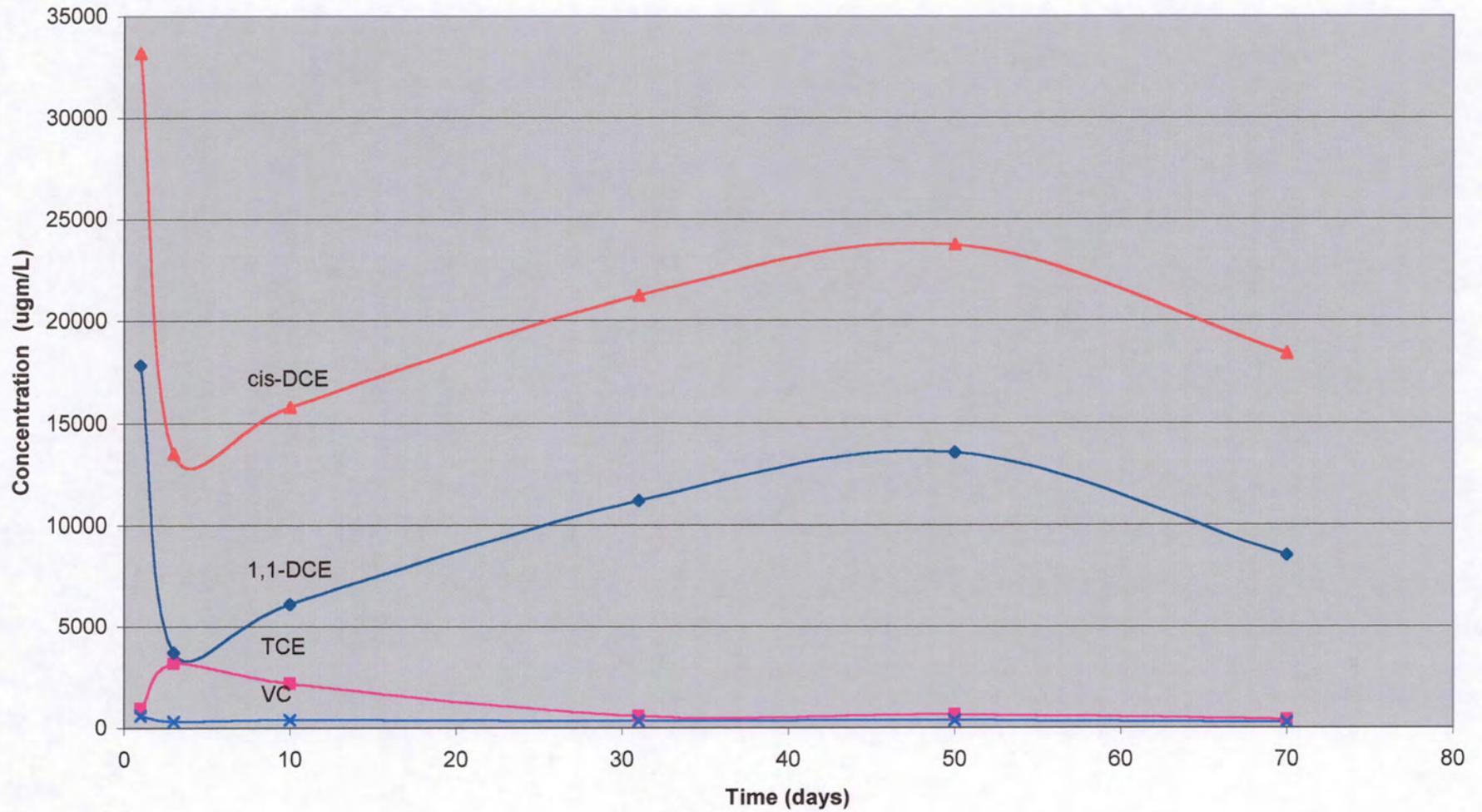
Hamilton Beach Pilot
Implant B-M4 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



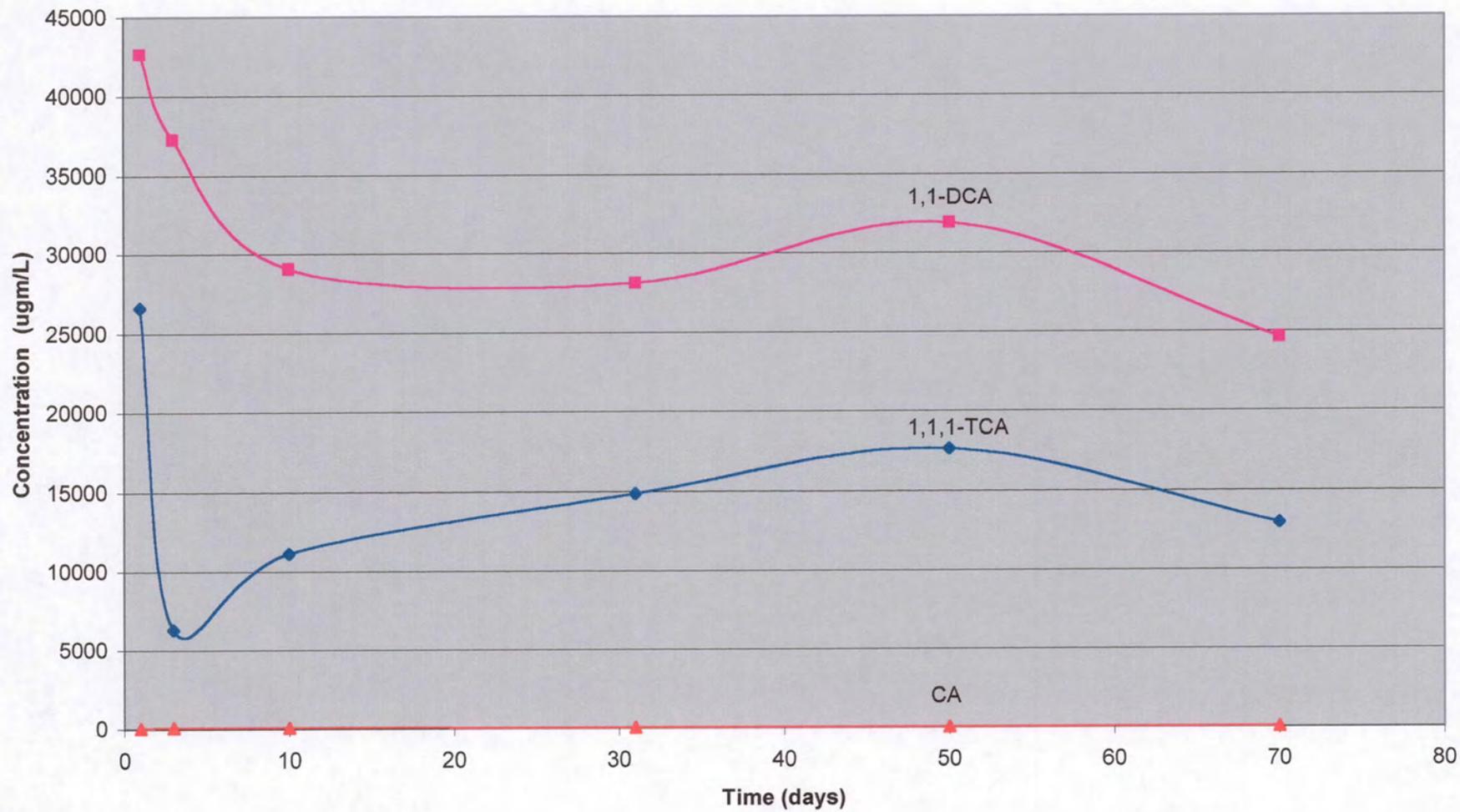
HAMILTON BEACH PILOT
IMPLANT B-M4 - CONCENTRATION VS. TIME
UGM/L - 1,1,1-TCA, 1,1-DCA, CA



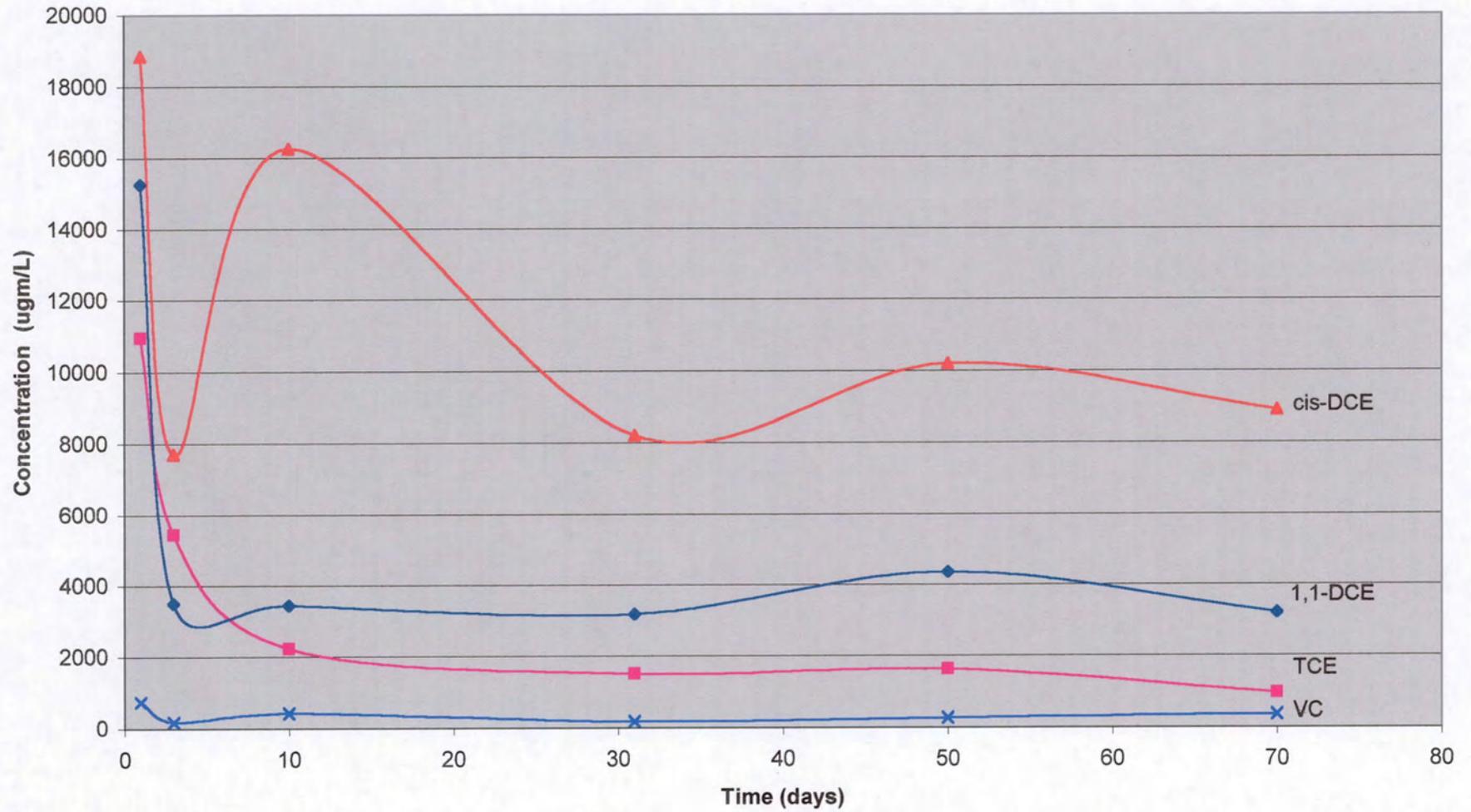
Hamilton Beach Pilot
Implant B-M5 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



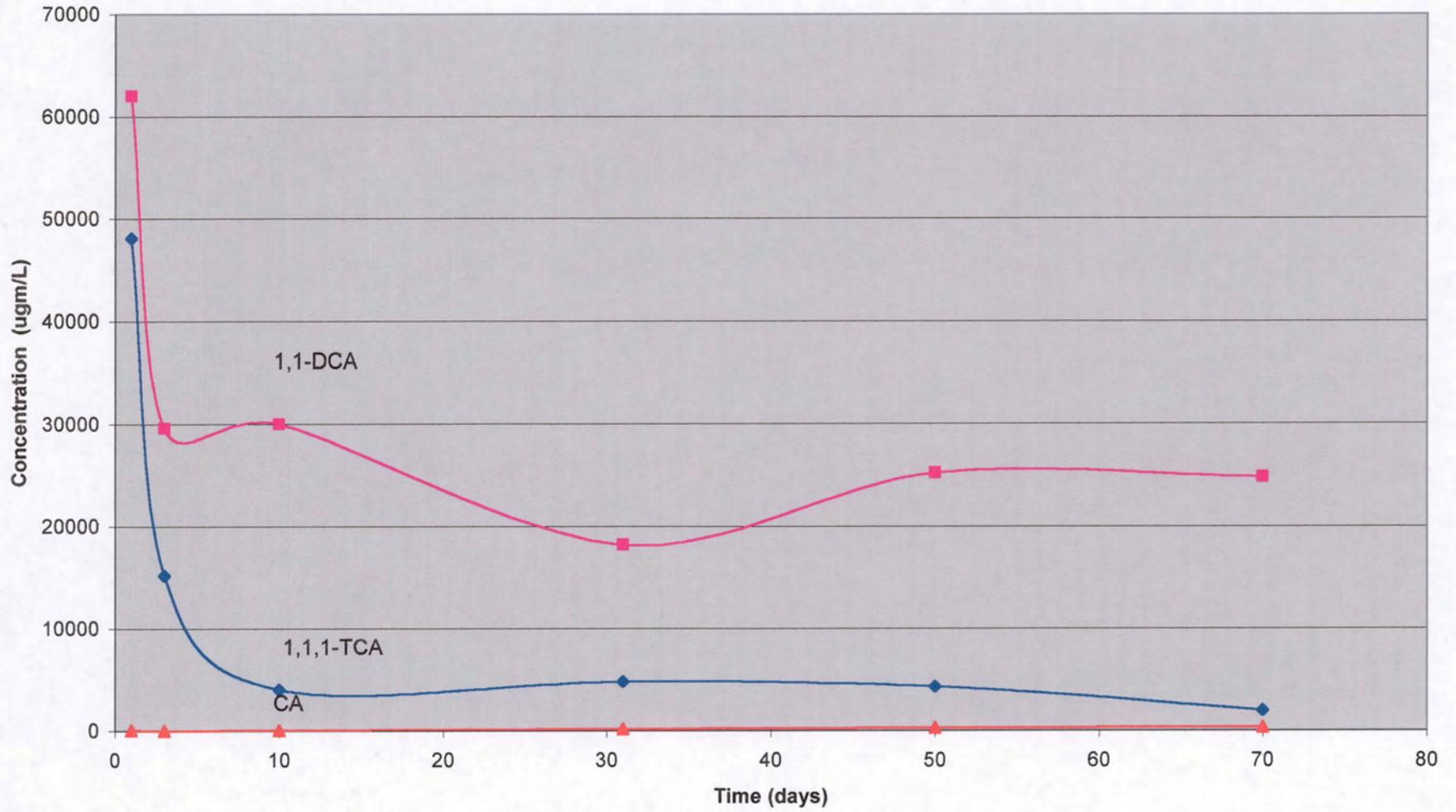
Hamilton Beach Pilot
Implant B-M5 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



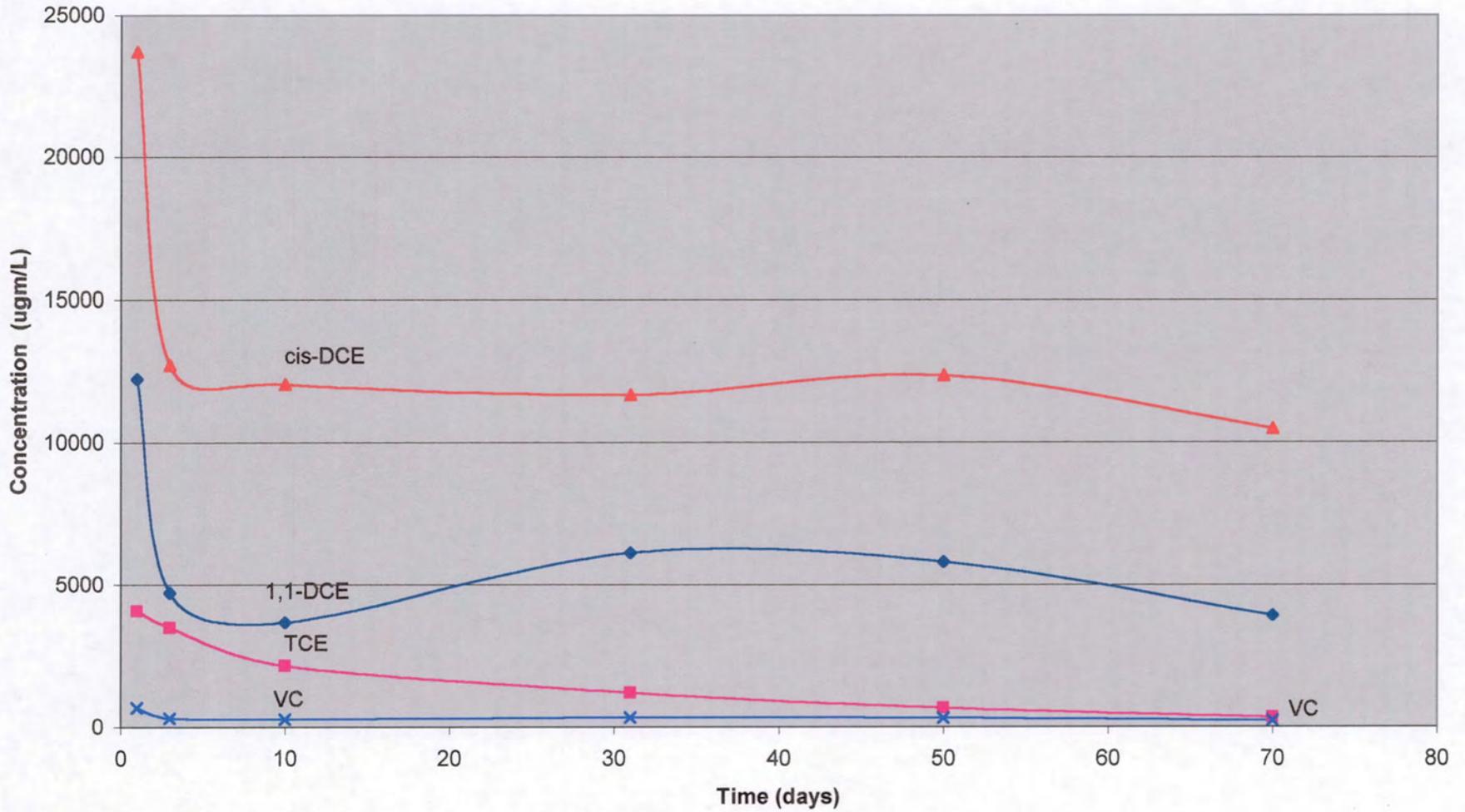
Hamilton Beach Pilot
Implant B-M6 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



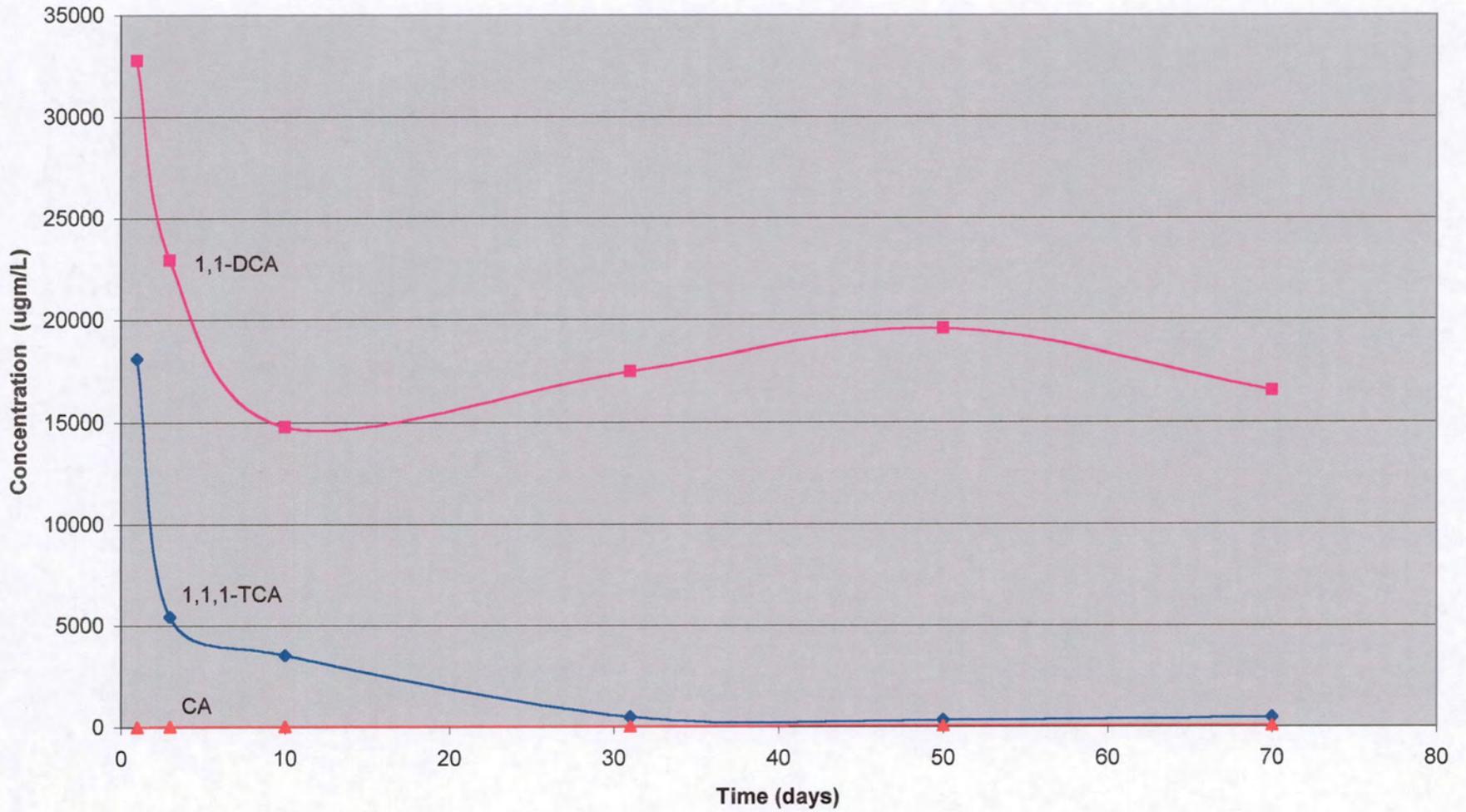
HAMILTON BEACH PILOT
IMPLANT B-M6 - CONCENTRATION VS. TIME
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



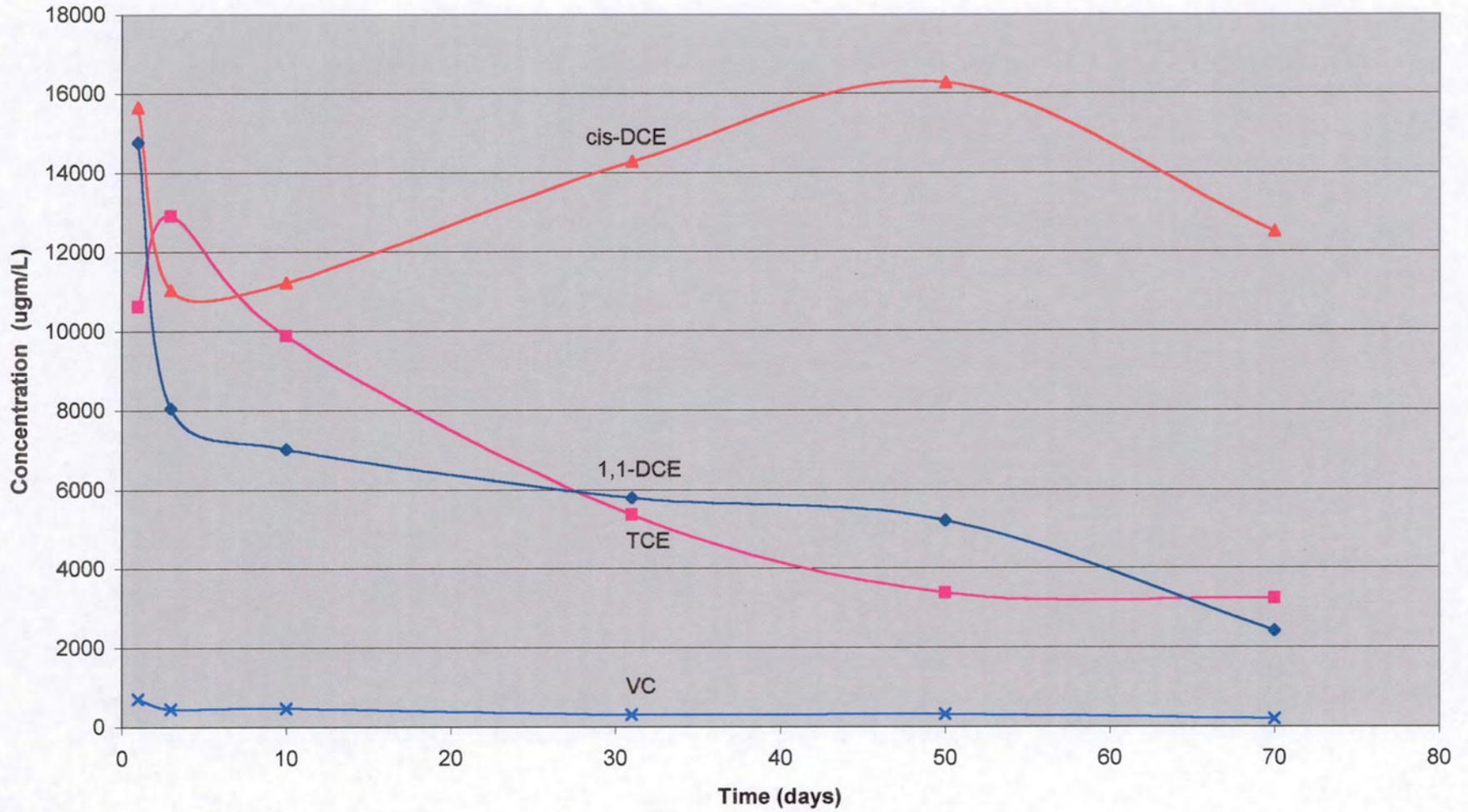
Hamilton Beach Pilot
Implant B-M7 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



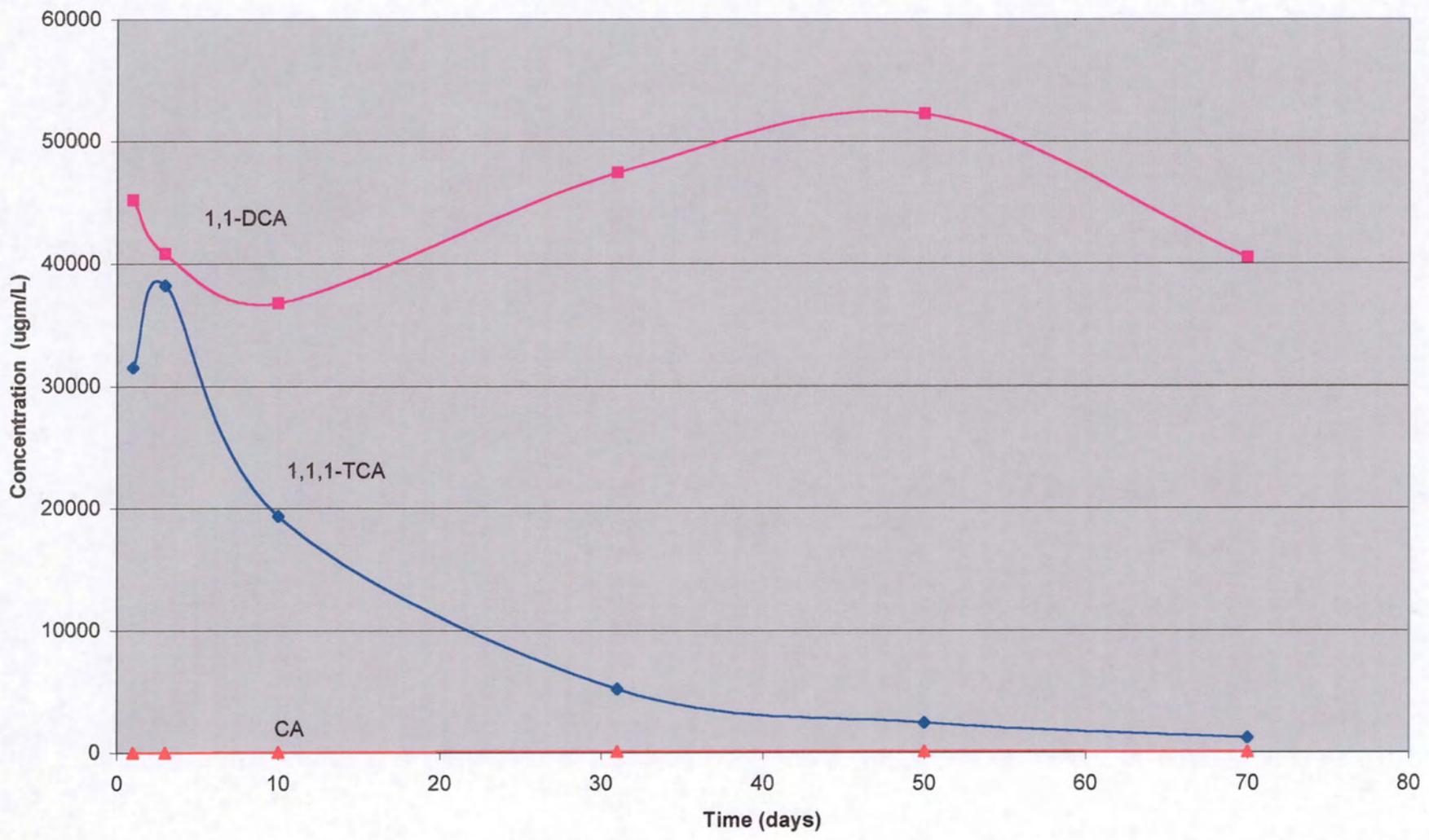
Hamilton Beach Pilot
Implant B-M7 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



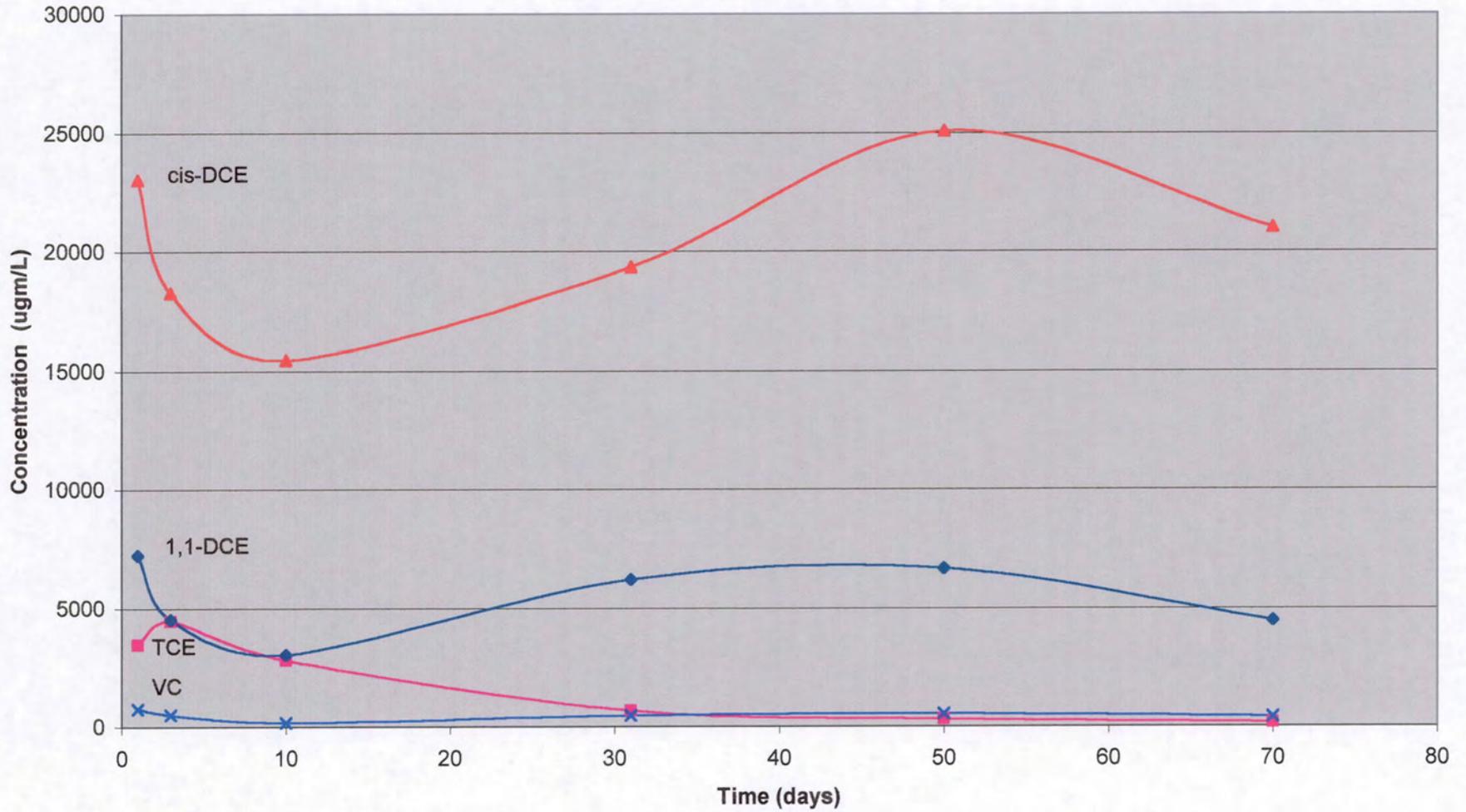
Hamilton Beach Pilot
Implant B-M8 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



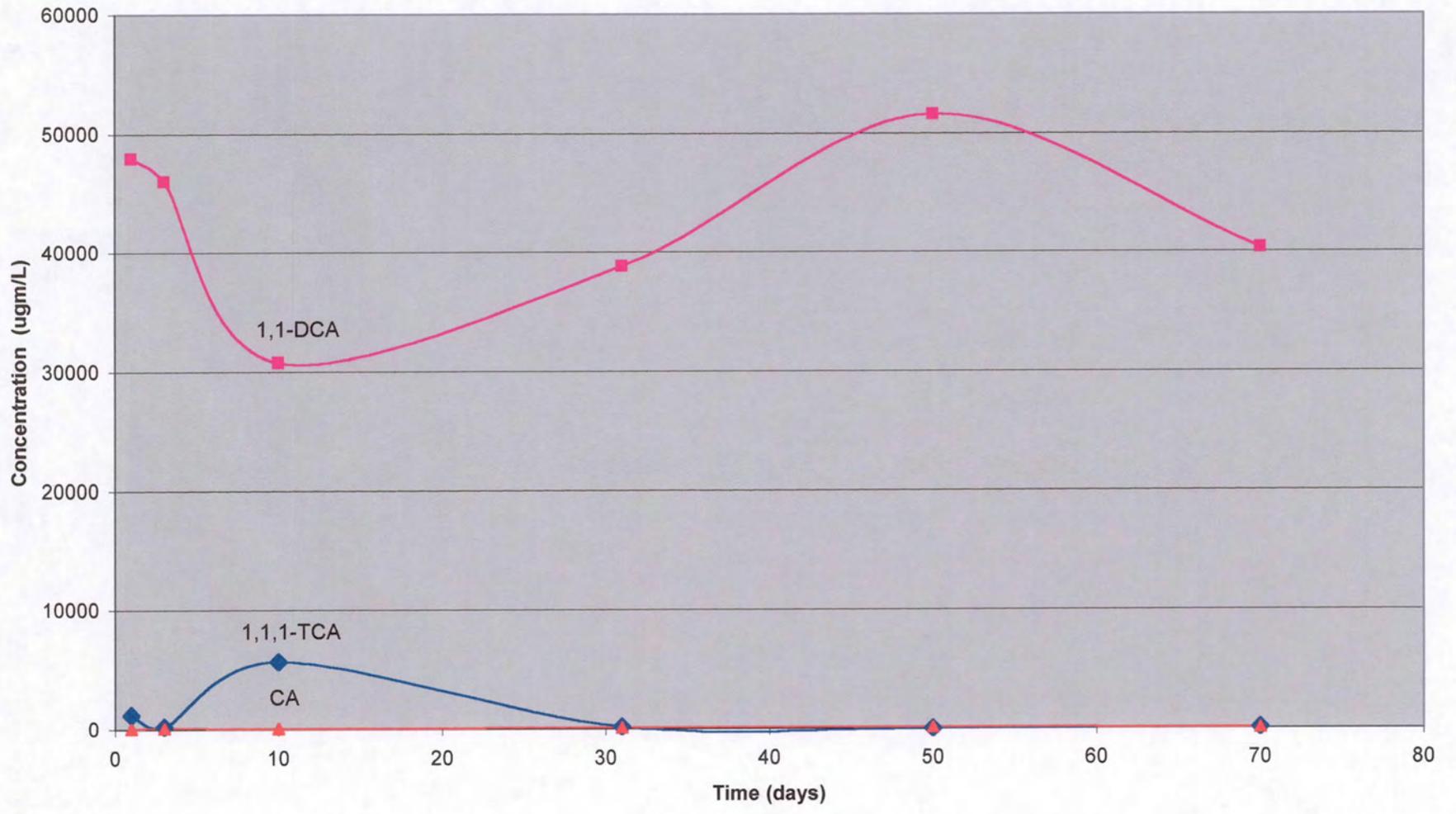
Hamilton Beach Pilot
Implant B-M8 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



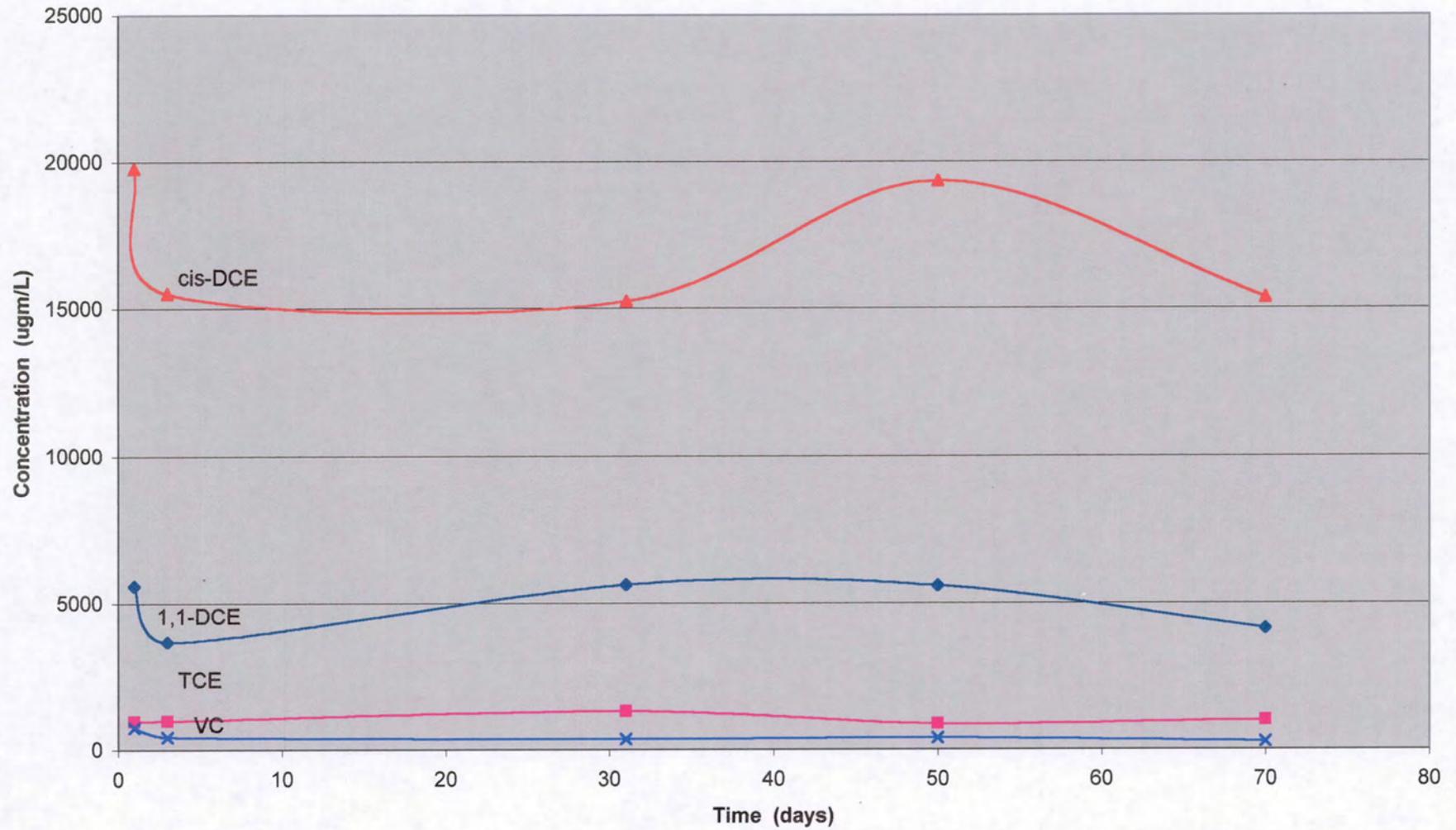
**Hamilton Beach Pilot
Implant B-M9 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC**



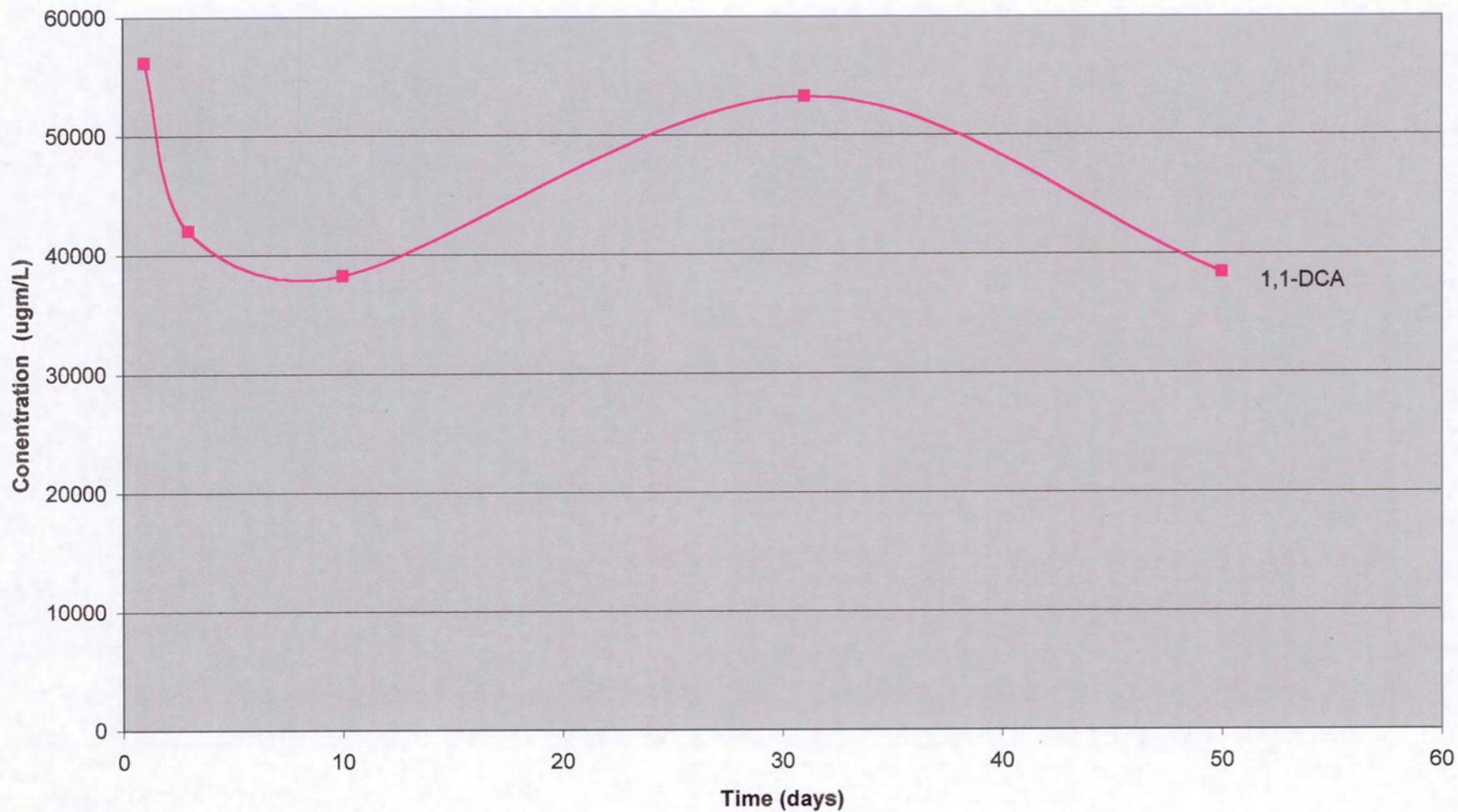
Hamilton Beach Pilot
Implant B-M9 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



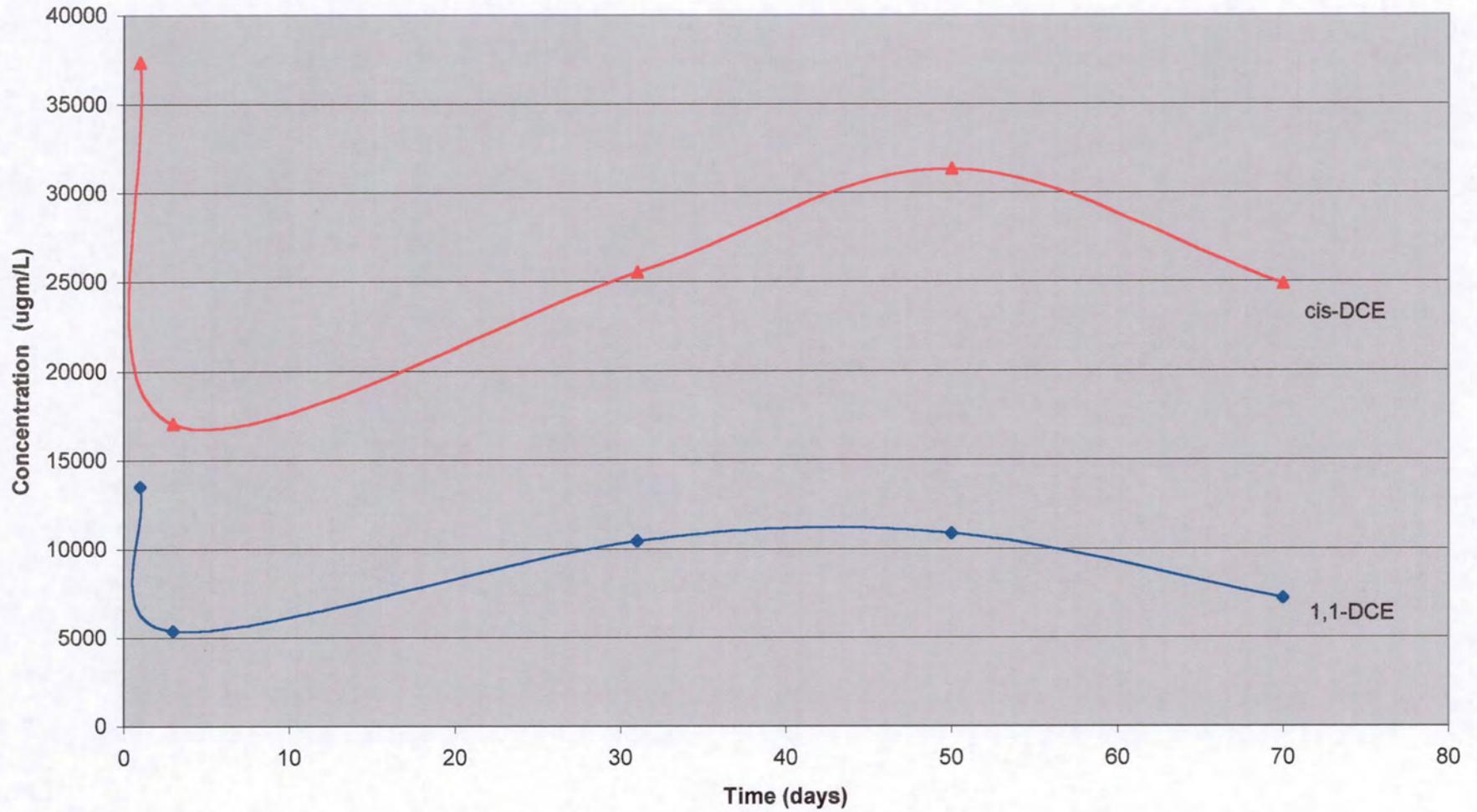
Hamilton Beach Pilot
Implant B-M10 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



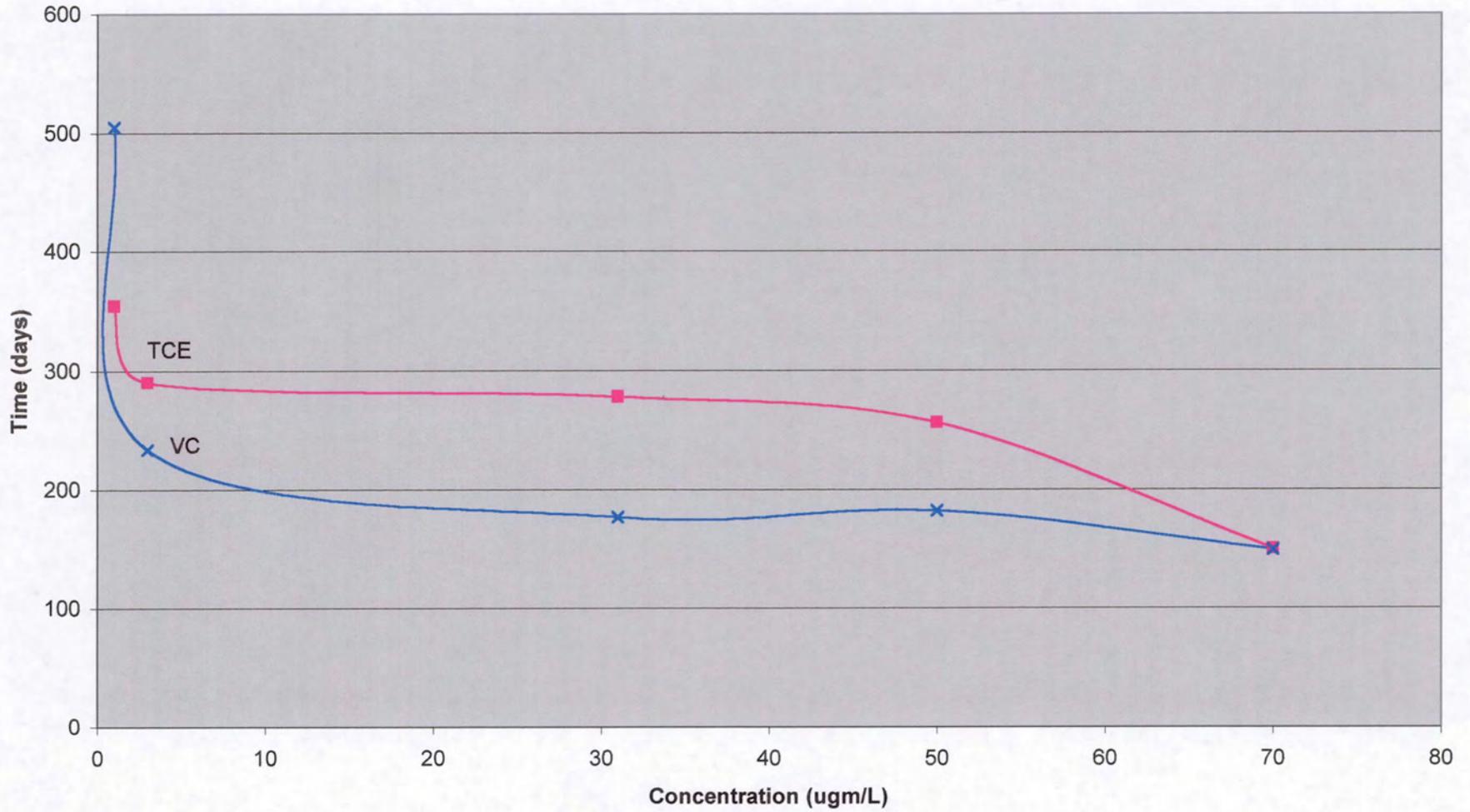
**Hamilton Beach Pilot
Implant B-M10 - Concentration vs. Time
ugm/L - DCA only**



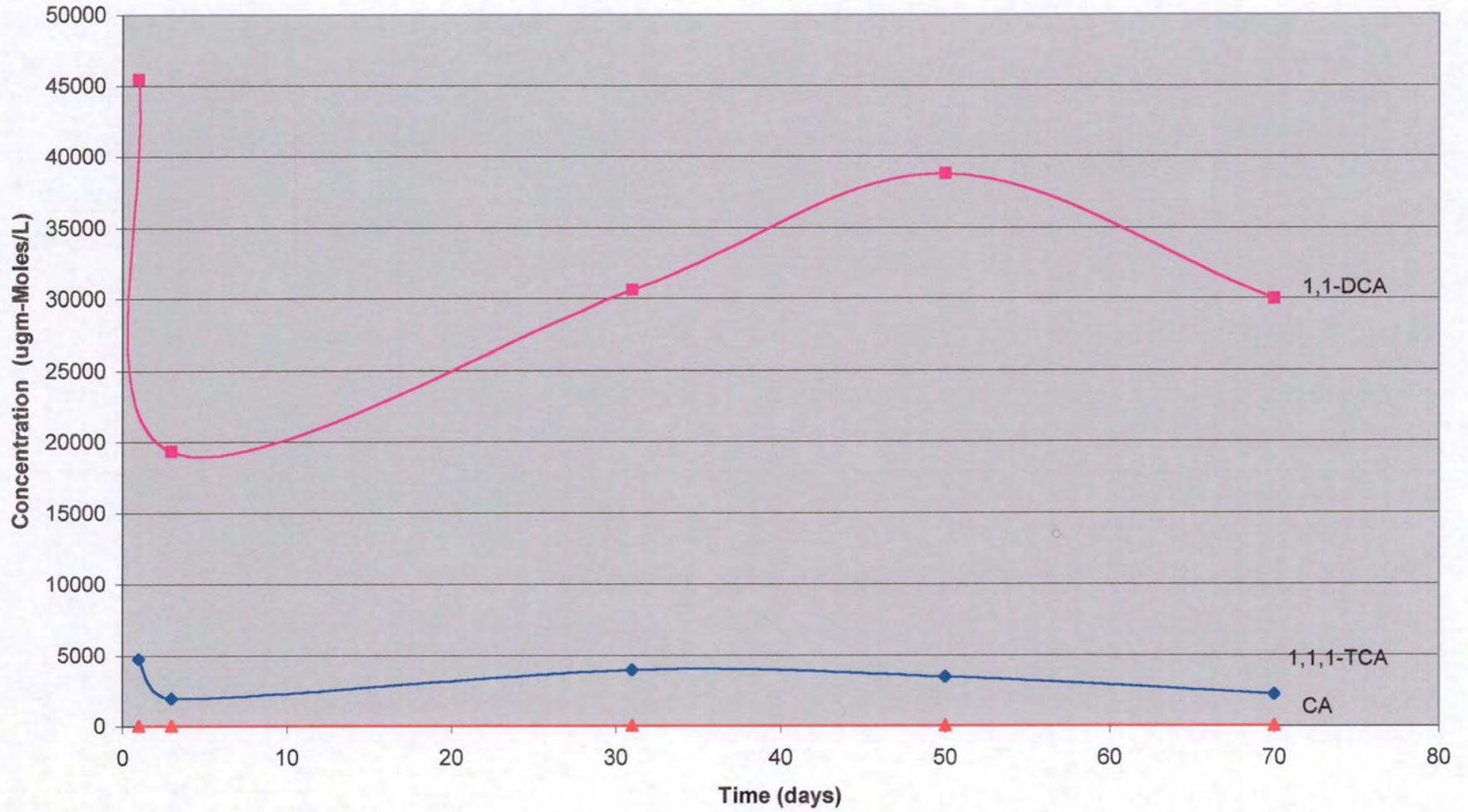
Hamilton Beach Pilot
Implant B-M11 - Concentration vs. Time
ugm/L - 1,1-DCE, cis-DCE



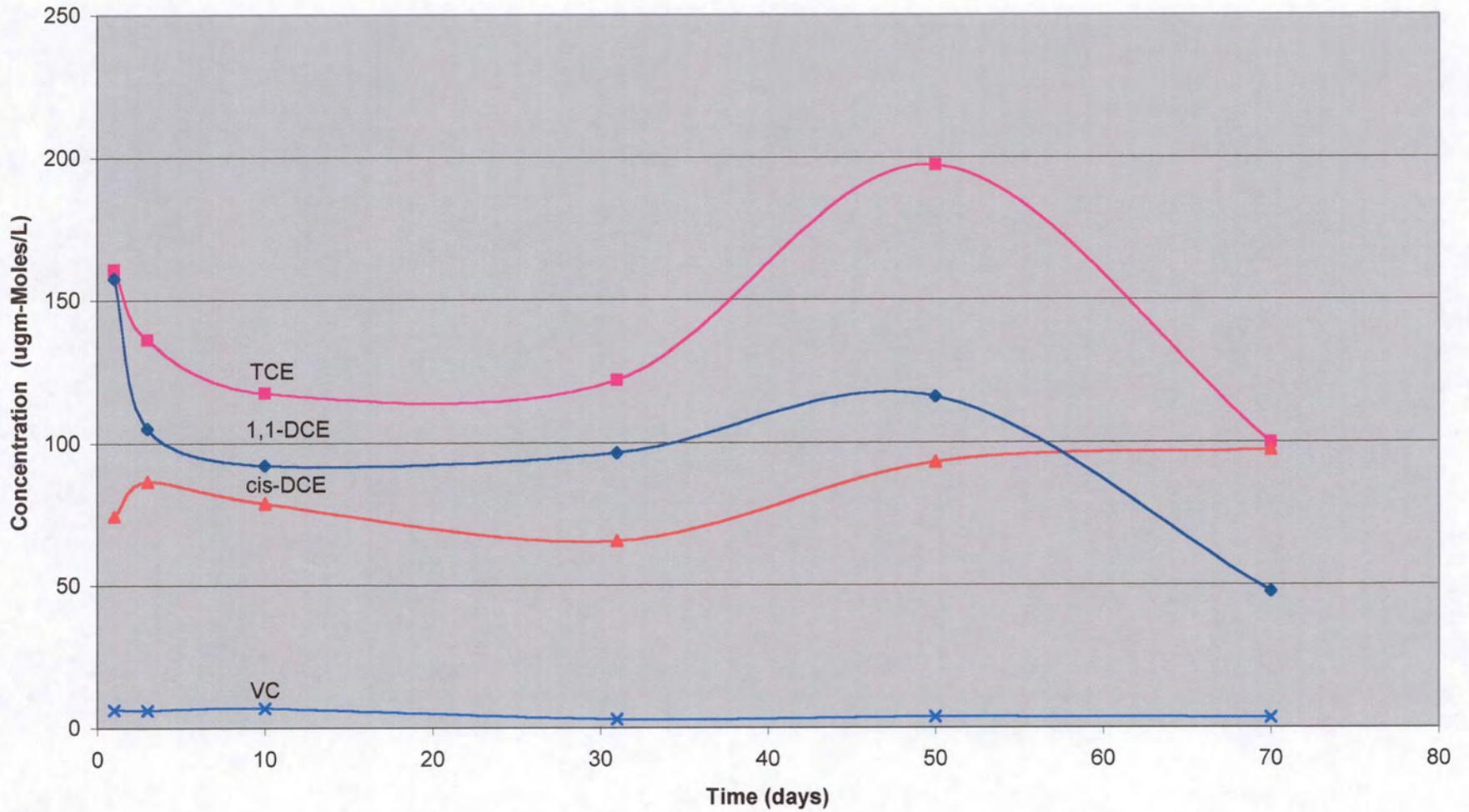
HAMILTON BEACH PILOT
IMPLANT B-M11 - CONCENTRATION VS. TIME
ugm/L - TCE, VC



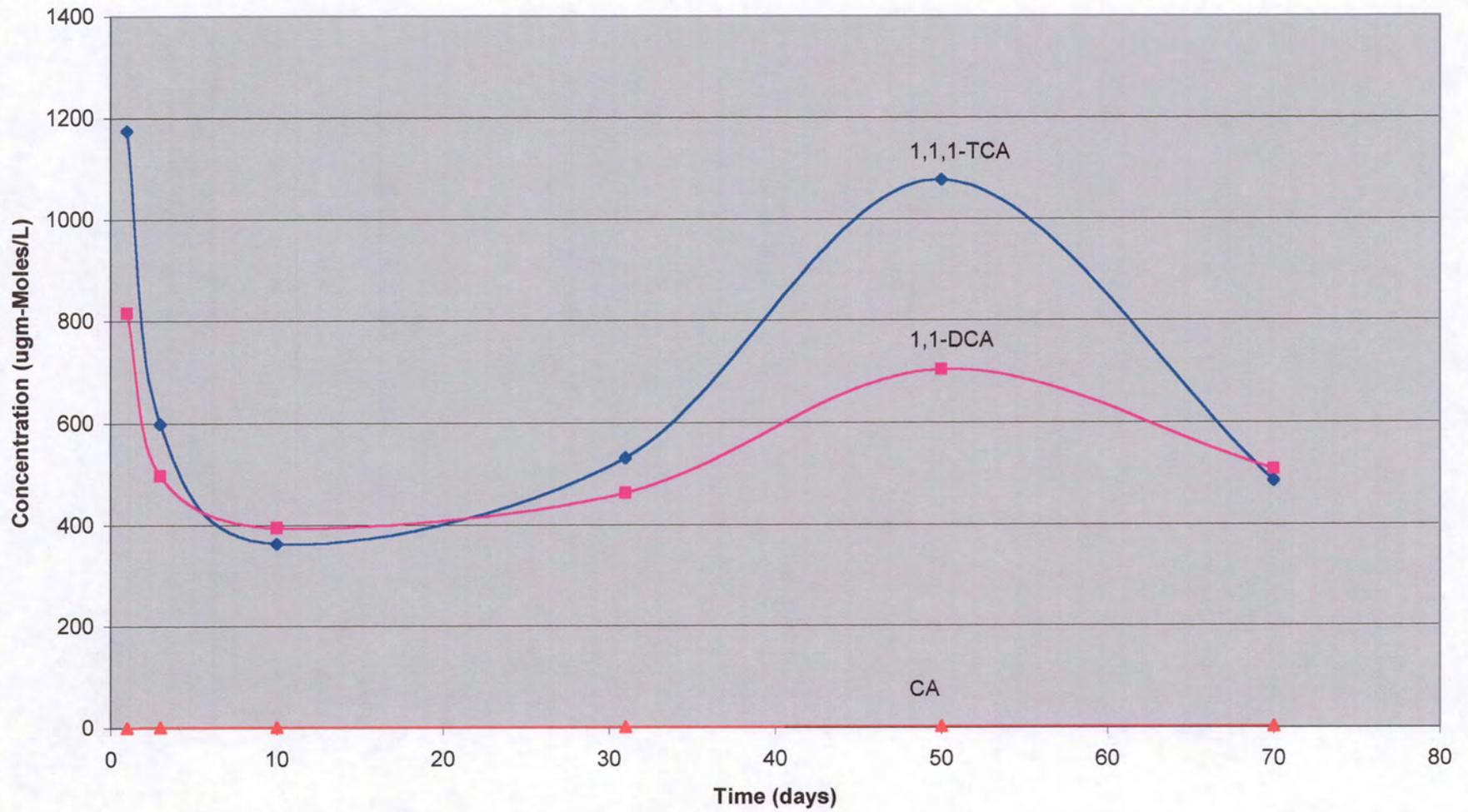
HAMILTON BEACH PILOT
IMPLANT B-M11 - CONCENTRATION VS. TIME
UGM/L - 1,1,1-TCA, 1,1-DCA, CA



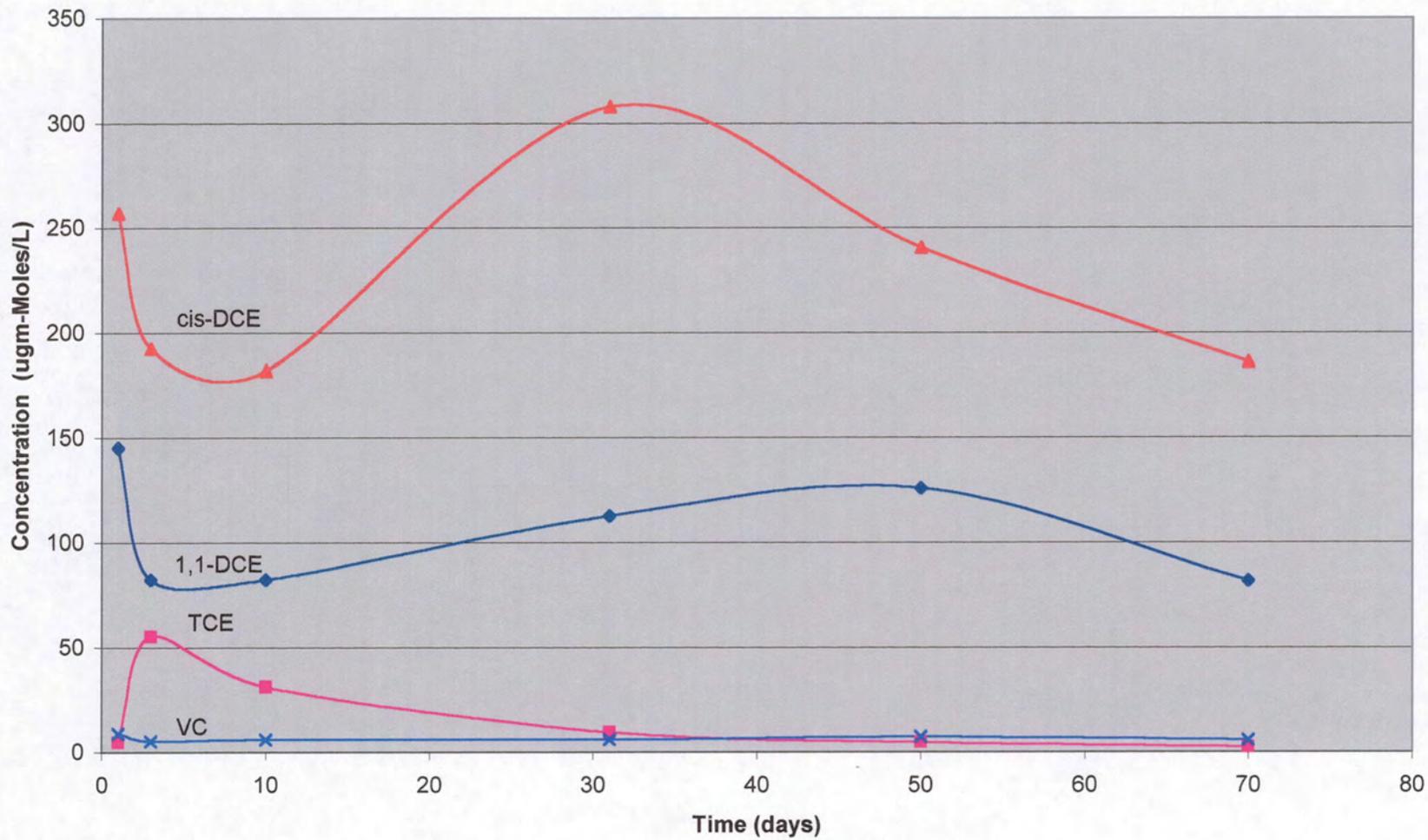
Hamilton Beach Pilot
Implant B-M1 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



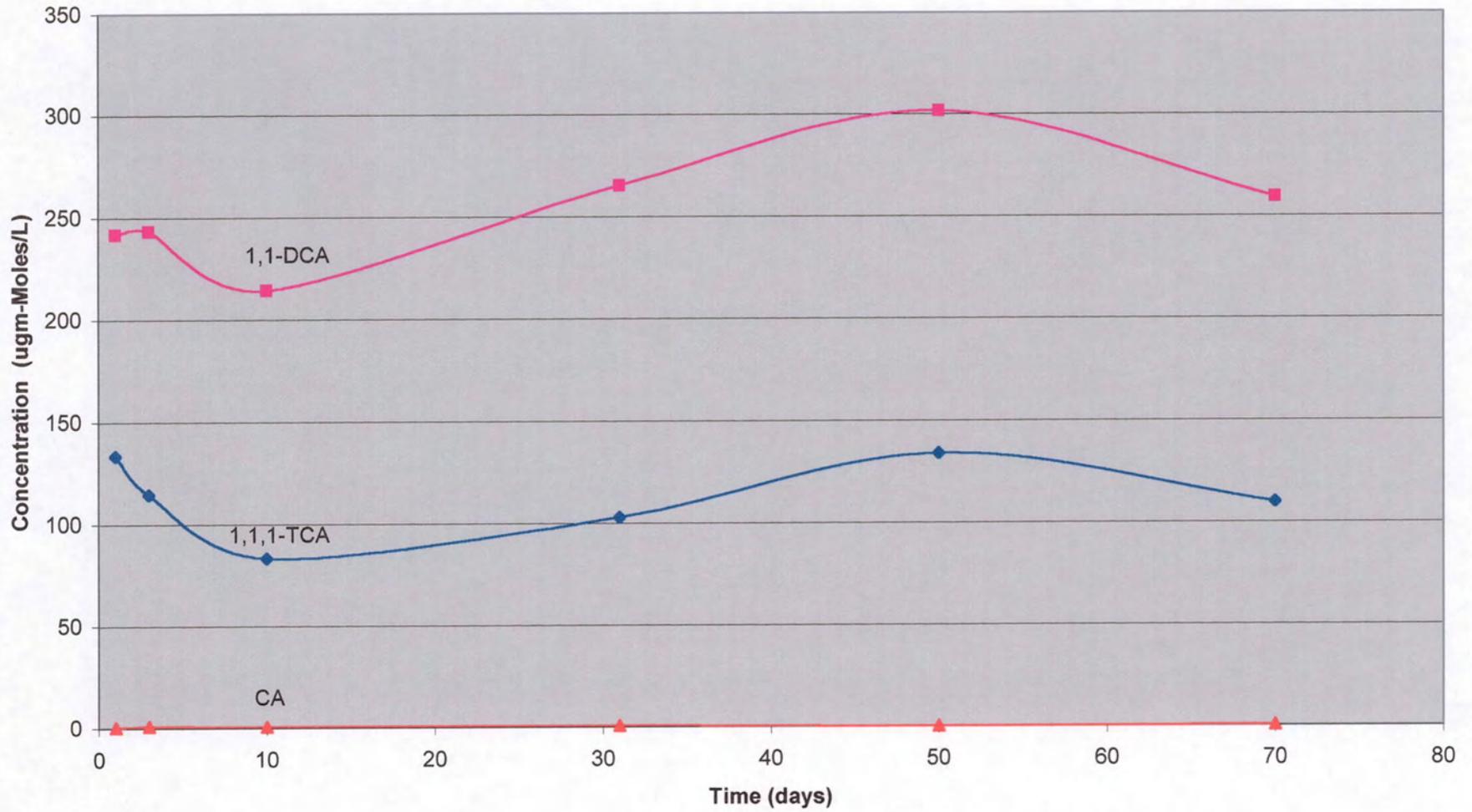
**Hamilton Beach Pilot
Implant B-M1 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA**



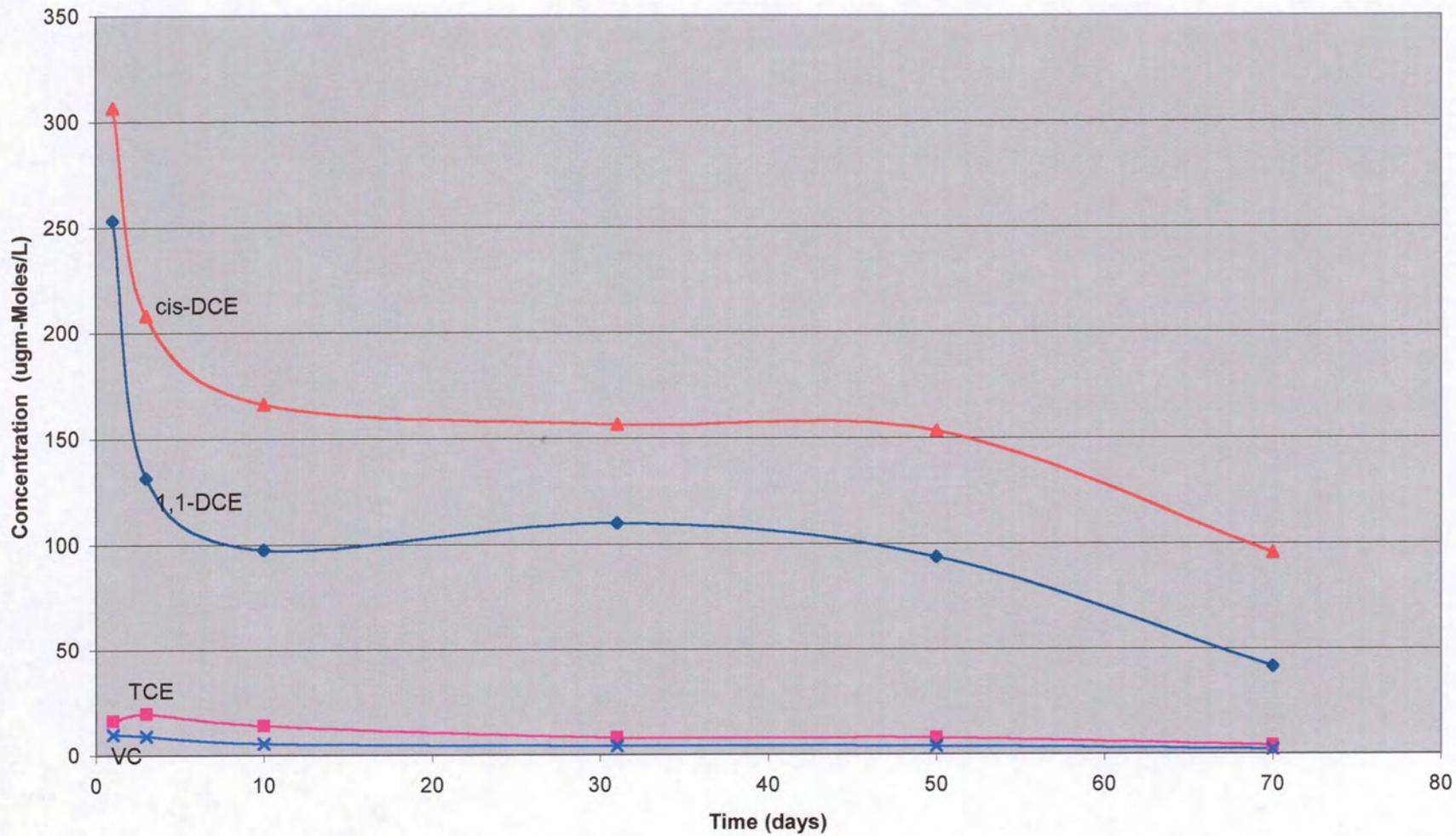
**Hamilton Beach Pilot
Implant B-M2 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC**



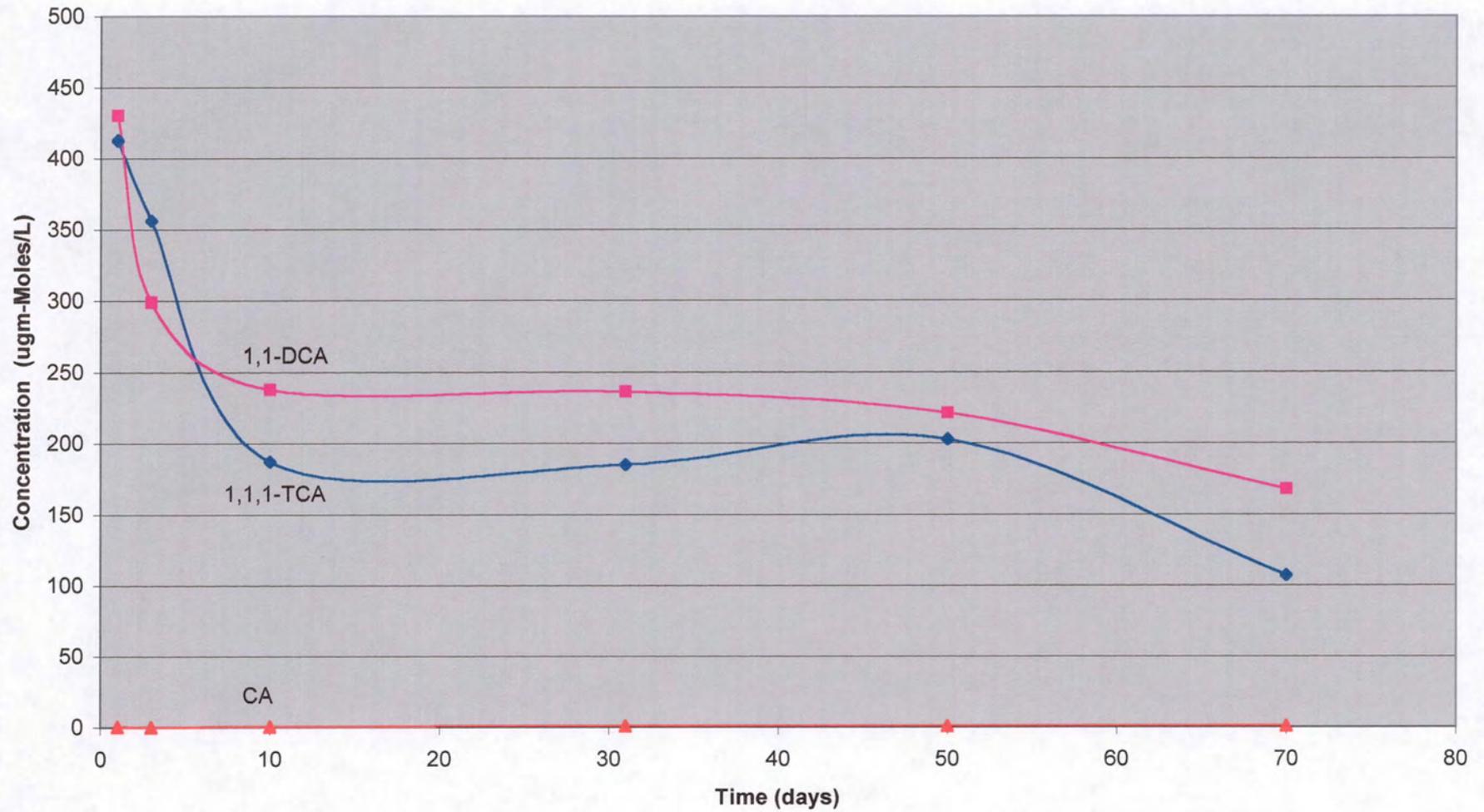
Hamilton Beach Pilot
Implant B-M2 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



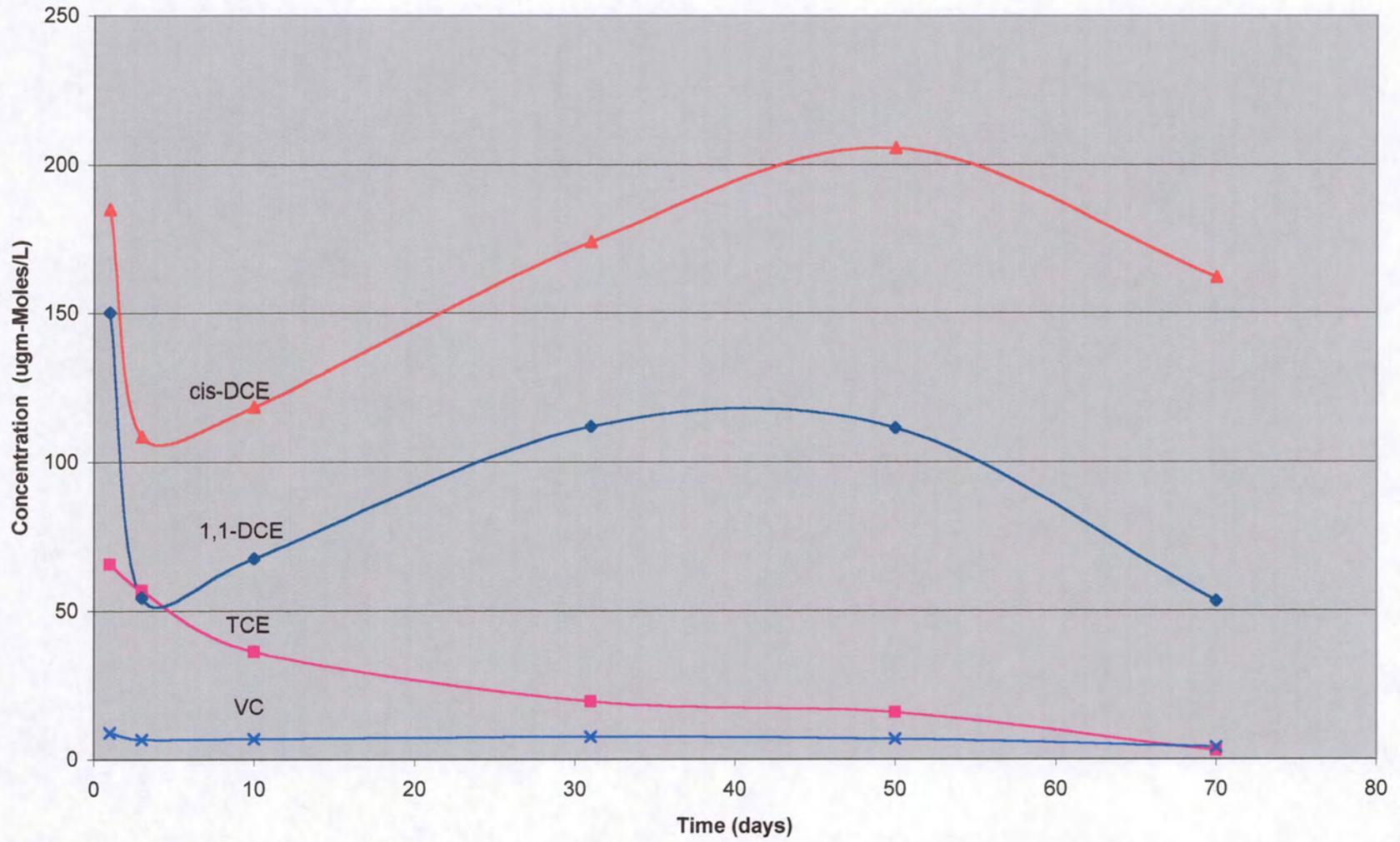
Hamilton Beach Pilot
Implant B-M3 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



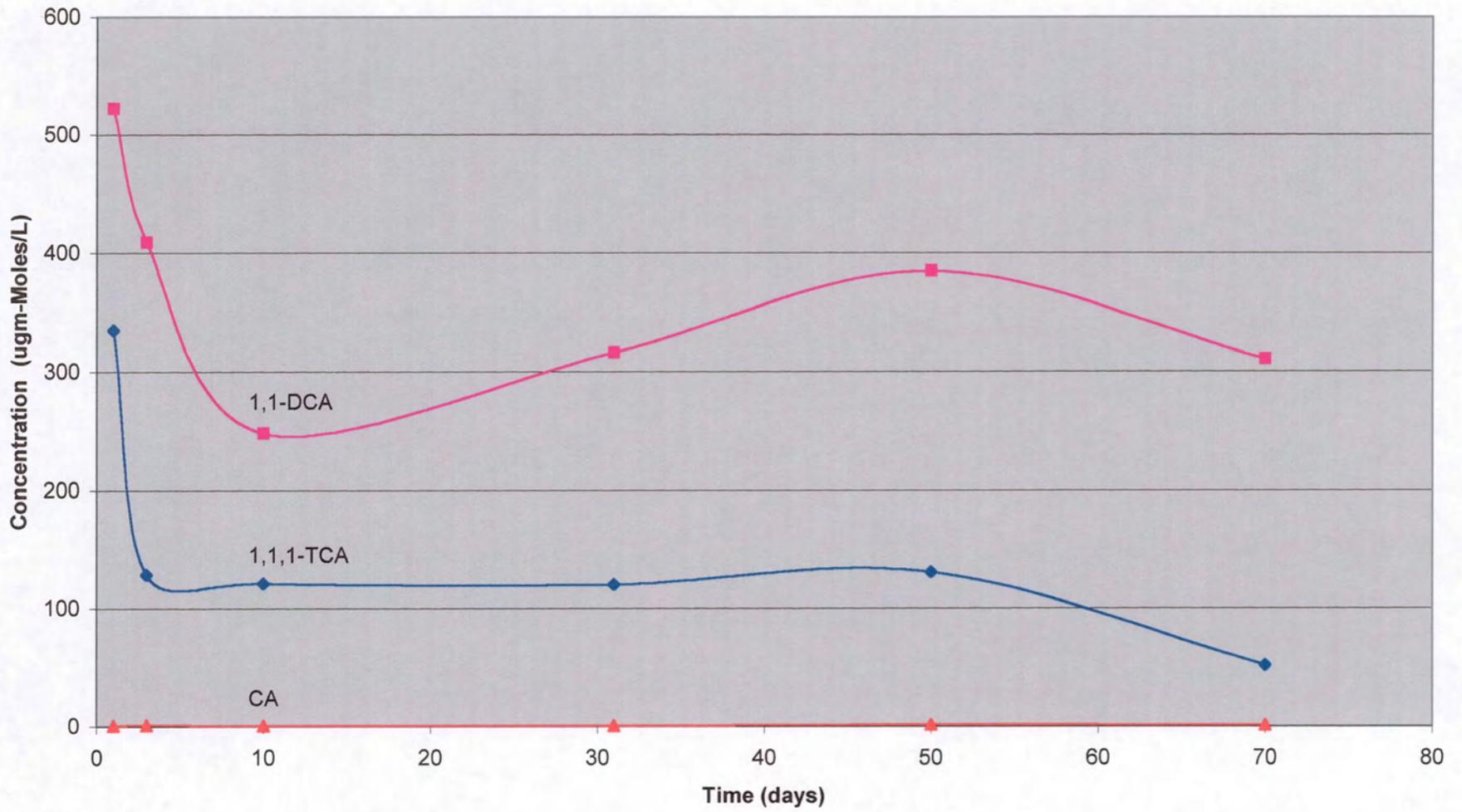
Hamilton Beach Pilot
Implant B-M3 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



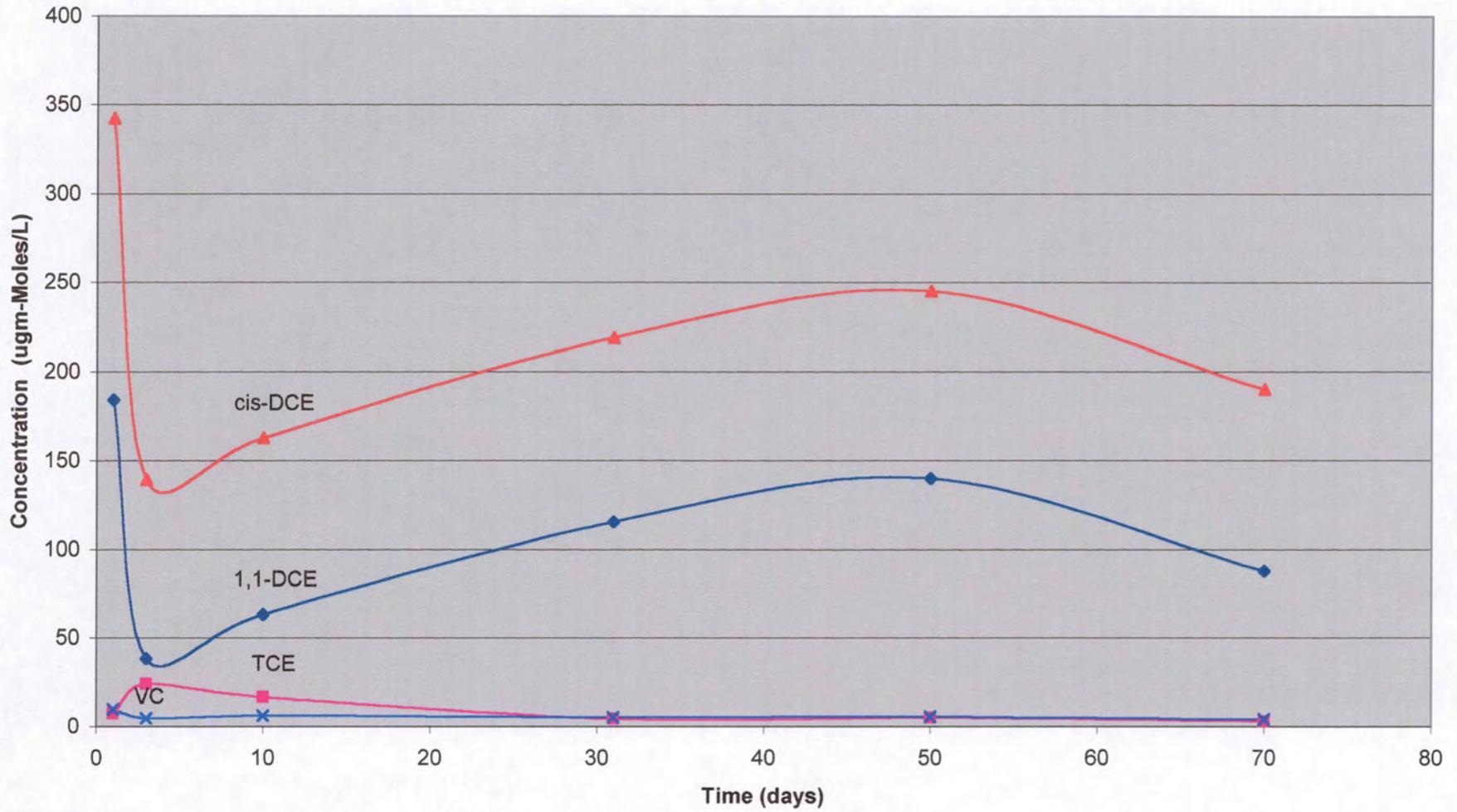
Hamilton Beach Pilot
Implant B-M4 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



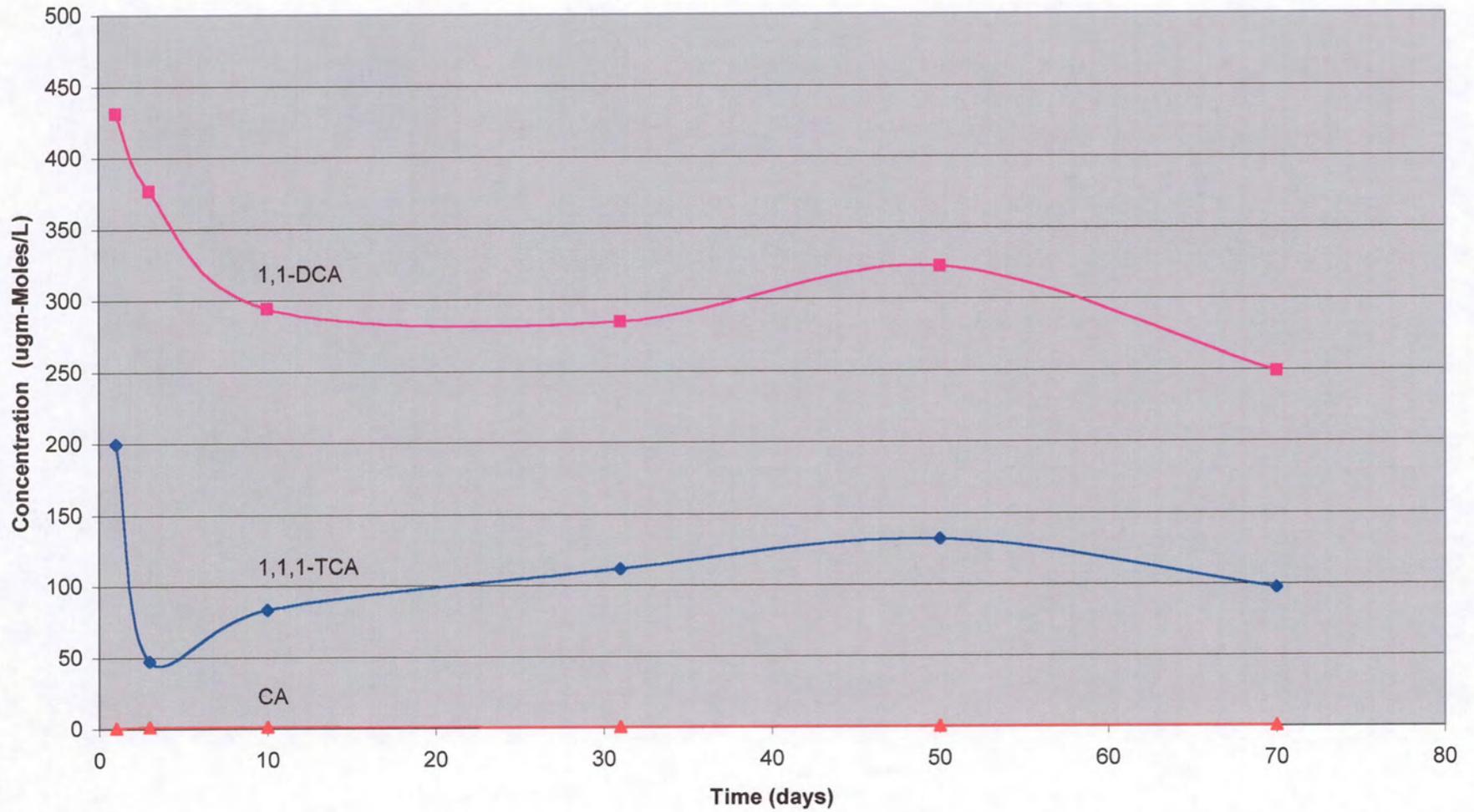
HAMILTON BEACH PILOT
IMPLANT B-M4 - CONCENTRATION VS. TIME
MOLAR UNITS - 1,1,1-TCA, 1,1-DCA, CA



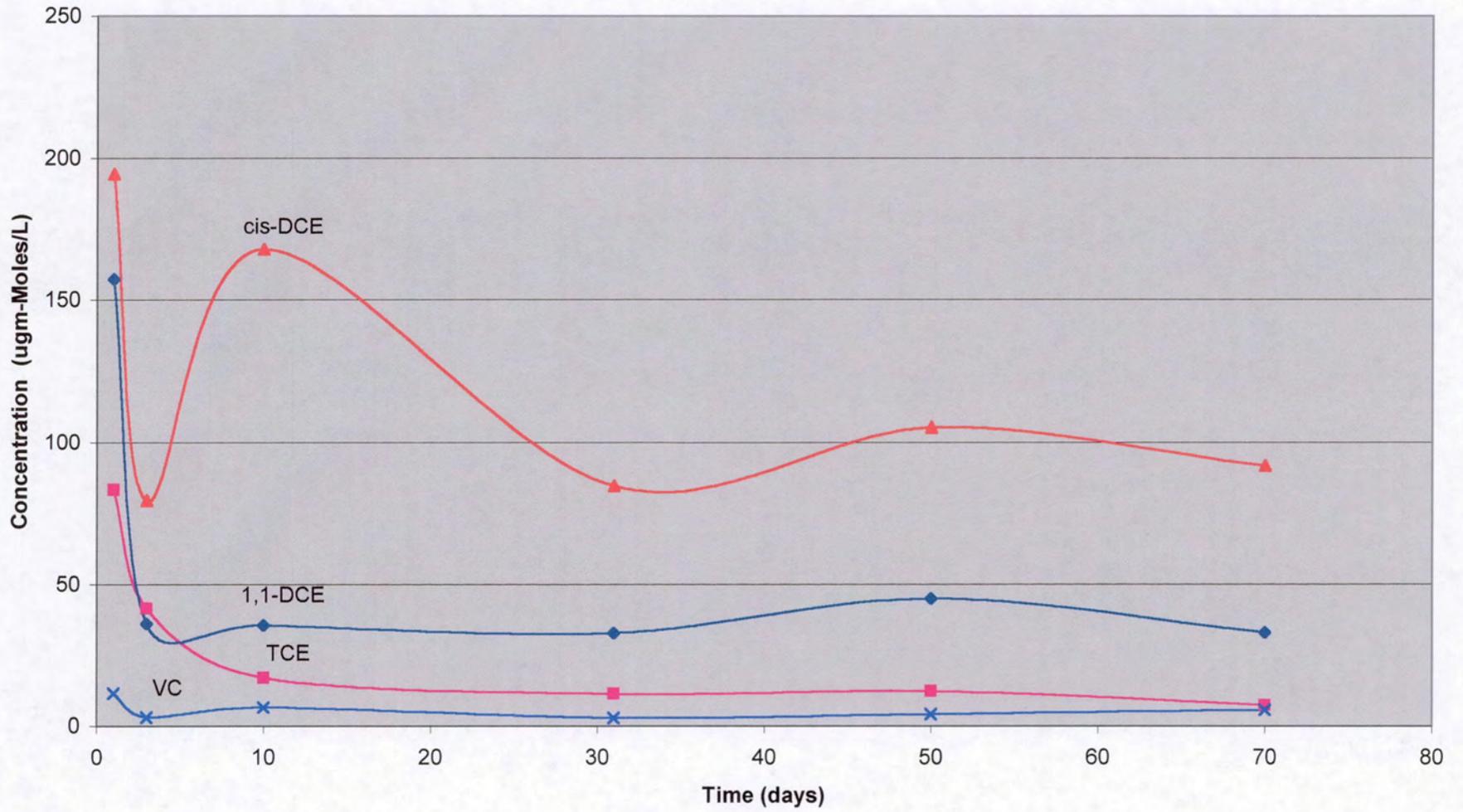
**Hamilton Beach Pilot
Implant B-M5 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC**



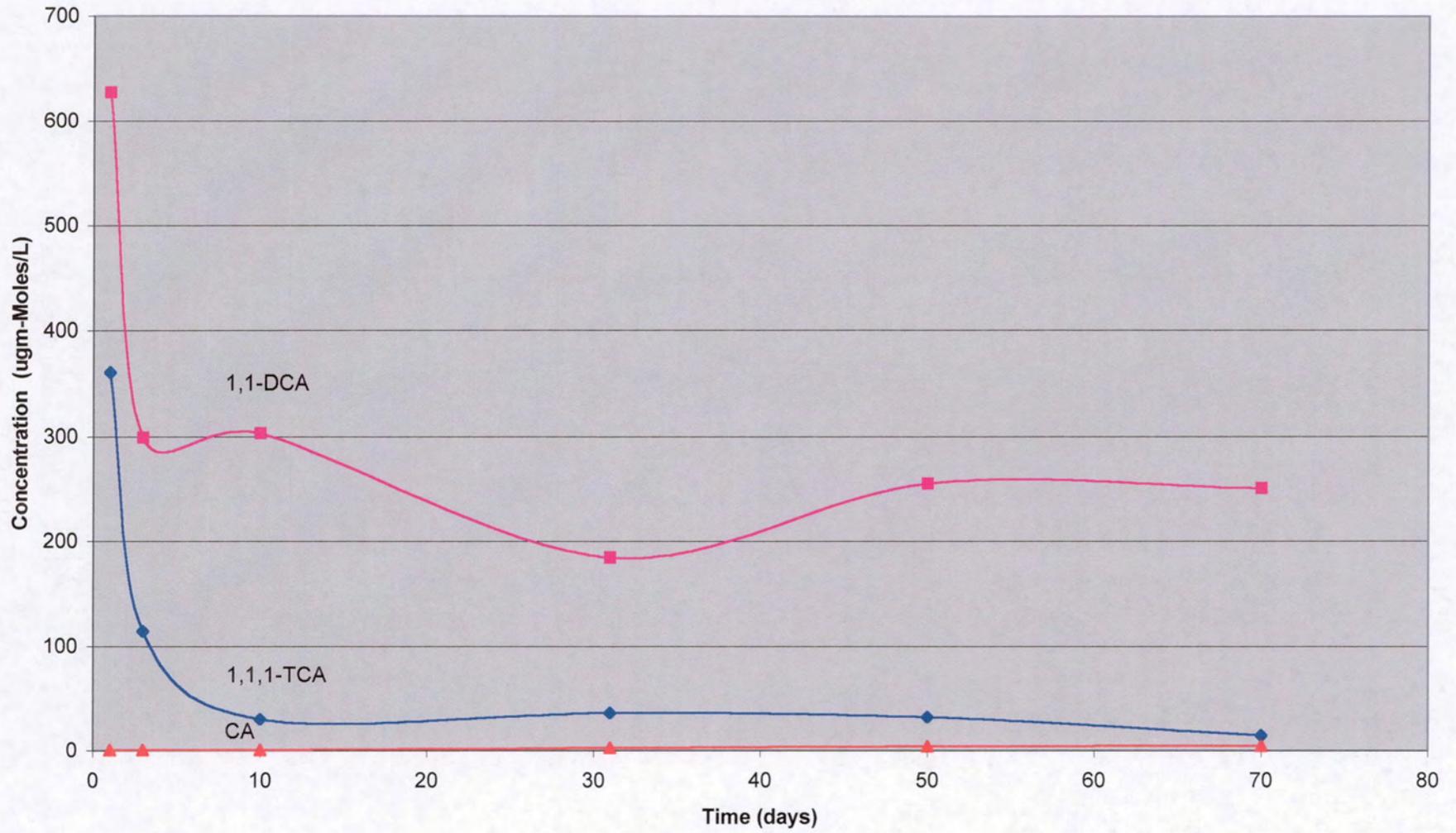
Hamilton Beach Pilot
Implant B-M5 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



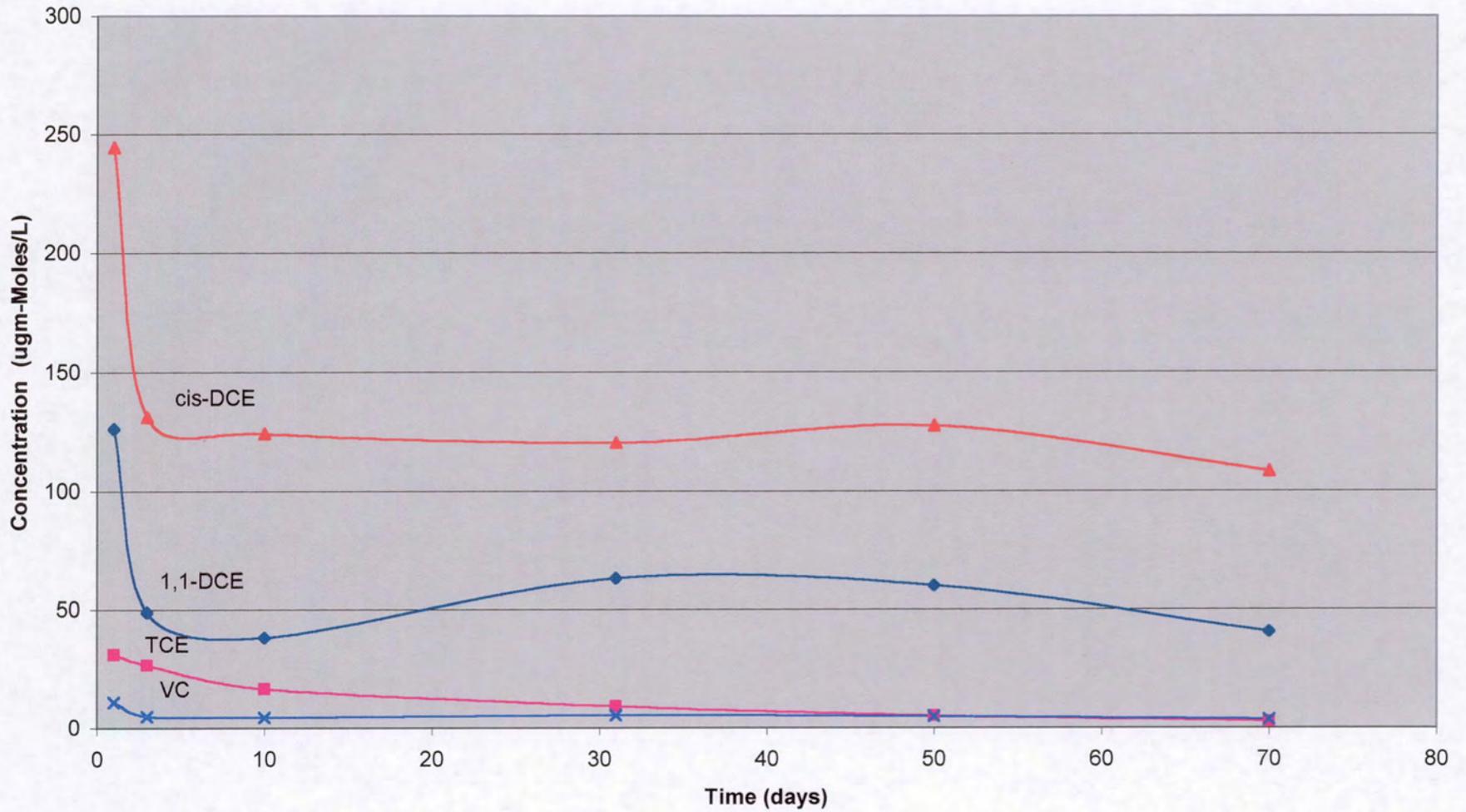
Hamilton Beach Pilot
Implant B-M6 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



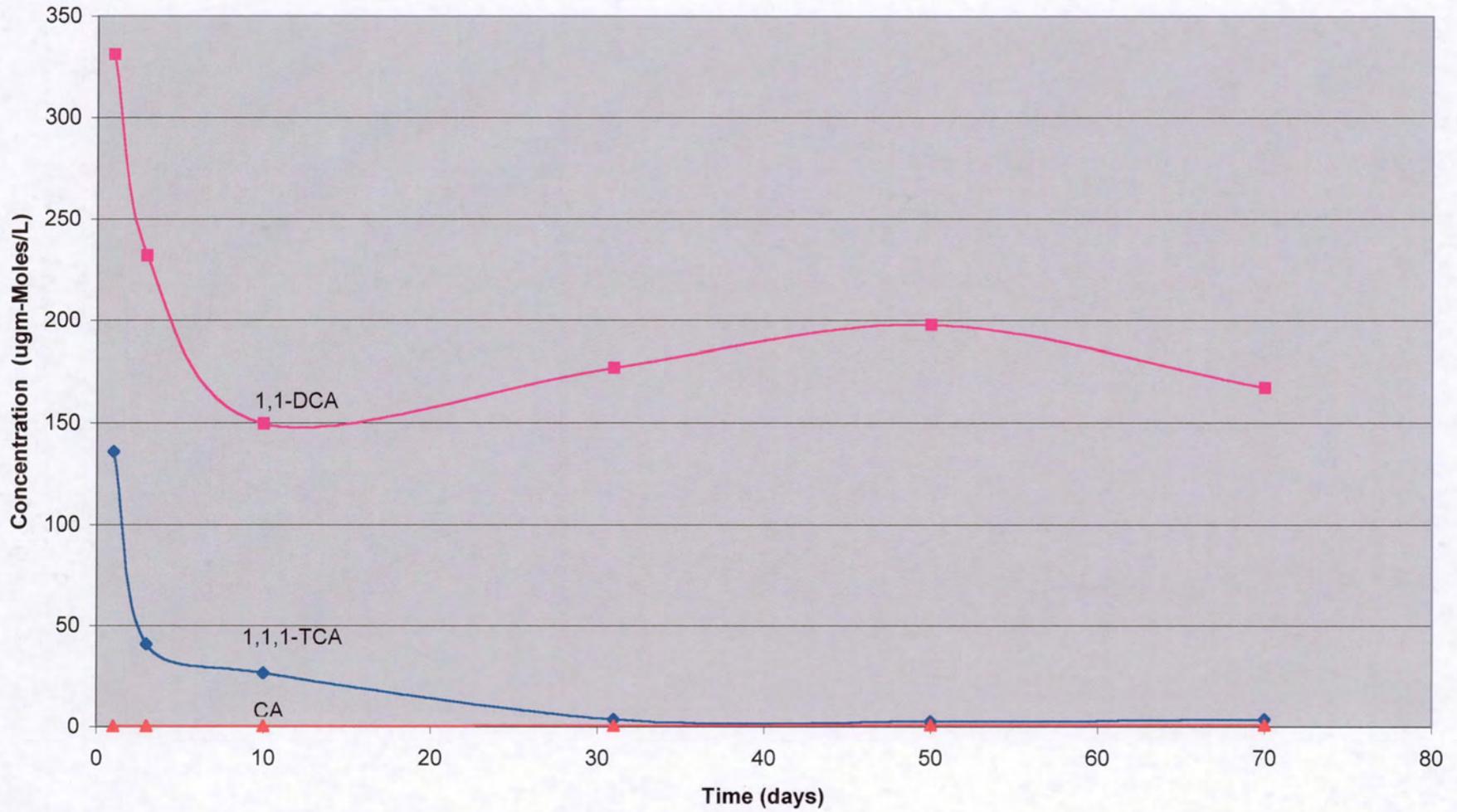
Hamilton Beach Pilot
Implant B-M6 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



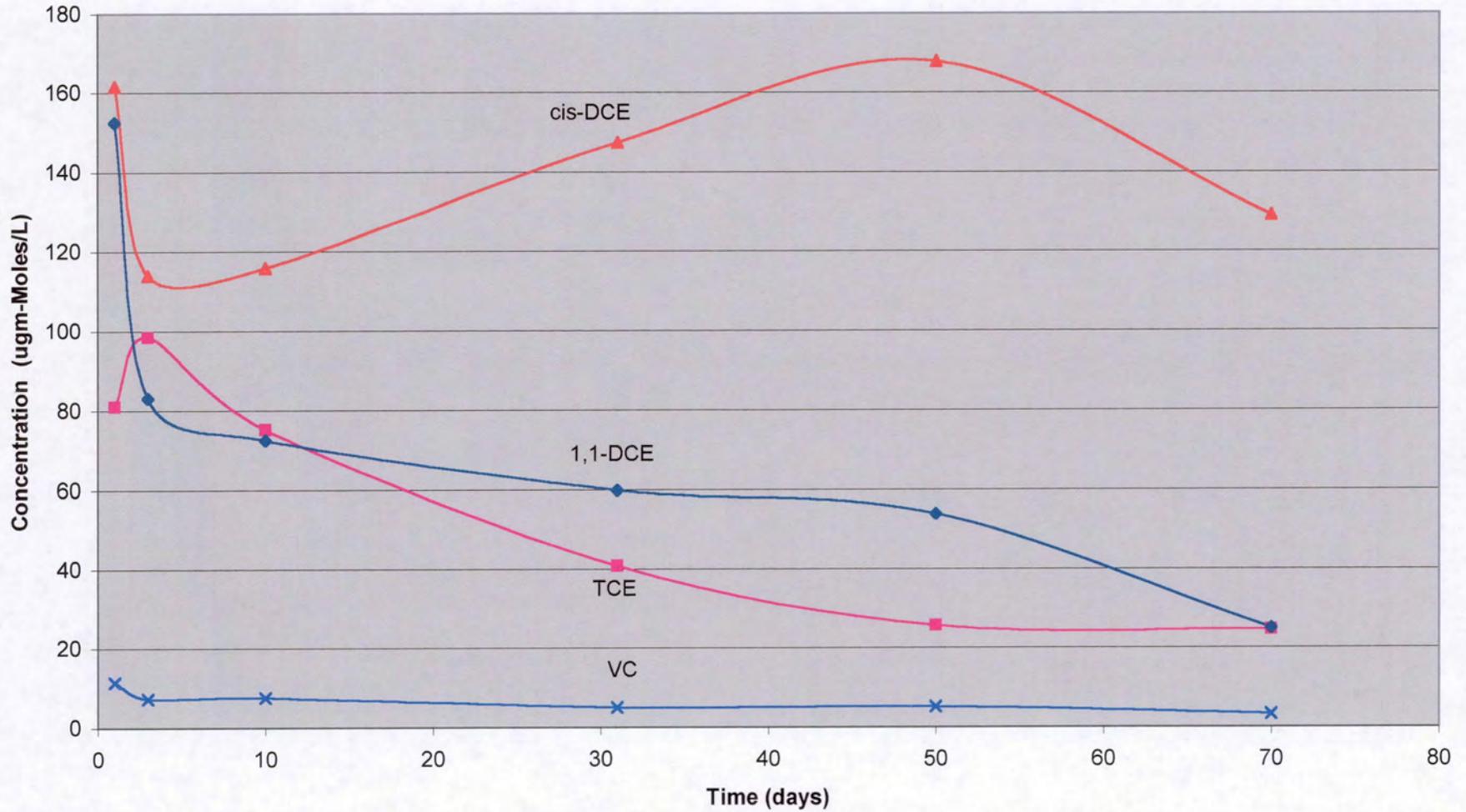
HAMILTON BEACH PILOT
IMPLANT B-M7 - CONCENTRATION VS. TIME
MOLAR UNITS - TCE, 1,1-DCE, CIS-DCE, VC



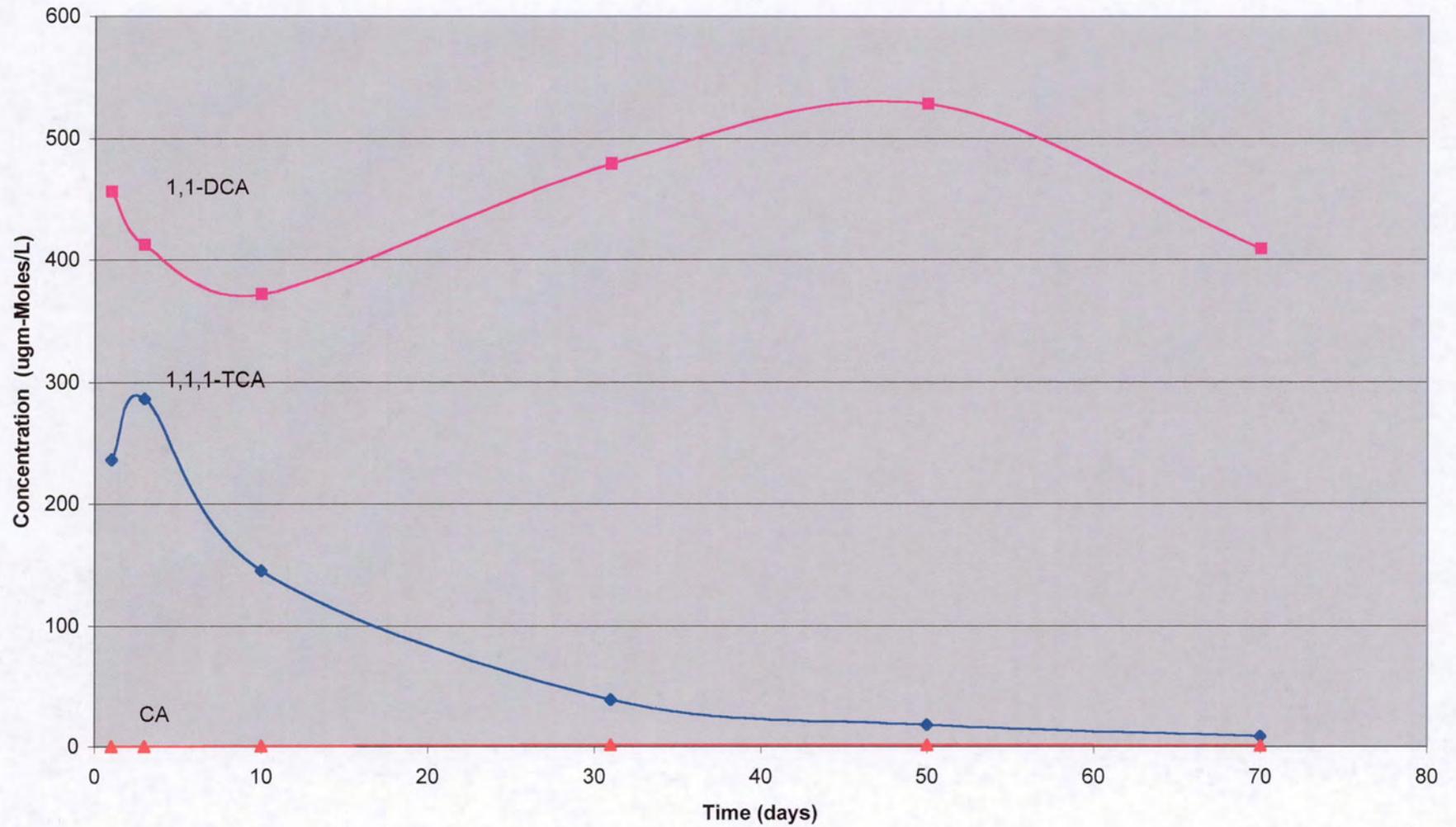
**Hamilton Beach Pilot
Implant B-M7 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA**



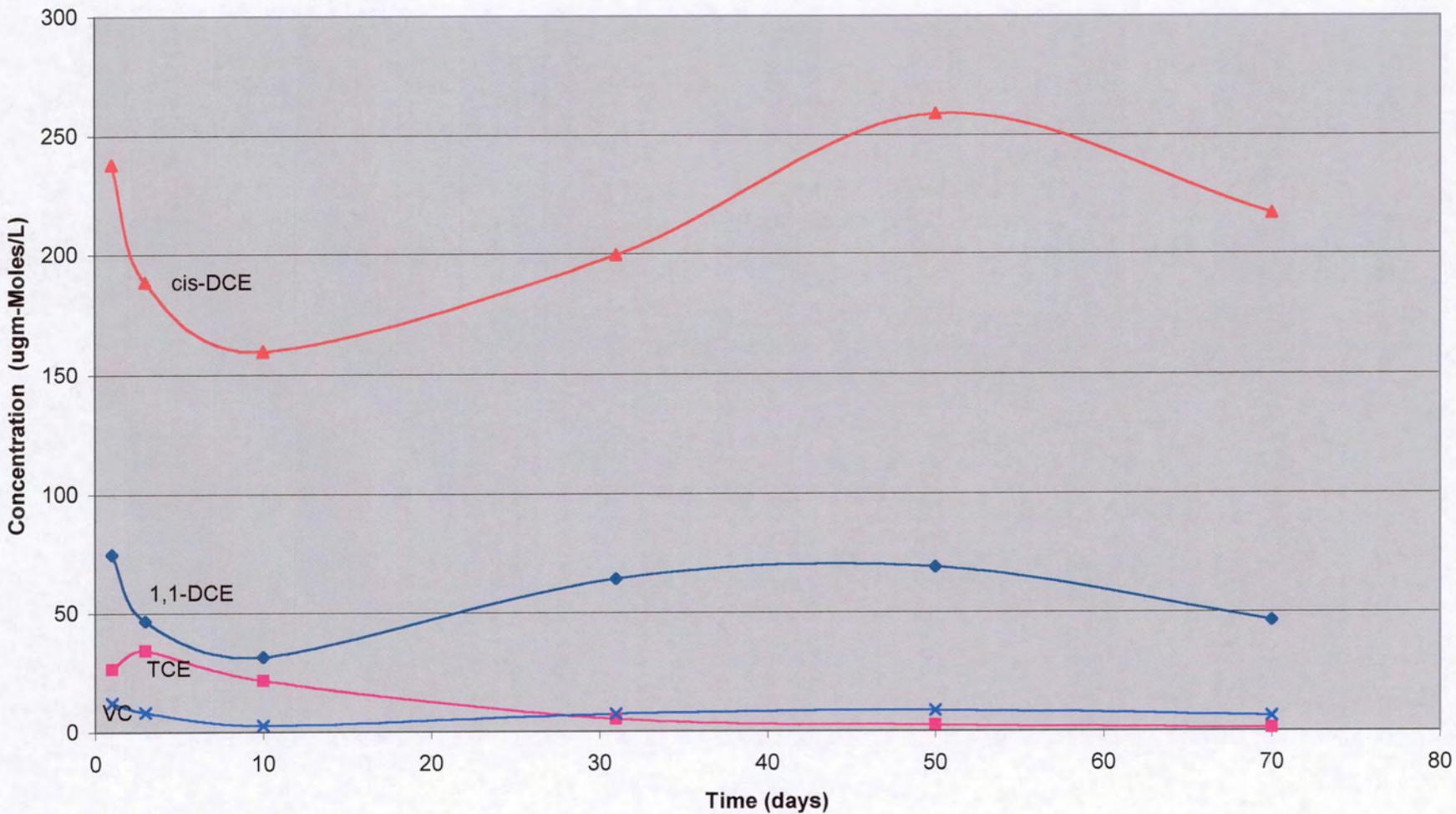
Hamilton Beach Pilot
Implant B-M8 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



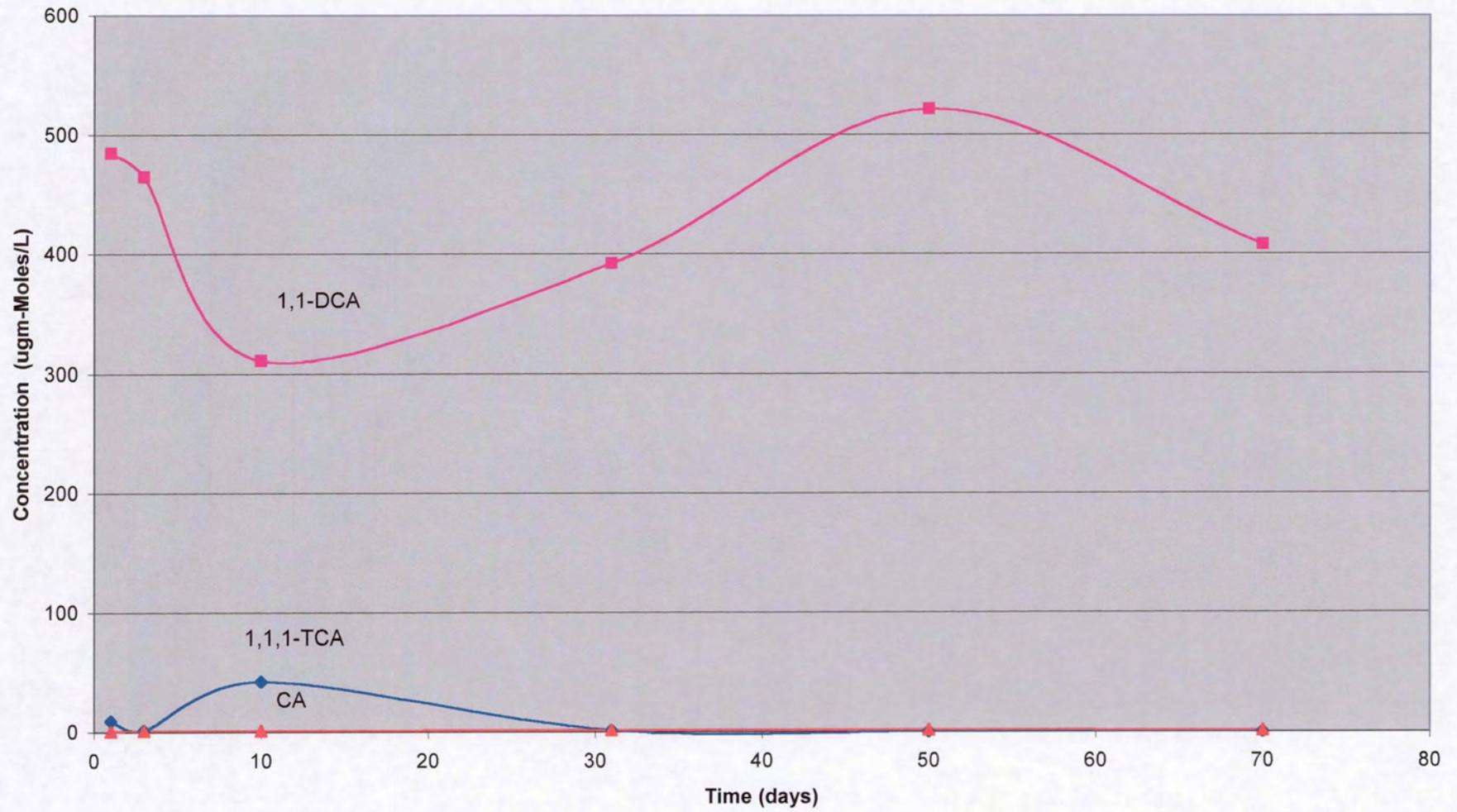
Hamilton Beach Pilot
Implant B-M8 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



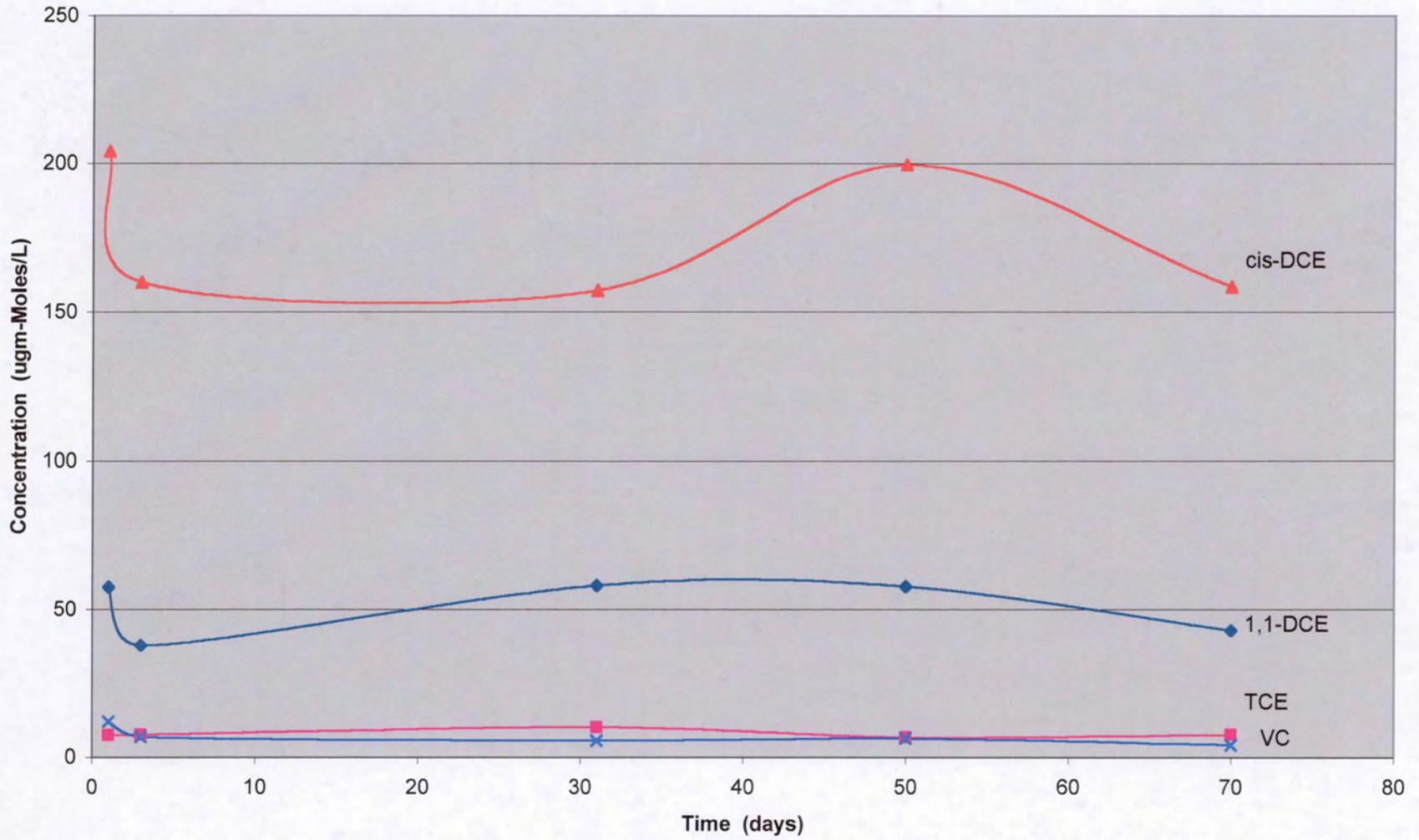
Hamilton Beach Pilot
Implant B-M9 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



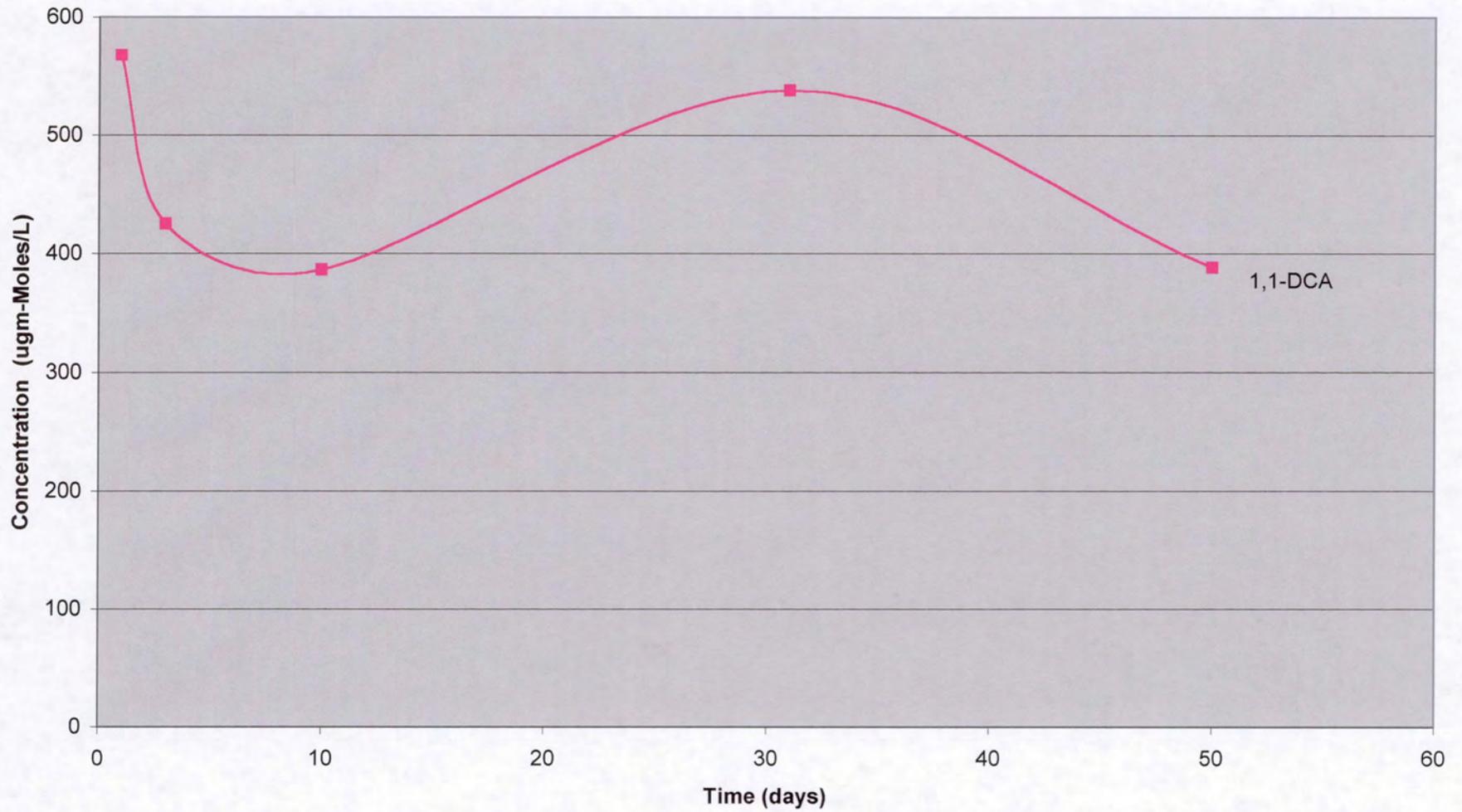
Hamilton Beach Pilot
Implant B-M9 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



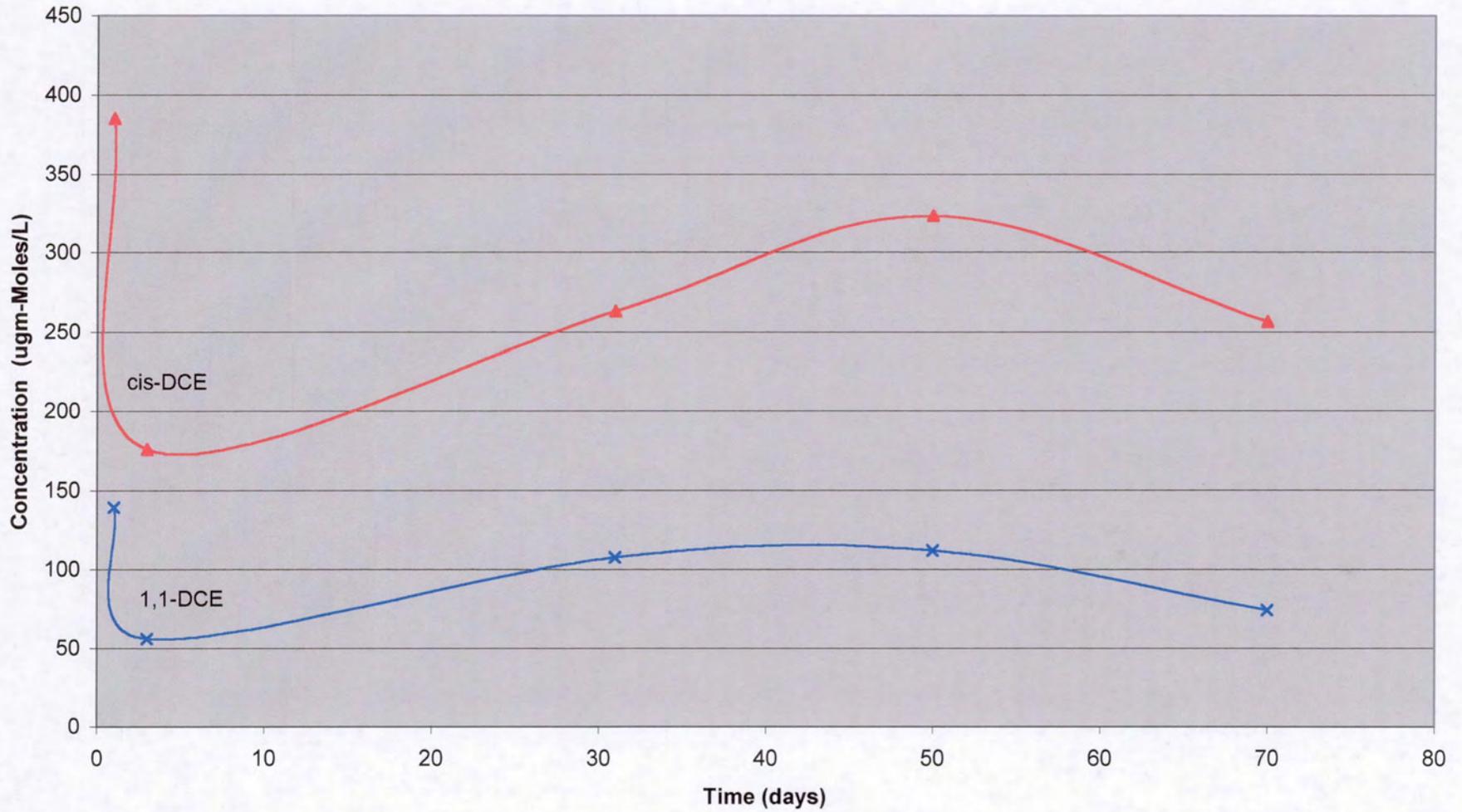
Hamilton Beach Pilot
Implant B-M10 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



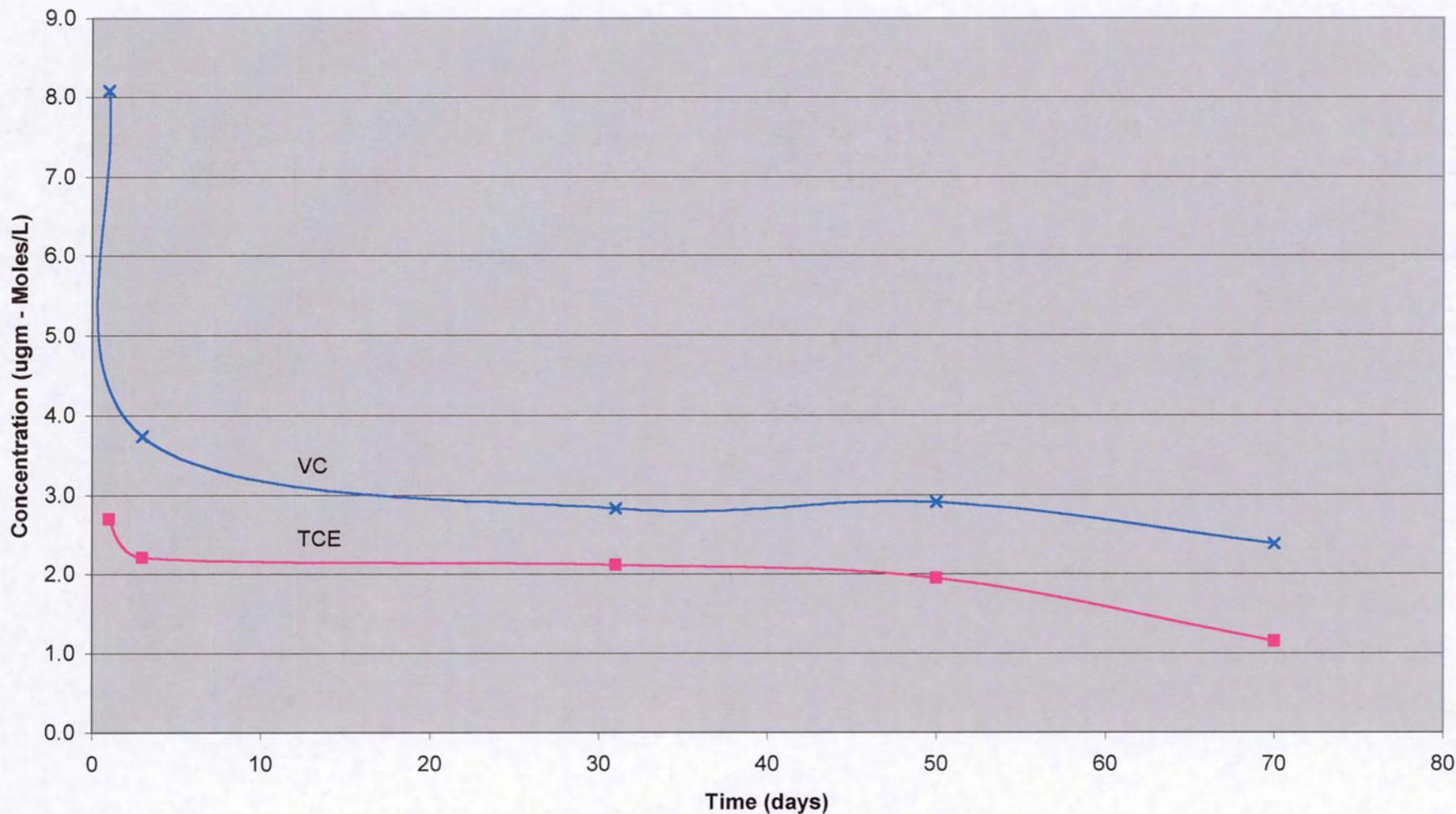
**Hamilton Beach Pilot
Implant B-M10 - Concentration vs. Time
Molar Units - 1,1-DCA only**



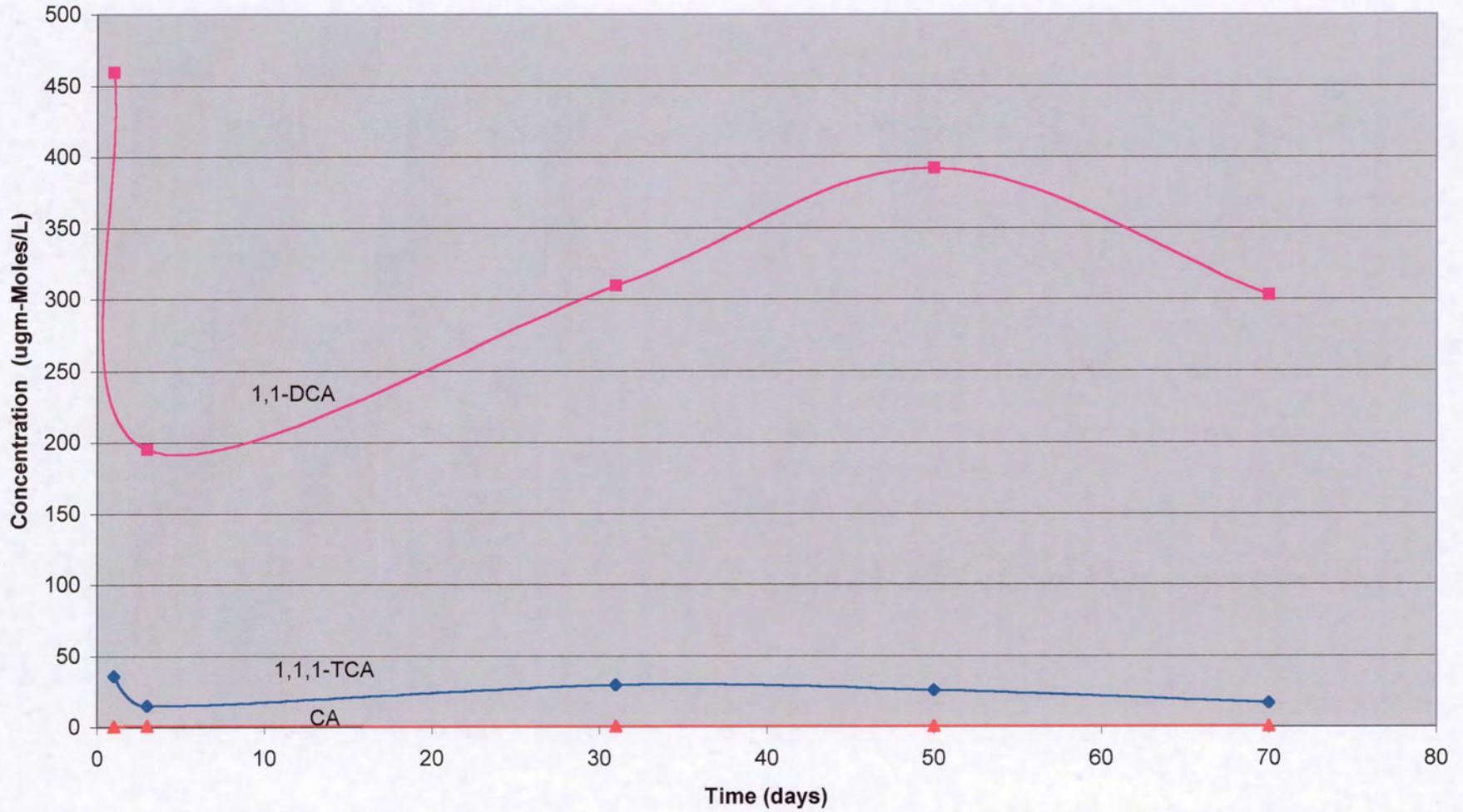
Hamilton Beach Pilot
Implant B-M11 - Concentration vs. Time
Molar Units - 1,1-DCE, cis-DCE



Hamilton Beach Pilot
Implant B-M-11 - Concentration vs. Time
Molar Units - TCE, VC



Hamilton Beach Pilot
Implant B-M11 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA





Hamilton Beach Pilot Unit A Groundwater Sampling Results

Sample ID. No.	HB-A-M1																			
Date Sampled	10/04/01		10/09/01		10/10/01		10/17/01		11/08/01		11/27/01		12/17/01		02/12/02		03/12/02		04/09/02	
Sample Type	BL		PR		PR		PR		MT											
Units	ug/L																			
Analyte	1		6		7		14		35		54		75		132		160		188	
Chloromethane*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)	ND	(1)										
Chloroethane*	16	(1)*	23	(1)*	7.4	(1)*	11	(1)*	24	(1)*	21	(1)*	25	(1)	17	(1)	15	(1)	25	(1)
Trichlorofluoromethane*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)	ND	(1)										
Vinyl Chloride*	1.2	(1)*	3	(1)*	0.88	(1)*	0.93	(1)*	4.2	(1)*	6.7	(1)*	12	(1)	6.3	(1)	5.1	(1)	8.2	(1)
1,1-Dichloroethene	213	(1)	330	(1)	146	(1)	179	(1)	449	(10)	354	(10)	291	(1)	203	(1)	219	(10)	201	(1)
Acetone	20	(1)	23	(1)	21	(1)	6737	(1)E	66	(1)	75	(1)	68	(1)	1019	(10)	844	(10)	1079	(10)
Methylene Chloride	ND	(1)	2.9	(1)	ND	(1)	ND	(1)	ND	(1)	3.1	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Methyl Ethyl Ketone	79	(1)	ND	(1)	64	(1)	ND	(1)	28	(1)	392	(1)	48	(10)	191	(10)	375	(10)	138	(1)
cis-Dichloroethene	176	(1)	292	(1)	96	(1)	181	(1)	286	(10)	453	(10)	490	(10)	1479	(10)	1089	(10)	1275	(10)
1,1-Dichloroethane	306	(1)	373	(1)	139	(1)	250	(1)	430	(10)	426	(10)	341	(10)	333	(10)	233	(1)	219	(1)
1,2-Dichloroethane	ND	(1)																		
Chloroform	ND	(1)	1.1	(1)	ND	(1)														
1,1,1-Trichloroethane	68	(1)	58	(1)	40	(1)	59	(1)	72	(1)	67	(1)	58	(1)	51	(1)	40	(1)	37	(1)
1,2-Dichloropropane	ND	(1)	2.6	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)								
Trichloroethene	452	(1)	467	(1)	410	(1)	618	(1)E	925	(10)	926	(10)	857	(10)	406	(10)	209	(1)	102	(1)
Toluene	1.7	(1)	3.3	(1)	1.4	(1)	1.4	(1)	1.4	(1)	1.3	(1)	1.6	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	11	(1)	7.4	(1)	13	(1)	13	(1)	13	(1)	15	(1)	13	(1)	12	(1)	12	(1)	10	(1)
Surrogates (% Recovery)																				
Dibromofluoromethane	108		144		99		108		103		101		114		107		94		101	
d8-Toluene	98		110		98		95		99		107		99		104		102		100	
p-Bromofluorobenzene	99		114		89		109		92		101		98		103		95		100	

⋯ = Groundwater levels were erratic during this period.

ND=not detected

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E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2	HB-A-M2
Date Sampled	10/04/01	10/09/01	10/10/01	11/08/01	11/27/01	12/17/01	02/12/02	03/12/02	04/09/02								
Sample Type	BL	BL	PR	MT	MT	MT	MT	MT	MT								
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L								
Analyte	1	6	7	35	54	75	132	160	188								
Chloromethane*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)							
Chloroethane*	15.8 (1)*	30.3 (1)*	9.1 (1)*	24.3 (1)*	32 (1)*	25 (1)	4.6 (1)	7.7 (1)	11 (1)								
Trichlorofluoromethane*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)*	ND (1)	ND (1)	ND (1)	ND (1)								
Vinyl Chloride*	7.5 (1)*	34 (1)*	8.5 (1)*	28 (1)*	31 (1)*	5.3 (1)	1.7 (1)	2.5 (1)	3.1 (1)								
1,1-Dichloroethene	109 (1)	284 (1)	128 (1)	391 (10)	421 (10)	305 (10)	90 (1)	235 (1)	142 (1)								
Acetone	18 (1)	32 (1)	50 (1)	797 (1)E	484 (10)	454 (10)	403 (10)	404 (10)	764 (10)								
Methylene Chloride	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)								
Methyl Ethyl Ketone	15 (1)	3.2 (1)	ND (1)	63 (1)	60 (1)	86 (1)	33 (1)	207 (1)	89 (1)								
cis-Dichloroethene	45 (1)	112 (1)	81 (1)	102 (1)	120 (1)	141 (1)	46 (1)	106 (1)	147 (1)								
1,1-Dichloroethane	232 (1)	374 (1)	130 (1)	414 (10)	451 (10)	374 (10)	88 (1)	144 (1)	135 (1)								
1,2-Dichloroethane	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)								
Chloroform	ND (1)	1.2 (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)								
1,1,1-Trichloroethane	66 (1)	112 (1)	63 (1)	143 (1)	175 (1)	135 (1)	49 (1)	80 (1)	68 (1)								
1,2-Dichloropropane	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)								
Trichloroethene	151 (1)	429 (1)	281 (1)	1068 (10)	1242 (10)	1208 (10)	449 (10)	930 (10)	773 (10)								
Toluene	2.4 (1)	1.7 (1)	1.6 (1)	1.1 (1)	1.1 (1)	1.3 (1)	ND (1)	ND (1)	ND (1)								
Tetrachloroethene	1.6 (1)	5.1 (1)	6.2 (1)	13 (1)	16 (1)	13 (1)	11 (1)	18 (1)	17 (1)								
Surrogates (% Recovery)																	
Dibromofluoromethane	110	141	99	103	107	111	104	94	103								
d8-Toluene	95	112	97	99	110	99	102	102	101								
p-Bromofluorobenzene	100	116	90	99	103	100	95	96	100								

⋯ = Groundwater levels were erratic during this period.

ND=not detected

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E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M3		HB-A-M3	HB-A-M3	HB-A-M3													
Date Sampled	10/04/01		10/09/01		10/10/01		10/17/01		11/08/01		11/27/01		02/12/02	03/12/02	04/09/02			
Sample Type	BL		PR		PR		PR		MT		MT		MT	MT	MT			
Units	ug/L		ug/L	ug/L	ug/L													
Analyte	1		6		7		14		35		54		132	160	188			
Chloromethane*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)										
Chloroethane*	40	(1)*	50	(1)*	11	(1)*	25	(1)*	32	(1)*	32	(1)*	32	(1)	23	(1)	30	(1)
Trichlorofluoromethane*	1.2	(1)*	1.2	(1)	ND	(1)*	1.1	(1)*	1.2	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	1.5	(1)*	3	(1)*	0.4	(1)*	1.7	(1)*	1.7	(1)*	2.1	(1)*	3.8	(1)	3.1	(1)	4.1	(1)
1,1-Dichloroethene	315	(1)	283	(1)	110	(1)	262	(1)	426	(10)	321	(10)	318	(10)	323	(10)	387	(10)
Acetone	242	(10)	21	(1)	52	(1)	2135	(1)E	2371	(1)E	601	(10)	562	(10)	419	(10)	960	(10)
Methylene Chloride	ND	(1)	ND	(1)	ND	(1)												
Methyl Ethyl Ketone	6.1	(1)	3.8	(1)	ND	(1)	ND	(1)	44	(1)	50	(1)	23	(1)	95	(1)	59	(1)
cis-Dichloroethene	58	(1)	64	(1)	62	(1)	135	(1)	66	(1)	75	(1)	141	(1)	162	(1)	207	(1)
1,1-Dichloroethane	596	(10)	442	(1)	158	(1)	343	(1)	473	(10)	442	(10)	480	(10)	467	(10)	477	(10)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)												
Chloroform	ND	(1)	ND	(1)	ND	(1)												
1,1,1-Trichloroethane	303	(1)	140	(1)	106	(1)	188	(1)	237	(1)	263	(1)	211	(1)	183	(1)	159	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)												
Trichloroethene	708	(10)	334	(1)	386	(1)	601	(1)E	935	(10)	944	(10)	1127	(10)	1146	(10)	896	(10)
Toluene	1.1	(1)	1.8	(1)	1.3	(1)	1.2	(1)	1.1	(1)	1.2	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	26	(1)	3.6	(1)	14	(1)	11	(1)	15	(1)	16	(1)	22	(1)	24	(1)	22	(1)
Surrogates (% Recovery)																		
Dibromofluoromethane	107	140	97	110	102	112	106	95	104									
d8-Toluene	95	106	99	96	98	110	101	101	100									
p-Bromofluorobenzene	100	116	92	107	91	108	97	96	99									

⋮ = Groundwater levels were erratic during this period.

ND=not detected

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E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M4	HB-A-M4	HB-A-M4	HB-A-M4	HB-A-M4	HB-A-M4	HB-A-M4	HB-A-M4								
Date Sampled	10/04/01	10/09/01	10/10/01	10/17/01	11/08/01	11/27/01	02/12/02	03/12/02	04/09/02							
Sample Type	BL	PR	PR	PR	MT	MT	MT	MT	MT							
Units	ug/L															
Analyte																
Chloromethane*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)*	1	(1)*	ND	(1)*	ND	(1)	ND	(1)
Chloroethane*	20	(1)*	33	(1)*	7	(1)*	13	(1)*	22	(1)*	21	(1)*	16	(1)	21	(1)
Trichlorofluoromethane*	1.0	(1)*	1.3	(1)*	ND	(1)*	1.2	(1)*	1.3	(1)*	1.4	(1)*	ND	(1)	ND	(1)
Vinyl Chloride*	1.1	(1)*	2.0	(1)*	ND	(1)*	ND	(1)*	2.1	(1)*	2.6	(1)*	2.9	(1)	3.4	(1)
1,1-Dichloroethene	167	(1)	270	(1)	98	(1)	205	(1)	382	(10)	414	(10)	180	(1)	276	(1)
Acetone	24	(1)	34	(1)	81	(1)	2475	(1)E	666	(1)E	106	(1)	288	(10)	337	(10)
Methylene Chloride	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Methyl Ethyl Ketone	4	(1)	5.1	(1)	ND	(1)	ND	(1)	163	(1)	88	(1)	37	(1)	94	(1)
cis-Dichloroethene	32	(1)	44	(1)	73	(1)	84	(1)	65	(1)	91	(1)	148	(1)	483	(10)
1,1-Dichloroethane	288	(1)	413	(1)	106	(1)	253	(1)	405	(10)	460	(10)	243	(10)	285	(10)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Chloroform	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
1,1,1-Trichloroethane	122	(1)	89	(1)	35	(1)	106	(1)	128	(1)	167	(1)	77	(1)	65	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Trichloroethene	187	(1)	252	(1)	165	(1)	410	(1)	595	(10)	743	(10)	507	(10)	344	(10)
Toluene	1.8	(1)	1.6	(1)	1.8	(1)	1.5	(1)	1.4	(1)	1.3	(1)	ND	(1)	ND	(1)
Tetrachloroethene	4.8	(1)	2.6	(1)	5.9	(1)	9.2	(1)	8.8	(1)	12	(1)	12	(1)	13	(1)
Surrogates (% Recovery)																
Dibromofluoromethane	106		147		101		107		99		104		107		95	
d8-Toluene	95		111		95		95		98		108		102		102	
p-Bromofluorobenzene	101		116		88		103		92		104		102		95	

▨ = Groundwater levels were erratic during this period.

ND=not detected

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E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M5																	
Date Sampled	10/04/01		10/09/01		10/10/01		10/17/01		11/08/01		11/27/01		02/12/02		03/12/02		04/09/02	
Sample Type	BL		PR		PR		PR		MT									
Units	ug/L																	
Analyte																		
Chloromethane*	ND	(1)*	4.3	(1)*	ND	(1)	ND	(1)	ND	(1)								
Chloroethane*	40	(1)*	46	(1)*	19	(1)*	23	(1)*	29	(1)*	22	(1)*	17	(1)	25	(1)	38	(1)
Trichlorofluoromethane*	4.9	(1)*	2.8	(1)*	1.2	(1)*	2.3	(1)*	2.4	(1)*	1.5	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	13	(1)*	26	(1)*	7.9	(1)*	18	(1)*	23	(1)*	19	(1)*	2.6	(1)	1.8	(1)	2.7	(1)
1,1-Dichloroethene	446	(1)	375	(1)	195	(1)	305	(1)	507	(10)	388	(10)	133	(1)	87	(1)	107	(1)
Acetone	10	(1)	23	(1)	39	(1)	1567	(1)E	57	(1)	81	(1)	1106	(10)	936	(10)	1518	(10)
Methylene Chloride	ND	(1)	1.2	(1)	ND	(1)	ND	(1)	ND	(1)								
Methyl Ethyl Ketone	4	(1)	15	(1)	ND	(1)	ND	(1)	30	(1)	133	(1)	125	(1)	197	(1)	75	(1)
cis-Dichloroethene	41	(1)	51	(1)	46	(1)	47	(1)	48	(1)	50	(1)	65	(1)	49	(1)	95	(1)
1,1-Dichloroethane	531	(1)	516	(1)	243	(1)	352	(1)	465	(10)	466	(10)	215	(1)	138	(1)	136	(1)
1,2-Dichloroethane	ND	(1)																
Chloroform	ND	(1)																
1,1,1-Trichloroethane	357	(1)	178	(1)	110	(1)	159	(1)	205	(1)	203	(1)	101	(1)	36	(1)	55	(1)
1,2-Dichloropropane	ND	(1)																
Trichloroethene	394	(1)	213	(1)	177	(1)	292	(1)	472	(10)	499	(10)	340	(10)	125	(1)	159	(1)
Toluene	ND	(1)	2	(1)	1.7	(1)	1.2	(1)	1.1	(1)	1.2	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	18	(1)	2.5	(1)	2.5	(1)	3.9	(1)	6.4	(1)	8.3	(1)	10	(1)	8.6	(1)	10	(1)
Surrogates (% Recovery)																		
Dibromofluoromethane	112		148		98		110		103		104		106		96		105	
d8-Toluene	96		108		101		96		99		108		102		102		99	
p-Bromofluorobenzene	99		116		99		110		95		102		103		97		100	

⋮ = Groundwater levels were erratic during this period.

ND=not detected

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E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M6		HB-A-M6	HB-A-M6	HB-A-M6													
Date Sampled	10/04/01		10/09/01		10/10/01		10/17/01		11/08/01		11/27/01		02/12/02	03/12/02	04/09/02			
Sample Type	BL		PR		PR		PR		MT		MT		MT	MT	MT			
Units	ug/L		ug/L	ug/L	ug/L													
Analyte																		
Chloromethane	ND	(1)*	ND	(1)	ND	(1)	ND	(1)										
Chloroethane*	18	(1)*	30	(1)*	6.6	(1)*	19	(1)*	21	(1)*	18.6	(1)*	9.1	(1)	6.9	(1)	10	(1)
Trichlorofluoromethane	1.3	(1)*	1.9	(1)*	ND	(1)*	2.4	(1)*	2.5	(1)*	1.7	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	1.3	(1)*	2.1	(1)*	ND	(1)*	1.7	(1)*	1.8	(1)*	2.0	(1)*	1.8	(1)	1.1	(1)	1.4	(1)
1,1-Dichloroethene	213	(1)	274	(1)	119	(1)	289	(1)	452	(10)	362	(10)	109	(1)	72	(1)	91	(1)
Acetone	67	(1)	72	(1)	54	(1)	548	(1)E	747	(1)E	97	(1)	226	(1)	115	(1)	208	(1)
Methylene Chloride	56	(1)	ND	(1)	ND	(1)	ND	(1)										
Methyl Ethyl Ketone	11	(1)	6.7	(1)	ND	(1)	ND	(1)	278	(1)	93	(1)	46	(1)	45	(1)	24	(1)
cis-Dichloroethene	28	(1)	33	(1)	55	(1)	47	(1)	44	(1)	48	(1)	52	(1)	59	(1)	171	(1)
1,1-Dichloroethane	274	(1)	363	(1)	99	(1)	297	(1)	400	(10)	418	(10)	165	(1)	111	(1)	102	(1)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)												
Chloroform	ND	(1)	ND	(1)	ND	(1)												
1,1,1-Trichloroethane	123	(1)	112	(1)	60	(1)	150	(1)	181	(1)	195	(1)	104	(1)	49	(1)	47	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)												
Trichloroethene	158	(1)	152	(1)	124	(1)	249	(1)	392	(10)	417	(10)	317	(10)	131	(1)	67	(1)
Toluene	2	(1)	1.9	(1)	2	(1)	1.6	(1)	1.1	(1)	1.3	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	3.4	(1)	1.5	(1)	2.8	(1)	3.7	(1)	5.5	(1)	6.9	(1)	10	(1)	9.4	(1)	8.6	(1)
Surrogates (% Recovery)																		
Dibromofluoromethane	112		143		100		101		101		105		107		97		107	
d8-Toluene	96		107		98		97		99		110		103		102		99	
p-Bromofluorobenzene	103		117		90		105		97		103		103		97		98	

⋯ = Groundwater levels were erratic during this period.

ND=not detected

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E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M7		HB-A-M7	HB-A-M7	HB-A-M7													
Date Sampled	10/04/01		10/09/01		10/10/01		10/17/01		11/08/01		11/27/01		02/12/02	03/13/02	04/09/02			
Sample Type	BL		PR		PR		PR		MT		MT		MT	MT	MT			
Units	ug/L		ug/L	ug/L	ug/L													
Analyte																		
Chloromethane*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)										
Chloroethane*	12	(1)*	26	(1)*	6.2	(1)*	11	(1)*	8.6	(1)*	9.7	(1)*	18	(1)	24	(1)	49	(1)
Trichlorofluoromethane*	2.4	(1)*	4.2	(1)*	2.1	(1)*	3.4	(1)*	2.0	(1)*	1.5	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	6.6	(1)*	10	(1)*	2.6	(1)*	6.1	(1)*	5.1	(1)*	5.8	(1)*	6.6	(1)	6.3	(1)	9.1	(1)
1,1-Dichloroethene	296	(1)	414	(1)	197	(1)	372	(1)	353	(1)	396	(1)	237	(1)	300	(1)	302	(10)
Acetone	25	(1)	56	(1)	85	(1)	197	(1)	1426	(10)	173	(1)	1256	(10)	757	(10)	1619	(10)
Methylene Chloride	44	(1)	ND	(1)	ND	(1)	ND	(1)										
Methyl Ethyl Ketone	11	(1)	3.9	(1)	ND	(1)	ND	(1)	ND	(1)	36	(1)	191	(1)	173	(1)	92	(1)
cis-Dichloroethene	65	(1)	69	(1)	79	(1)	79	(1)	70	(1)	77	(1)	242	(10)	226	(1)	347	(10)
1,1-Dichloroethane	270	(1)	404	(1)	115	(1)	258	(1)	220	(1)	270	(1)	361	(10)	315	(10)	318	(10)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)												
Chloroform	1.2	(1)	1.3	(1)	ND	(1)	1.4	(1)	ND	(1)	1.0	(1)	ND	(1)	ND	(1)	ND	(1)
1,1,1-Trichloroethane	135	(1)	146	(1)	81	(1)	129	(1)	114	(1)	132	(1)	108	(1)	94	(1)	88	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)												
Trichloroethene	148	(1)	113	(1)	122	(1)	190	(1)	204	(1)	254	(1)	233	(1)	217	(1)	145	(1)
Toluene	1.4	(1)	1.8	(1)	1.8	(1)	1.2	(1)	1.1	(1)	1.5	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	4.5	(1)	1.4	(1)	2.8	(1)	3	(1)	3.7	(1)	4.5	(1)	7.2	(1)	7.8	(1)	7.8	(1)
Surrogates (% Recovery)																		
Dibromofluoromethane	113	144	98	109	102	111	108	99	109									
d8-Toluene	98	107	97	94	98	111	103	103	100									
p-Bromofluorobenzene	101	115	86	105	100	106	106	98	100									

⋮ = Groundwater levels were erratic during this period.

ND=not detected

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

Hamilton Beach Pilot Unit A Groundwater Sampling Results

Sample ID. No.	HB-A-M8		HB-A-M8		HB-A-M8		HB-A-M8											
Date Sampled	10/04/01		10/09/01		10/10/01		10/17/01		11/08/01		11/27/01		02/12/02		03/12/02		04/09/02	
Sample Type	BL		PR		PR		PR		MT		MT		MT		MT		MT	
Units	ug/L		ug/L		ug/L		ug/L											
Analyte																		
Chloromethane*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)										
Chloroethane*	3.1	(1)*	10	(1)*	4.0	(1)*	5.0	(1)*	6.8	(1)*	4.2	(1)*	2.2	(1)	2.8	(1)	3.4	(1)
Trichlorofluoromethane*	1.0	(1)*	4.2	(1)*	1.3	(1)*	1.8	(1)*	2.3	(1)*	1.4	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	12	(1)*	30	(1)*	9.0	(1)*	10	(1)*	19	(1)*	15	(1)*	6.5	(1)	10	(1)	12	(1)
1,1-Dichloroethene	148	(1)	390	(1)	158	(1)	254	(1)	513	(10)	372	(10)	87	(1)	93	(1)	94	(1)
Acetone	45	(1)	29	(1)	53	(1)	2905	(1)E	99	(1)	105	(1)	278	(1)	112	(1)	288	(1)
Methylene Chloride	1.1	(1)	ND	(1)	ND	(1)	ND	(1)										
Methyl Ethyl Ketone	5.5	(1)	3.1	(1)	ND	(1)	ND	(1)	38	(1)	75	(1)	31	(1)	34	(1)	23	(1)
cis-Dichloroethene	58	(1)	94	(1)	57	(1)	98	(1)	82	(1)	86	(1)	25	(1)	24	(1)	28	(1)
1,1-Dichloroethane	131	(1)	275	(1)	113	(1)	177	(1)	230	(1)	202	(1)	79	(1)	70	(1)	63	(1)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)										
Chloroform	ND	(1)	1.4	(1)	ND	(1)	1.1	(1)	1.1	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
1,1,1-Trichloroethane	23	(1)	72	(1)	35	(1)	47	(1)	71	(1)	54	(1)	37	(1)	29	(1)	26	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)	ND	(1)										
Trichloroethene	31	(1)	62	(1)	58	(1)	84	(1)	113	(1)	128	(1)	72	(1)	59	(1)	44	(1)
Toluene	1.9	(1)	1.3	(1)	1.5	(1)	ND	(1)	1.1	(1)	1.1	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	ND	(1)	1.2	(1)	2.2	(1)	1.3	(1)	1.7	(1)	2	(1)	4.2	(1)	4	(1)	4	(1)
Surrogates (% Recovery)																		
Dibromofluoromethane	113		138		97		107		99		105		108		100		110	
d8-Toluene	99		103		100		95		98		109		103		101		100	
p-Bromofluorobenzene	104		112		91		109		91		103		105		96		98	

⋯ = Groundwater levels were erratic during this period.

ND=not detected

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M9	HB-A-M9	HB-A-M9	HB-A-M9	HB-A-M9	HB-A-M9	HB-A-M9							
Date Sampled	10/04/01	10/09/01	10/10/01	11/08/01	02/12/02	03/12/02	04/09/02							
Sample Type	BL	PR	PR	MT	MT	MT	MT							
Units	ug/L													
Analyte														
Chloromethane*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
Chloroethane*	1.3	(1)*	4.6	(1)*	2.4	(1)*	2.7	(1)*	ND	(1)	ND	(1)	ND	(1)
Trichlorofluoromethane*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
1,1-Dichloroethene	31	(1)	127	(1)	73	(1)	111	(1)	4.8	(1)	19	(1)	9.5	(1)
Acetone	11	(1)	19	(1)	15	(1)	168	(1)	23	(1)	6.4	(1)	17	(1)
Methylene Chloride	58	(1)	1.8	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Methyl Ethyl Ketone	21	(1)	2.2	(1)	ND	(1)	28	(1)	3.3	(1)	3.6	(1)	3.4	(1)
cis-Dichloroethene	25	(1)	71	(1)	51	(1)	60	(1)	3.5	(1)	11	(1)	5.3	(1)
1,1-Dichloroethane	31	(1)	90	(1)	55	(1)	69	(1)	4.4	(1)	14	(1)	7.2	(1)
1,2-Dichloroethane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Chloroform	2.3	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
1,1,1-Trichloroethane	24	(1)	89	(1)	62	(1)	92	(1)	7.7	(1)	20	(1)	10	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Trichloroethene	198	(1)	687	(1)	526	(1)	1060	(10)	80	(1)	192	(1)	61	(1)
Toluene	2	(1)	1.1	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	4.4	(1)	12	(1)	7.4	(1)	20	(1)	5.1	(1)	7.6	(1)	4.3	(1)
Surrogates (% Recovery)														
Dibromofluoromethane	115		133		97		103		107		100		110	
d8-Toluene	97		105		100		98		103		102		100	
p-Bromofluorobenzene	103		113		96		99		105		97		97	

⋮ = Groundwater levels were erratic during this period.

ND=not detected

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

**Hamilton Beach Pilot
Unit A
Groundwater Sampling Results**

Sample ID. No.	HB-A-M10													
Date Sampled	10/04/01	10/09/01	10/10/01	11/08/01	02/12/02	03/12/02	04/09/02							
Sample Type	BL	PR	PR	MT	MT	MT	MT							
Units	ug/L													
Analyte														
Chloromethane	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
Chloroethane*	12	(1)*	15	(1)*	9.8	(1)*	8.5	(1)*	5.5	(1)	3.2	(1)	6.3	(1)
Trichlorofluoromethane*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
Vinyl Chloride*	ND	(1)*	1.3	(1)*	1.0	(1)*	ND	(1)*	ND	(1)	ND	(1)	ND	(1)
1,1-Dichloroethene	205	(1)	311	(1)	221	(1)	226	(1)	126	(1)	71	(1)	144	(1)
Acetone	23	(1)	41	(1)	ND	(1)	13	(1)	5.6	(1)	1.5	(1)	2.8	(1)
Methylene Chloride	3.7	(1)	2.3	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Methyl Ethyl Ketone	36	(1)	1.8	(1)	ND	(1)	6.1	(1)	ND	(1)	ND	(1)	ND	(1)
cis-Dichloroethene	193	(1)	169	(1)	153	(1)	160	(1)	97	(1)	51	(1)	93	(1)
1,1-Dichloroethane	201	(1)	236	(1)	155	(1)	145	(1)	100	(1)	53	(1)	94	(1)
1,2-Dichloroethane	ND	(1)	ND	(1)										
Chloroform	1.0	(1)	ND	(1)	ND	(1)								
1,1,1-Trichloroethane	187	(1)	241	(1)	180	(1)	190	(1)	142	(1)	79	(1)	124	(1)
1,2-Dichloropropane	ND	(1)	ND	(1)										
Trichloroethene	883	(10)	1434	(1)E	1541	(1)E	2038	(10)	1494	(10)	873	(10)	1269	(10)
Toluene	1.0	(1)	1.1	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)	ND	(1)
Tetrachloroethene	40	(1)	39	(1)	43	(1)	58	(1)	65	(1)	38	(1)	59	(1)
Surrogates (% Recovery)														
Dibromofluoromethane	117		138		100		105		107		101		114	
d8-Toluene	99		105		99		97		102		101		101	
p-Bromofluorobenzene	103		111		97		97		104		98		98	

⋮ = Groundwater levels were erratic during this period.

ND=not detected

*=Reported concentrations with an asterisk have been reduced by a factor of 10 due to an error in calibration.

E=estimate

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M1									
Date Sampled		10/4/01	10/9/01	10/10/01	10/17/01	11/8/01	11/27/01	12/17/01	2/12/02	3/12/02	4/9/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT	MT
Units		10 ⁻⁶									
Analyte	MW										
Chloromethane*	50.49	ND									
Chloroethane*	64.52	0.25	0.36	0.11	0.16	0.37	0.33	0.39	0.26	0.23	0.39
Trichlorofluoromethane*	137.37	ND									
Vinyl Chloride*	62.5	0.02	0.05	0.01	0.01	0.07	0.11	0.19	0.10	0.08	0.13
1,1-Dichloroethene	96.94	2.20	3.40	1.51	1.85	4.63	3.65	3.00	2.09	2.26	2.07
Acetone	59.07	0.34	0.39	0.36	114.05	1.12	1.27	1.15	17.25	14.29	18.27
Methylene Chloride	85.93	ND	0.03	ND	ND	ND	0.04	ND	ND	ND	ND
Methyl Ethyl Ketone	72.11	1.10	ND	0.89	ND	0.39	5.44	0.67	2.65	5.20	1.91
cis-Dichloroethene	96.94	1.82	3.01	0.99	1.87	2.95	4.67	5.05	15.26	11.23	13.15
1,1-Dichloroethane	98.96	3.09	3.77	1.40	2.53	4.35	4.30	3.45	3.36	2.35	2.21
1,2-Dichloroethane	98.96	ND									
Chloroform	120.37	ND	0.01	ND							
1,1,1-Trichloroethane	133.41	0.51	0.43	0.30	0.44	0.54	0.50	0.43	0.38	0.30	0.28
1,2-Dichloropropane	112.99	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND
Trichloroethene	131.39	3.44	3.55	3.12	ND	7.04	7.05	6.52	3.09	1.59	0.78
Toluene	93.13	0.02	0.04	0.02	0.02	0.02	0.01	0.02	ND	ND	ND
Tetrachloroethene	165.83	0.07	0.04	0.08	0.08	0.08	0.09	0.08	0.07	0.07	0.06
Surrogates (% Recovery)											
Dibromofluoromethane		108	144	99	108	103	101	114	107	94	101
d8-Toluene		98	110	98	95	99	107	99	104	102	100
p-Bromofluorobenzene		99	114	89	109	92	101	98	103	95	100

 = Groundwater levels were erratic during this period.

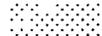
ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M2								
Date Sampled		10/4/01	10/9/01	10/10/01	11/8/01	11/27/01	12/17/01	2/12/02	3/12/02	4/9/02
Sample Type		BL	BL	PR	MT	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND								
Chloroethane*	64.52	0.24	0.47	0.14	0.38	0.50	0.39	0.07	0.12	0.17
Trichlorofluoromethane*	137.37	ND								
Vinyl Chloride*	62.5	0.12	0.54	0.14	0.45	0.50	0.08	0.03	0.04	0.05
1,1-Dichloroethene	96.94	1.12	2.93	1.32	4.03	4.34	3.15	0.93	ND	1.46
Acetone	59.07	0.30	0.54	0.85	13.49	8.19	7.69	6.82	6.84	12.93
Methylene Chloride	85.93	ND								
Methyl Ethyl Ketone	72.11	0.21	0.04	ND	0.87	0.83	1.19	0.46	2.87	1.23
cis-Dichloroethene	96.94	0.46	1.16	0.84	1.05	1.24	1.45	0.47	1.09	1.52
1,1-Dichloroethane	98.96	2.34	3.78	1.31	4.18	4.56	3.78	0.89	1.46	1.36
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	ND	0.01	ND						
1,1,1-Trichloroethane	133.41	0.49	0.84	0.47	1.07	1.31	1.01	0.37	0.60	0.51
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	1.15	3.27	2.14	8.13	9.45	9.19	3.42	7.08	5.88
Toluene	93.13	0.03	0.02	0.02	0.01	0.01	0.01	ND	ND	ND
Tetrachloroethene	165.83	0.01	0.03	0.04	0.08	0.10	0.08	0.07	0.11	0.10
Surrogates (% Recovery)										
Dibromofluoromethane		110	141	99	103	107	111	104	94	103
d8-Toluene		95	112	97	99	110	99	102	102	101
p-Bromofluorobenzene		100	116	90	99	103	100	95	96	100

 = Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M3								
Date Sampled		10/4/01	10/9/01	10/10/01	10/17/01	11/8/01	11/27/01	2/12/02	3/12/02	4/9/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND								
Chloroethane*	64.52	0.62	0.77	0.17	0.39	0.49	0.49	0.23	0.36	0.46
Trichlorofluoromethane*	137.37	0.01	0.01	ND	0.01	0.01	ND	ND	ND	ND
Vinyl Chloride*	62.5	0.02	0.05	0.01	0.03	0.03	0.03	0.06	0.05	0.07
1,1-Dichloroethene	96.94	3.25	2.92	1.13	2.70	4.39	3.31	3.28	3.33	3.99
Acetone	59.07	4.10	0.36	0.88	36.14	40.14	10.17	9.51	7.09	16.25
Methylene Chloride	85.93	ND								
Methyl Ethyl Ketone	72.11	0.08	0.05	ND	ND	0.61	0.69	0.32	1.32	0.82
cis-Dichloroethene	96.94	0.60	0.66	0.64	1.39	0.68	0.77	1.45	1.67	2.14
1,1-Dichloroethane	98.96	6.02	4.47	1.60	3.47	4.78	4.47	4.85	4.72	4.82
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	ND								
1,1,1-Trichloroethane	133.41	2.27	1.05	0.79	1.41	1.78	1.97	1.58	1.37	1.19
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	5.39	2.54	2.94	4.57	7.12	7.18	8.58	8.72	6.82
Toluene	93.13	0.01	0.02	0.01	0.01	0.01	0.01	ND	ND	ND
Tetrachloroethene	165.83	0.16	0.02	0.08	ND	0.09	0.10	0.13	0.14	0.13
Surrogates (% Recovery)										
Dibromofluoromethane		107	140	97	110	102	112	106	95	104
d8-Toluene		95	106	99	96	98	110	101	101	100
p-Bromofluorobenzene		100	116	92	107	91	108	97	96	99

 = Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M4								
Date Sampled		10/04/01	10/09/01	10/10/01	10/17/01	11/08/01	11/27/01	02/12/02	03/12/02	04/09/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND	ND	ND	ND	0.02	ND	ND	ND	0.02
Chloroethane*	64.52	0.31	0.51	0.11	0.20	0.34	0.33	0.25	0.33	0.64
Trichlorofluoromethane*	137.37	0.01	0.01	ND	0.01	0.01	0.01	ND	ND	ND
Vinyl Chloride*	62.5	0.02	0.03	ND	ND	0.03	0.04	0.05	0.05	0.07
1,1-Dichloroethene	96.94	1.72	2.79	1.01	2.11	3.94	4.27	1.86	2.85	1.99
Acetone	59.07	0.41	0.58	1.37	41.90	11.27	1.79	4.88	5.71	16.93
Methylene Chloride	85.93	ND								
Methyl Ethyl Ketone	72.11	0.06	0.07	ND	ND	2.26	1.22	0.51	1.30	0.69
cis-Dichloroethene	96.94	0.33	0.45	0.75	0.87	0.67	0.94	1.53	4.98	8.59
1,1-Dichloroethane	98.96	2.91	4.17	1.07	2.56	4.09	4.65	2.46	2.88	2.30
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	ND								
1,1,1-Trichloroethane	133.41	0.91	0.67	0.26	0.79	0.96	1.25	0.58	0.49	0.38
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	1.42	1.92	1.26	3.12	4.53	5.65	3.86	2.62	0.33
Toluene	93.13	0.02	0.02	0.02	0.02	0.02	0.01	ND	ND	ND
Tetrachloroethene	165.83	0.03	0.02	0.04	0.06	0.05	0.07	0.07	0.08	0.07
Surrogates (% Recovery)										
Dibromofluoromethane		106	147	101	107	99	104	107	95	105
d8-Toluene		95	111	95	95	98	108	102	102	100
p-Bromofluorobenzene		101	116	88	103	92	104	102	95	99

 = Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M5								
Date Sampled		10/04/01	10/09/01	10/10/01	10/17/01	11/08/01	11/27/01	02/12/02	03/12/02	04/09/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND	ND	ND	ND	ND	0.09	ND	ND	ND
Chloroethane*	64.52	0.62	0.71	0.30	0.35	0.45	0.34	0.26	0.39	0.59
Trichlorofluoromethane*	137.37	0.04	0.02	0.01	0.02	0.02	0.01	ND	ND	ND
Vinyl Chloride*	62.5	0.21	0.42	0.13	0.29	0.37	0.30	0.04	0.03	0.04
1,1-Dichloroethene	96.94	4.60	3.87	2.01	3.15	5.23	4.00	1.37	0.90	1.10
Acetone	59.07	0.17	0.39	0.66	26.53	0.96	1.37	18.72	15.85	25.70
Methylene Chloride	85.93	ND	ND	ND	ND	ND	0.01	ND	ND	ND
Methyl Ethyl Ketone	72.11	0.06	0.21	ND	ND	0.42	1.84	1.73	2.73	1.04
cis-Dichloroethene	96.94	0.42	0.53	0.47	0.48	0.50	0.52	0.67	0.51	0.98
1,1-Dichloroethane	98.96	5.37	5.21	2.46	3.56	4.70	4.71	2.17	1.39	1.37
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	ND								
1,1,1-Trichloroethane	133.41	2.68	1.33	0.82	1.19	1.54	1.52	0.76	0.27	0.41
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	3.00	1.62	1.35	2.22	3.59	3.80	2.59	0.95	1.21
Toluene	93.13	ND	0.02	0.02	0.01	0.01	0.01	ND	ND	ND
Tetrachloroethene	165.83	0.11	0.02	0.02	0.02	0.04	0.05	0.06	0.05	0.06
Surrogates (% Recovery)										
Dibromofluoromethane		112	148	98	110	103	104	106	96	105
d8-Toluene		96	108	101	96	99	108	102	102	99
p-Bromofluorobenzene		99	116	99	110	95	102	103	97	100

 = Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M6								
Date Sampled		10/04/01	10/09/01	10/10/01	10/17/01	11/08/01	11/27/01	02/12/02	03/12/02	04/09/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND								
Chloroethane*	64.52	0.27	0.47	0.10	0.29	0.32	0.29	0.14	0.11	0.155
Trichlorofluoromethane*	137.37	0.01	0.01	ND	0.02	0.02	0.01	ND	ND	ND
Vinyl Chloride*	62.5	0.02	0.03	ND	0.03	0.03	0.03	0.03	0.02	0.02
1,1-Dichloroethene	96.94	2.20	2.83	1.23	2.98	4.66	3.73	1.12	0.74	0.94
Acetone	59.07	1.13	1.22	0.91	9.28	12.65	1.64	3.83	1.95	3.52
Methylene Chloride	85.93	0.65	ND							
Methyl Ethyl Ketone	72.11	0.15	0.09	ND	ND	3.86	1.29	0.64	0.62	0.33
cis-Dichloroethene	96.94	0.29	0.34	0.57	0.48	0.45	0.50	0.54	0.61	1.76
1,1-Dichloroethane	98.96	2.77	3.67	1.00	3.00	4.04	4.22	1.67	1.12	1.03
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	ND								
1,1,1-Trichloroethane	133.41	0.92	0.84	0.45	1.12	1.36	1.46	0.78	0.37	0.35
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	1.20	1.16	0.94	1.90	2.98	3.17	2.41	1.00	0.51
Toluene	93.13	0.02	0.02	0.02	0.02	0.01	0.01	ND	ND	ND
Tetrachloroethene	165.83	0.02	0.01	0.02	0.02	0.03	0.04	0.06	0.06	0.05
Surrogates (% Recovery)										
Dibromofluoromethane		112	143	100	101	101	105	107	97	107
d8-Toluene		96	107	98	97	99	110	103	102	99
p-Bromofluorobenzene		103	117	90	105	97	103	103	97	98

= Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M7								
Date Sampled		10/04/01	10/09/01	10/10/01	10/17/01	11/08/01	11/27/01	02/12/02	03/12/02	04/09/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND								
Chloroethane*	64.52	0.18	0.40	0.10	0.18	0.13	0.15	0.28	0.37	0.76
Trichlorofluoromethane*	137.37	0.02	0.03	0.02	0.02	0.01	0.01	ND	ND	ND
Vinyl Chloride*	62.5	0.11	0.16	0.04	0.10	0.08	0.09	0.11	0.10	0.15
1,1-Dichloroethene	96.94	3.05	4.27	2.03	3.84	3.64	4.09	2.44	3.09	3.12
Acetone	59.07	0.42	0.95	1.44	3.34	24.14	2.93	21.26	12.82	27.41
Methylene Chloride	85.93	0.51	ND							
Methyl Ethyl Ketone	72.11	0.15	0.05	ND	ND	ND	0.50	2.65	2.40	1.28
cis-Dichloroethene	96.94	0.67	0.71	0.81	0.81	0.72	0.79	2.50	2.33	3.58
1,1-Dichloroethane	98.96	2.73	4.08	1.16	2.61	2.22	2.73	3.65	3.18	3.21
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	0.01	0.01	ND	0.01	ND	0.01	ND	ND	ND
1,1,1-Trichloroethane	133.41	1.01	1.09	0.61	0.97	0.85	0.99	0.81	0.70	0.66
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	1.13	0.86	0.93	1.45	1.55	1.93	1.77	1.65	1.10
Toluene	93.13	0.02	0.02	0.02	0.01	0.01	0.02	ND	ND	ND
Tetrachloroethene	165.83	0.03	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.05
Surrogates (% Recovery)										
Dibromofluoromethane		113	144	98	109	102	111	108	99	109
d8-Toluene		98	107	97	94	98	111	103	103	100
p-Bromofluorobenzene		101	115	86	105	100	106	106	98	100

 = Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M8								
Date Sampled		10/04/01	10/09/01	10/10/01	10/17/01	11/08/01	11/27/01	02/12/02	03/12/02	04/09/02
Sample Type		BL	PR	PR	PR	MT	MT	MT	MT	MT
Units		10 ⁻⁶								
Analyte	MW									
Chloromethane*	50.49	ND								
Chloroethane*	64.52	0.05	0.16	0.06	0.08	0.11	0.07	0.03	0.04	0.05
Trichlorofluoromethane*	137.37	0.01	0.03	0.01	0.01	0.02	0.01	ND	ND	ND
Vinyl Chloride*	62.5	0.19	0.48	0.14	0.17	0.30	0.23	0.10	0.16	0.19
1,1-Dichloroethene	96.94	1.53	4.02	1.63	2.62	5.29	3.84	0.90	0.96	0.97
Acetone	59.07	0.76	0.49	0.90	49.18	1.68	1.78	4.71	1.90	4.88
Methylene Chloride	85.93	0.01	ND							
Methyl Ethyl Ketone	72.11	0.08	0.04	ND	ND	0.53	1.04	0.43	0.47	0.32
cis-Dichloroethene	96.94	0.60	0.97	0.59	1.01	0.85	0.89	0.26	0.25	0.29
1,1-Dichloroethane	98.96	1.32	2.78	1.14	1.79	2.32	2.04	0.80	0.71	0.64
1,2-Dichloroethane	98.96	ND								
Chloroform	120.37	ND	0.01	ND	0.01	0.01	ND	ND	ND	ND
1,1,1-Trichloroethane	133.41	0.17	0.54	0.26	0.35	0.53	0.40	0.28	0.22	0.19
1,2-Dichloropropane	112.99	ND								
Trichloroethene	131.39	0.24	0.47	0.44	0.64	0.86	0.97	0.55	0.45	0.33
Toluene	93.13	0.02	0.01	0.02	ND	0.01	0.01	ND	ND	ND
Tetrachloroethene	165.83	ND	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.02
Surrogates (% Recovery)										
Dibromofluoromethane		113	138	97	107	99	105	108	100	110
d8-Toluene		99	103	100	95	98	109	103	101	100
p-Bromofluorobenzene		104	112	91	109	91	103	105	96	98

* Values for Chloroethane and Vinyl Chloride in the shaded area have been reduced by a factor of 10 due to an error in calibration.

▨ = Groundwater levels were erratic during this period.

ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M9						
Date Sampled		10/04/01	10/09/01	10/10/01	11/08/01	02/12/02	03/12/02	04/09/02
Sample Type		BL	PR	PR	MT	MT	MT	MT
Units		10 ⁻⁶						
Analyte	MW							
Chloromethane*	50.49	ND						
Chloroethane*	64.52	0.02	0.07	0.04	0.04	ND	ND	ND
Trichlorofluoromethane*	137.37	ND						
Vinyl Chloride*	62.5	ND						
1,1-Dichloroethene	96.94	0.32	1.31	0.75	1.15	0.05	0.20	0.10
Acetone	59.07	0.19	0.32	0.25	2.84	0.39	0.11	0.29
Methylene Chloride	85.93	0.67	0.02	ND	ND	ND	ND	ND
Methyl Ethyl Ketone	72.11	0.29	0.03	ND	0.39	ND	0.05	0.05
cis-Dichloroethene	96.94	0.26	0.73	0.53	0.62	0.04	0.11	0.05
1,1-Dichloroethane	98.96	0.31	0.91	0.56	0.70	0.04	0.14	0.07
1,2-Dichloroethane	98.96	ND						
Chloroform	120.37	0.02	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	133.41	0.18	0.67	0.46	0.69	0.06	0.15	0.07
1,2-Dichloropropane	112.99	ND						
Trichloroethene	131.39	1.51	5.23	4.00	8.07	0.61	1.46	0.46
Toluene	93.13	0.02	0.01	ND	ND	ND	ND	ND
Tetrachloroethene	165.83	0.03	0.07	0.04	0.12	0.03	0.05	0.03
Surrogates (% Recovery)								
Dibromofluoromethane		115	133	97	103	107	100	110
d8-Toluene		97	105	100	98	103	102	100
p-Bromofluorobenzene		103	113	96	99	105	97	97

 = Groundwater levels were erratic during this period.

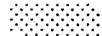
ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

MW = molecular weight

Hamilton Beach Pilot Unit A - Molar Units

Sample ID. No.		HB-A-M10						
Date Sampled		10/4/01	10/9/01	10/10/01	11/8/01	2/12/02	3/12/02	4/9/02
Sample Type		BL	PR	PR	MT	MT	MT	MT
Units		10 ⁻⁶						
Analyte	MW							
Chloromethane*	50.49	ND						
Chloroethane*	64.52	0.19	0.24	0.15	0.13	0.09	0.05	0.10
Trichlorofluoromethane*	137.37	ND						
Vinyl Chloride*	62.5	ND	0.02	0.02	ND	ND	ND	ND
1,1-Dichloroethene	96.94	2.11	3.21	2.28	2.33	1.30	0.73	1.49
Acetone	59.07	0.39	0.69	ND	0.22	0.09	0.03	0.05
Methylene Chloride	85.93	0.04	0.03	ND	ND	ND	ND	ND
Methyl Ethyl Ketone	72.11	0.50	0.02	ND	0.08	ND	ND	ND
cis-Dichloroethene	96.94	1.99	1.74	1.58	1.65	1.00	0.53	0.96
1,1-Dichloroethane	98.96	2.03	2.38	1.57	1.47	1.01	0.54	0.95
1,2-Dichloroethane	98.96	ND						
Chloroform	120.37	0.01	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	133.41	1.40	1.81	1.35	1.42	1.06	0.59	0.93
1,2-Dichloropropane	112.99	ND						
Trichloroethene	131.39	6.72	10.91	11.73	15.51	11.37	6.64	9.66
Toluene	93.13	0.01	0.01	ND	ND	ND	ND	ND
Tetrachloroethene	165.83	0.24	0.24	0.26	0.35	0.39	0.23	0.36
Surrogates (% Recovery)								
Dibromofluoromethane		117	138	100	105	107	101	114
d8-Toluene		99	105	99	97	102	101	101
p-Bromofluorobenzene		103	111	97	97	104	98	98

 = Groundwater levels were erratic during this period.

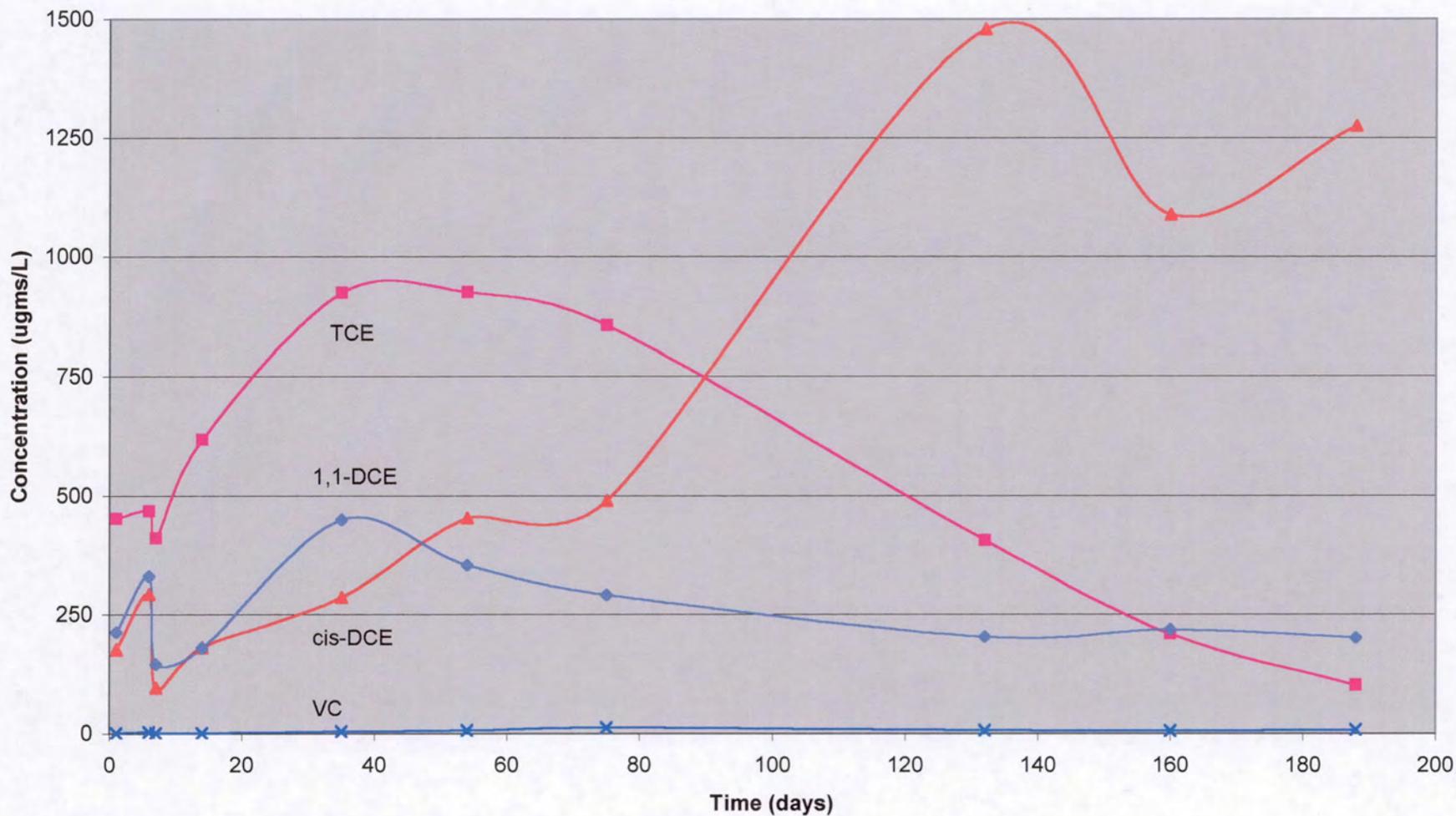
ND=not detected

*=Values in the shaded area for the first 4 analytes have been reduced by a factor of 10 due to an error in calibration.

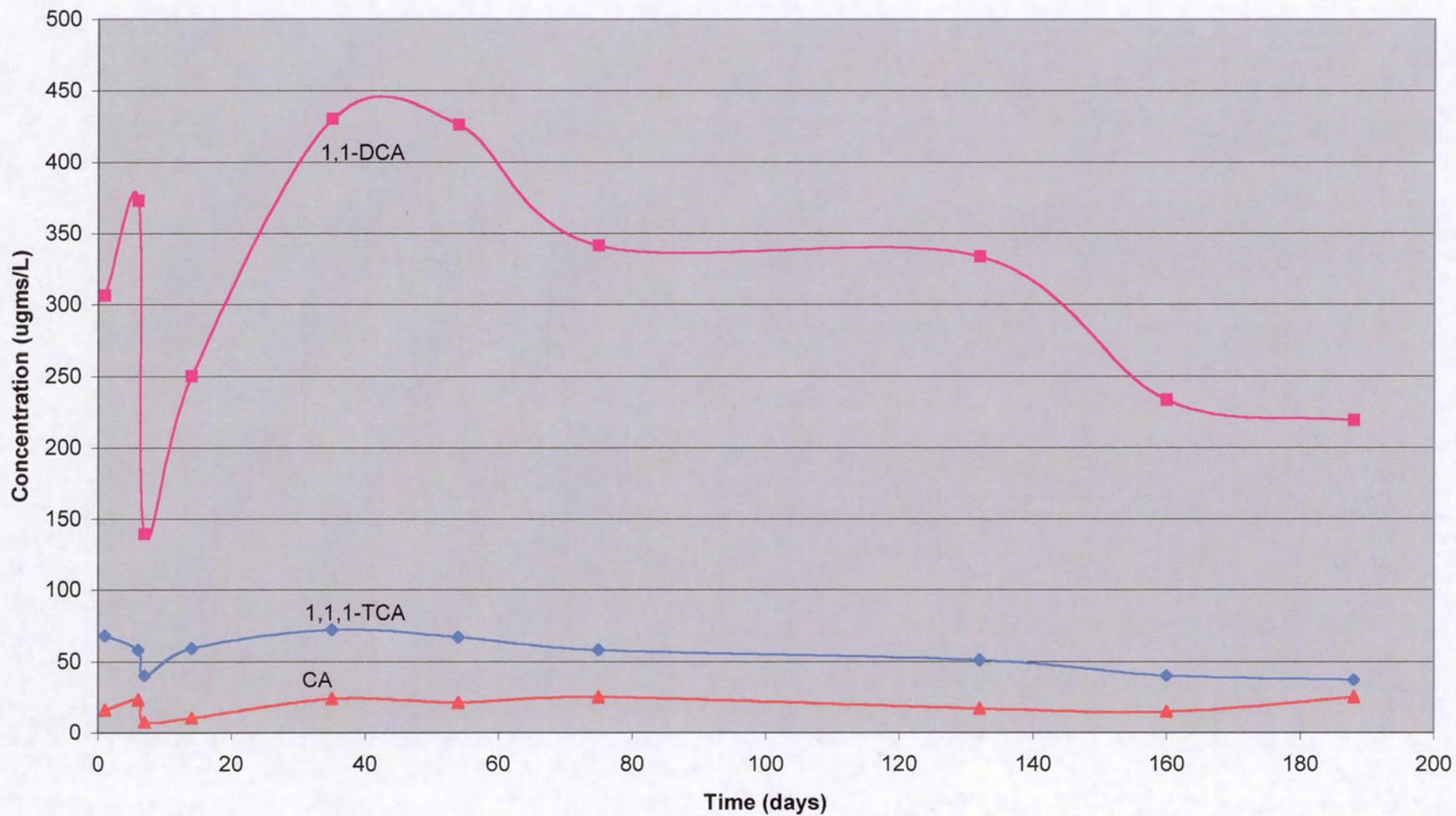
MW = molecular weight



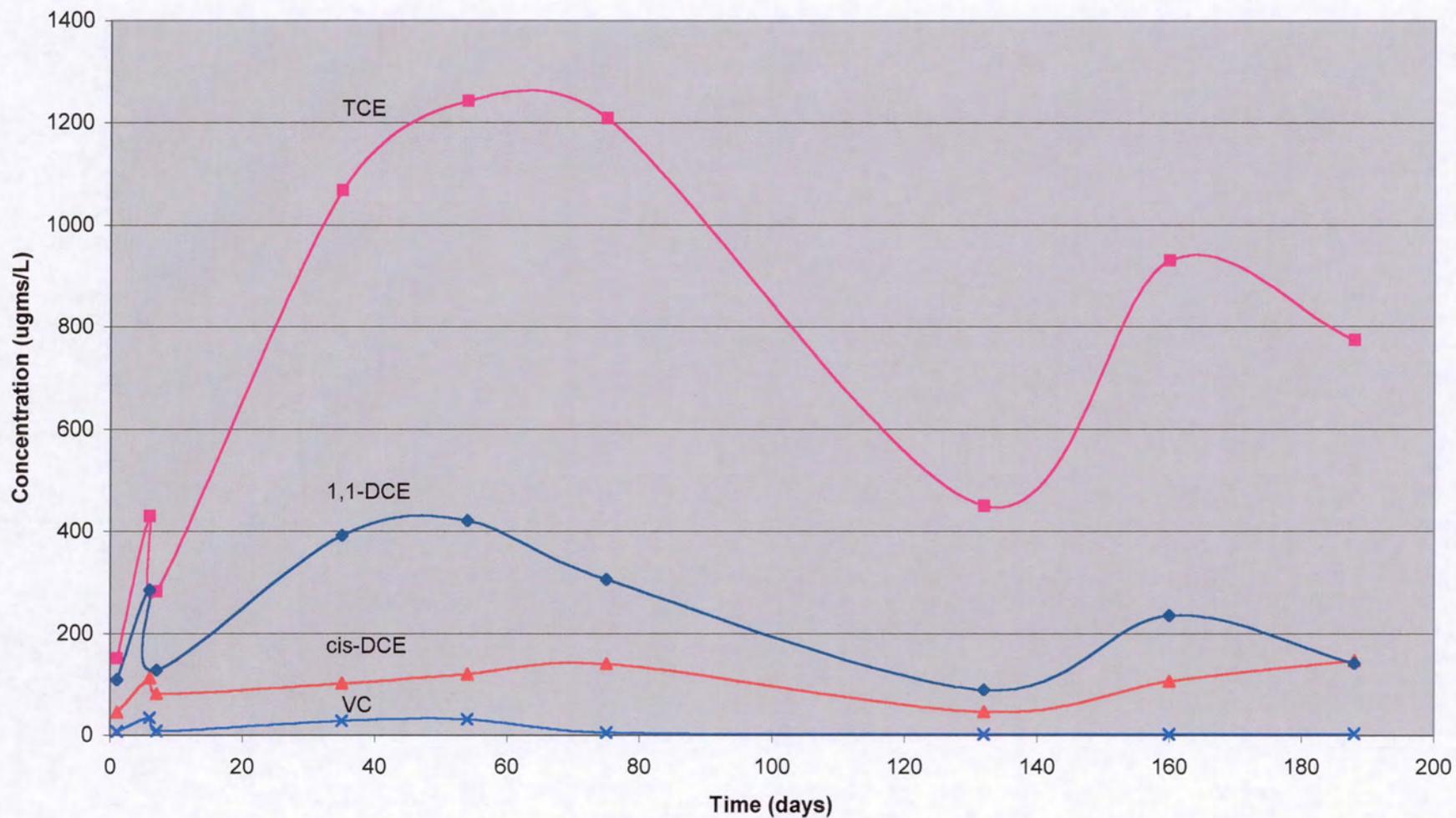
Hamilton Beach Pilot
Implant A-M1 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



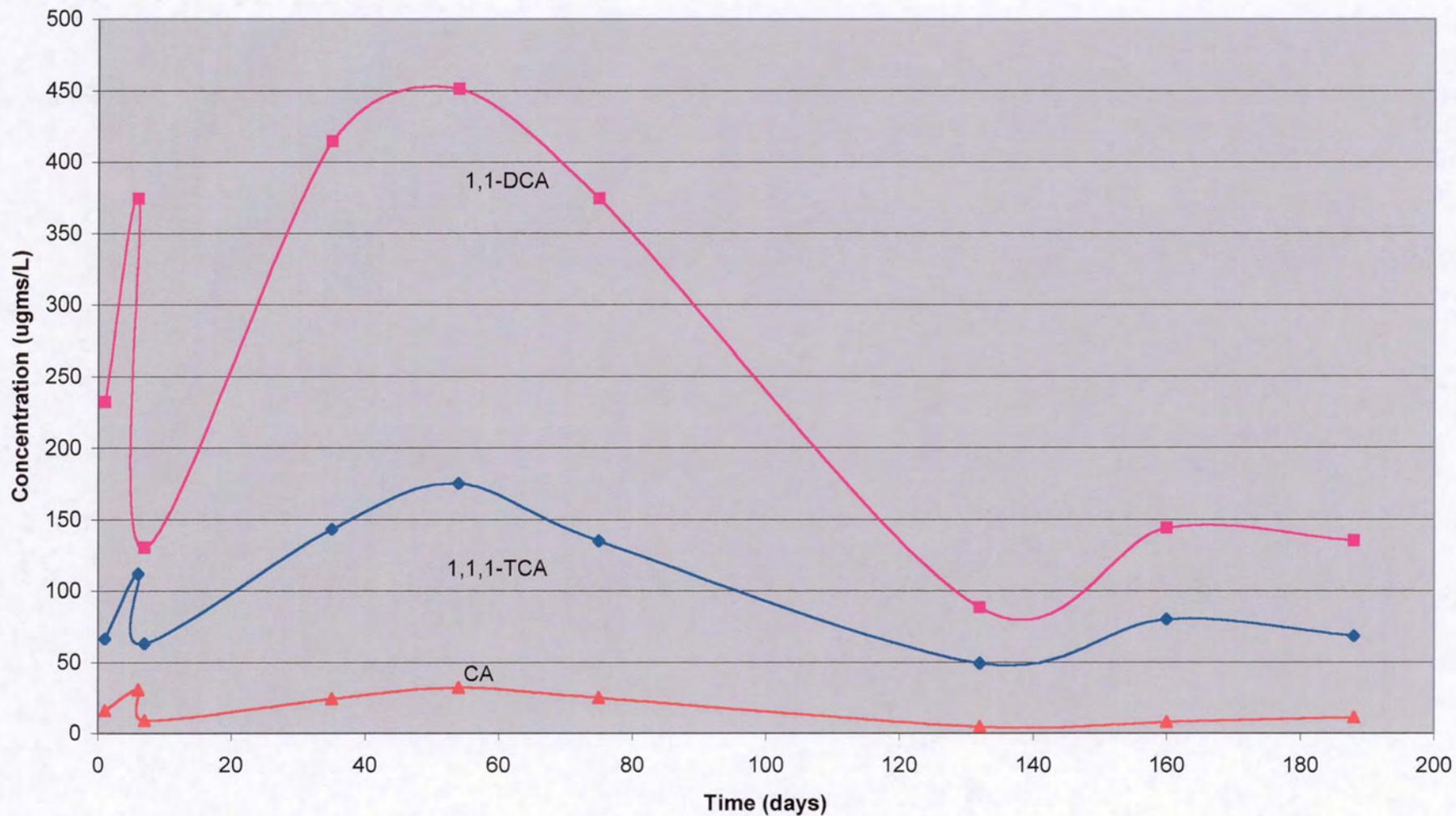
Hamilton Beach Pilot
Implant A-M1 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



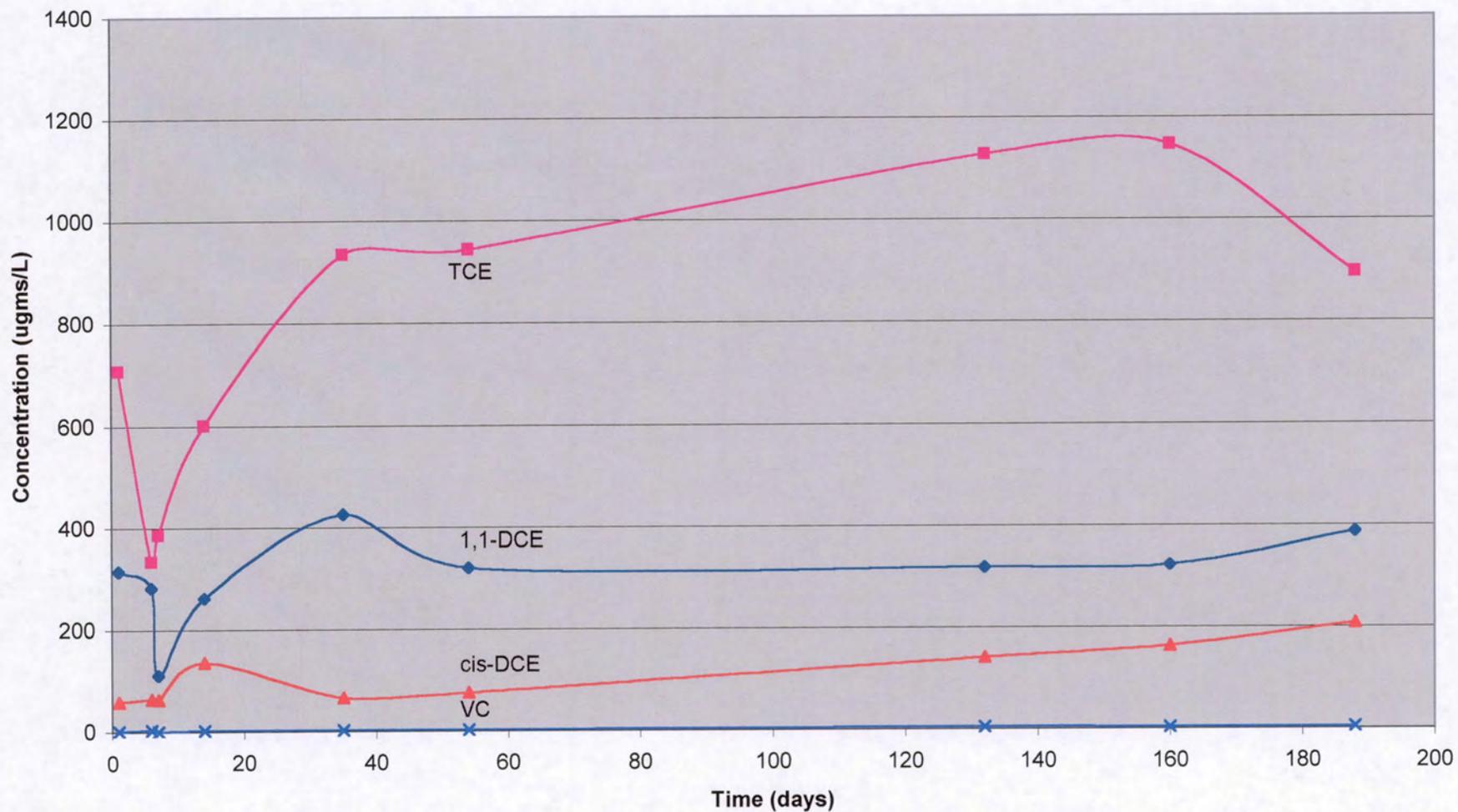
Hamilton Beach Pilot
Implant A-M2 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



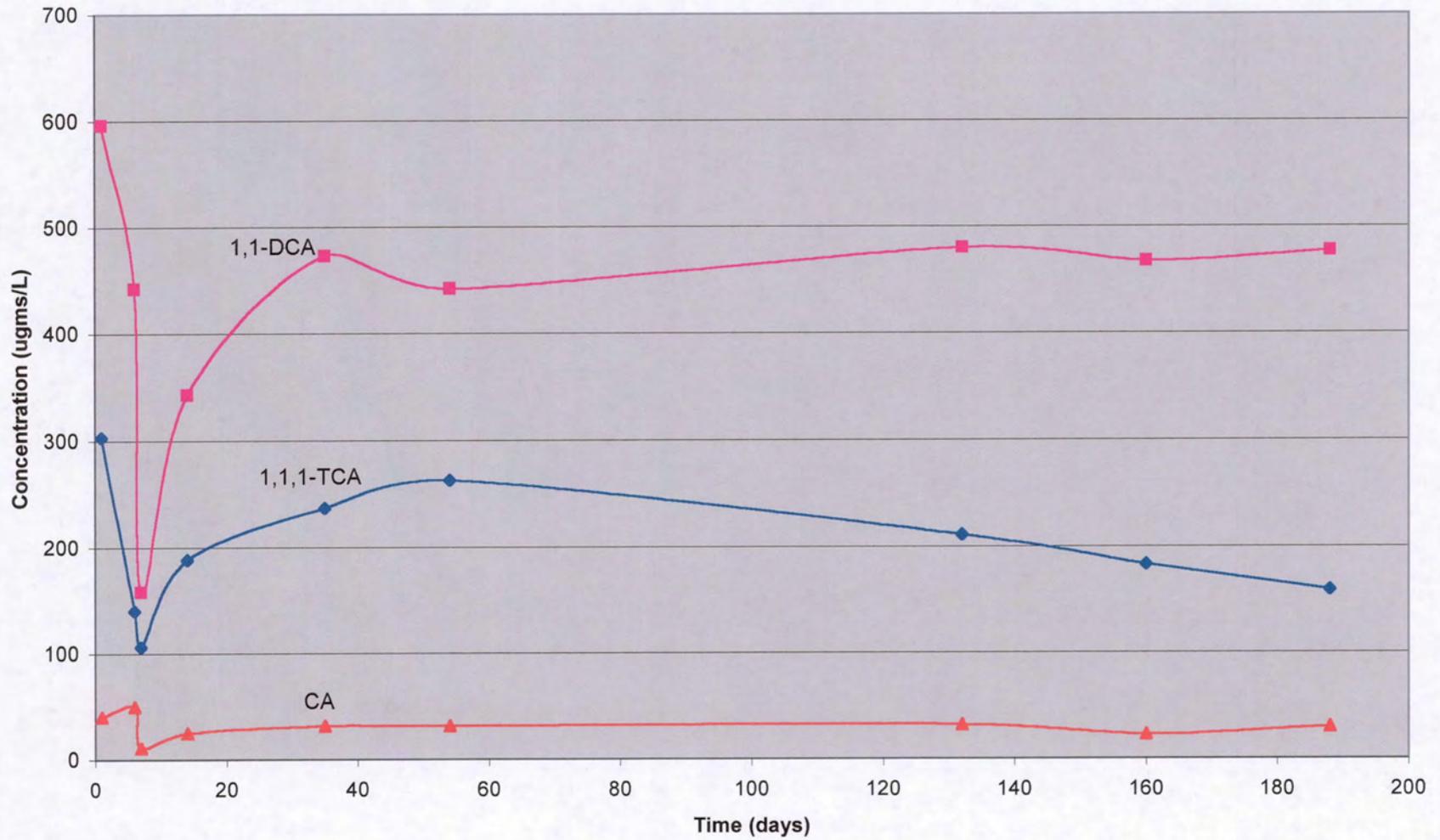
Hamilton Beach Pilot
Implant A-M2 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



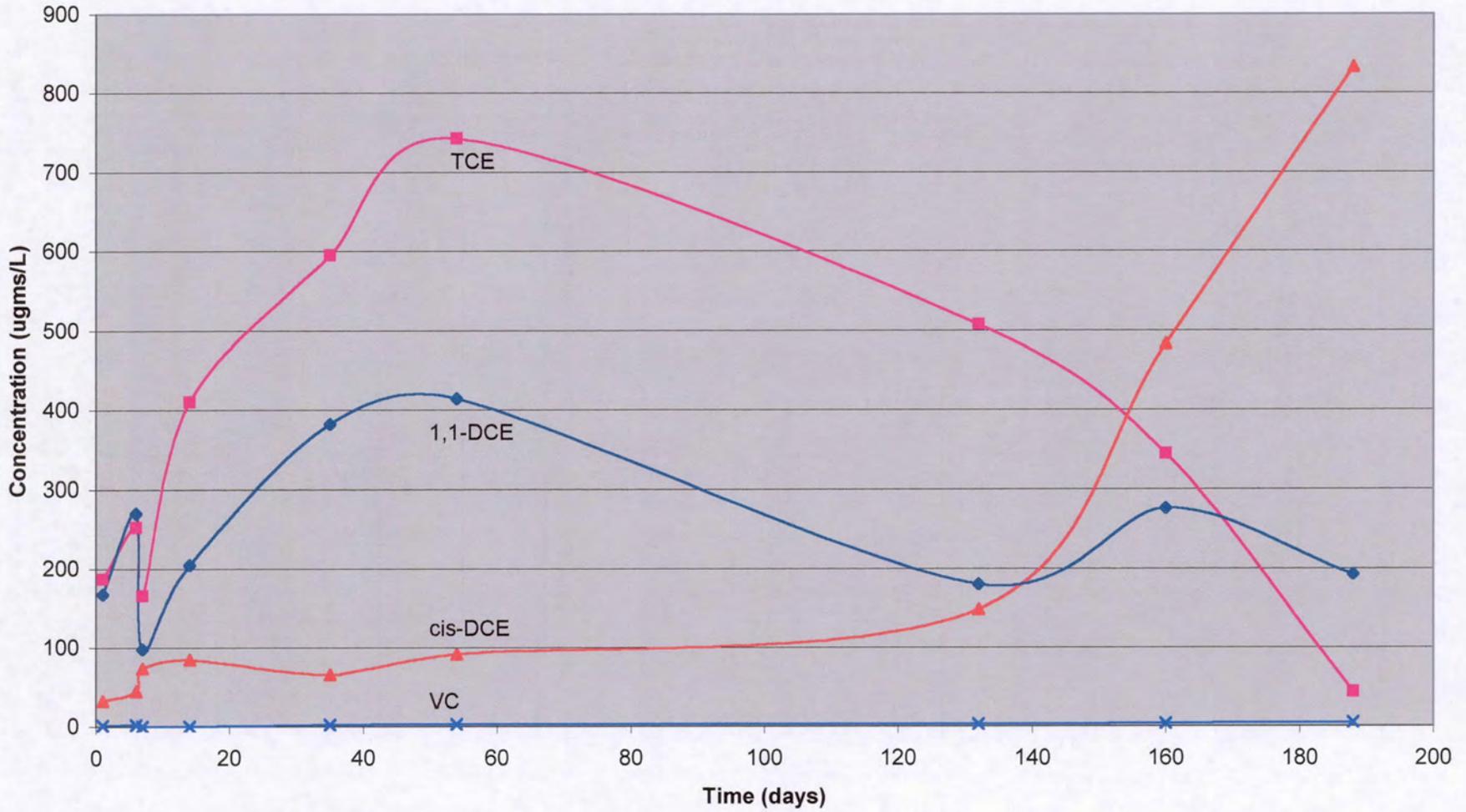
Hamilton Beach Pilot
Implant A-M3 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



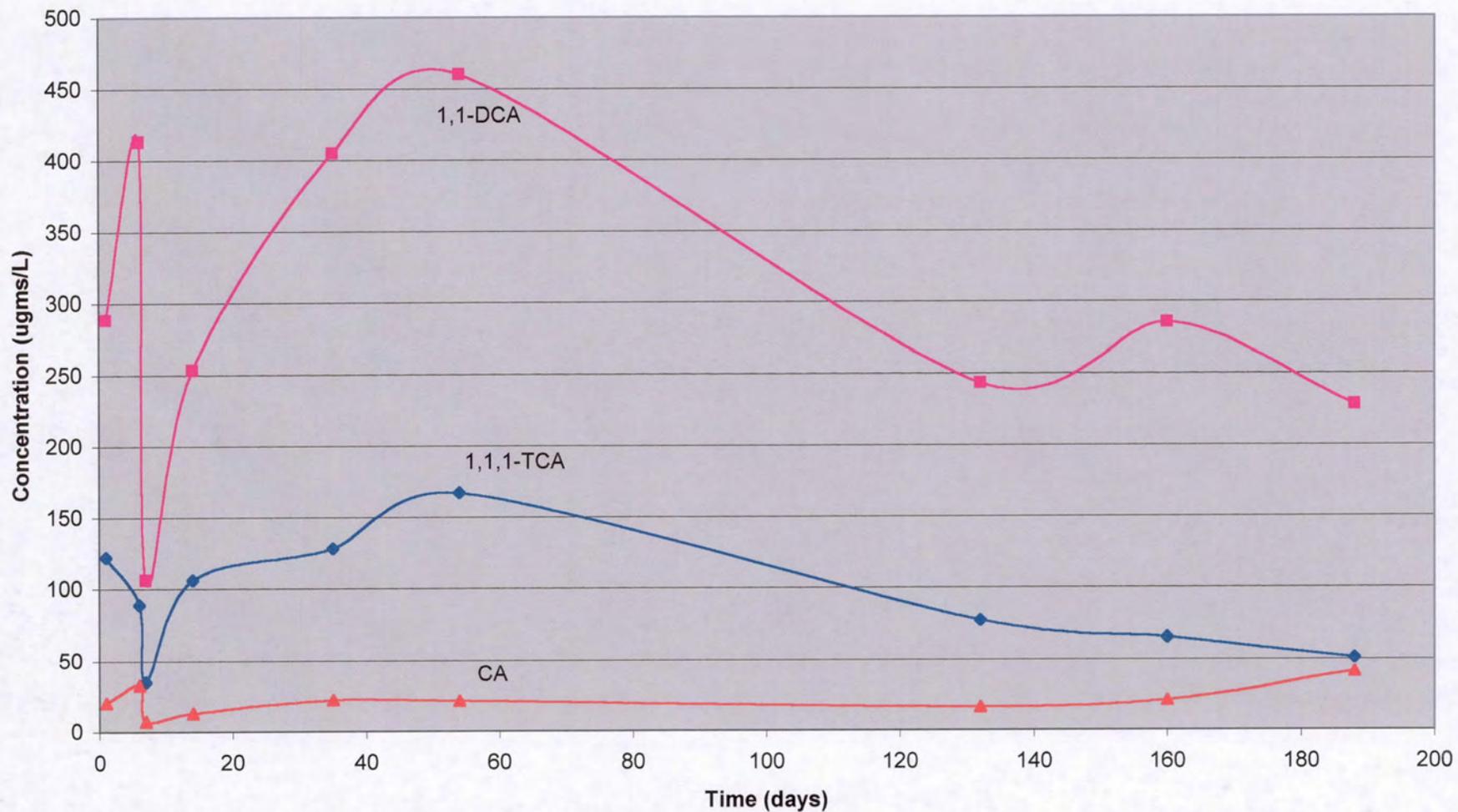
**Hamilton Beach Pilot
Implant M-A3 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA**



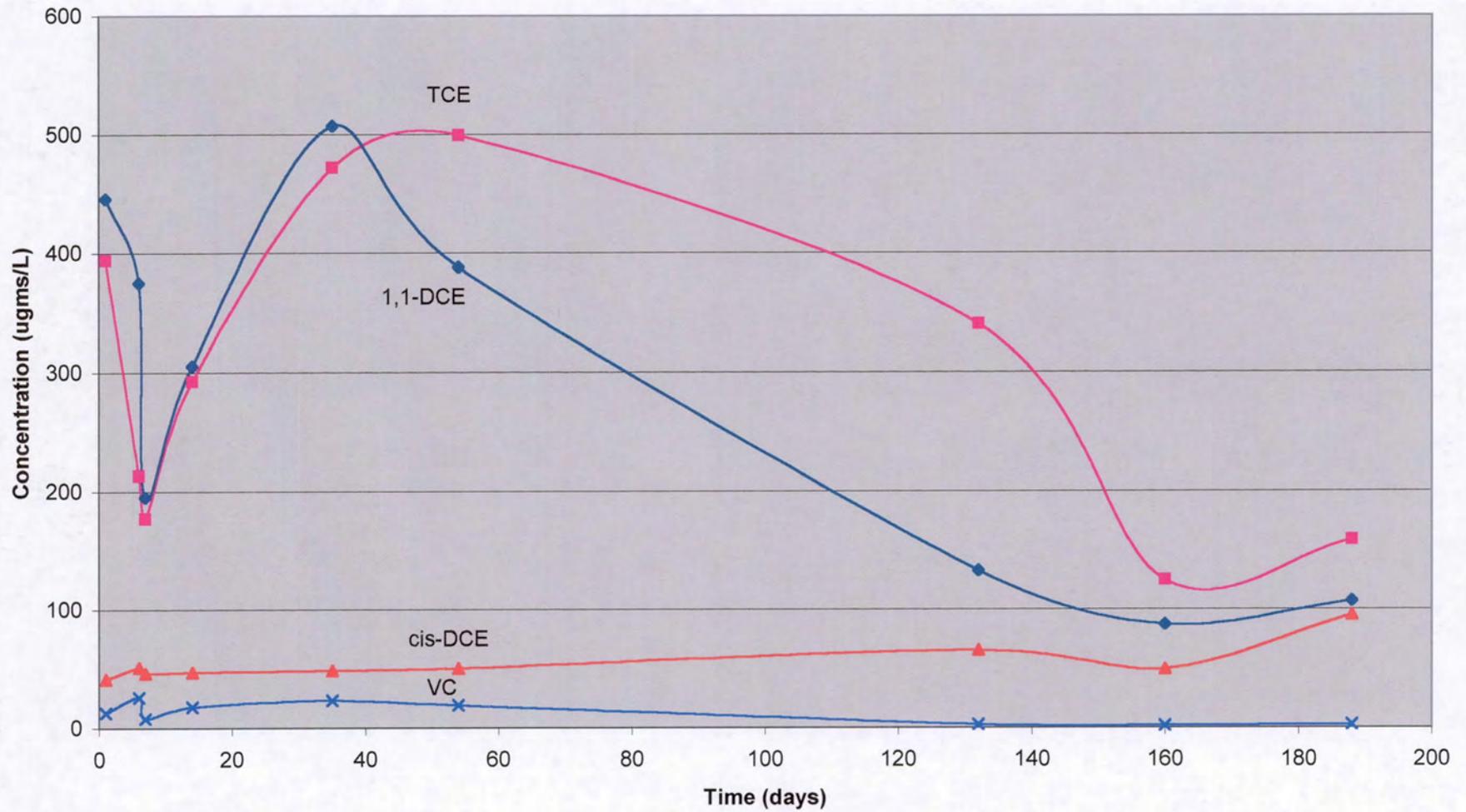
Hamilton Beach Pilot
Implant A-M4 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



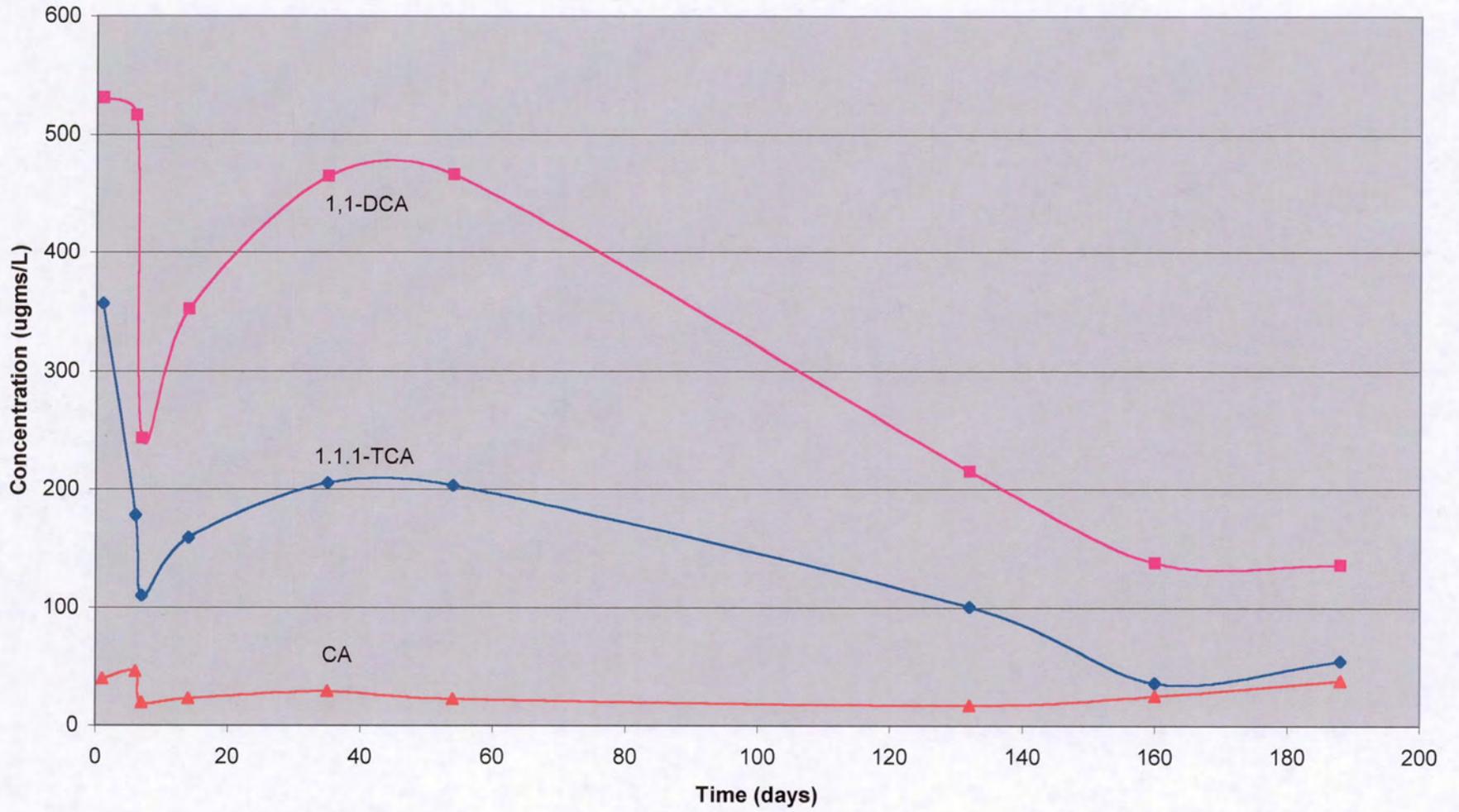
Hamilton Beach Pilot
Implant A-M4 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



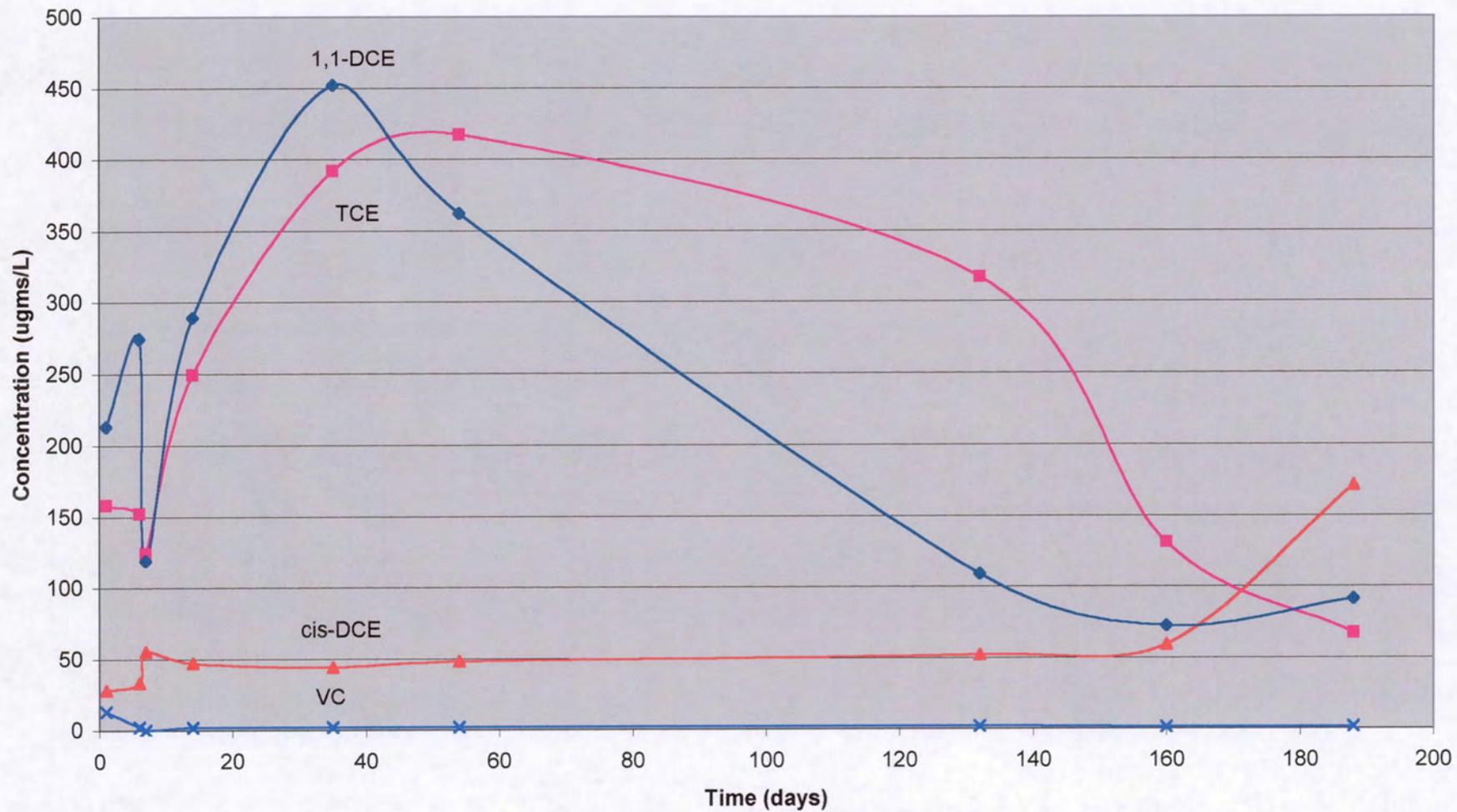
Hamilton Beach Pilot
Implant A-M5 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



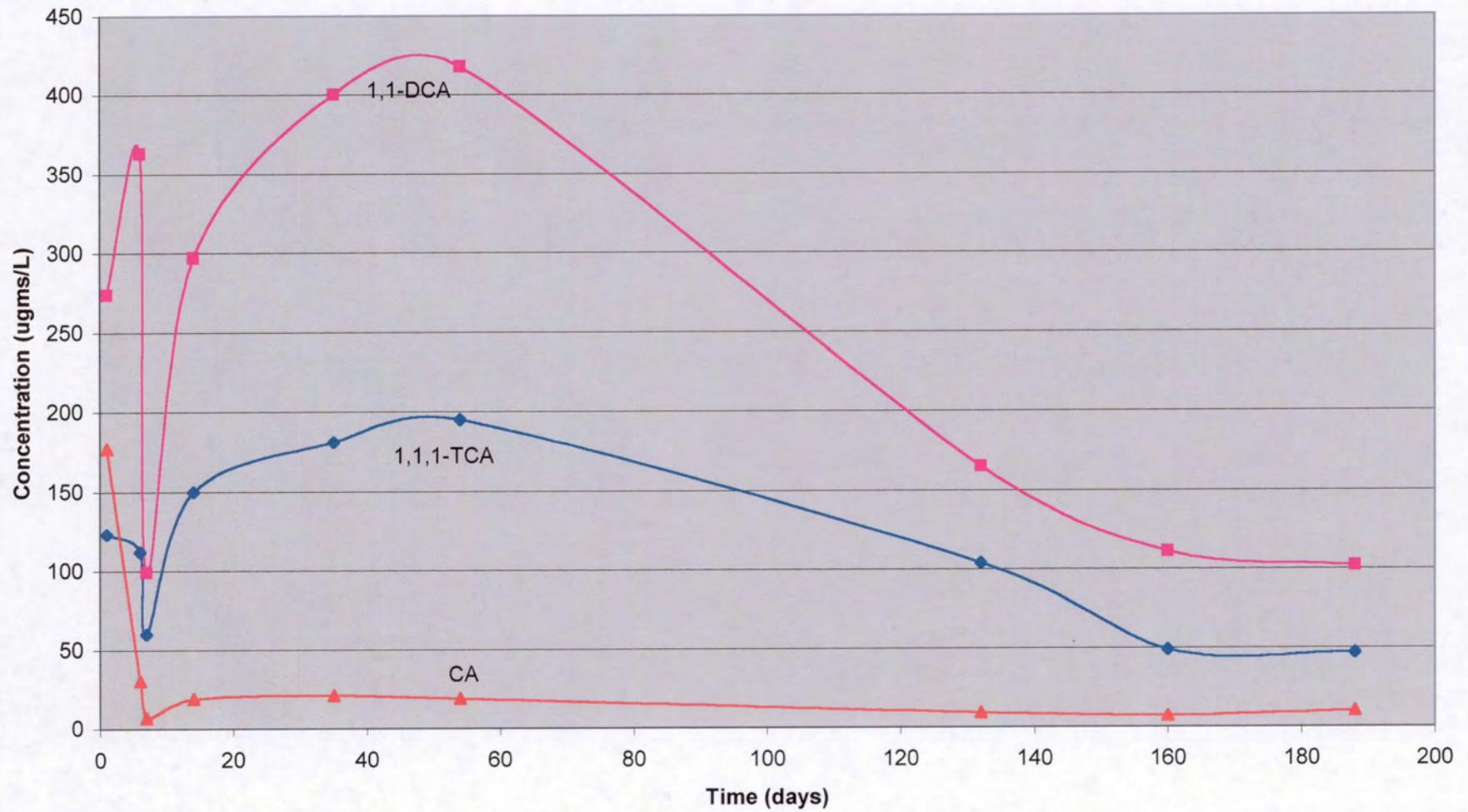
Hamilton Beach Pilot
Implant A-M5 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



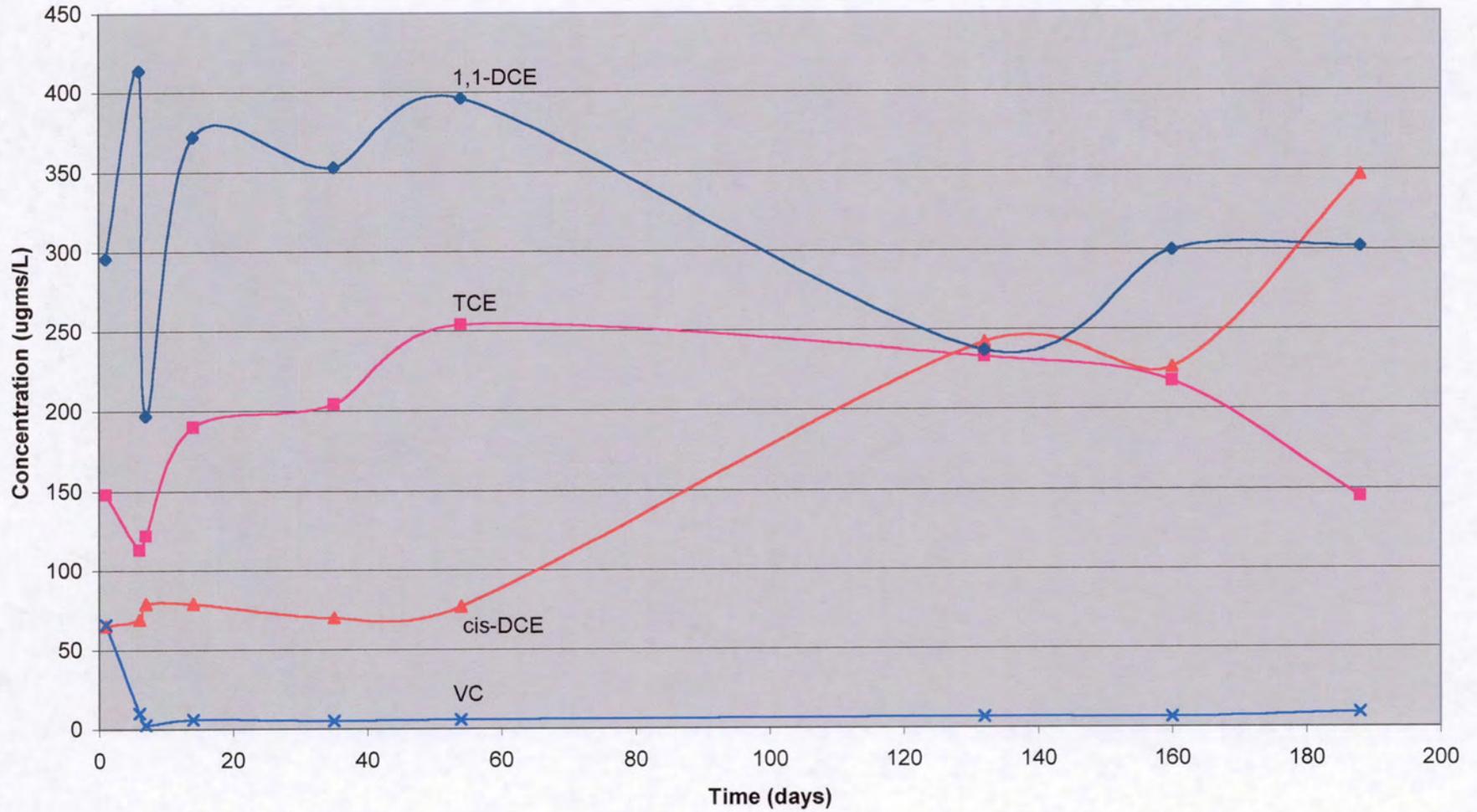
Hamilton Beach Pilot
Implant A-M6 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



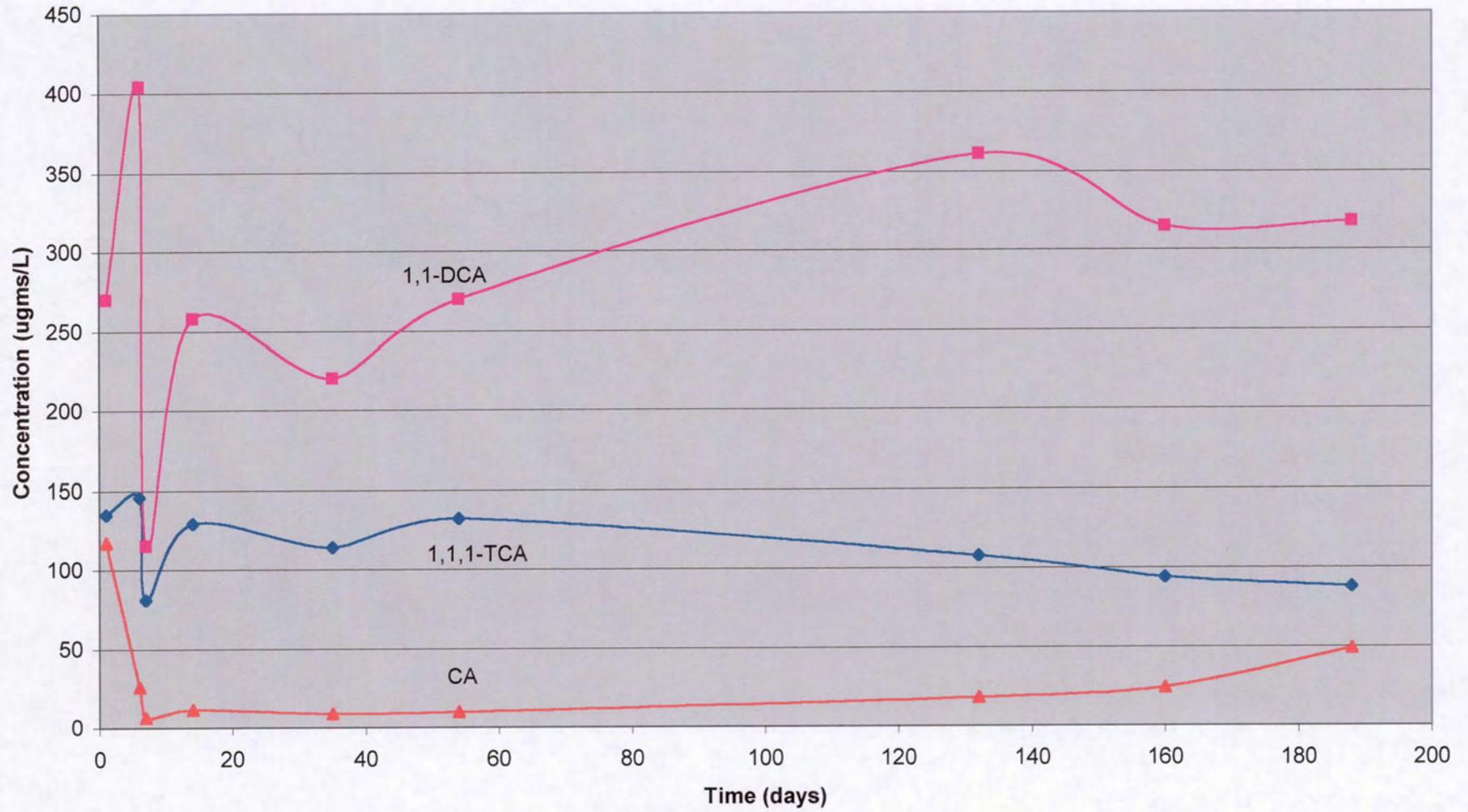
Hamilton Beach Pilot
Implant A-M6 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



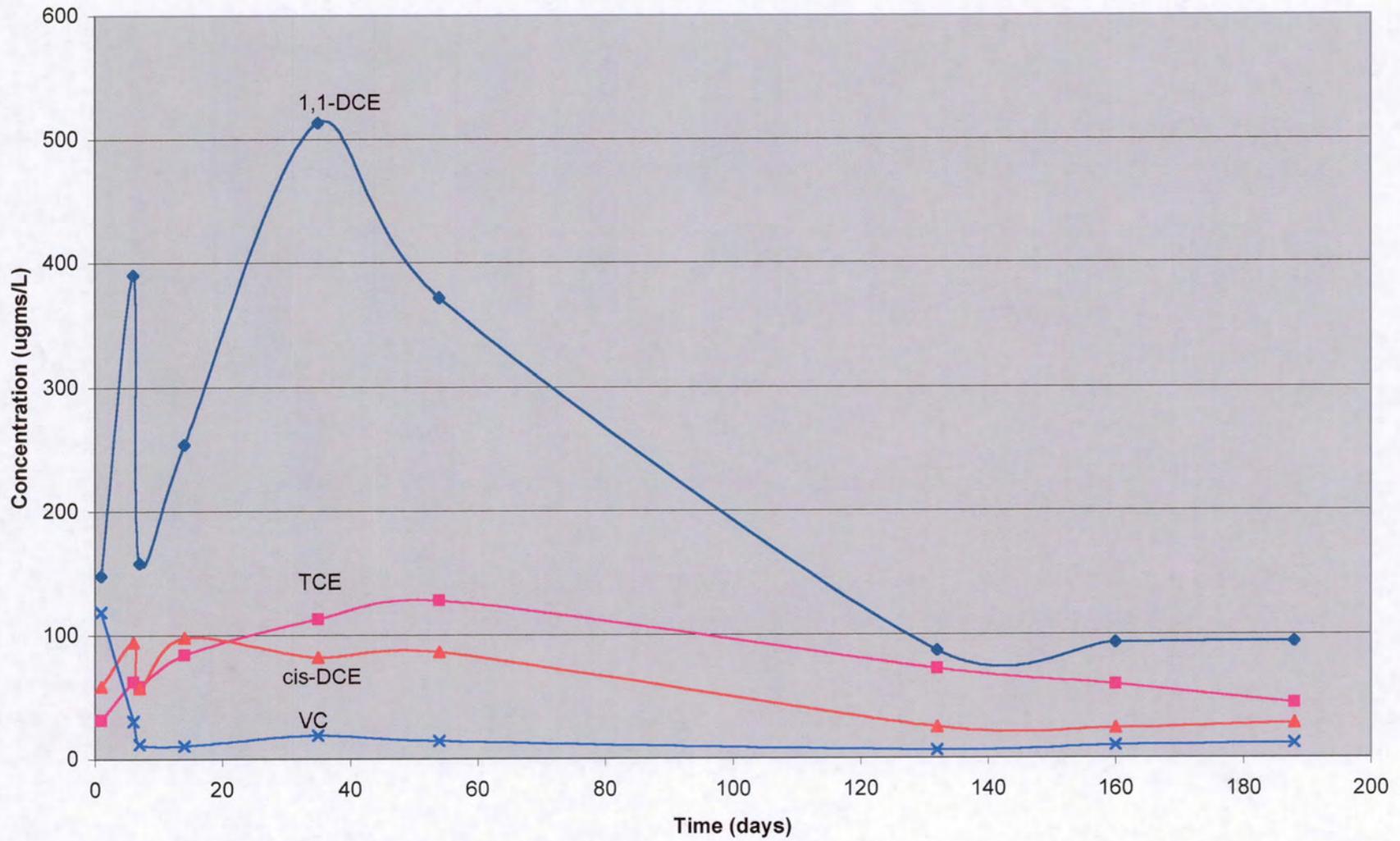
Hamilton Beach Pilot
Implant A-M7 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



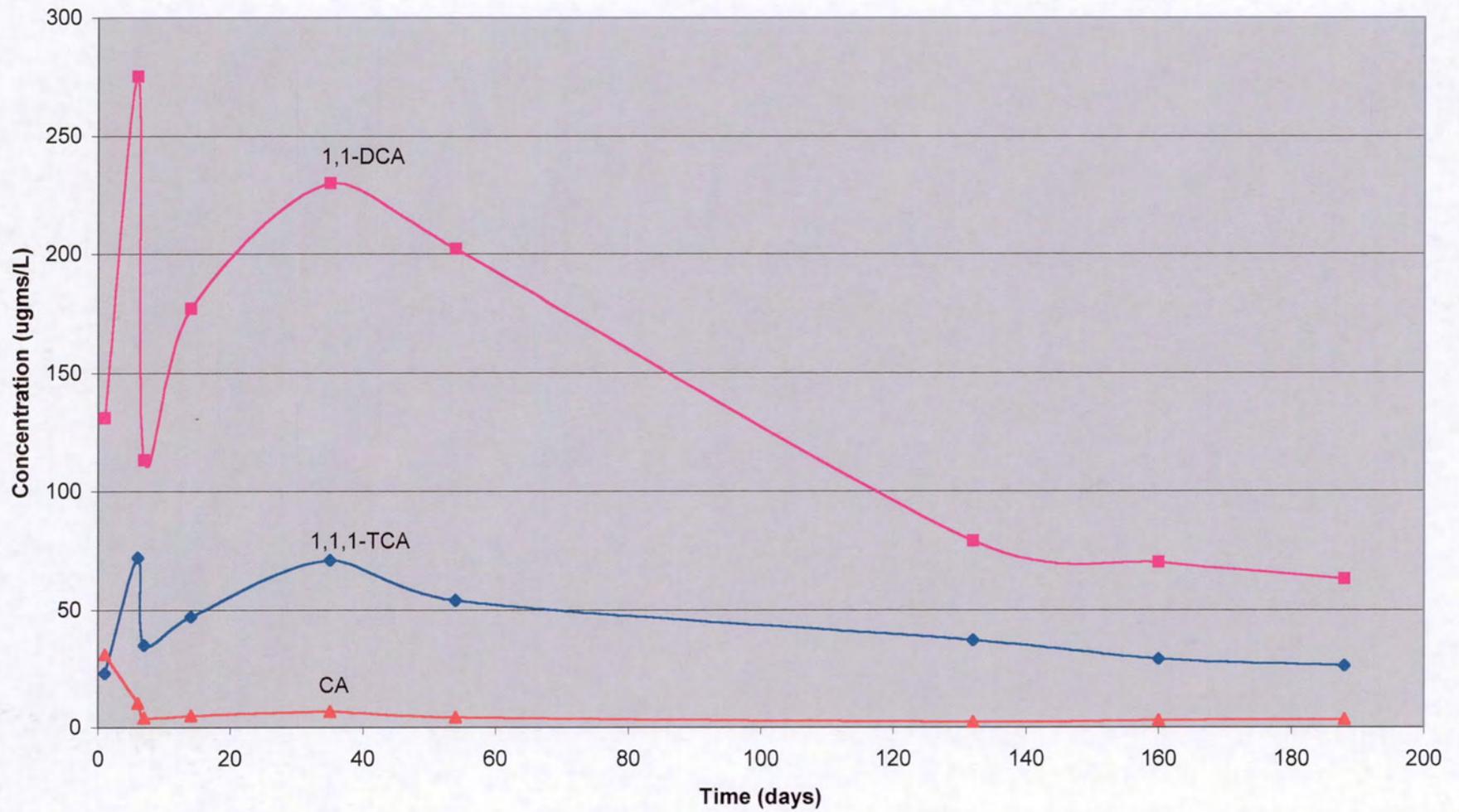
Hamilton Beach Pilot
Implant A-M7 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



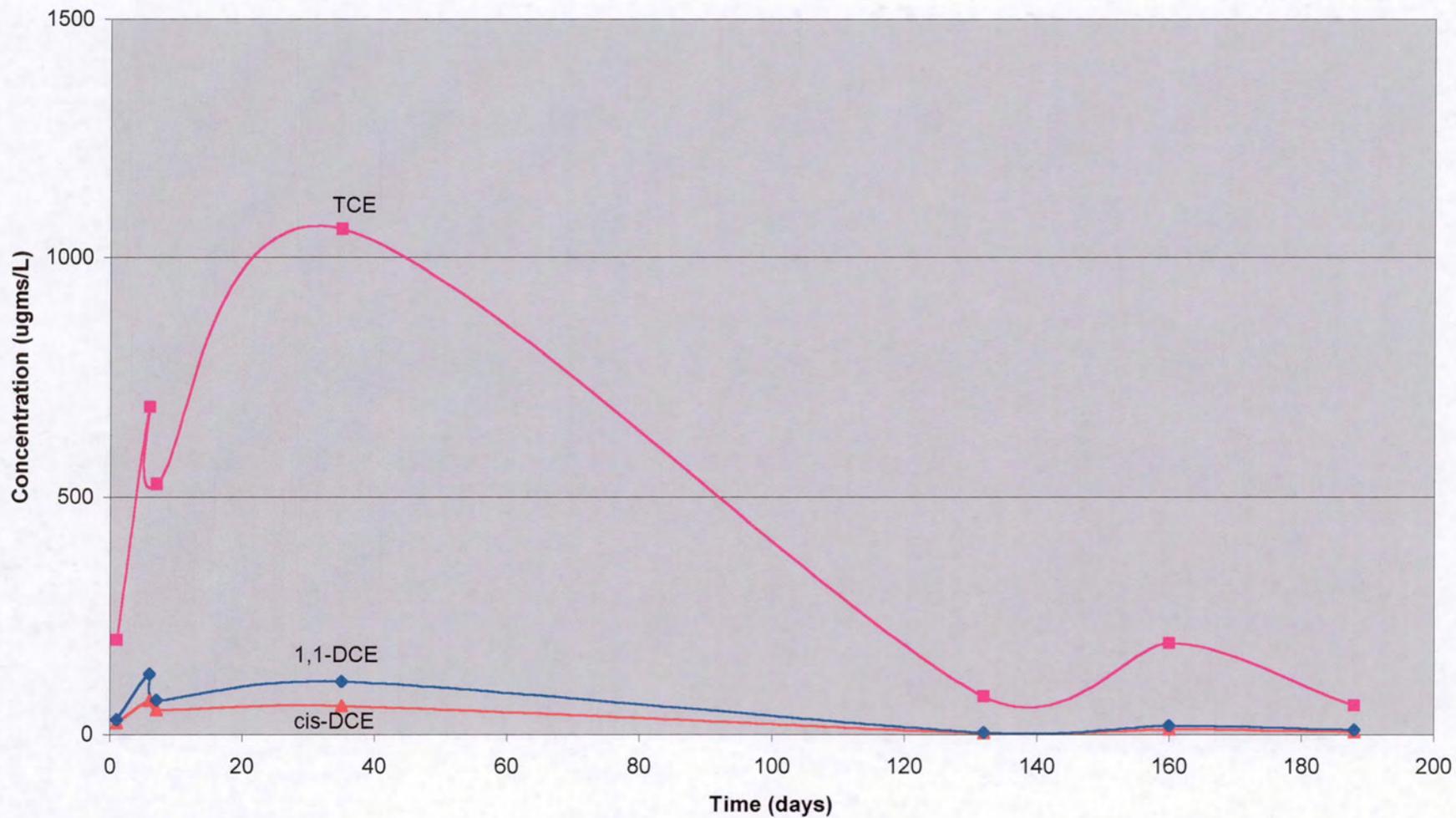
Hamilton Beach Pilot
Implant A-M8 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



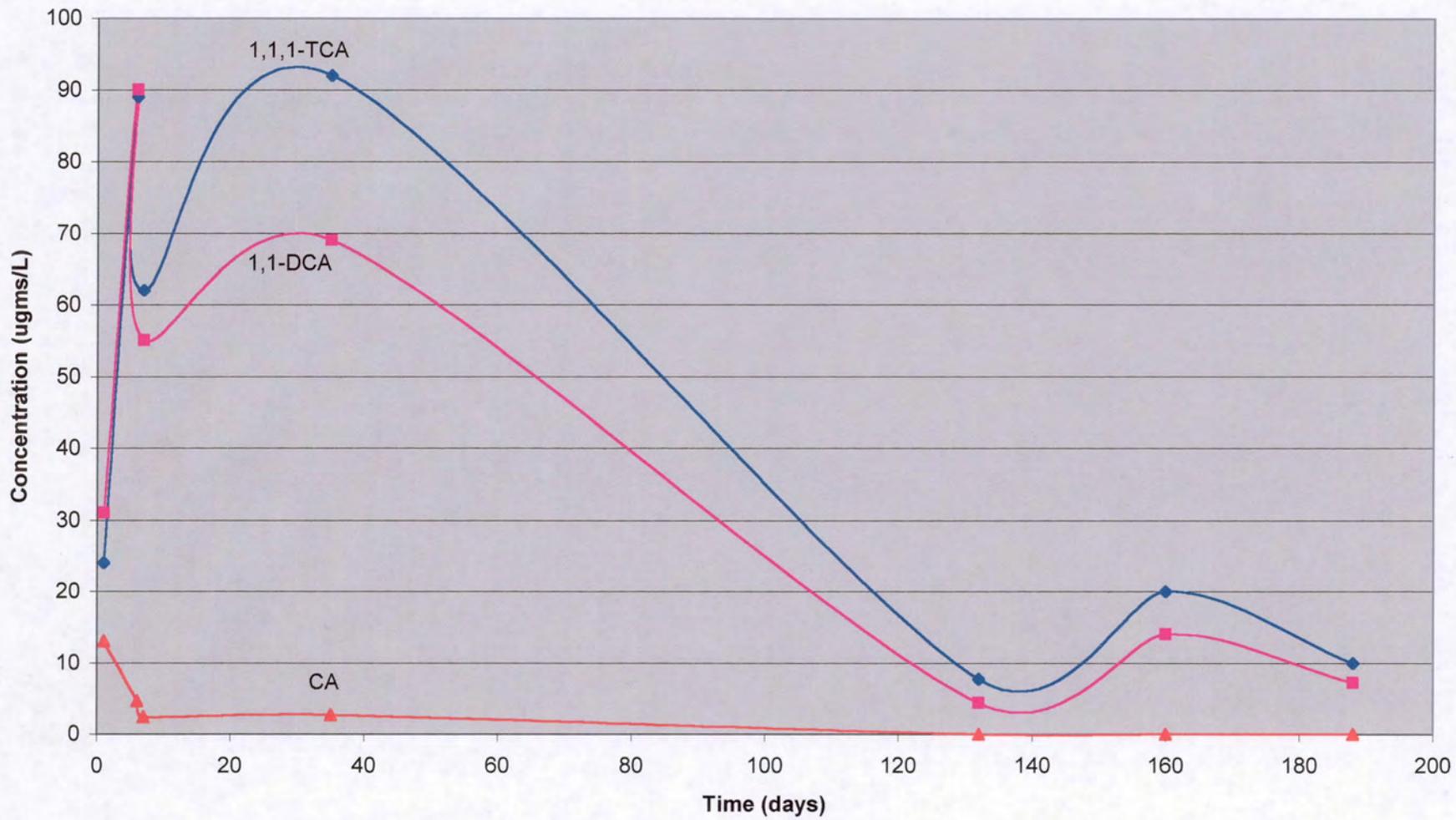
Hamilton Beach Pilot
Implant A-M8 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



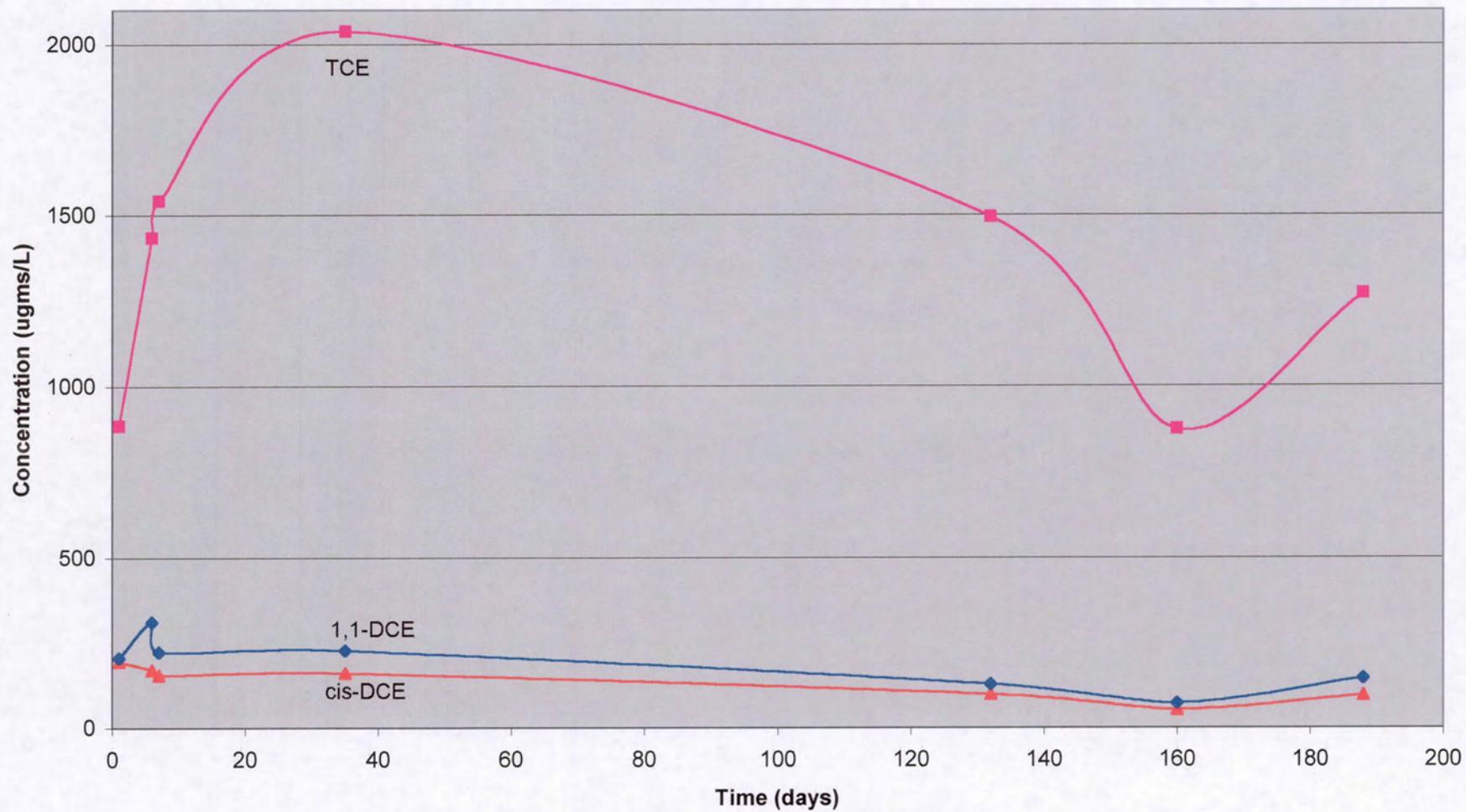
HAMILTON BEACH PILOT
IMPLANT A-M9 - CONCENTRATION VS. TIME
ugm/L - TCE, 1,1-DCE, cis-DCE



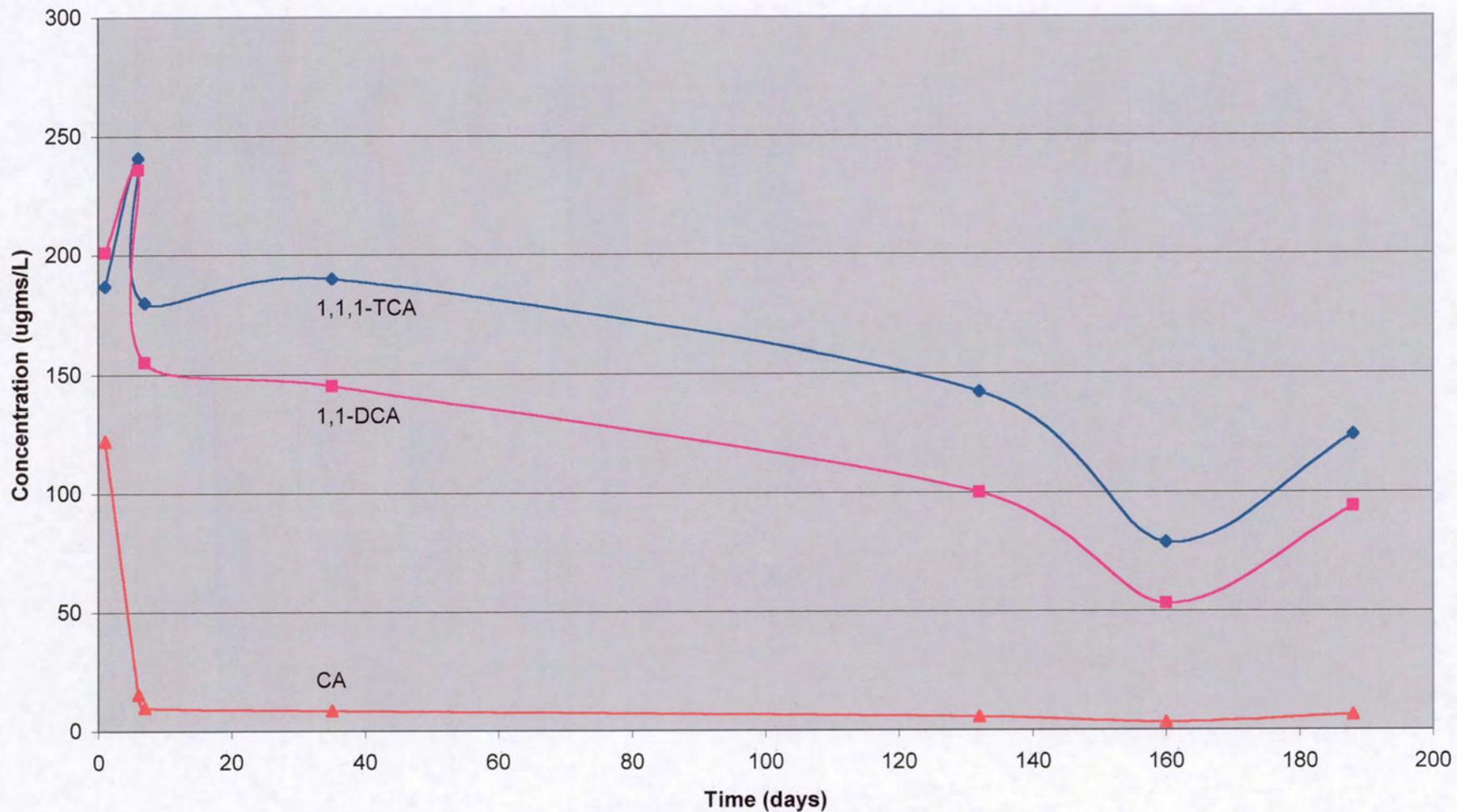
Hamilton Beach Pilot
Implant A-M9 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



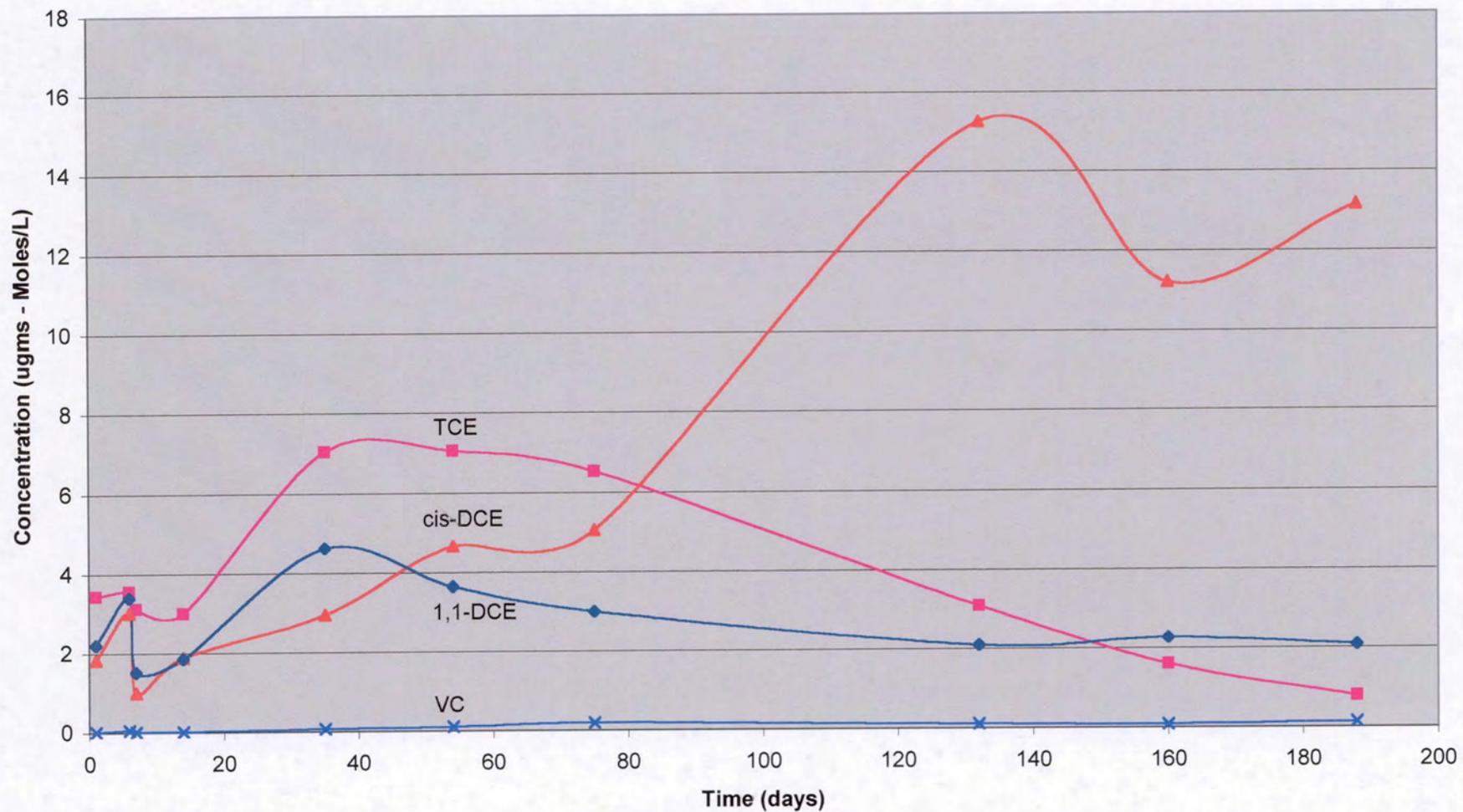
Hamilton Beach Pilot
Implants A-M10 - Concentration vs. Time
ugm/L - TCE, 1,1-DCE, cis-DCE, VC



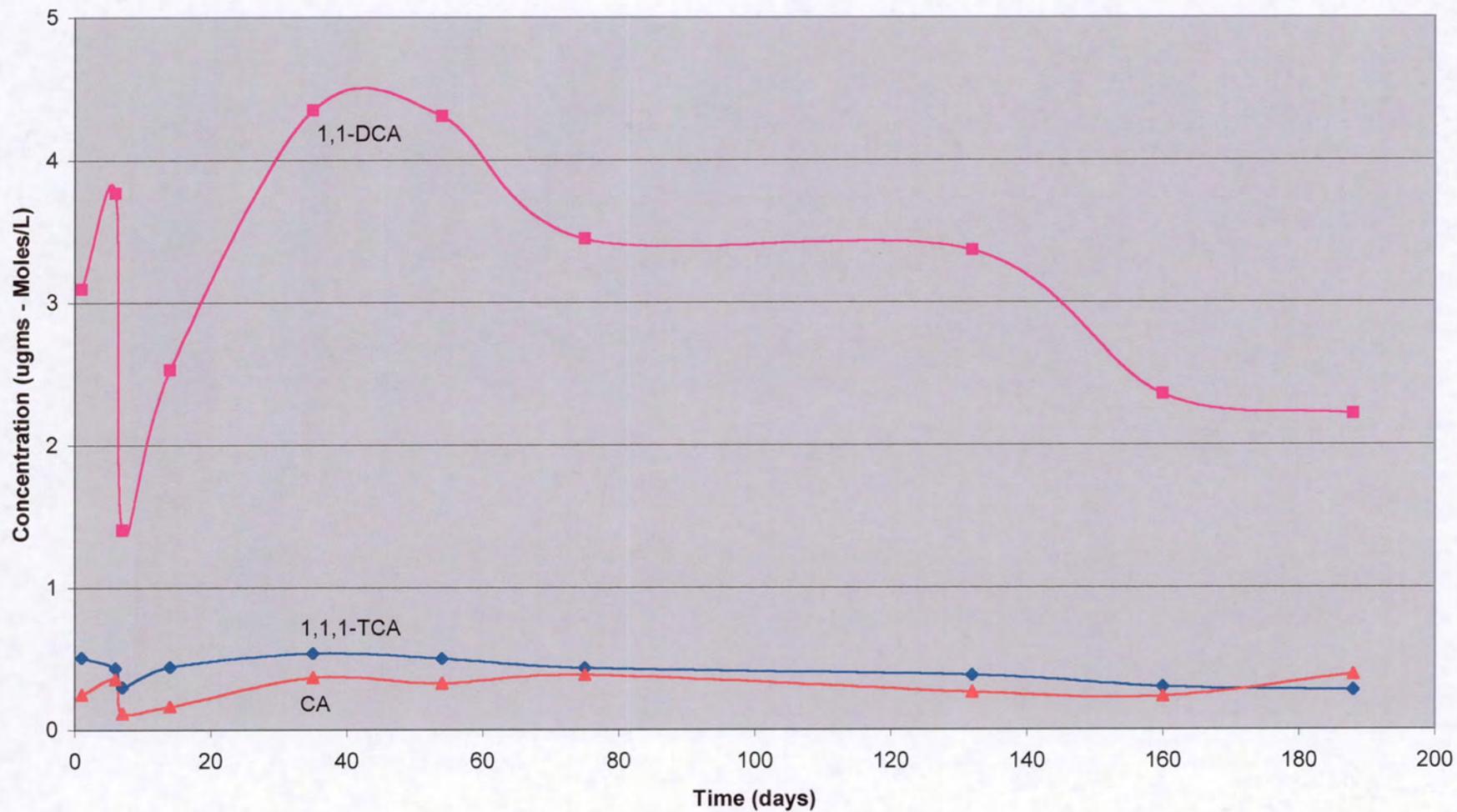
Hamilton Beach Pilot
Implant A-M10 - Concentration vs. Time
ugm/L - 1,1,1-TCA, 1,1-DCA, CA



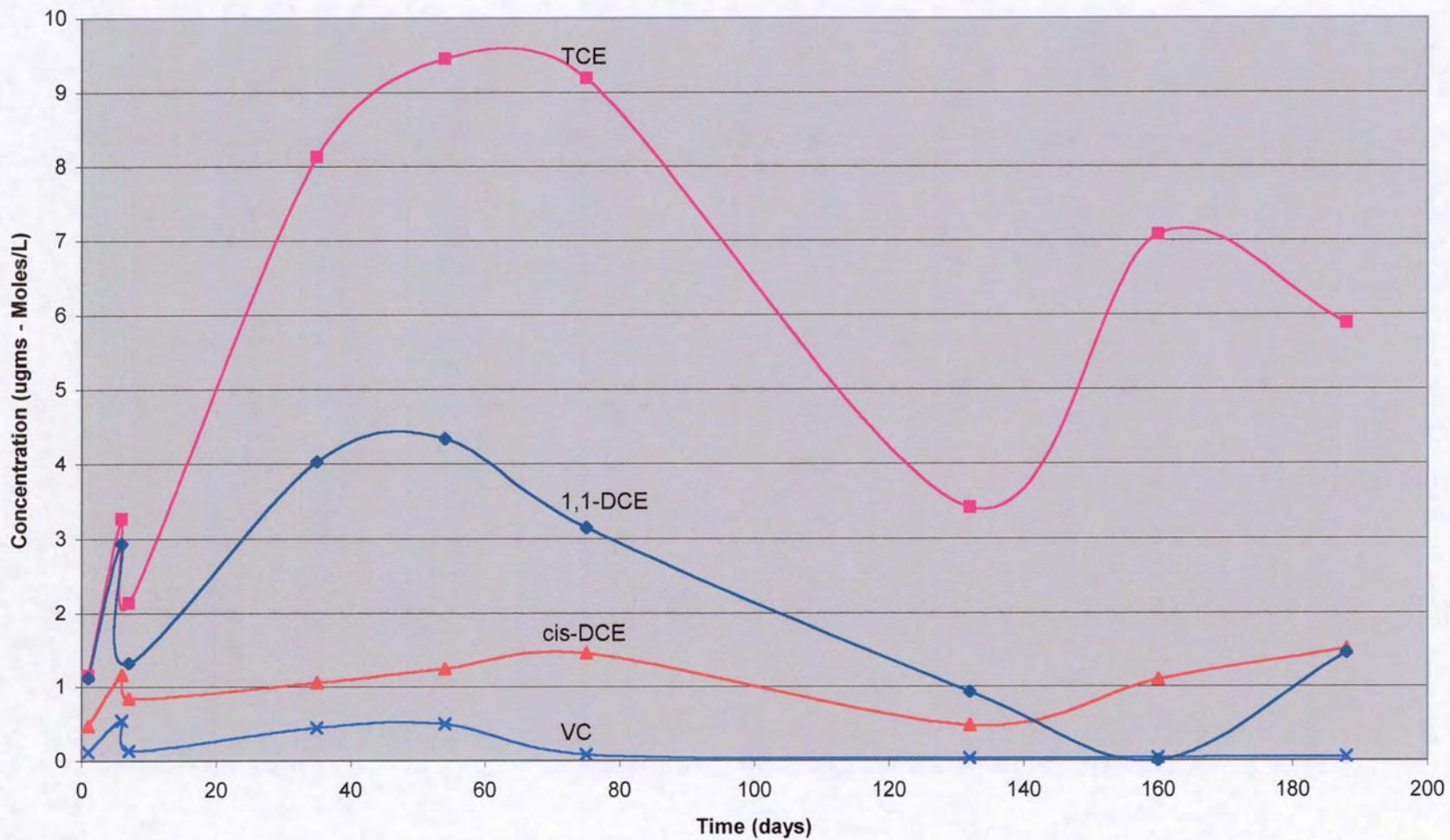
Hamilton Beach Pilot
Implant A-M1 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



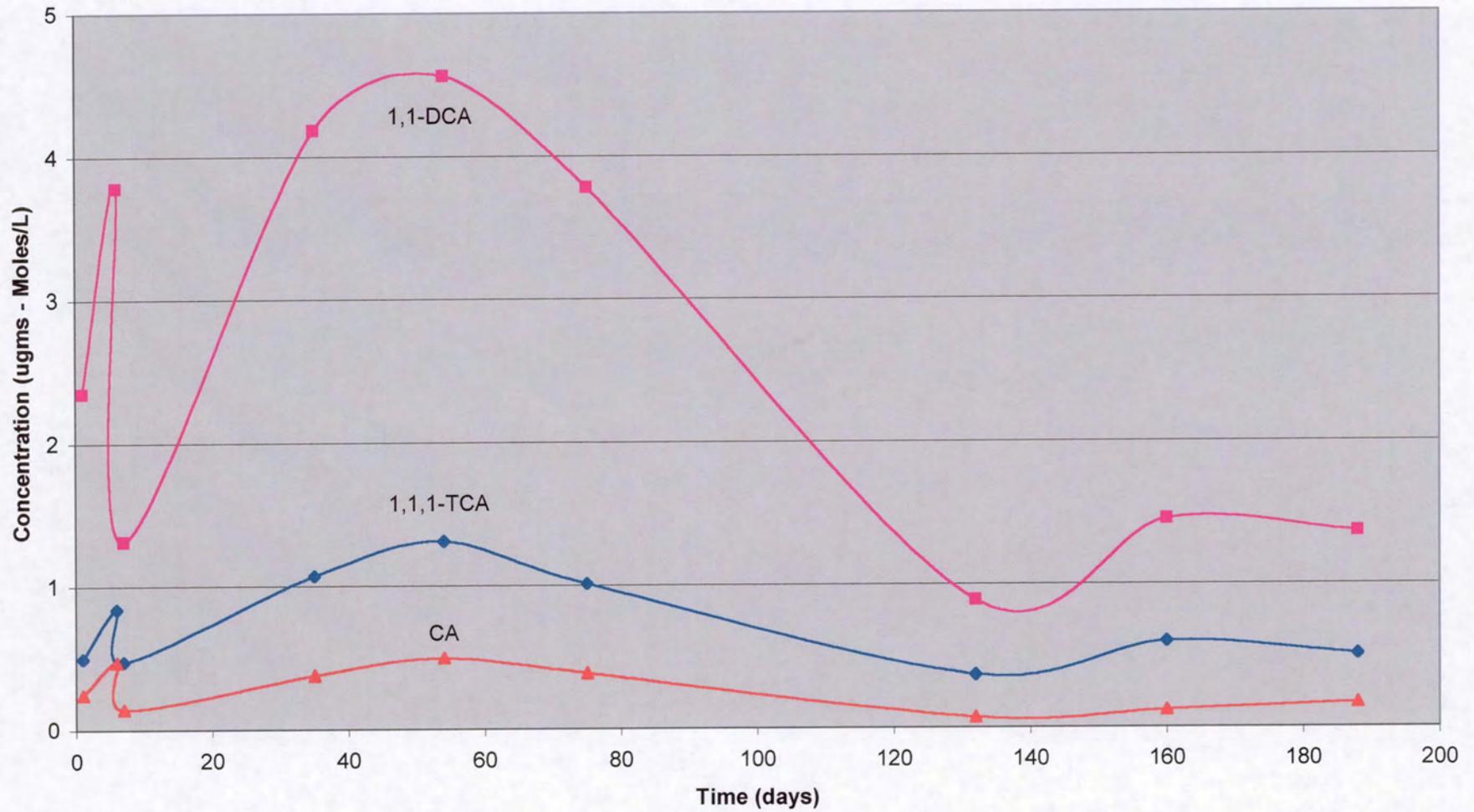
Hamilton Beach Pilot
Implant A-M1 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



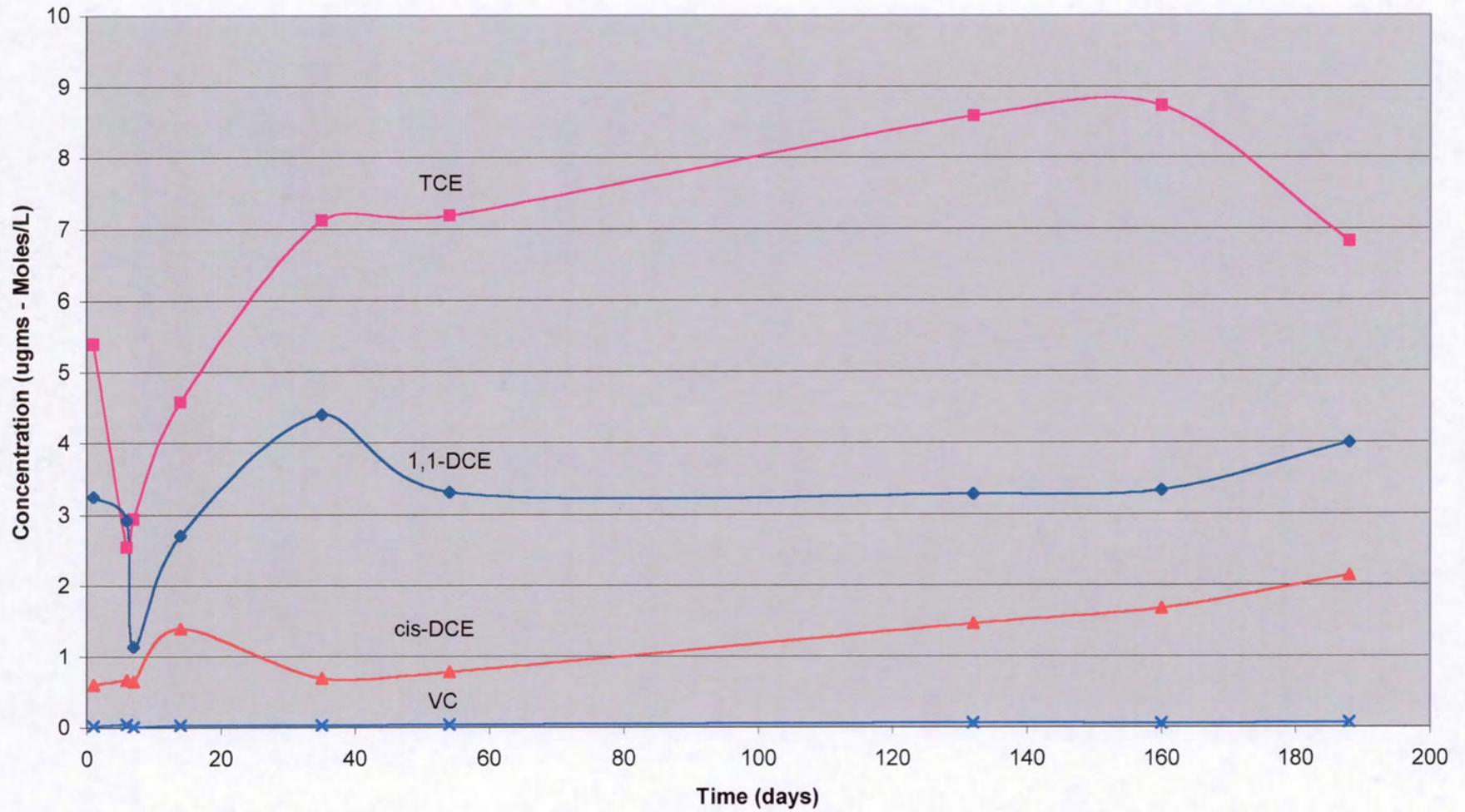
HAMILTON BEACH PILOT
IMPLANT A-M2 - CONCENTRATION VS. TIME
MOLAR UNITS - TCE, 1,1-DCE, CIS-DCE, VC



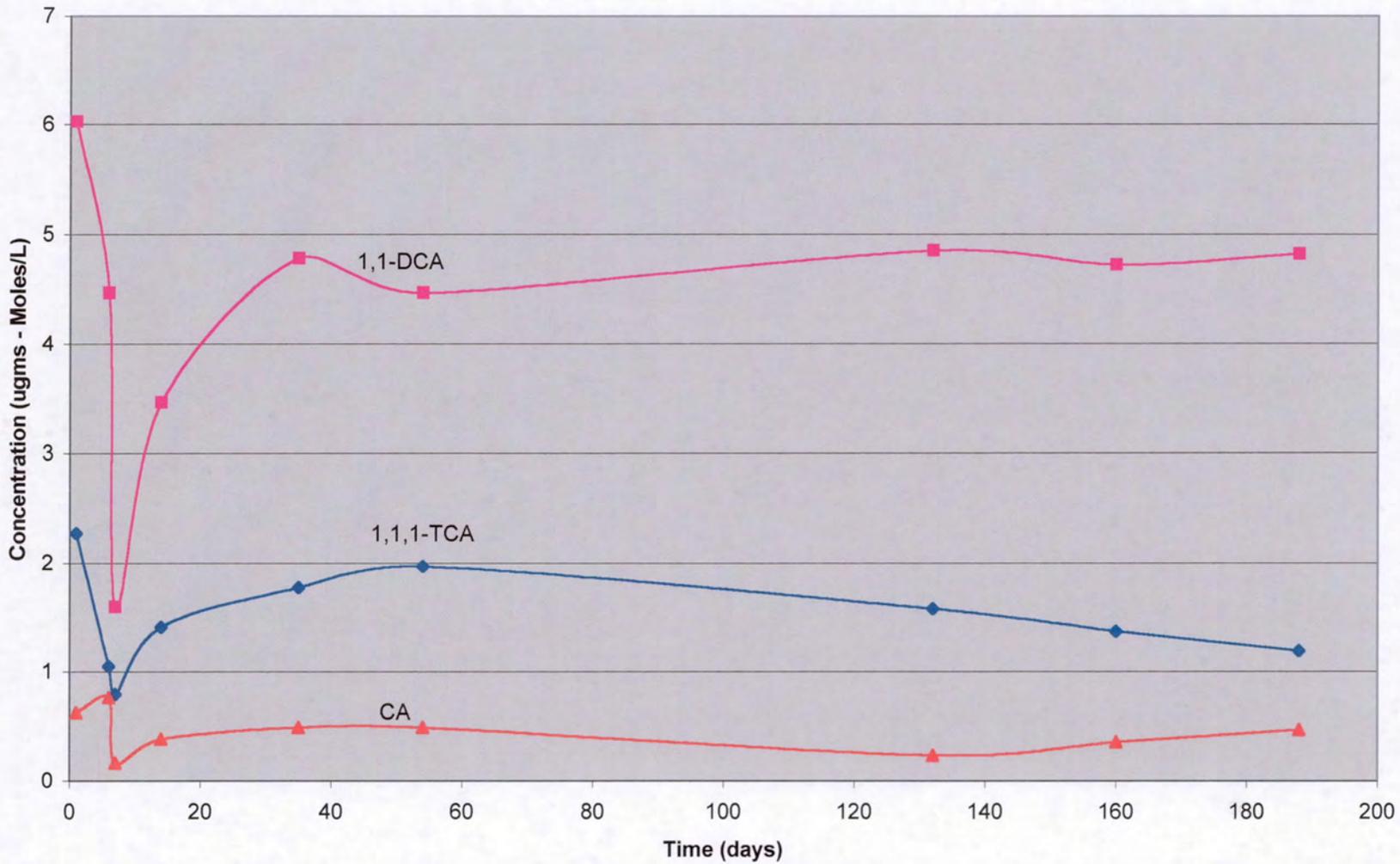
Hamilton Beach Pilot
Implant A-M2 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



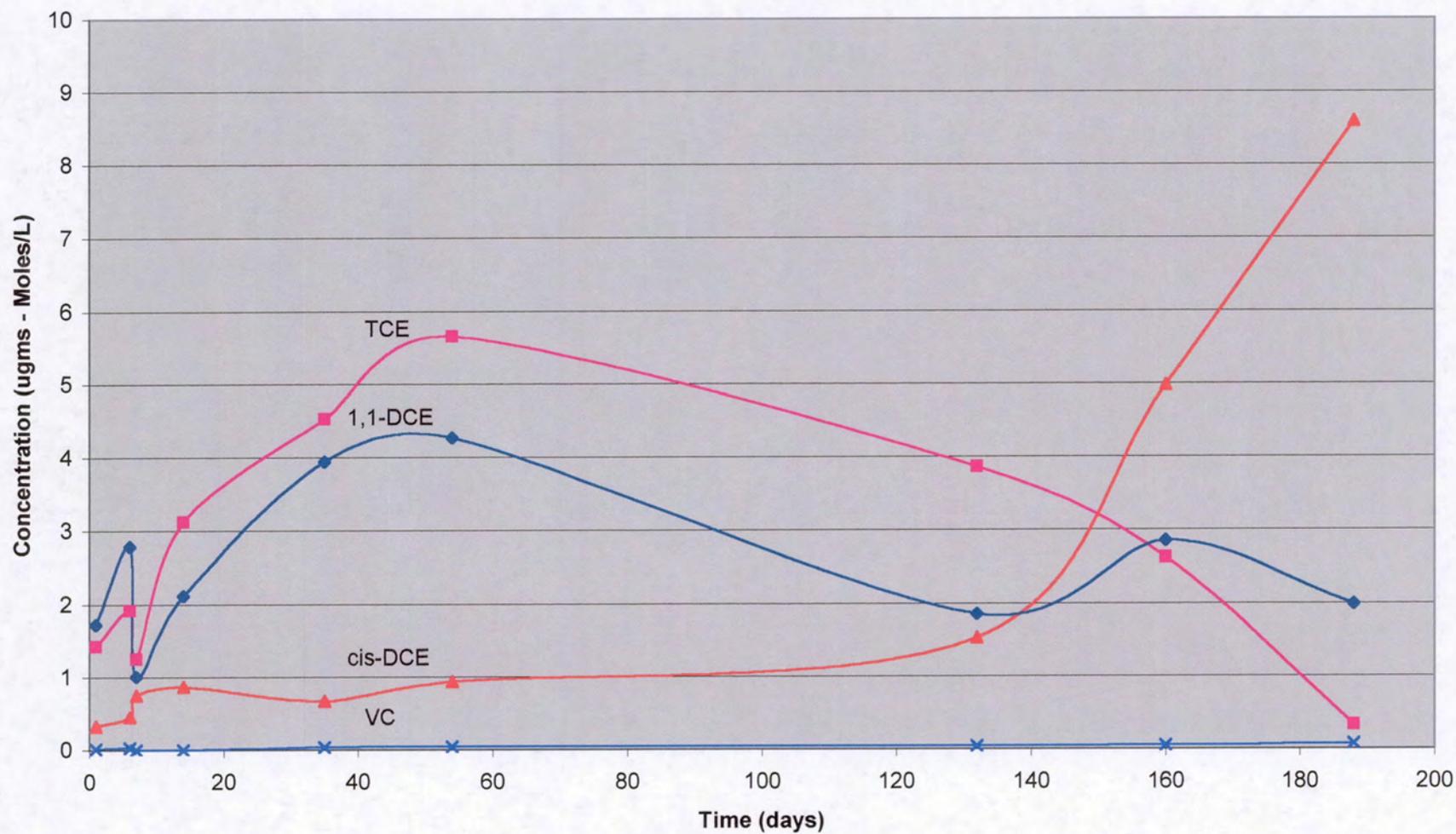
Hamilton Beach Pilot
Implant A-M3 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



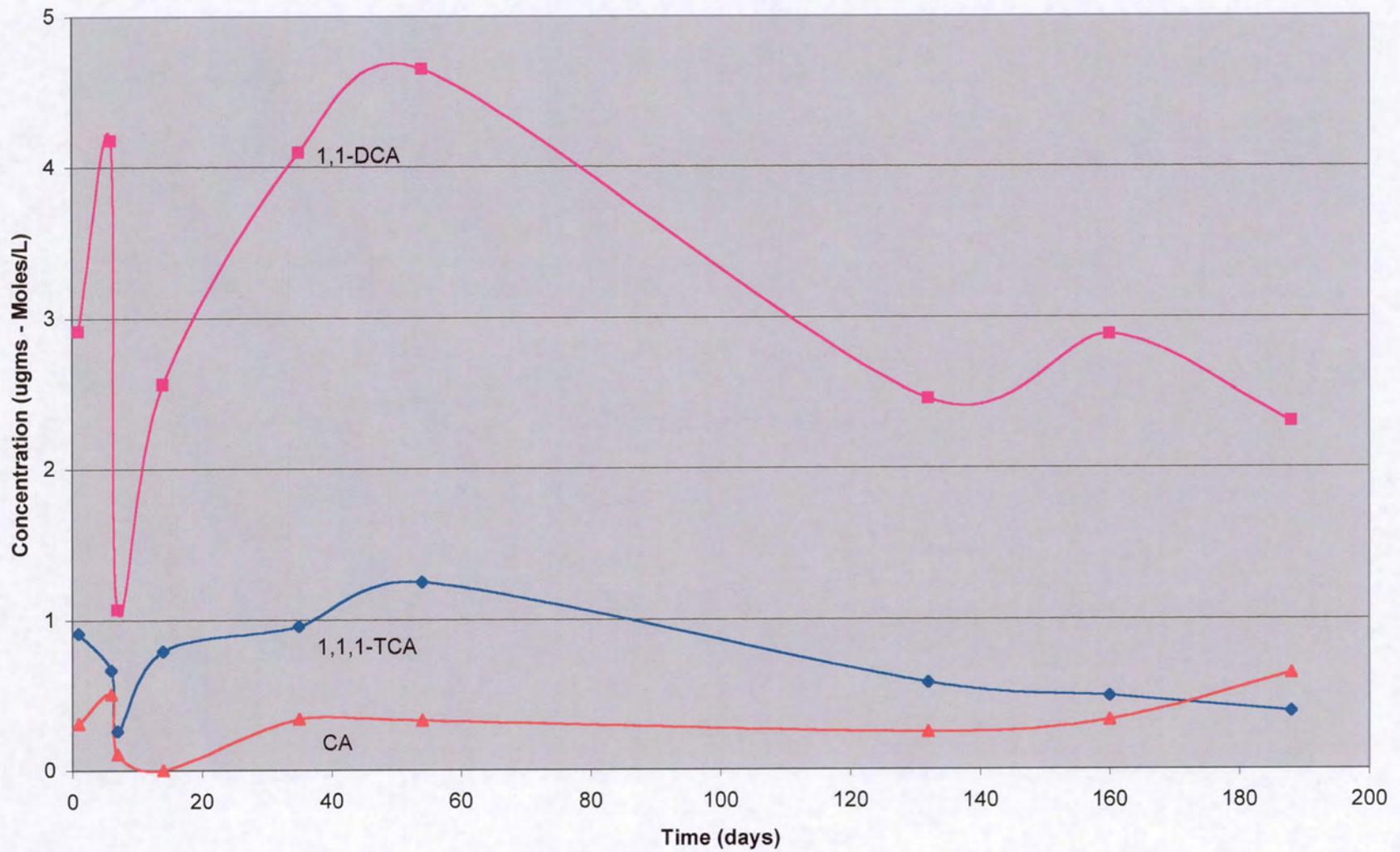
Hamilton Beach Pilot
Implant M-A3 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



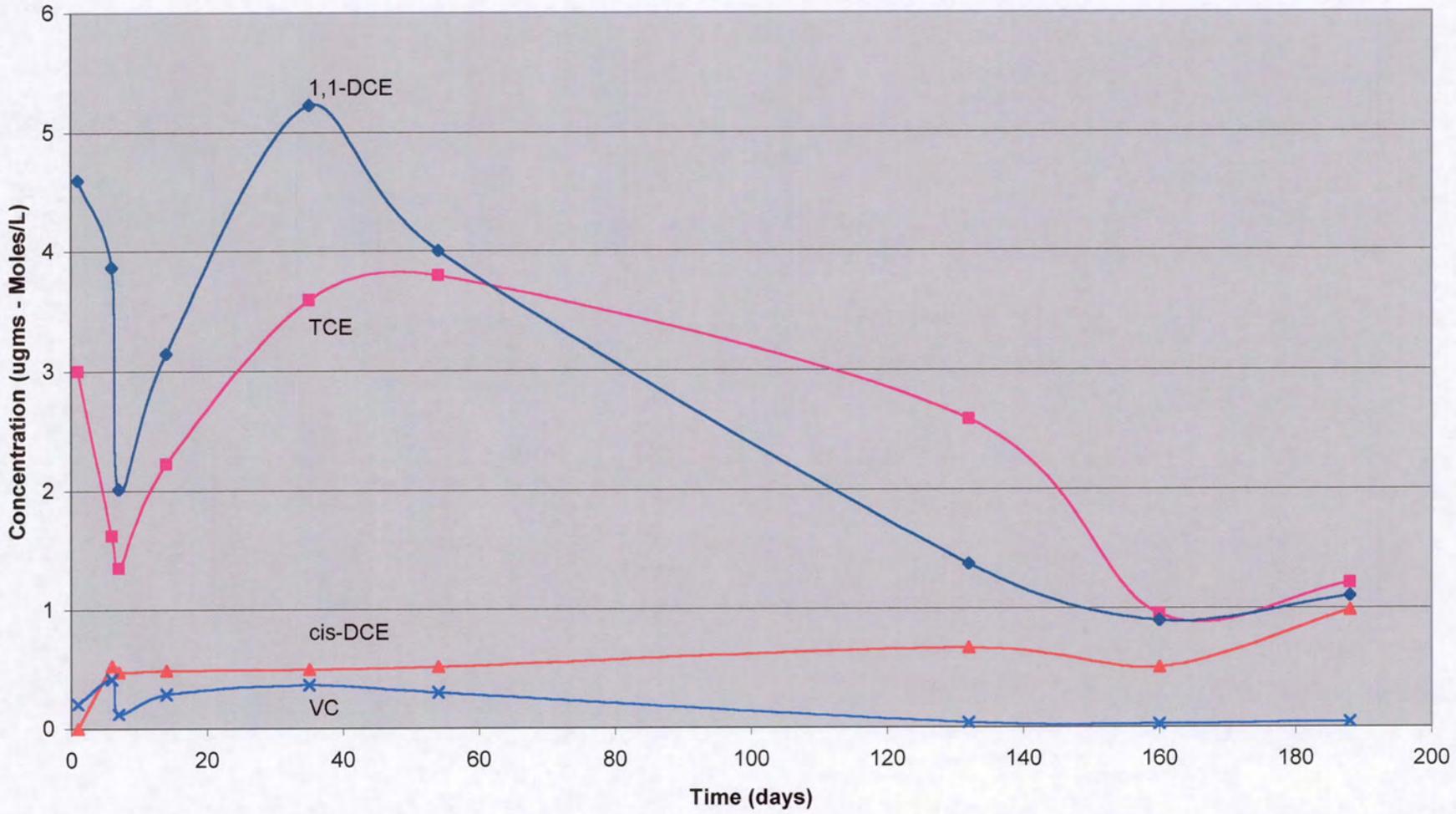
Hamilton Beach Pilot
Implant A-M4 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



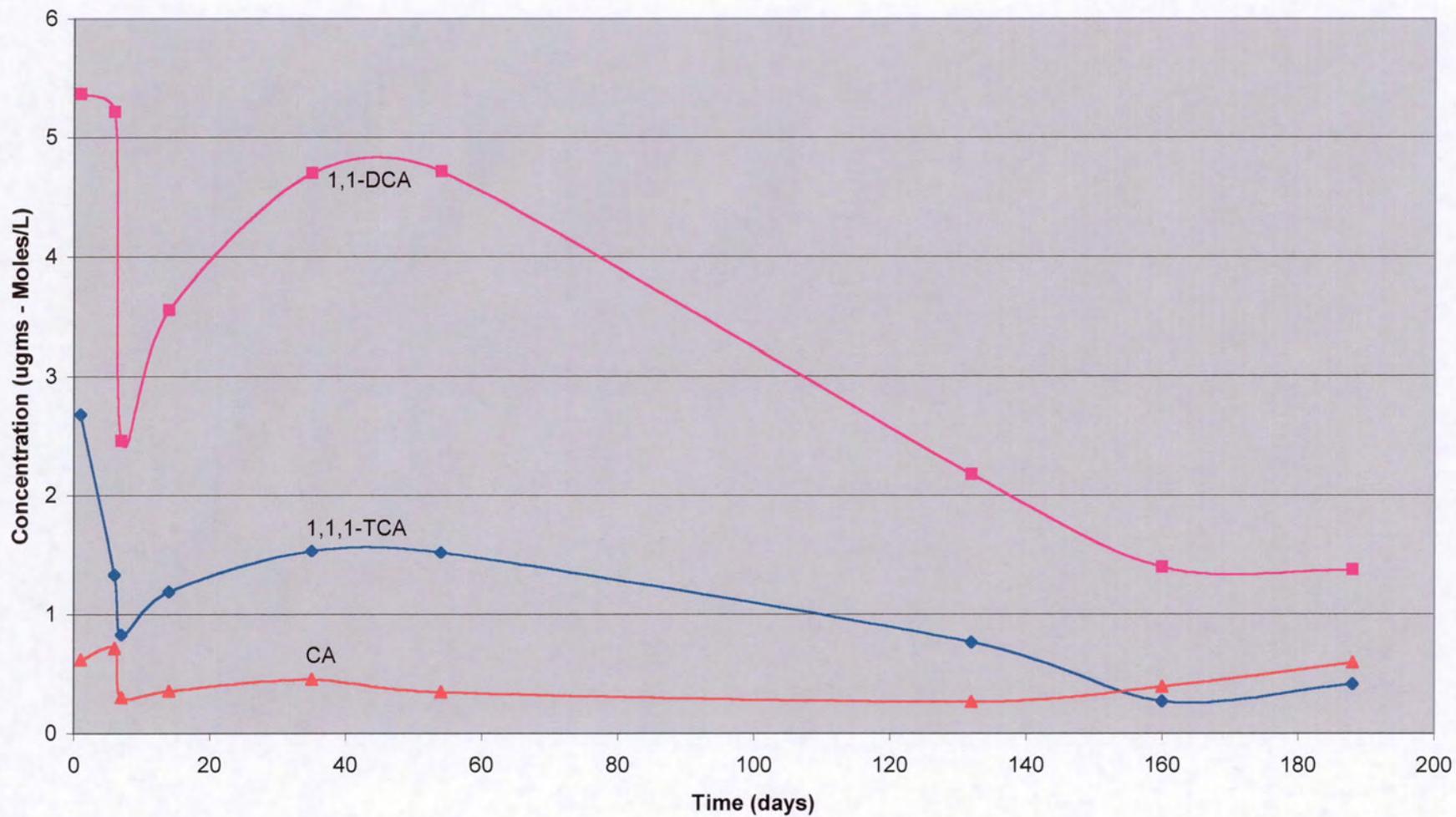
Hamilton Beach Pilot
Implant A-M4 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



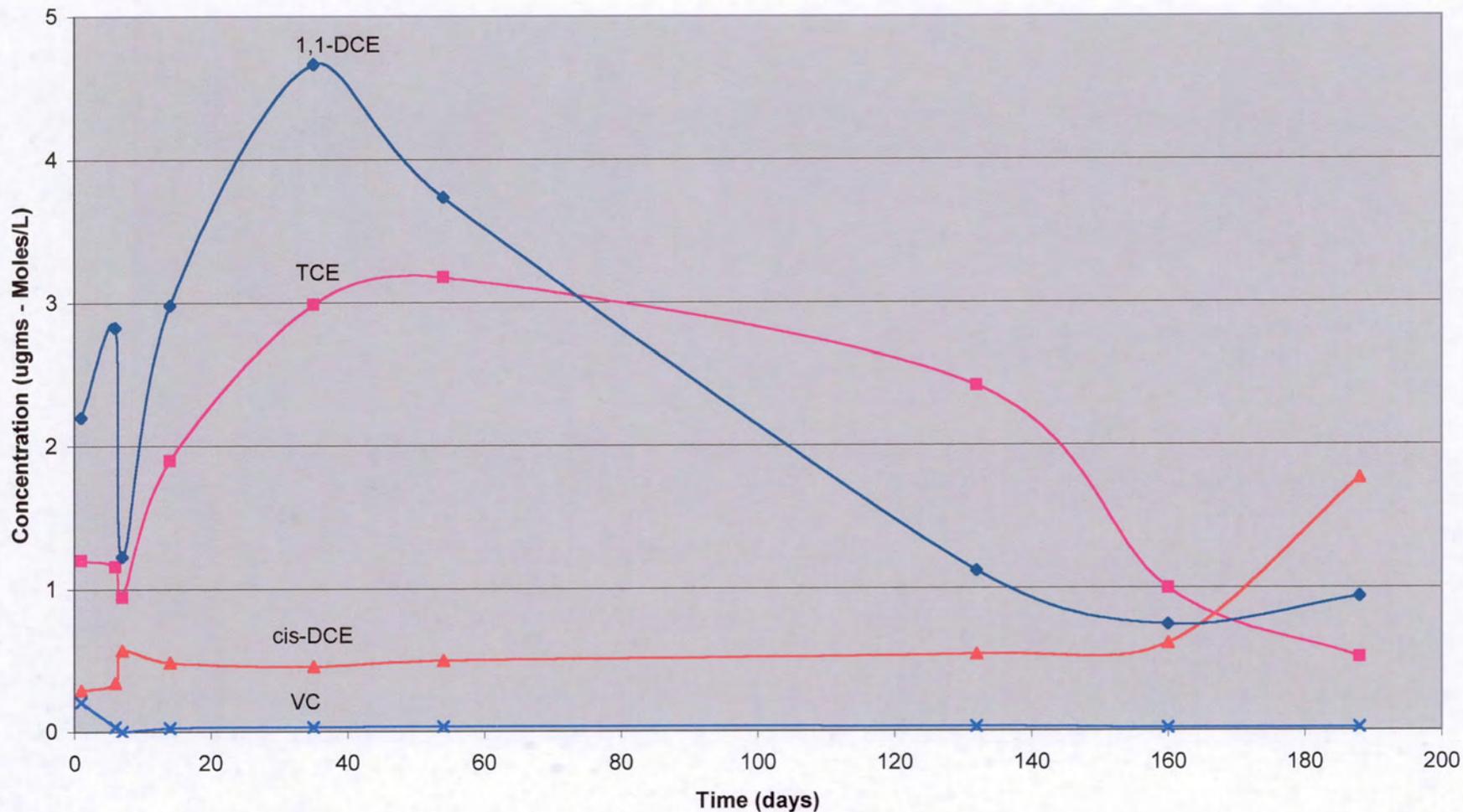
Hamilton Beach Pilot
Implant A-M5 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



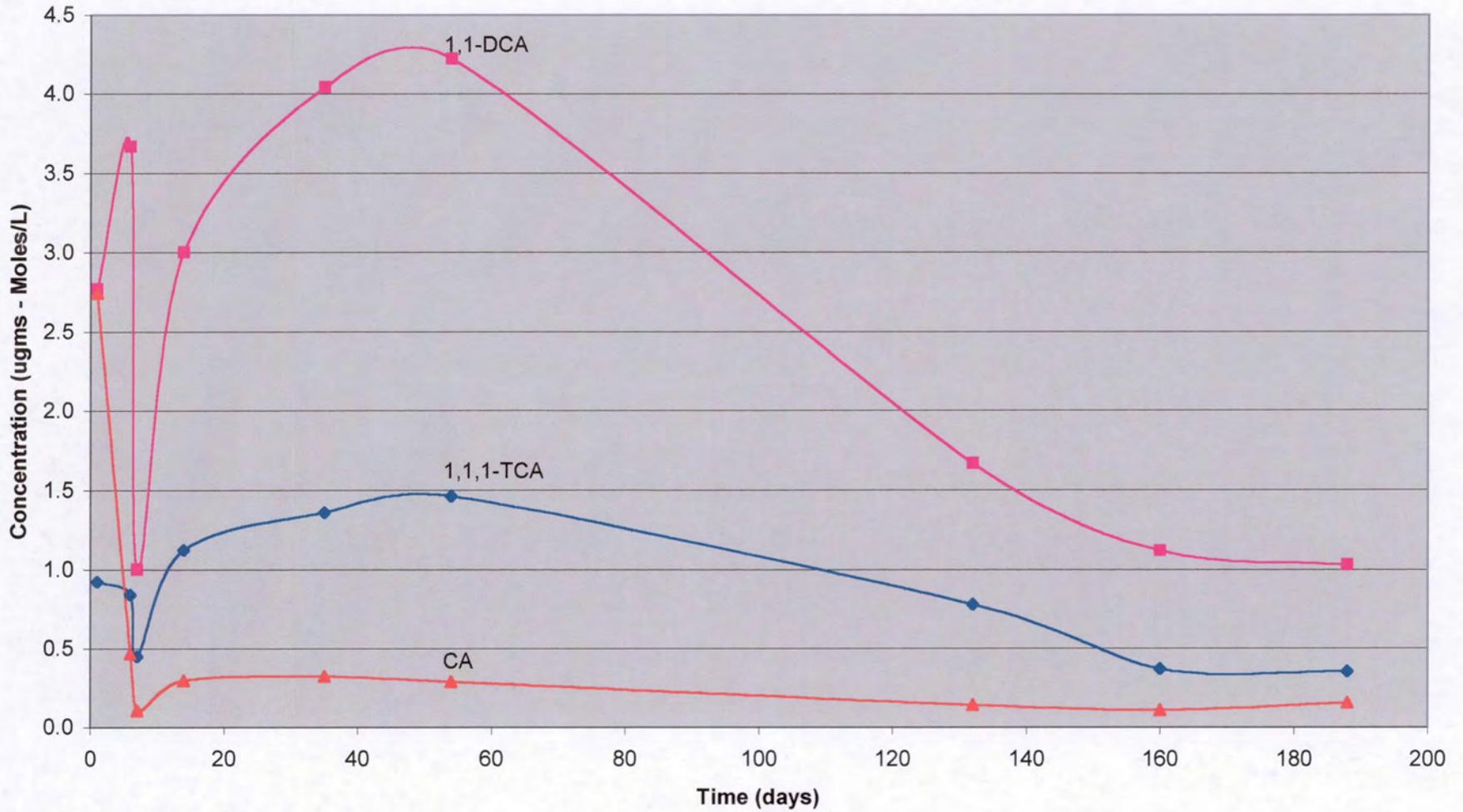
Hamilton Beach Pilot
Implant A-M5 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



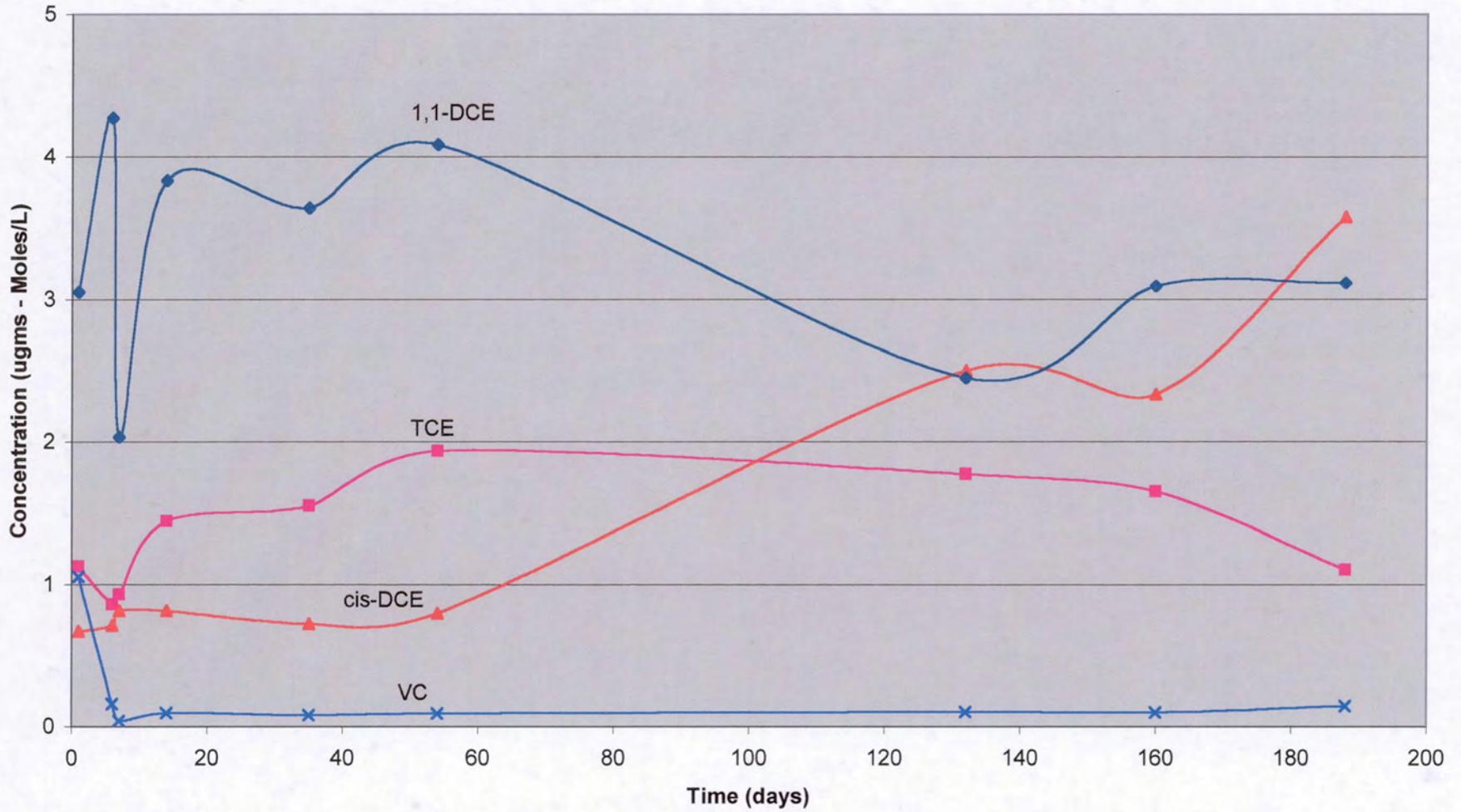
Hamilton Beach Pilot
Implant A-M6 - Concentration vs. Time
Molar Units - 1,1-DCE, TCE, cis-DCE, VC



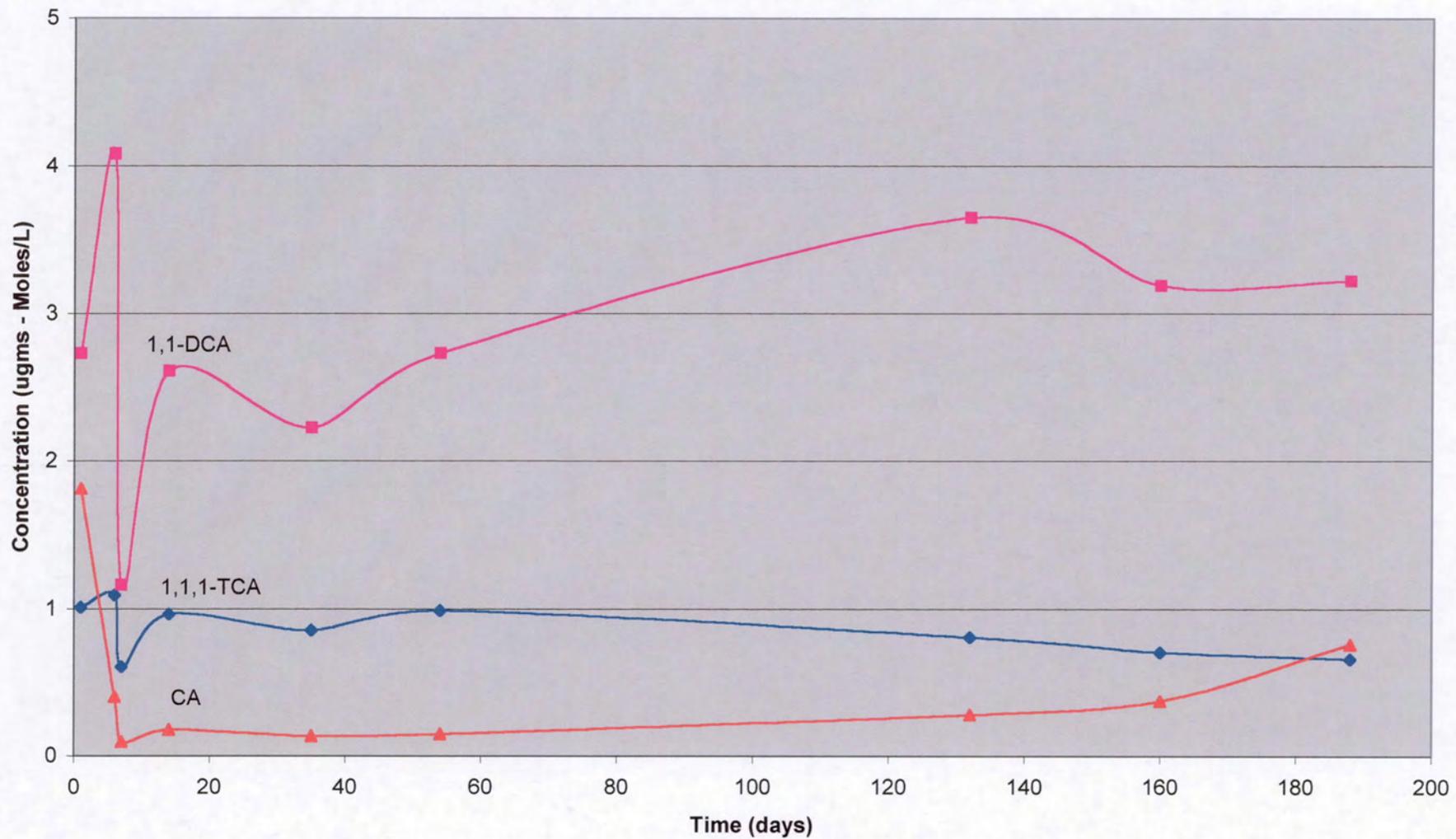
**Hamilton Beach Pilot
Implant A-M6 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCE, CA**



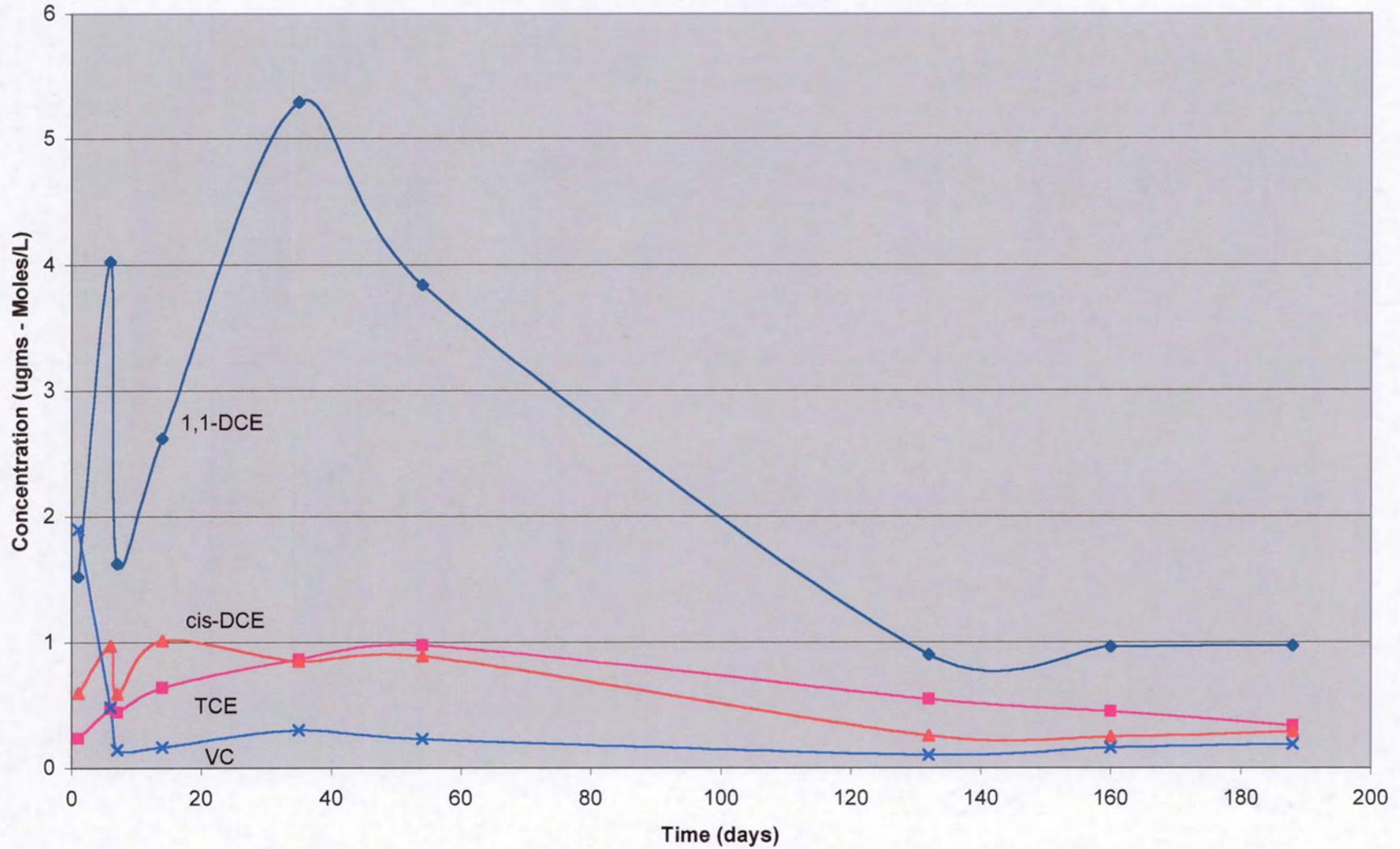
Hamilton Beach Pilot
Implant A-M7 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



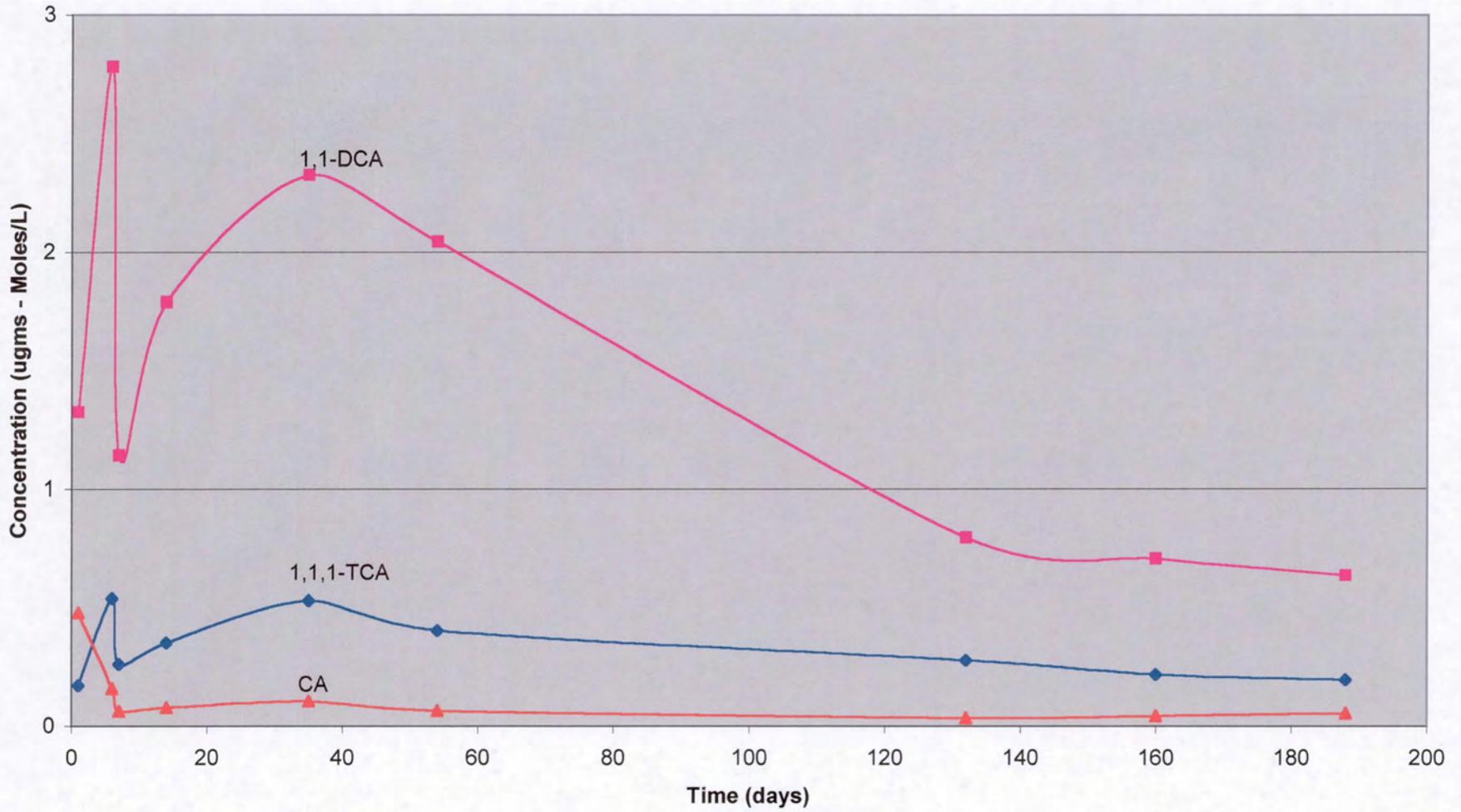
Hamilton Beach Pilot
Implant A-M7 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



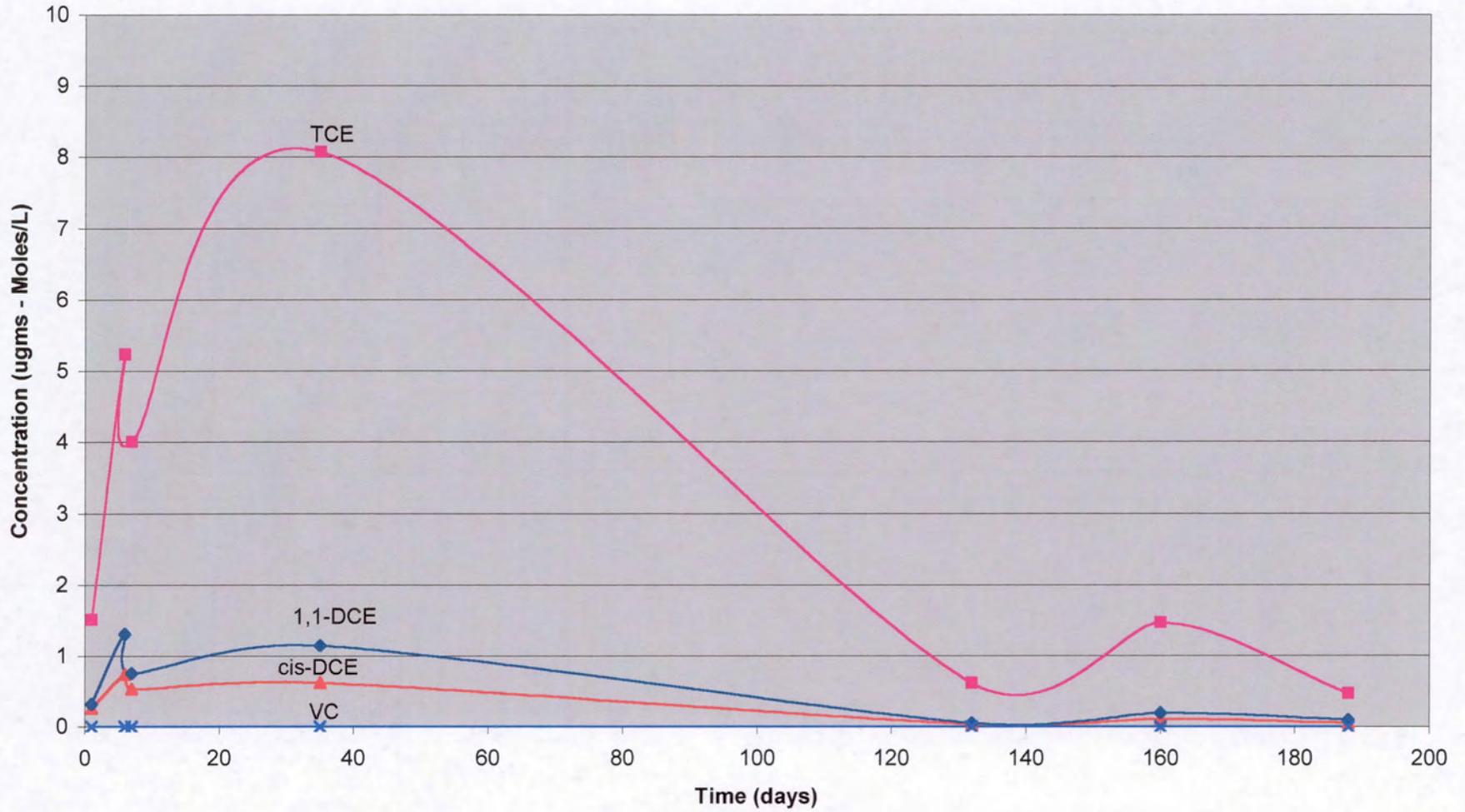
Hamilton Beach Pilot
Implant A-M8 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



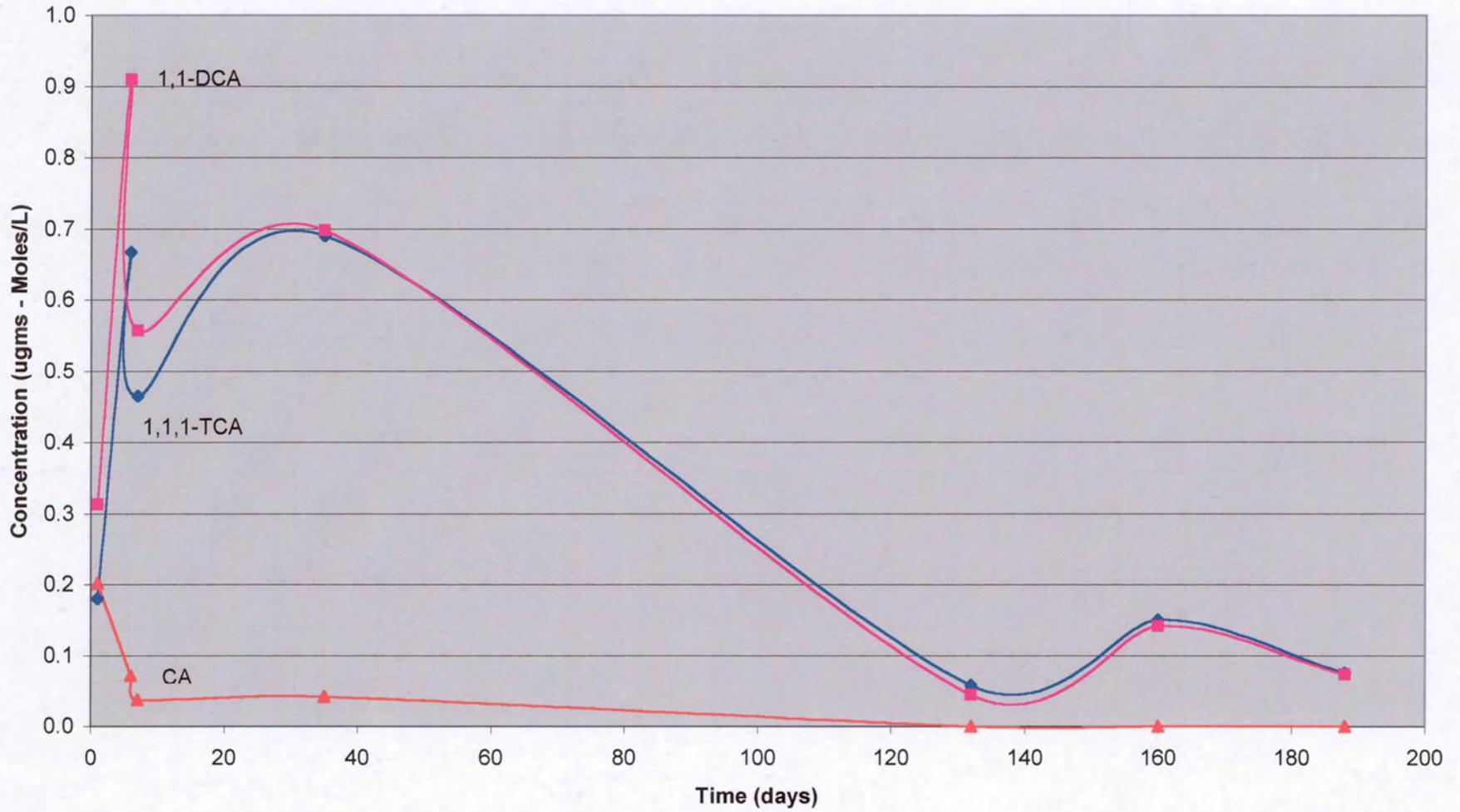
HAMILTON BEACH PILOT
IMPLANT A-M8 - CONCENTRATION VS. TIME
MOLAR UNITS - 1,1,1-TCA, 1,1-DCA, CA



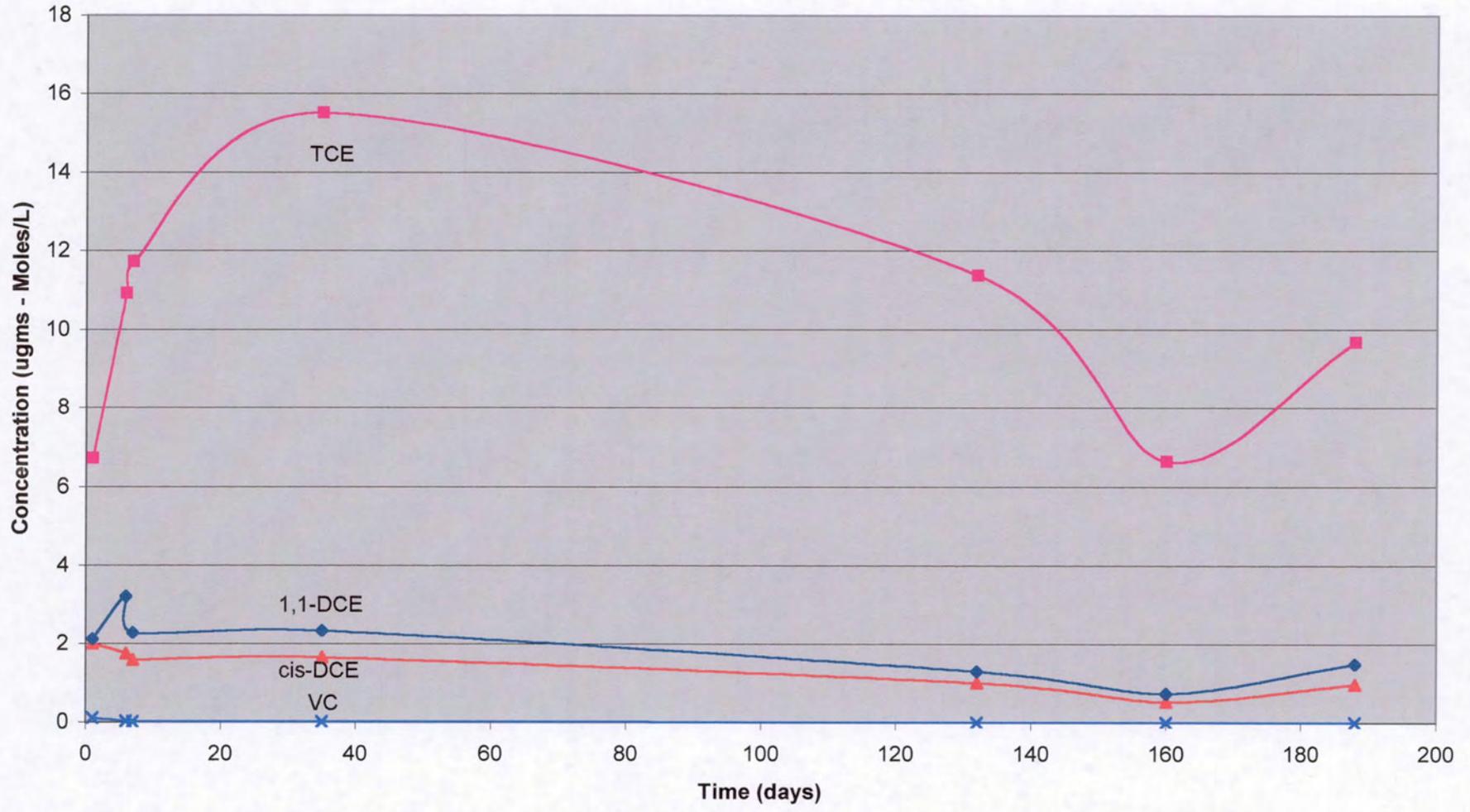
HAMILTON BEACH PILOT
IMPLANT A-M9 - CONCENTRATION VS. TIME
MOLAR UNITS - TCE, 1,1-DCE, CIS-DCE



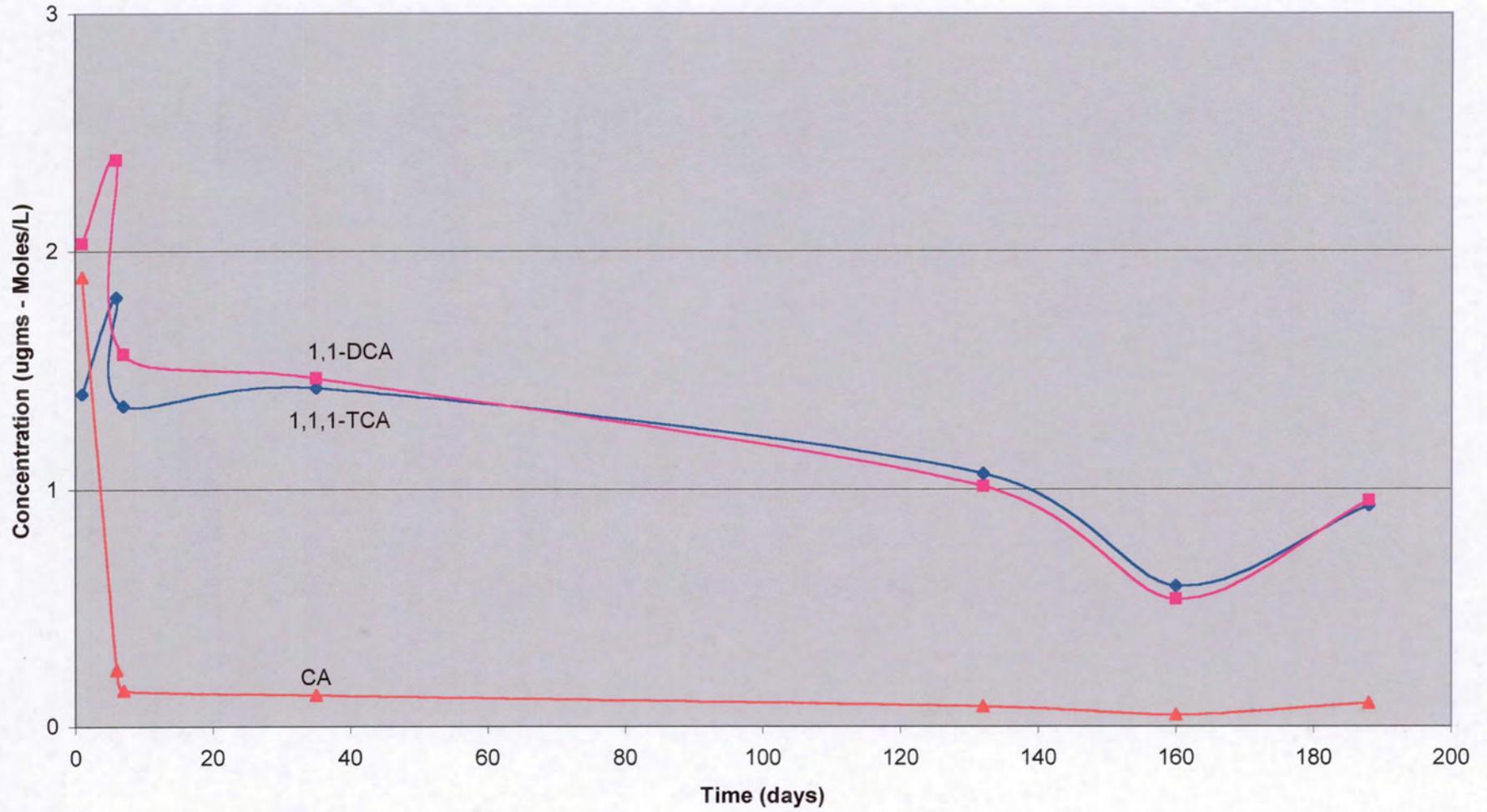
Hamilton Beach Pilot
Implant A-M9 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA



Hamilton Beach Pilot
Implants A-M10 - Concentration vs. Time
Molar Units - TCE, 1,1-DCE, cis-DCE, VC



Hamilton Beach Pilot
Implant A-M10 - Concentration vs. Time
Molar Units - 1,1,1-TCA, 1,1-DCA, CA





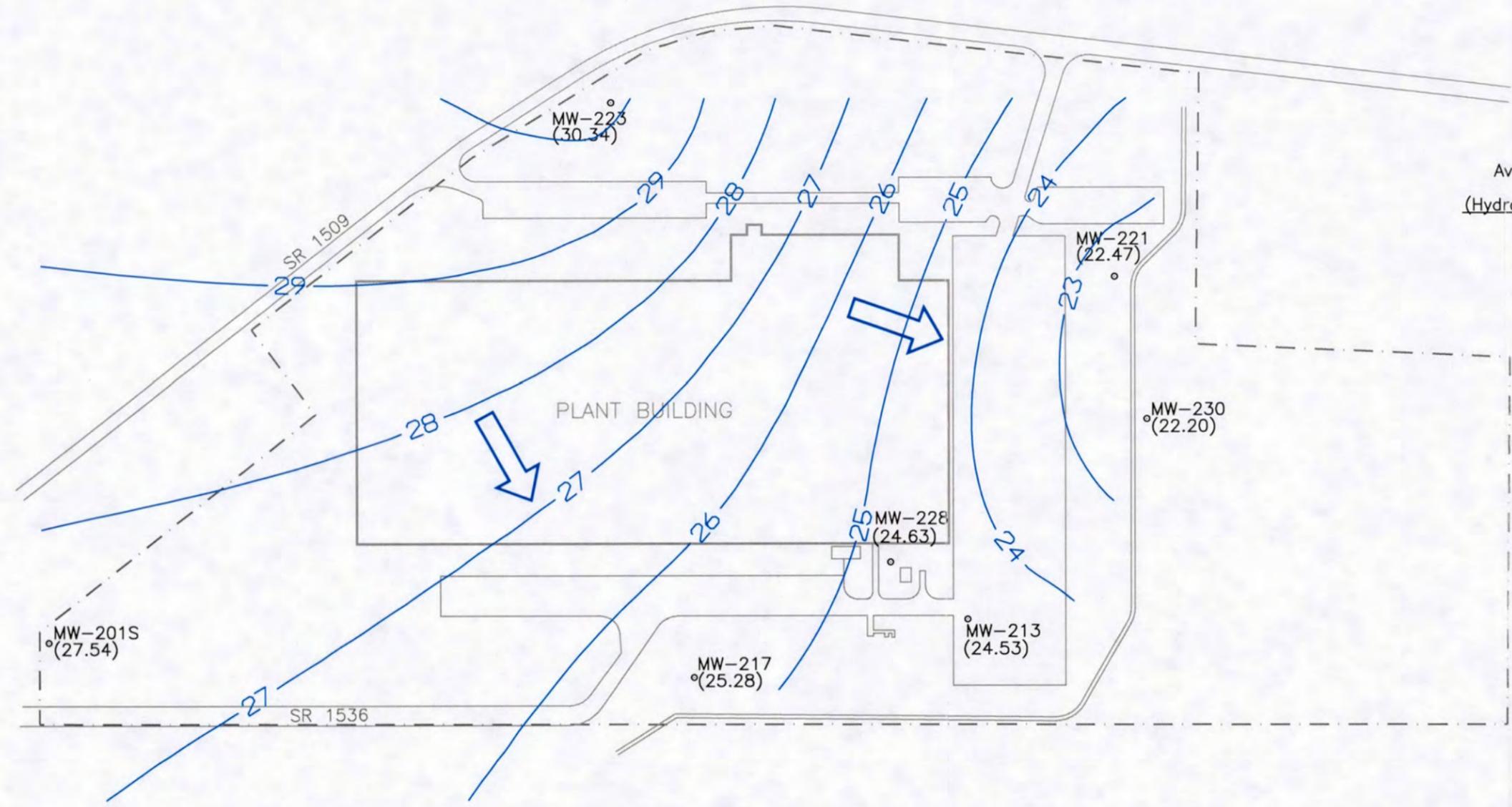


Average Groundwater Flow Velocity =

$$\frac{(\text{Hydraulic Conductivity})(\text{Hydraulic Gradient})}{\text{Effective Porosity}}$$

$$\frac{(0.07 \text{ ft/day})(0.006)}{0.12} =$$

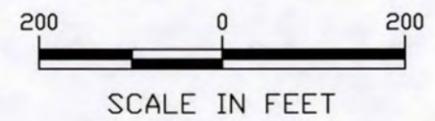
$$0.0035 \text{ ft/day}$$



LEGEND

- Monitoring Well
- ← Generalized Flow Direction
- Groundwater Elevation Contour

Water level elevations measured on 8/14/01 shown in parentheses.

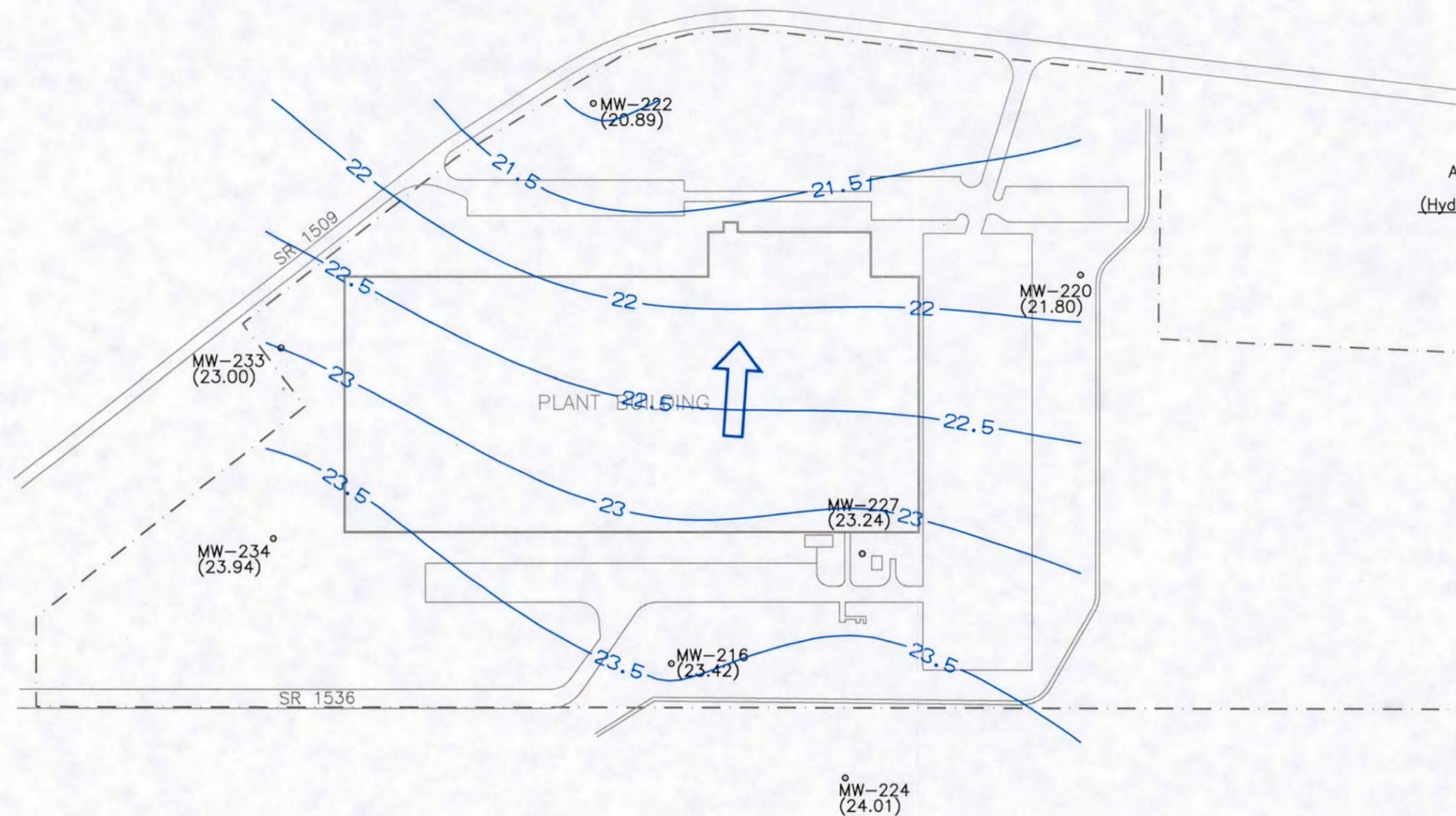


SCALE	AS SHOWN	DESIGNED BY	DATE	DRAWING TITLE		
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	TSH	17SEP01	Figure 3-1. Generalized Groundwater Flow Direction for Hydrogeologic Unit A Washington Facility		
	RADIAN INTERNATIONAL	CHECKED BY	DATE			
	A CH2M HILL COMPANY	JN	19SEP01			
	ISSUED BY	DATE	REV.			
	CLK	19SEP01		80396910.01	AFLO-0801	0



$$\text{Average Groundwater Flow Velocity} = \frac{(\text{Hydraulic Conductivity})(\text{Hydraulic Gradient})}{\text{Effective Porosity}}$$

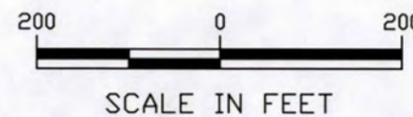
$$= \frac{(3 \text{ ft/day})(0.003)}{0.20} = 0.045 \text{ ft/day}$$



LEGEND

- Monitoring Well
- ← Generalized Flow Direction
- Groundwater Elevation Contour

Water level elevations measured on 8/14/01 shown in parentheses.

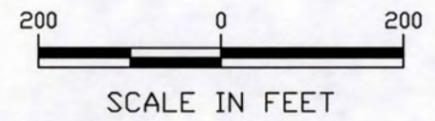
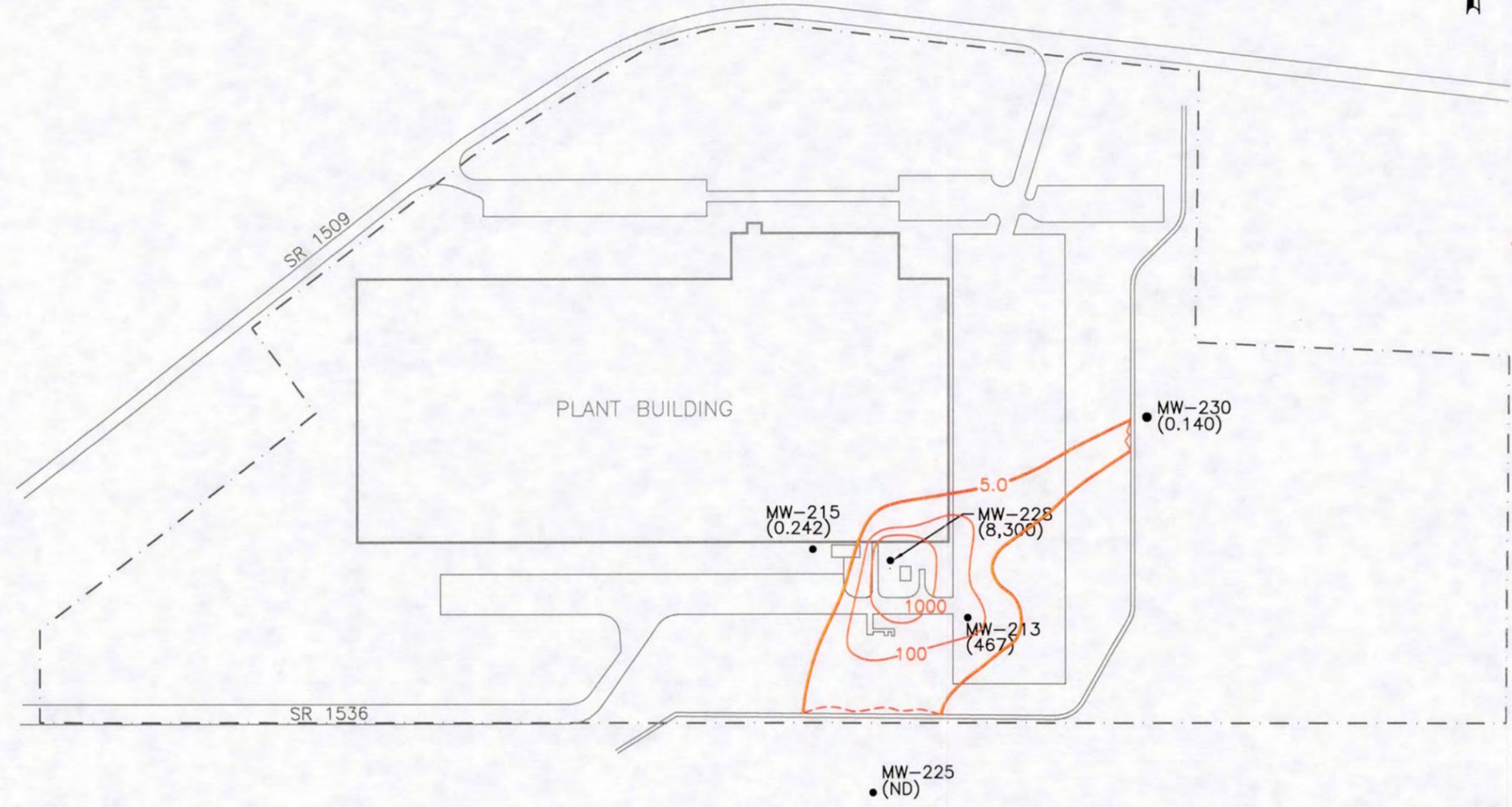


SCALE	AS SHOWN	REVISIONS	DATE	BY	DESCRIPTION	
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF					
	RADIAN INTERNATIONAL					
	A CH2M HILL GROUP COMPANY					
	8000 TRIUMPH PKW, NEW WALKEN, PA					
REVISIONS	DATE	BY	DESCRIPTION	CONTRACT NO.	DRAWING NO.	REV.
	17SEP01	TSH		80396910.01	BFLO-0801	0
	19SEP01	JN				
	19SEP01	CLK				

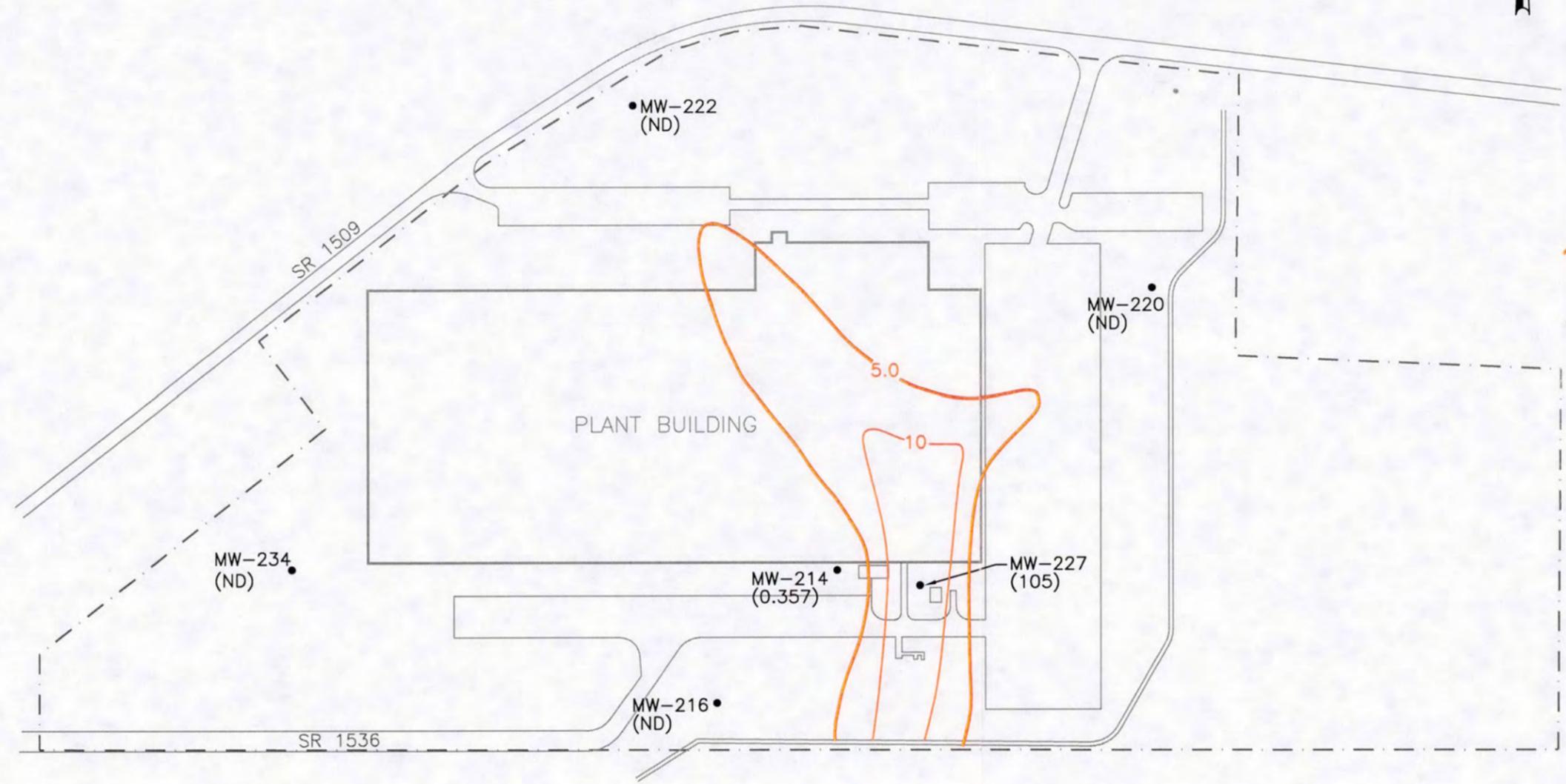
Figure 3-2. Generalized Groundwater Flow Direction for Hydrogeologic Unit B Washington Facility



- LEGEND**
- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
 - Outer Contour Line Indicates Estimated Quantitation Limit 5.0 ug/L
 - (ND) Not Detected

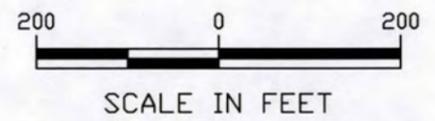


SCALE	AS SHOWN	REVISIONS BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	BY	DATE	
	 RADIANT INTERNATIONAL A DANIEL & JOHNSON GROUP COMPANY	TSH	17SEP01	Figure 3-3. Aproximate Distribution of TCE in Unit A Hamilton Beach Proctor Silex, Inc
		JN	19SEP01	
		CLK	19SEP01	
		CONTRACT NO.	80396910.01	
		ISSUE NO.	3-3-TCE	
		REV.	0	



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates Estimated Quantitation Limit 5.0 ug/L
- (ND) Not Detected

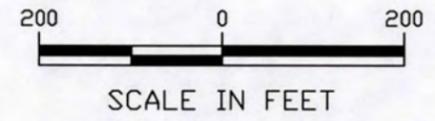
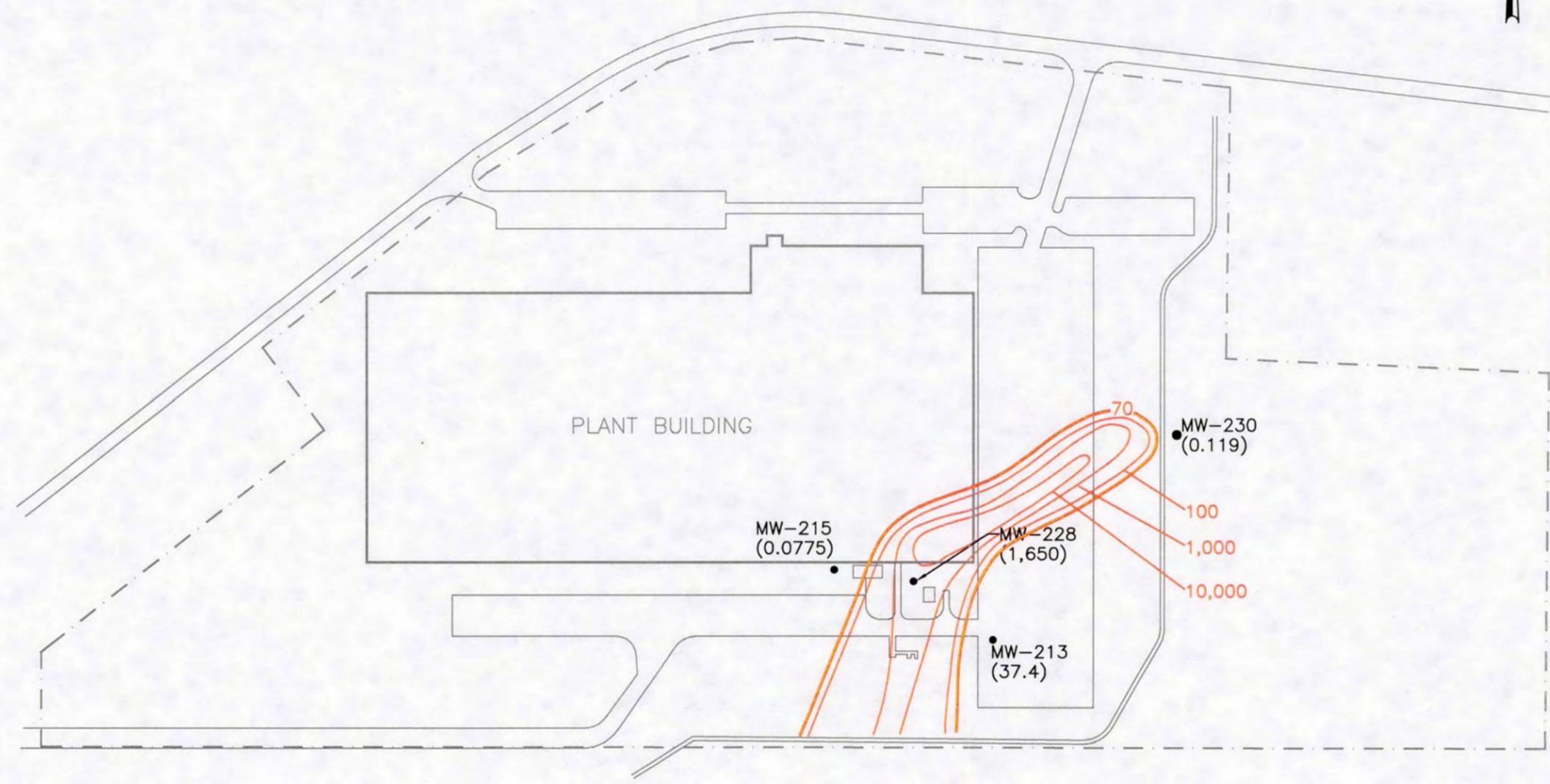


SCALE	AS SHOWN	DESIGNED BY	DATE	ISSUING TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DRAWN BY	DATE	Figure 3-4. Aproximate Distribution of TCE in Unit B
	 RADIANT INTERNATIONAL A CH2M HILL GROUP COMPANY	CHECKED BY	DATE	Hamilton Beach ♦ Proctor Silex, Inc
		APPROVED BY	DATE	CONTRACT NO.
		CLK	19SEP01	80396910.01
				ISSUING NO.
				3-4-TCE
				REV.
				0

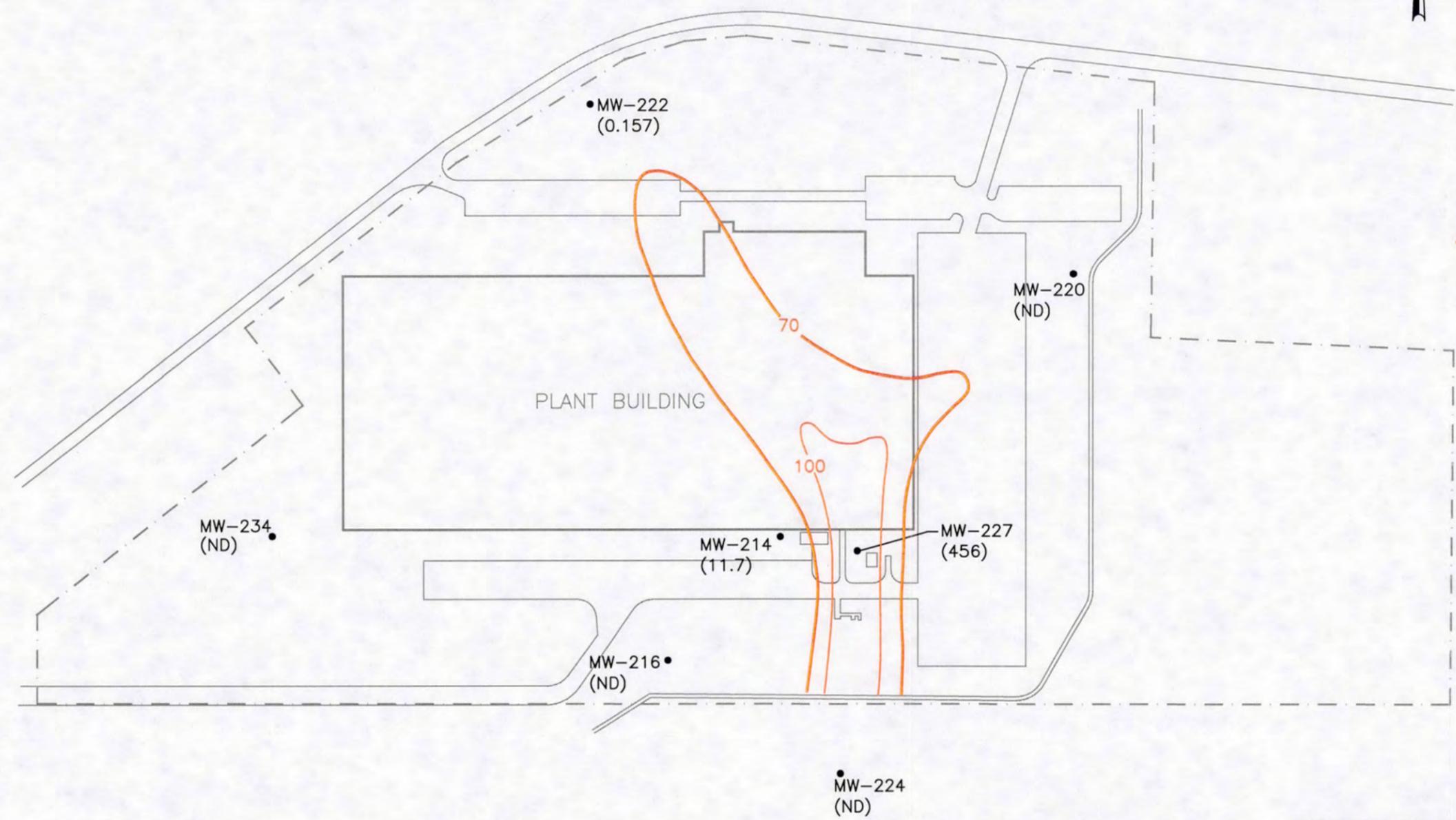


LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 70 ug/L
- (ND) Not Detected

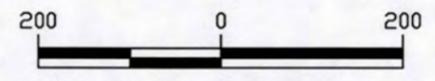


SCALE	AS SHOWN	REVISIONS BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DRN		
	RADIAN INTERNATIONAL	TSH	17SEP01	Figure 3-7. Approximate Distribution of cis-1,2-Dichloroethene in Unit A, Hamilton Beach Proctor Silex, Inc.
	A DANIEL & JOHNSON GROUP COMPANY	JN	19SEP01	
		CLK	19SEP01	
			80396910.01	3-7-CIS
				0



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 70 ug/L
- (ND) Not Detected



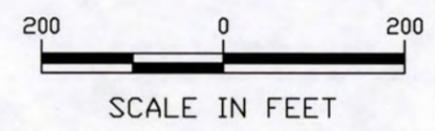
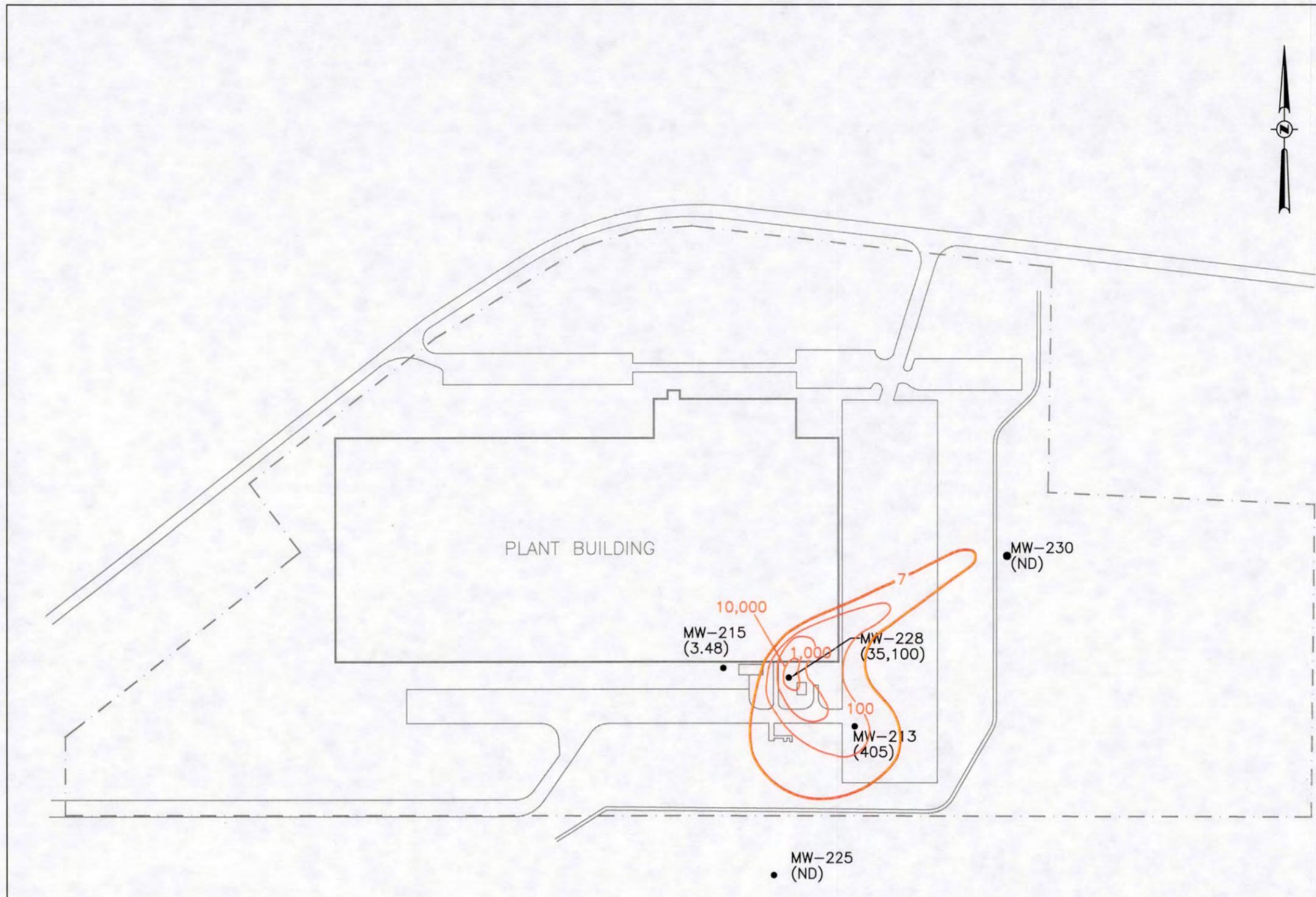
SCALE IN FEET

SCALE	AS SHOWN	REVISIONS BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	BY	DATE	
	 RADIANT INTERNATIONAL	TSH	17SEP01	Figure 3-8. Approximate Distribution of cis-1,2-Dichloroethene in Unit B
	A DANIEL & JOHNSON GROUP COMPANY	JN	19SEP01	Hamilton Beach Proctor Sillex, Inc
		APPROVED BY	DATE	CONTRACT NO.
		CLK	19SEP01	80396910.01
				DRAWING NO.
				3-8-CIS
				REV.
				0

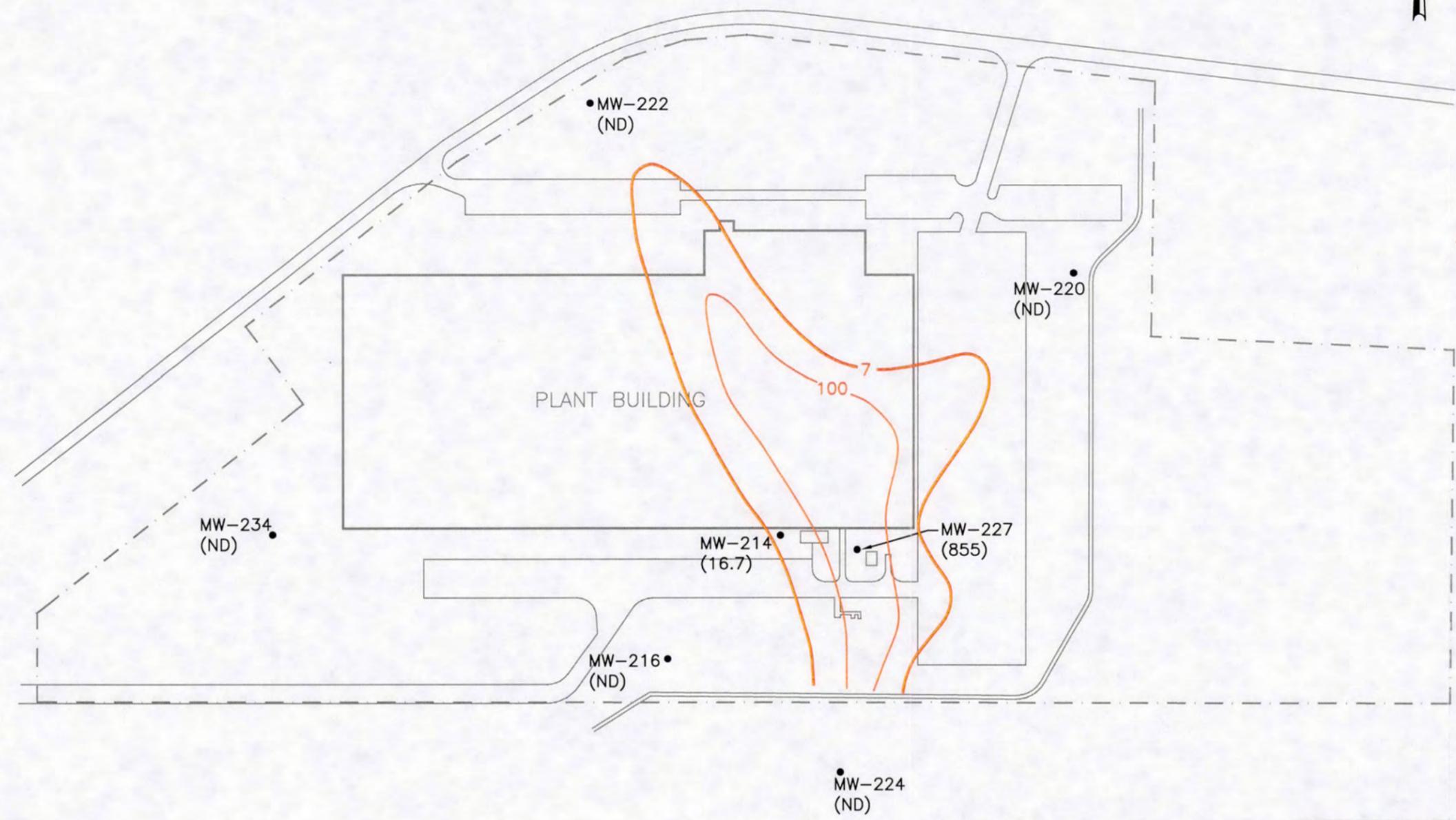


LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 7 ug/L
- (ND) Not Detected

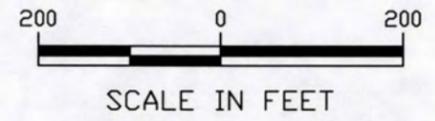


SCALE	AS SHOWN	DESIGNED BY	DATE	DRAWING TITLE		
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	TSH	17SEP01	Figure 3-11.		
	RADIAN INTERNATIONAL	JN	19SEP01	Approximate Distribution		
	A DANIEL & JOHNSON GROUP COMPANY	CLK	19SEP01	of 1,1-Dichloroethene in Unit A		
				Hamilton Beach & Proctor Silex, Inc		
				CONTRACT NO.	DRAWING NO.	REV.
				80396910.01	3-11-DCE	0



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 7 ug/L
- (ND) Not Detected

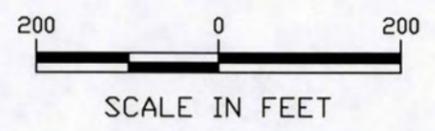
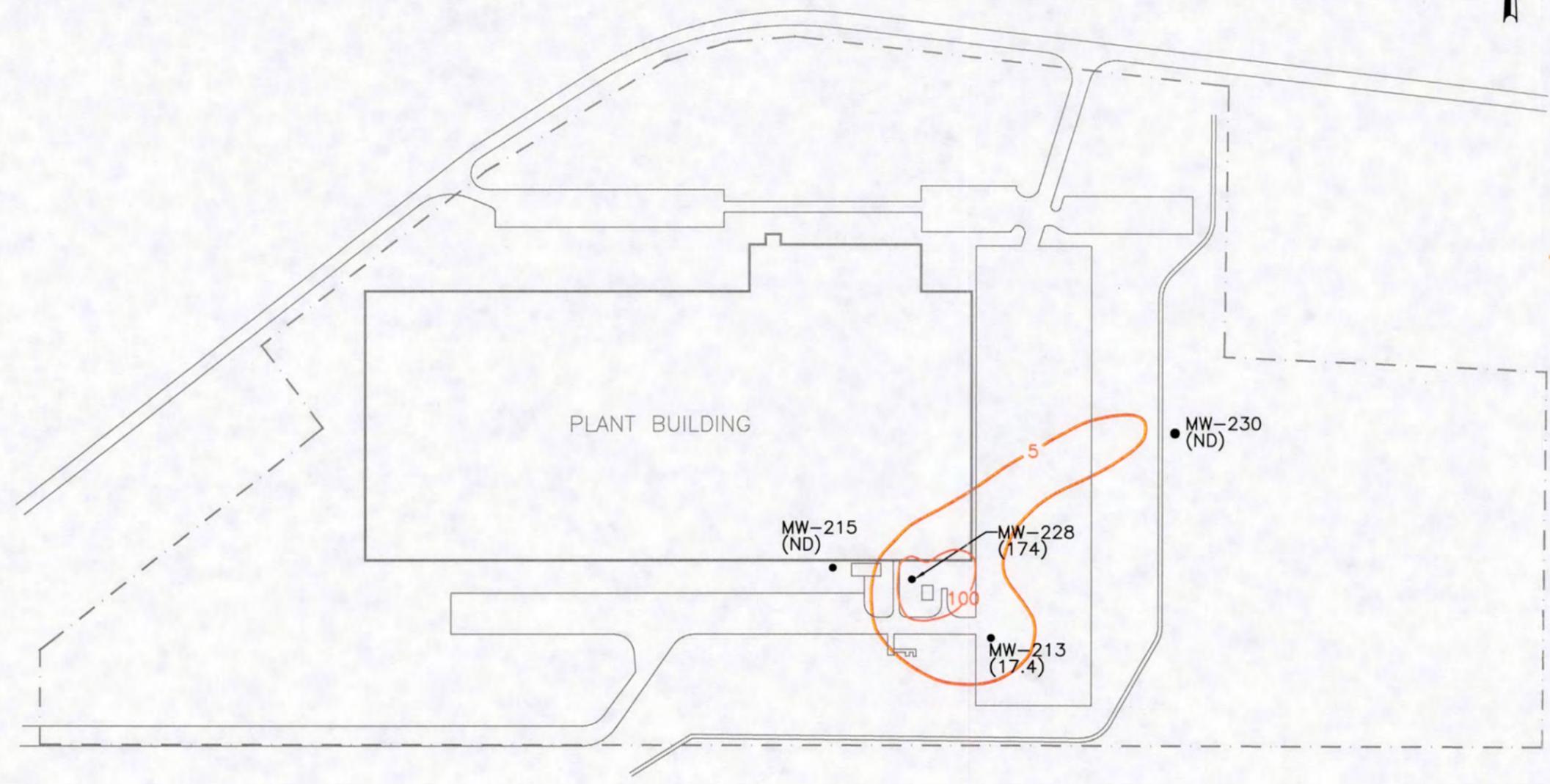


SCALE	AS SHOWN	REVISIONS	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	ISSUED BY	DATE	Figure 3-12. Approximate Distribution of 1,1-Dichloroethene in Unit B Hamilton Beach ♦ Proctor Silex, Inc
	RADIAN INTERNATIONAL A DANIEL & JOHNSON GROUP COMPANY	CREATED BY	DATE	
		APPROVED BY	DATE	
		CLK	19SEP01	80396910.01 3-12-DCE 0

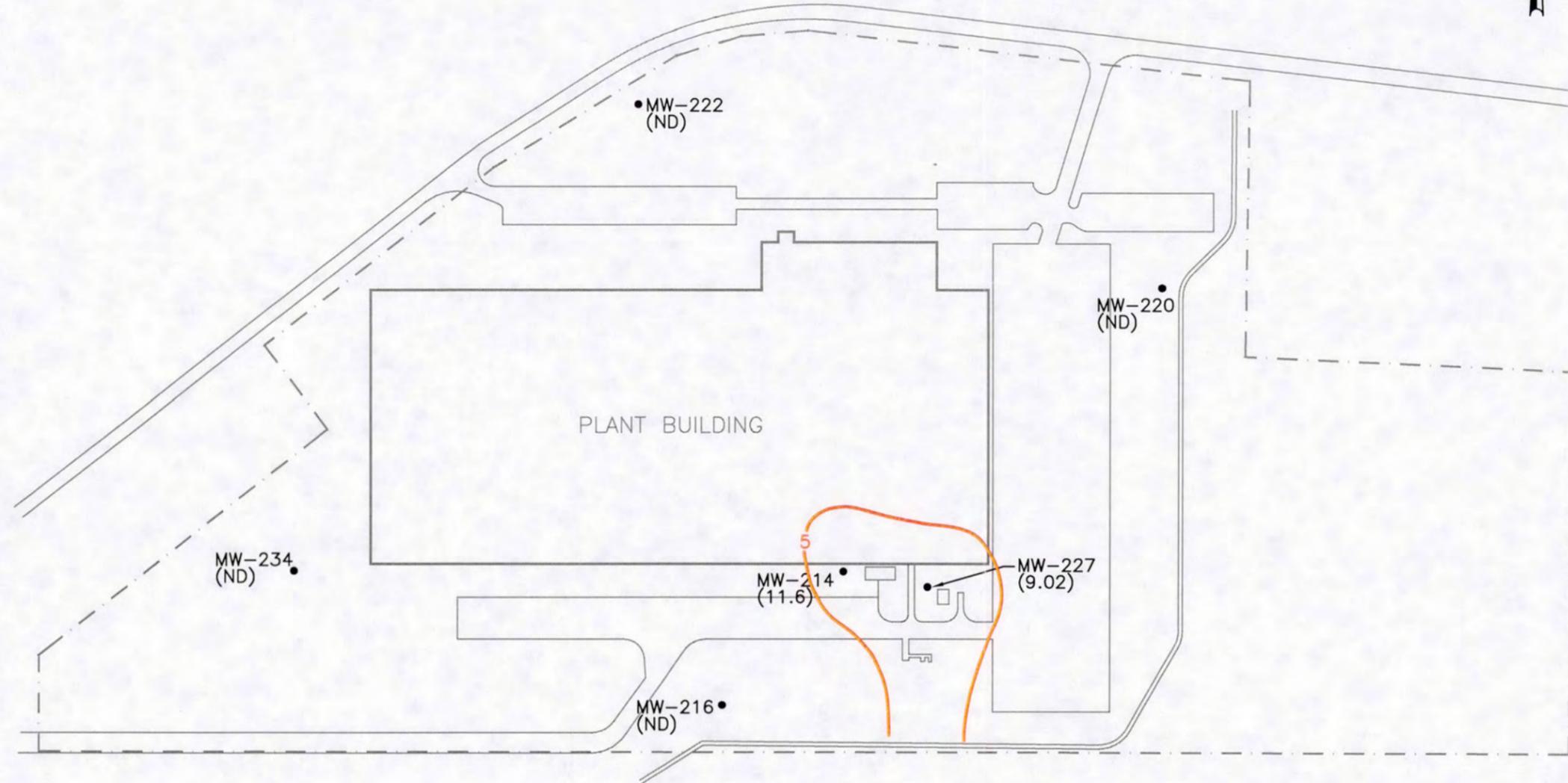


LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates Estimated Quantitation Limit of 5 ug/L
- (ND) Not Detected

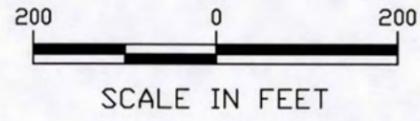


SCALE	AS SHOWN	REVISION BY	DATE	REVISION TITLE	Figure 3-15. Approximate Distribution of Vinyl Chloride in Unit A Hamilton Beach ♦ Proctor Silex, Inc.		
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DRAWN BY	DATE		CONTRACT NO.	ISSUANCE NO.	REV.
	 RADIAN INTERNATIONAL A DANBARD & MOORE GROUP COMPANY	TSH	17SEP01		80396910.01	3-15-VC	0
		CHECKED BY	DATE				
		JN	19SEP01				
		APPROVED BY	DATE				
		CLK	19SEP01				



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates Estimated Quantitation Limit of 5 ug/L
- (ND) Not Detected

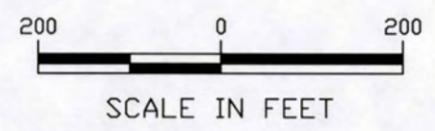
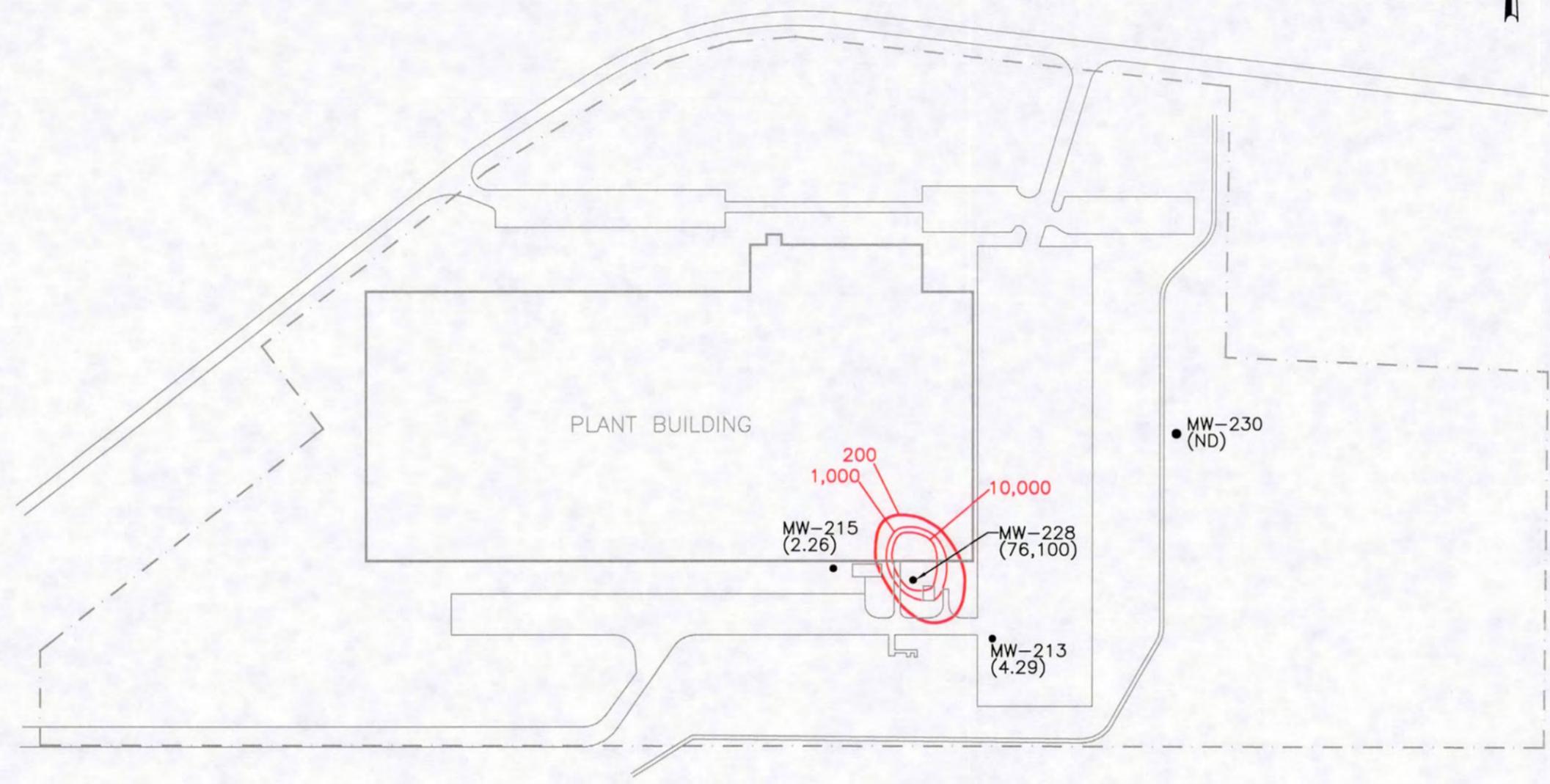


SCALE	AS SHOWN	REVISIONS BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	TSH	17SEP01	Figure 3-16. Approximate Distribution of Vinyl Chloride in Unit B Hamilton Beach Proctor Silix, Inc.
	 RADIANT INTERNATIONAL A DANIEL & JOHNSON GROUP COMPANY	JN	19SEP01	
		APPROVED BY	DATE	
		CLK	19SEP01	
		CONTRACT NO.	80396910.01	
		DRAWING NO.	3-16-VC	
		REV.	0	



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 200 ug/L
- (ND) Not Detected

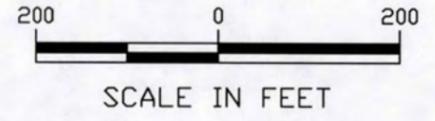
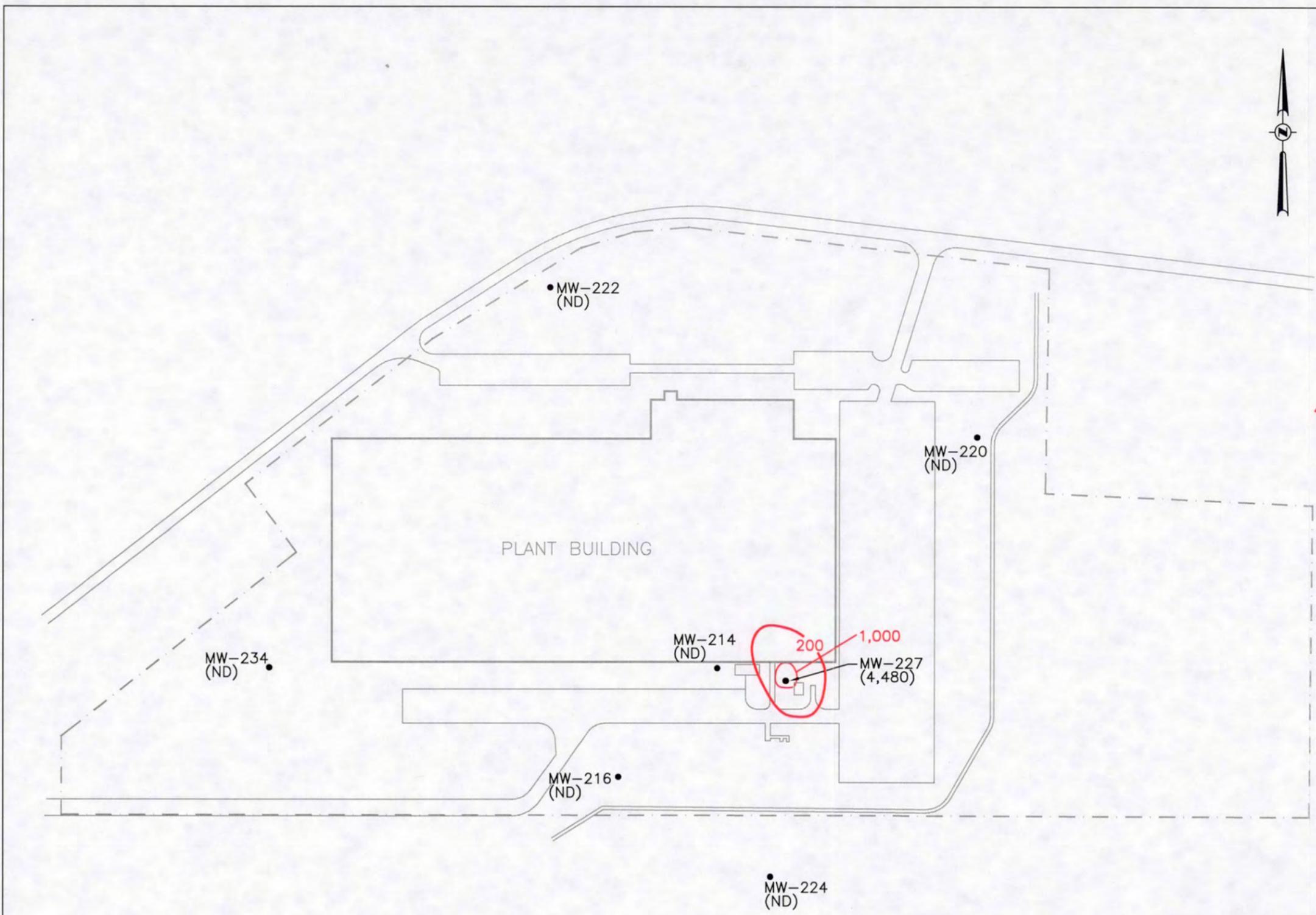


SCALE	AS SHOWN	DESIGNED BY	DATE	ISSUE TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DESIGNED BY	DATE	Figure 3-19.
	 RADIANT INTERNATIONAL A CHAMBER & MOORE GROUP COMPANY	TSH	17SEP01	Approximate Distribution
		OWNED BY	DATE	of 1,1,1-Trichloroethane in Unit A
		JN	19SEP01	Hamilton Beach Proctor Silex, Inc
		APPROVED BY	DATE	CONTRACT NO.
		CLK	19SEP01	80396910.01
				ISSUE NO.
				3-19-TCA
				REV.
				0



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 200 ug/L
- (ND) Not Detected

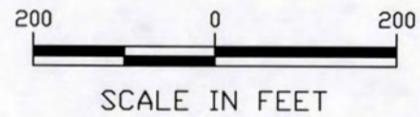
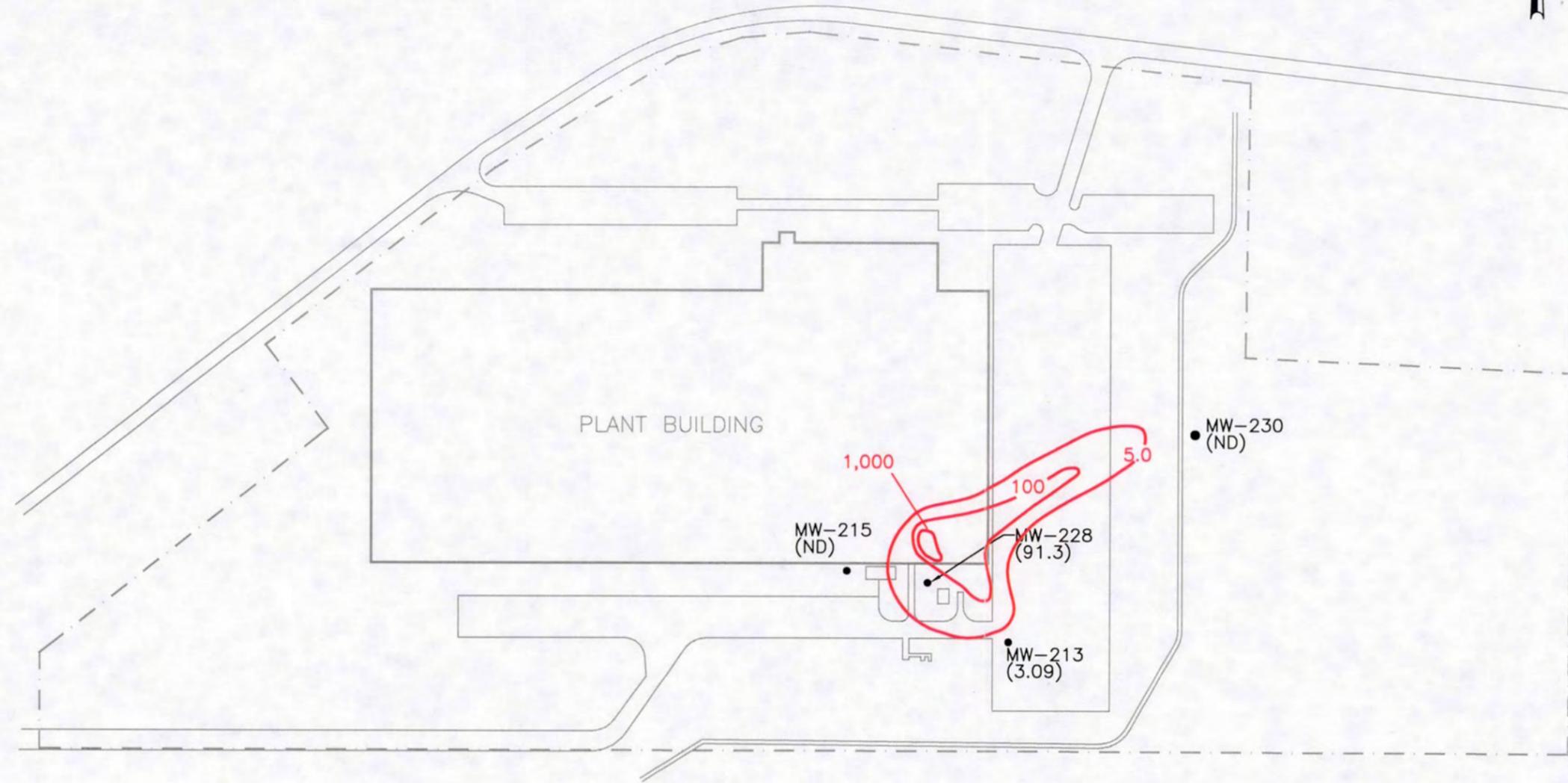


SCALE	AS SHOWN	REVISIONS BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	TSH	17SEP01	Figure 3-20. Approximate Distribution 1,1,1-Trichloroethane in Unit B Hamilton Beach Proctor Silix, Inc
	 RADIANT INTERNATIONAL A DANBARD & MOORE GROUP COMPANY	JN	19SEP01	
		APPROVED BY	DATE	CONTRACT NO.
		CLK	19SEP01	80396910.01
				ISSUE NO.
				3-20-TCA
				REV.
				0

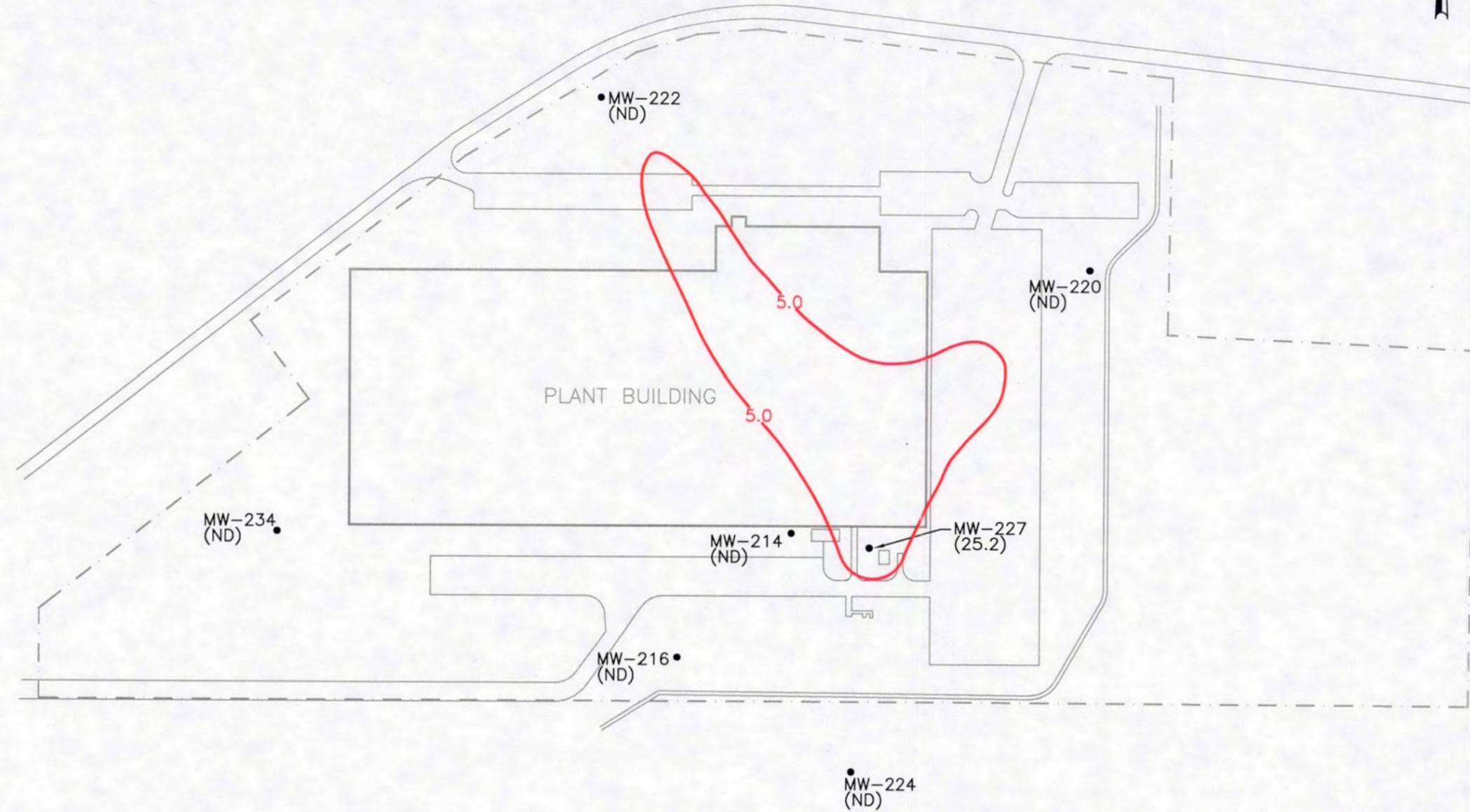


LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates Estimated Quantitation Limit 5.0 ug/L
- (ND) Not Detected

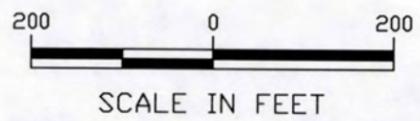


SCALE	AS SHOWN	DESIGNED BY	DATE	DRAWING TITLE	Figure 3-23. Approximate Distribution of 1,2-Dichloroethane in Unit A Hamilton Beach & Proctor Silex, Inc		
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DRAWN BY	DATE				
		TSH	17SEP01				
		JN	19SEP01				
		CLK	19SEP01				
	 RADIANT INTERNATIONAL A DANIEL & BOONE GROUP COMPANY			CONTRACT NO.	80396910.01	DRAWING NO.	3-23-DCA
				REV.			0



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates Estimated Quantitation Limit 5.0 ug/L
- (ND) Not Detected

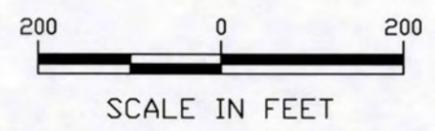
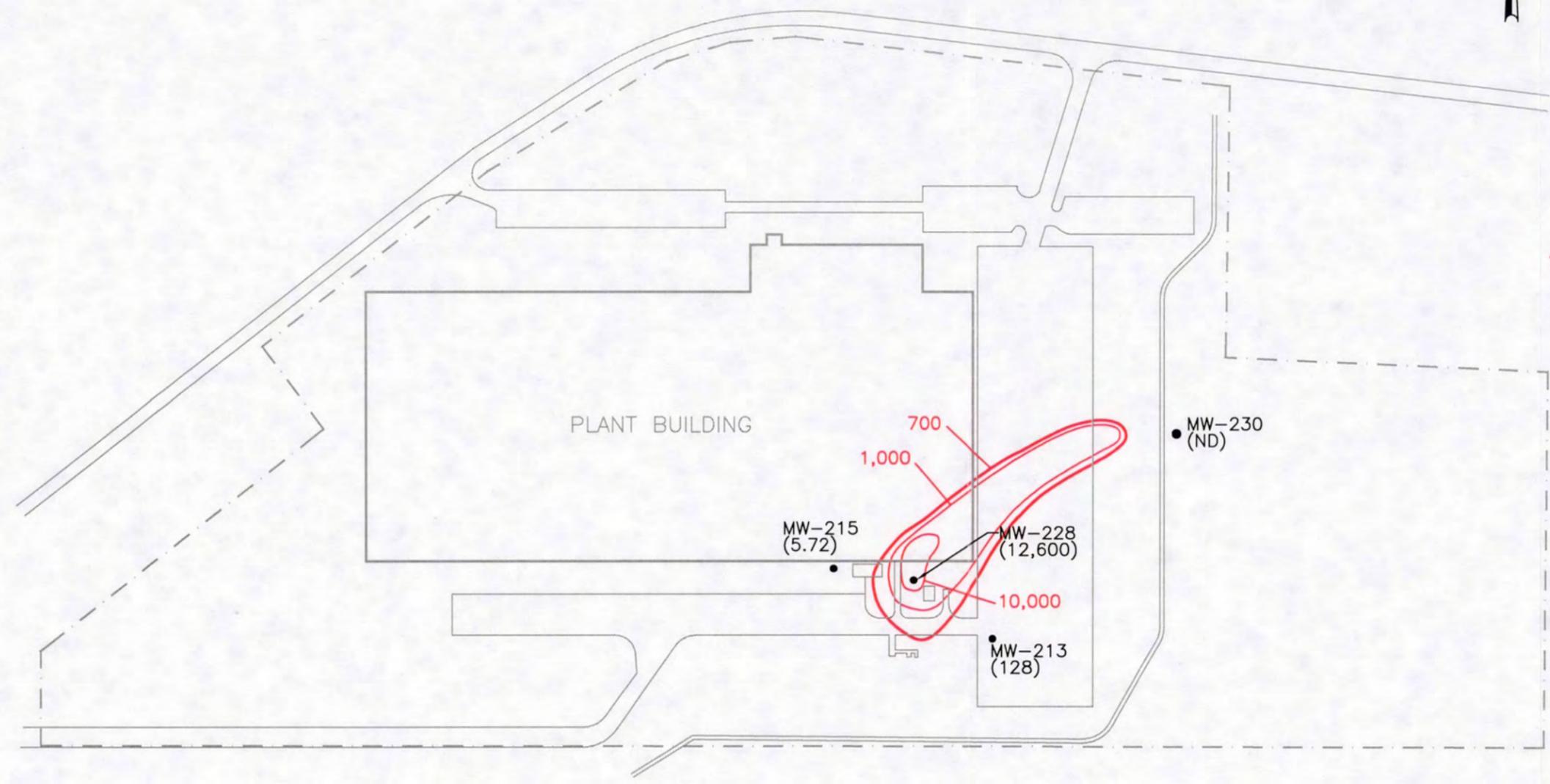


SCALE	AS SHOWN	DESIGNED BY	DATE	DRAWING TITLE		
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DRN BY	DATE	Figure 3-24.		
		TSH	17SEP01	Approximate Distribution of		
		JN	19SEP01	1,2-Dichloroethane in Unit B		
		CLK	19SEP01	Hamilton Beach ♦ Proctor Silex, Inc		
				CONTRACT NO.	DRAWING NO.	REV.
				80396910.01	3-24-DCA	0



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 700 ug/L
- (ND) Not Detected

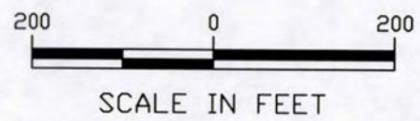


SCALE	AS SHOWN	REVISION BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	TSH	17SEP01	Figure 3-27. Approximate Distribution of 1,1-Dichloroethane in Unit A Hamilton Beach Proctor Silex, Inc
	 RADIANT INTERNATIONAL A DANIEL & JOHNSON GROUP COMPANY	JN	19SEP01	
		CLK	19SEP01	
		CONTRACT NO.	80396910.01	
		DRAWING NO.	3-27-DCA	
		REV.	0	

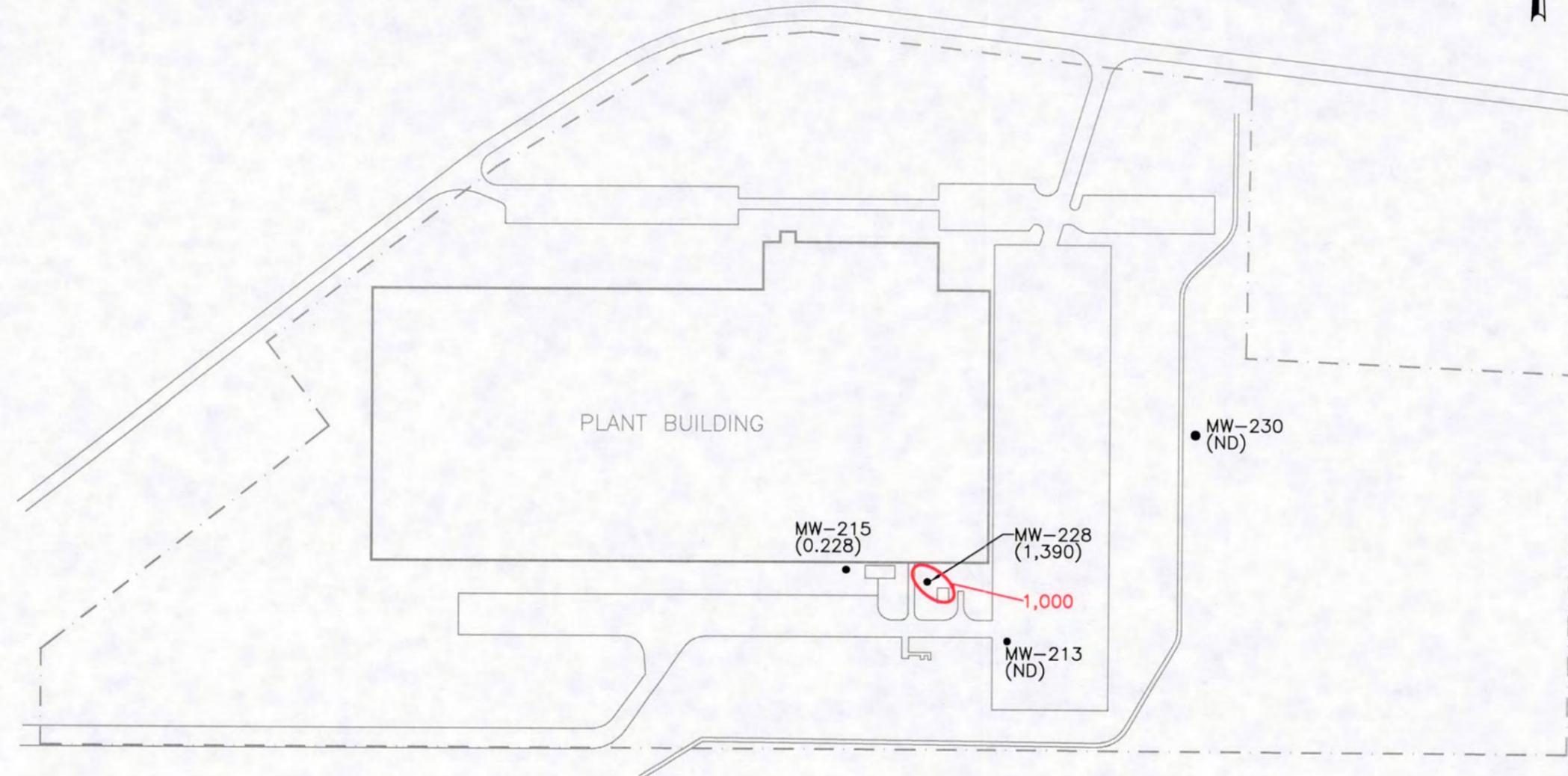


LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 700 ug/L
- (ND) Not Detected



SCALE	AS SHOWN	DESIGNED BY	DATE	DRAWING TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	DRN BY	DATE	Figure 3-28.
		TSH	17SEP01	Approximate Distribution
		JN	19SEP01	1,1-Dichloroethane in Unit B
		CLK	19SEP01	Hamilton Beach & Proctor Silex, Inc.
				CONTRACT NO.
				80396910.01
				DRAWING NO.
				3-28-DCA
				REV.
				0



LEGEND

- Monitoring Well Location and Reported Concentration in ug/L (August 2001)
- Outer Contour Line Indicates 2L Standard of 1,000 ug/L
- (ND) Not Detected

PLANT BUILDING

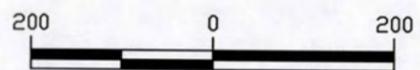
MW-215
(0.228)

MW-228
(1,390)

MW-213
(ND)

MW-230
(ND)

MW-225
(ND)



SCALE IN FEET

SCALE	AS SHOWN	REVISIONS BY	DATE	REVISION TITLE
	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF	ORDERED BY	DATE	Figure 3-31. Approximate Distribution of Toluene in Unit A Hamilton Beach Proctor Silex, Inc.
		TSH	17SEP01	
		JN	19SEP01	
		APPROVED BY	DATE	CONTRACT NO.
		CLK	19SEP01	80396910.01
				ISSUE NO.
				3-31-TOL
				REV.
				0