GROUNDWATER MONITORING REPORT FOR 2008 AND 2009
OMEGA CHEMICAL CORPORATION SUPERFUND SITE
OPERABLE UNIT 2

LOS ANGELES COUNTY, CALIFORNIA

EPA CONTRACT NO. EP-S9-08-04
EPA WORK ASSIGNMENT NO. 038-RICO-09BC
CH2M HILL PROJECT NO. 386743

Prepared for
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Prepared by
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3550 Vine Street, Suite 320
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May 2011

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Acronyms and Abbreviations

µg/L	microgram(s) per liter
°C	degree(s) Celsius
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-trichloroethane
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2,3-TCP	1,2,3-trichloropropane
1,2-DCA	1,2-dichloroethane
AMK	former Angeles Chemical Company and former McKesson Corporation
amsl	above mean sea level
B	(soil) boring
bgs	below ground surface
CDM	Camp Dresser & McKee
CENCO	former CENCO Refinery
cis-1,2-DCE	cis-1-2-dichloroethene
CLP	Contract Laboratory Program
COV	Coefficient of Variation
DO	dissolved oxygen
EPA	United States Environmental Protection Agency
F11	trichlorofluoromethane [Freon 11]
F113	1,1,2-trichloro-1,2,2-trifluoroethane [Freon 113]
F12	dichlorodifluoromethane [Freon 12]
FS	feasibility study
FSP	field sampling plan
ft/ft	foot (feet) per foot
HPLC	high-performance liquid chromatography
J	estimated value
L	liter

LCL	Lower Confidence Limit
MCL	maximum contaminant level
MS	matrix spike
MSD	matrix spike duplicate
MTBE	methyl tertiary butyl ether
MW	EPA monitoring wells
NA	not applicable
NAVD	North American Vertical Datum
ND	non-detect
NDMA	n-nitrosodimethylamine
NE	not established
NTU	nephelometric turbidity unit
OFRP	Oil Field Reclamation Project
Omega	Omega Chemical Corporation
Omega Site	Omega Chemical Corporation Superfund Site
OPOG	Omega Chemical Site PRP Organized Group
ORP	oxidation-reduction potential
OU	operable unit
OW	OPOG monitoring wells
PCE	perchloroethylene (tetrachloroethylene)
PHG	public health goal
PID	photoionization detector
PP	push-probe sampling
PRP	potentially responsible party
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act of 1978
RI	remedial investigation
RI/FS	remedial investigation/feasibility study

SAP	sampling and analysis plan
SCH	schedule
SST	stainless steel
TCE	trichloroethene
TOC	top of casing
trans-1,2-DCE	trans-1,2-dichloroethene
UCL	Upper Confidence Limit
VOA	volatile organic analytes
VOC	volatile organic compound
WA	Work Assignment
WDI	Waste Disposal, Inc.

1. Introduction

This groundwater monitoring report has been prepared to support the United States Environmental Protection Agency (EPA) in conducting a remedial investigation/feasibility study (RI/FS) at the Omega Chemical Corporation (Omega) Superfund site (Omega Site), located in Whittier, California (Figure 1-1). The report summarizes the results of the March 2008 (1Q2008), March 2009 (1Q2009), and September 2009 (3Q2009) groundwater sampling events performed by CH2M HILL for Operable Unit (OU) 2 of the Omega Site. In addition, sampling data for OU1 of the Omega Site, and other non-EPA, facility-specific well data for the facilities located with OU2 were included in the analyses conducted to evaluate water level and water quality trends at the Omega Site. This report covers 2 years of groundwater monitoring. EPA performed only one sampling event in 2008 due to funding considerations.

1.1 Background

This section briefly describes the operational history of the Omega facility and the past investigations and remediation activities conducted at the Omega Site. Detailed discussions regarding the Omega Site are provided in the Final RI Report for the site (CH2M HILL, 2010).

Omega is a former refrigerant/solvent recycling operation located in Whittier, California, a community of approximately 85,000 people. The Omega property occupies Los Angeles County Assessor Tract Number 13486 (Lots 3 and 4). It covers an area of approximately 41,000 square feet (200 feet wide by 205 feet long) and contains two structures: a 140-foot by 50-foot warehouse, and an 80-foot by 30-foot administrative building. A loading dock is attached to the rear of the warehouse. The Omega property is paved with concrete and secured with a 7-foot-high perimeter fence topped with razor wire, and locking gate. The facility operated as a Resource Conservation and Recovery Act of 1978(RCRA) solvent and refrigerant recycling and treatment facility from approximately 1976 to 1991, handling primarily chlorinated hydrocarbons and chlorofluorocarbons. Drums and bulk loads of waste solvents and chemicals from various industrial activities were processed at the former Omega facility to form commercial products. Chemical, thermal, and physical treatment processes were reportedly used to recycle the waste materials. Wastes generated from these treatment and recycling activities included distillation column (still) bottoms, aqueous fractions, and nonrecoverable solvents. Prior to constructing the buildings at the Omega property in July 1951, the property was used for agriculture.

The Omega Site was placed on the National Priorities List (NPL) in January 1999. EPA currently manages the Omega Site as three OUs (OU1, OU2, and OU3). OU1 includes the soil and groundwater contamination at the former Omega facility, located at 12504 and 12512 East Whittier Boulevard, and approximately 100 feet west-southwest of Putnam Street.

OU2 generally includes the groundwater-contaminated area that extends from the former Omega facility to approximately 4.5 miles south-southwest of the site. A site map showing the approximate boundaries of OU1 and OU2 is presented in Figure 1-2.

EPA created OU3 to address indoor air impacts at the former Omega property, as well as adjacent and nearby properties where the underlying vadose zone has been affected by contamination derived from the former Omega property.

Groundwater at the Omega Site is found to be primarily affected by volatile organic compounds (VOCs). Chlorinated hydrocarbons (for example, tetrachloroethylene [PCE], trichloroethene [TCE], and others), freons (trichlorofluoromethane [F11] and 1,1,2-trichloro-1,2,2-trifluoroethane [F113]), and emergent compound 1,4-dioxane are among the contaminants with the highest concentrations.

1.2 Monitoring Wells

The groundwater monitoring well network at the Omega Site consists of the monitoring wells installed by EPA and the Omega Site Potentially Responsible Party (PRP) Organized Group (OPOG):

- **OPOG** installed Monitoring Wells OW1 through OW10 at OU1 and OU2. Boring logs, downhole geophysical logs, and well completion diagrams for Wells OW1 to OW8 can be found in the Final RI report (CH2M HILL, 2010). Wells OW9 and OW10 were installed in December 2008 as part of the OU1 interim groundwater extraction system.
- **EPA and another PRP group** installed Monitoring Wells MW1 through MW31. Boring logs, geophysical logs, and well completion diagrams are also included in the Final RI report (CH2M HILL, 2010).

The groundwater monitoring wells installed by Camp Dresser & McKee (CDM) on behalf of OPOG are collectively referred to as "OPOG wells." These wells are sampled by CDM on a biannual basis. When CDM performs this sampling, CH2M HILL collects split samples concurrently on behalf of the EPA.

The EPA monitoring wells are generally located downgradient of OU1. CH2M HILL samples the EPA wells on a biannual basis.

The convention used for the well identifications includes "OW" for the OPOG monitoring wells, a sequential number, and a suffix "A" (shallow well) or "B" (deep well). EPA monitoring wells are designated as "MW" plus a sequential number and a suffix "A" (shallowest well) through "D" (deepest well).

Figure 1-2 is a well location map for all monitoring wells. Well survey and construction information is provided in Table 1-1.

1.3 Report Organization

This report is organized into sections that describe the activities and analytical results of the sampling events stated above. An overview of this document is provided below:

- Section 1 — Introduces the groundwater investigation, including background information, monitoring well information, and report organization.
- Section 2 — Describes the sampling approach and chronology.
- Section 3 — Provides a discussion of the analytical data collected during the OU1 oversight sampling. Also provides a discussion of the water level and analytical data collected at OU2.
- Section 4 — Summary of Findings
- Section 5 —Recommendations
- Section 6 —List of all references.

The appendixes to this document include the following:

A – Monitoring Well Purge Forms (on CD only)
B – Chain-of-Custody Forms (on CD only)
C – Data Needs and Uses (on CD only)
D – OU2 Shallow Groundwater Gradient Calculations
E – VOC Detection Summary: 1Q2008, 1Q2009, and 3Q2009
F – OU1 and OU2 Lab Reports (on CD only)
G – Data Quality Assessment
H – VOC Time Series Plots
I – Statistical Plots

2. Sampling Approach

CH2M HILL collected groundwater samples from the EPA monitoring wells in March 2008, March 2009, and September 2009. An overview of sampling methods and analysis, laboratory assignments, and quality assurance/quality control (QA/QC) is presented in this section. Groundwater samples were collected and analyzed in accordance with the protocols outlined in the field sampling plan (FSP) (CH2M HILL, 2004a and 2004c) and Quality Assurance Project Plan (QAPP) (CH2M HILL, 2004b and 2004d), and the 2006 sampling and analysis plan (SAP) Addendum 1 (CH2M HILL, 2006a and 2006b).

2.1 Sample Collection Methods

The following subsections describe the general sample collection procedures for groundwater sampling at the OU2 monitoring well network. Monitoring well purge forms are provided in Appendix A and chain-of-custody forms in Appendix B.

2.1.1 EPA Well Sampling

EPA monitoring wells are equipped with dedicated pump tubing and bladder pumps to allow sampling using low-flow sampling techniques. During well purging, careful continuous measurements of field parameters including specific conductance, pH, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity were used to assess when purged water had reached equilibrium. A flow-through cell was used to check that the purge water was continuously monitored. Each well was pumped until the measured field parameters stabilized within 10 percent over three successive readings prior to collecting samples.

If wells do not produce enough water for purging with a pump, the dedicated bladder pump is manually removed from the well, a disposable polyethylene bailer and new polyethylene string is used to collect samples, and the bladder pump is manually lowered down to the same depth in the well. During 2009 first quarter sampling events, Wells MW8A, MW9A, MW11, and MW19 were sampled with bailers, and Wells MW13A, MW16A, and MW17A were not sampled because of dry conditions. During 2009 third quarter sampling events, several wells were either dry or not enough groundwater was present for bailer samplings. These included Wells MW8A, MW9A, MW11, MW13A, MW16A, MW17A, MW19, MW20C, and MW25D.

2.1.2 Field Parameters Measurement

A digital combination conductivity-pH-temperature-DO-ORP meter was used for specific conductance, pH, temperature, DO, and ORP measurements. Turbidity measurements were made with a digital readout turbidity meter (readout in nephelometric turbidity units [NTUs]). A photoionization detector (PID) was used to measure organic vapor measurements (headspace) inside the well immediately after opening the well caps. Equipment used to measure field parameters was maintained and calibrated daily according to the manufacturer's specifications.

2.1.3 Depth to Water Measurement

Depth to groundwater was measured at monitoring wells immediately prior to well purging and sampling activities to establish a static water level. Water levels were measured with a decontaminated electronic water level indicator (sounder) to the nearest 0.01-foot. Water levels were also measured at regular intervals during purging activities to check that a constant drawdown was maintained during pumping. A final water level was recorded after sample collection. The reference point for water level measurement was the top of the casing. For wells with both inner and outer (conductor) casing, the top of the inner casing was used as the reference point.

2.2 Sample Analysis and Laboratory Assignments

Monitoring wells were sampled for VOCs (including methyl tertiary butyl ether [MTBE]) and 1,4-dioxane.

A summary of the above analytical parameters and applicable regulatory limits is provided in the Data Needs and Uses table of the QAPP (CH2M HILL, 2004d), which is also included in Appendix C.

The groundwater samples were analyzed using the EPA-approved methods described in SAP Addendum 1 (CH2M HILL, 2006a and 2006b).

2.3 Quality Assurance/Quality Control

QA/QC samples were collected in accordance with the protocols outlined in the FSP and QAPP. QC samples include ambient blanks, equipment blanks, field duplicates, laboratory QC samples (for matrix spike and matrix spike duplicates [MS/MSDs]), and temperature blanks. Ambient and equipment blanks were analyzed for VOCs and 1,2,3-trichloropropane (1,2,3-TCP). Field duplicates and laboratory QC samples were analyzed for the standard list of parameters as presented in Section 2.2. Twice the normal volume of sample was collected for laboratory QC samples. Equipment blanks were collected only during OPOG well sampling.

Provided below is a brief description of the QA/QC samples collected during this investigation.

- **Ambient Blanks.** Ambient blanks were collected to verify that contamination was not introduced to samples during collection, handling, or shipping. They were prepared by pouring high-performance liquid chromatography (HPLC) water directly into the sample bottles in the field. Ambient blanks were prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. Ambient blanks were collected at a frequency of 1 in every 10 consecutively collected samples or 1 per week, whichever was greater.
- **Equipment Blanks**. Equipment blanks are collected to verify whether or not contamination was introduced to samples through the repeated use of sampling equipment at different sample locations. One equipment blank per sampling event was collected during biannual sampling of OPOG wells. The OPOG wells have dedicated

pump tubing, but not dedicated pumps. Equipment blanks were prepared by pouring HPLC water directly into the pump inlet, through the pump, and into sample containers. These samples are not included in this report. Equipment blanks are not collected for EPA well sampling.

- **Field Duplicates.** The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Field duplicates were labeled and packaged in the same manner as other samples so that the laboratory cannot distinguish between samples and duplicates. Each duplicate was taken using the same sampling and preservation method as other samples. An attempt was made to collect duplicate samples from monitoring wells that are known or suspected to contain the chemicals that are being analyzed. Field duplicates were collected at a frequency of 1 in every 10 consecutively collected samples or 1 per week, whichever was greater.
- **Laboratory QC Samples**. Laboratory QC samples were collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analyte and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method. Twice the normal water volume was collected for laboratory QC samples. Laboratory QC samples were collected at a frequency of 1 in every 20 consecutively collected samples or 1 per week, whichever was greater.
- **Temperature Blanks**. Temperature blanks were included with each cooler shipment containing samples sent to the laboratory (regardless of targeted analysis). A temperature blank consists of a VOC sample vial filled in the field with deionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a means of verifying that samples have been maintained at the proper temperature (4 degrees Celsius [°C]) following collection and during transport to the laboratory.

3. Results and Discussion

3.1 Groundwater Levels

Depth to water measurements were collected during each sampling event to evaluate the direction and gradient of groundwater flow underlying the Omega Site, and to help characterize the interactions between the shallow and deep aquifers. Groundwater elevations were calculated by subtracting the depth to static water level from the surveyed top of casing elevation of the corresponding monitoring wells. Top of casing elevations for EPA wells are consistent with the North American Vertical Datum (NAVD) 1988 (2000 adjusted) datum. The top of well casing elevations for the OPOG wells were increased by 2.2 feet to match the NAVD 1988 (2000 adjusted) datum in this report. The 2.2 feet elevation adjustment resolved the differences in elevations between the EPA and OPOG wells.

It is noted that the water table dropped below the bottoms of some water table wells during each sampling event. Water levels for those dry wells are therefore not available.

Table 3-1 presents historical groundwater elevation data for OPOG and EPA monitoring wells.

3.1.1 Hydrographs

Figure 3-1 presents hydrographs for Omega monitoring wells. As shown in the figures, fluctuations of water levels at OPOG and EPA monitoring wells display a similar pattern over time. Groundwater elevations generally decreased between 2002 and 2004 followed by a fairly quick recovery in the first half of 2005 in response to high precipitation; remained relatively steady during the period of mid-2005 to mid-2007; and declined again after mid-2007. Slightly steeper decreases in groundwater elevations were observed between June 2003 and December 2004 and between mid-2007 and September 2009 at most wells. Figure 3-2 presents annual rainfall in Whittier. The recent (2008-2009) decline in water levels in the monitoring wells coincides with the below-average annual rainfall during this period.

3.1.2 Water Table Contours

Groundwater contour maps were prepared for the three sampling events using the water levels measured at the shallow monitoring wells to show the general groundwater flow regime in the water table aquifer at the Omega Site. Figures 3-3, 3-4, and 3-5 show the water table contours for 1Q2008, 1Q2009 and 3Q2009, respectively. Although the overall groundwater flow direction is to the southwest in the vicinity of the Omega Site, the hydraulic gradient varies slightly with locations. Horizontal gradients were calculated at three selected locations: the upper (between Slauson Avenue and Whittier), middle (between Florence Avenue and Los Nietos Road), and lower (Imperial Hwy and Landland Road) OU2 for the shallow aquifer, and the results are presented on Figures 3-3, 3-4, and 3-5. Calculations of shallow groundwater horizontal gradients are included in Appendix D. Generally, water level measurements from the same set of wells were used to calculate the

horizontal gradients; however, nearby wells were selected to replace dry wells when dry conditions occurred during any sampling events.

Although there were some temporal variations in the calculated horizontal gradients for the upper, middle, and lower OU2 areas, the flow directions in the shallow aquifer at the Omega Site remained relatively constant for the three sampling events.

3.1.3 Vertical Gradients

Vertical gradients were calculated at locations where wells screened in different depth intervals are co-located. The calculations of vertical gradients were conducted for the two sampling events in 2009 (Table 3-2).

In general, a downward gradient (indicated by a positive vertical gradient value) was observed at most of the 32 well screen pairs, with a few exceptions where the water levels at the well screened in the deeper intervals were slightly higher than those screened in the shallow intervals (indicated by negative vertical gradient values). The generally downward gradient is mostly attributed to the areal recharges from precipitation and surface water bodies such as rivers and spreading basins, production pumping from deep aquifers throughout the basin, and the absence of major groundwater pumping in the shallow aquifer at OU2.

The upward gradients calculated for five well screen pairs (Table 3-2) were of small magnitude (thousandths to hundredths of foot per foot [ft/ft]). In comparison, downward gradients greater than 0.1 ft/ft were measured at 12 well screen pairs. The upward gradients could be attributable to local piezometric head variations caused by heterogeneity of the aquifer, but they could also be explained by measurement precision.

3.2 Analytical Results

This section discusses the analytical results of the three sampling events. Tables 3-3a, 3-3b, and 3-3c summarize the analytical results for those groundwater samples with detectable contaminant concentrations. Appendix E presents the entire analytical results, including the non-detects (NDs), and also includes summary tables for QC samples.

The "Lab QC" data listed in Tables 3-3a, 3-3b, and 3-3c and in Appendix E should be considered primary data. The "Lab QC" sample type indicates that MS/MSDs and primary samples were collected at that sample location.

3.2.1 Volatile Organic Compounds

The most frequently detected compounds are summarized below, followed by a discussion of individual compounds.

Laboratory Results for 1Q2008

PCE was detected in 66 wells. The maximum PCE concentration detected was 170,000 micrograms per liter (µg/L) in Well OW1A. TCE was detected in 62 wells. The maximum TCE concentration detected was 3,800 µg/L in Well OW1A. 1,1-Dichloroethene (1,1-DCE) was detected in 50 wells. The maximum 1,1-DCE concentration detected was 1,000 µg/L in Well OW1A. Chloroform was detected in 44 wells. The maximum chloroform

concentration detected was 1,100 µg/L in EW-2. F113 was detected in 44 wells. The maximum F113 concentration detected was 5,000 µg/L in Well OW8A. Well OW1A had the highest number of maximum detects in 1Q2008.

Laboratory Results for 1Q2009

PCE was detected in 61 wells. The maximum PCE concentration detected was 150,000 µg/L in Well OW1A. TCE was detected in 57 wells. The maximum TCE concentration detected was 11,000 µg/L in Well OW1B. 1,1-Dichloroethene (1,1-DCE) was detected in 49 wells. The maximum 1,1-DCE concentration detected was 1,500 µg/L in Well OW9. Chloroform was detected in 37 wells. The maximum chloroform concentration detected was 1,100 µg/L in OW9. F113 was detected in 43 wells. The maximum F113 concentration detected was 1,700 µg/L in Well OW8A.

Laboratory Results for 3Q2009

PCE was detected in 61 wells. The maximum PCE concentration detected was 24,000 µg/L in Well OW1A. TCE was detected in 61 wells. The maximum TCE concentration detected was 2,300 µg/L in Well OW1A. 1,1-Dichloroethene (1,1-DCE) was detected in 45 wells. The maximum 1,1-DCE concentration detected was 1,600 µg/L in Well OW9. Chloroform was detected in 46 wells. The maximum chloroform concentration detected was 1,100 µg/L in OW9. F113 was detected in 48 wells. The maximum F113 concentration detected was 710 µg/L in Well OW9.

The well-by-well results for 1Q2008, 1Q2009, and 3Q2009 are shown in Appendixes E1, E2, and E3, respectively. In addition, statistical summaries for the respective quarters are shown in Tables 3-3a, 3-3b, and 3-3c.

Sample dilutions were necessary in order to analyze several of the OPOG well samples (for example, OW1A, OW3, OW5 and OW8A), because the undiluted sample concentration exceeded the laboratory instrument calibration range. The dilutions raised the reporting limits for all VOC analytes included in the analytical method, resulting in estimated or ND results for lower concentration analytes.

3.2.1.1 Chlorinated VOCs

Chlorinated VOCs were the most frequently detected compounds.

Tetrachloroethene (PCE)

PCE was detected at all monitoring wells at concentrations above the California Primary maximum contaminant level (MCL) of 5 µg/L. Detections greater than 1,000 µg/L were reported at Wells OW1A (240,000 µg/L, 3Q2009), OW2 (4,000 µg/L, 1Q2009), OW3A (3,200 µg/L, 3Q2009), OW5 (1,400 µg/L, 1Q2008), and OW8A (33,000 µg/L, 1Q2009). The maximum PCE detection was reported at Well OW1A in the 3Q2009 sampling event. Detections were generally lower at EPA monitoring wells. Other than OPOG and EPA detections, Techni Braze, Inc. has reported concentrations ranging from non-detection to 6,100 µg/L in the 3Q2008 sampling event (LFR, 2008), Pilot Chemical Company has reported concentrations ranging from 2.9 to 140 µg/L in the December 2009 semi-annual groundwater monitoring report (URS, 2010), Phibro-Tech, Inc. has reported concentrations ranging from non-detection to 130 µg/L in the 3Q2009 sampling event (Iris, 2010), Site C has reported concentrations ranging from non-detection to 110 µg/L in 2007 annual

groundwater monitoring report (URS, 2008), Mission Linen Supply has reported concentrations ranging from non-detection to 460 µg/L in the 1Q2009 sampling event (CGC, 2009), former Angeles Chemical Company has reported concentrations ranging from non-detection to 344 µg/L in the 1Q2009 sampling event and to 76.5 µg/L in the 3Q2009 sampling event (Clean Soil Inc., 2009a and 2009b), and McKesson Corporation has reported concentrations ranging from non-detection to 1,100 µg/L in the 1Q2009 sampling event (GeoSyntec, 2009). PCE plume maps of 1Q2008, 1Q2009, and 3Q2009 are presented in Figures 3-6a, 3-6b, and 3-6c, respectively. The PCE plume is continuous over OU2. The distribution of PCE for these three quarters remained generally the same. PCE concentrations greater than 5 µg/L extend west-southwest downgradient from the former Omega property to near EPA Monitoring Well MW29. Concentrations exceeding 500 µg/L are associated with the Omega property and with another source area identified as the former Angeles Chemical Company and the former McKesson Chemical (AMK) properties.

Trichloroethene

TCE was detected at most monitoring wells at concentrations above the California Primary MCL of 5 µg/L. Detections greater than 1,000 µg/L were reported at Wells OW1A (3,300 µg/L, 1Q2008) and OW8A (1,400 µg/L, 1Q2008), OW9 (1,200 µg/L, 1Q2009), and MW31 (1,000 µg/L, 3Q2009). The maximum detection was reported at Well OW1A in the 1Q2008 sampling events. Other than OPOG and EPA detections, Techni Braze, Inc. has reported concentrations ranging from non-detection to 150 µg/L in the 3Q2008 sampling event (LFR, 2008), Pilot Chemical Company has reported concentrations ranging from 4.5 to 89 µg/L in the December 2009 semi-annual groundwater monitoring report (URS, 2010), Phibro-Tech, Inc. has reported concentrations ranging from non-detection to 98 µg/L in the 3Q2009 sampling event (Iris, 2010), Site C has reported concentrations ranging from non-detection to 85 µg/L in 2007 annual groundwater monitoring report (URS, 2008), Mission Linen Supply has reported concentrations ranging from non-detection to 11 µg/L in the 1Q2009 sampling event (CGC, 2009), former Angeles Chemical Company has reported concentrations ranging from non-detection to 233 µg/L in the 1Q2009 sampling event and to 44.2 µg/L in the 3Q2009 sampling event (Clean Soil Inc., 2009a and 2009b), and McKesson Corporation has reported concentrations ranging from non-detection to 820 µg/L in the 1Q2009 sampling event (GeoSyntec, 2009). TCE plume maps of 1Q2008, 1Q2009, and 3Q2009 are presented in Figures 3-7a, 3-7b, and 3-7c, respectively. The TCE plume is continuous over OU2. The distribution of TCE for these three quarters generally remained the same and is similar to the distribution of PCE.

F11 and F113

F11 was detected at a few wells in each sampling event. Detections were reported above the California Primary MCL (150 µg/L) at Wells OW2 (190 µg/L, 1Q2008), OW5 (180 µg/L, 1Q2008), OW8A (360 µg/L, 1Q2008), OW9 (280 µg/L, 1Q2009), MW1A (150 µg/L, 1Q2009 and 3Q2009), MW5 (210 µg/L, 1Q2008), MW14 (150 µg/L, 1Q2008), MW15 (370 µg/L, 1Q2008), MW23A (170 µg/L, 1Q2008), and MW23C (160 µg/L, 3Q2009). The maximum detection was reported at Well MW15 in the 1Q2008 sampling events. Other than OPOG and EPA detections, Phibro-Tech, Inc. has reported concentrations ranging from non-detection to 16 µg/L in the 3Q2009 sampling event (Iris, 2010), and McKesson Corporation has reported concentrations ranging from non-detection to 84 µg/L in the 1Q2009 sampling event (GeoSyntec, 2009). F11 plume maps of 1Q2008, 1Q2009, and 3Q2009 are presented in

Figures 3-8a, 3-8b, and 3-8c, respectively. F11 does not cover the same large area as the PCE or TCE plumes. Changes of 5 µg/L plume distribution are minor; however, distribution of concentrations greater than 150 µg/L successively reduce covered areas over time. F113 was detected in samples from a few wells in each sampling event. The maximum detection was reported at Well OW8A (1,700 µg/L) in 1Q2009. Detections greater than 500 µg/L were also reported at Wells OW2 (1,100 µg/L, 1Q2009), OW5 (540 µg/L, 1Q2008), OW9 (930 µg/L, 1Q2008), MW5 (580 µg/L, 1Q2008), MW15 (1,000 µg/L, 1Q2008), and MW23A (750 µg/L, 1Q2008). Only OW8A exceeds the California Primary MCL of 1,200 µg/L. Phibro-Tech, Inc. also has reported concentrations ranging from non-detection to 34 µg/L in the 3Q2009 sampling event (Iris, 2010). F113 plume maps of 1Q2008, 1Q2009, and 3Q2009 are presented in Figures 3-9a, 3-9b, and 3-9c, respectively. The Freon plumes are continuous over OU2. The distribution of F113 is similar to the distribution of F11. Both F113 and F11 are stable compounds in groundwater. The ratio of F113 to F11 can be assumed to remain constant (within a narrow range) once they are released to groundwater. Omega OU1 is the only known source of Freons; therefore, an analysis of the ratio of F113 and F11 can provide an indication as to whether multiple sources exist in OU2. Discussion of the ratio of F113 and Freon is presented in Section 3.2.1.3.

1,2-Dichloroethane (1,2-DCA)

1,2-DCA was detected at 20 wells in 1Q2008, 11 wells in 1Q2009, and 9 wells in 3Q2009 sampling events. The California Primary MCL is 0.5 µg/L and detections greater than 100 µg/L were reported at Wells OW8A and OW9. Maximum 1,2-DCA detection was reported at Well OW8A (310 µg/L) in the 1Q2009 sampling event. Other than OPOG and EPA detections, Techni Braze, Inc. has reported concentrations ranging from non-detection to 0.64 µg/L in the 3Q2008 sampling event (LFR, 2008), Pilot Chemical Company has reported concentrations ranging from non-detection to 43 µg/L in the December 2009 semi-annual groundwater monitoring report; it is noted that Pilot Chemical Company Well MW-1 was not sampled in December 2009, but in April 2009 it had 500 µg/L of 1,2-DCA and historical concentrations above 1,000 µg/L (URS, 2010). Phibro-Tech, Inc. has reported concentrations ranging from non-detection to 19 µg/L in the 3Q2009 sampling event (Iris, 2010), Site C has reported concentrations ranging from non-detection to 26 µg/L in the 2007 annual groundwater monitoring report (URS, 2008), former Angeles Chemical Company has reported concentrations ranging from non-detection to 2.8 µg/L in the 1Q2009 sampling event and to 29 µg/L in the 3Q2009 sampling event (Clean Soil Inc., 2009a and 2009b), and McKesson Corporation has reported concentrations ranging from non-detection to 530 µg/L in the 1Q2009 sampling event (GeoSyntec, 2009). 1,2-DCA plume maps of 1Q2008, 1Q2009, and 3Q2009 are presented in Figures 3-10a, 3-10b, and 3-10c, respectively. The 1,2-DCA plume is narrow and follows the main contaminant transport pathway from the former Omega property; the plume is collocated with the zone of high PCE and TCE concentrations. The plume appears to be continuous over OU2.

1,1-Dichloroethane (1,1-DCA)

1,1-DCA was detected at more than 20 wells in each sampling event. The California Primary MCL is 5 µg/L and the maximum concentrations were detected at Well MW17A in 1Q2008 (100 µg/L), Well OW8A in 1Q2009 (74J µg/L), and Well OW9 in 3Q2009 (46J µg/L) sampling events. The "J" qualifier indicates that the detection is an estimated value.

1,1-Dichloroethene (1,1-DCE)

1,1-DCE was detected at most wells in each sampling event, generally at concentrations above the California Primary MCL (6 µg/L). The maximum detection was reported at Well OW9 (1,600 µg/L) in 3Q2009. Detections greater than 500 µg/L were also reported at Wells OW8A (750 µg/L, 1Q2009), OW1A (730 µg/L, 1Q2008), OW3A (600 µg/L, 3Q2009), and OW2 (550 µg/L, 1Q2009).

1,1,1-Trichloroethane (1,1,1-TCA)

1,1,1-TCA was mainly detected above the California Primary MCL (200 µg/L) at Well OW1A in 3Q2009 (1,900 µg/L), 1Q2009 (1,900 µg/L), and 1Q2008 (2,600 µg/L, 1Q2008), and at Well OW1B in 1Q2009 (820 J µg/L). Detections were also reported at Wells OW3A, MW1A, MW15, MW17A, MW17B, MW21, MW23A, MW25A, MW26A, MW26B, MW27A, MW5, MW8C, and MW8D, but at concentrations below the MCL.

1,1,2,2-Tetrachloroethane

1,1,2,2-Tetrachloroethane (R-130) was only detected at three wells in the 1Q2009 sampling event. Detections were reported at Wells MW1A (0.5 J µg/L), MW8C (0.5 J µg/L), and MW8D (0.5 J µg/L). The detections are below the California Primary MCL of 1 µg/L.

1,1,2-Trichloroethane (1,1,2-TCA)

1,1,2-TCA was detected at a few wells in each sampling event. The California/EPA Primary MCL is 5 µg/L and the maximum detection was reported at Well OW8A (90 J µg/L, 1Q2009). Detections were also reported at Wells MW1A, MW 2, MW5, MW6, MW8C, MW8D, MW15, MW17A, MW17B, MW23A, MW23C, MW25A, MW27A, and OW1B, but at concentrations below the MCL.

1,2-Dibromoethane

1,2-Dibromoethane was detected at three wells in the 1Q2009 sampling event. The California Primary MCL is 0.05 µg/L and detections were reported at Wells MW1A (0.5 J µg/L), MW8C (0.5 J µg/L), and MW8D (0.5 J µg/L).

1,2-Dichlorobenzene

1,2-Dichlorobenzene was detected at a few wells and the maximum concentration was reported at Well MW1A (18 µg/L, 3Q2009). This detection was below the California Notification Level of 600 µg/L. The second highest concentration was reported at Well OW1B (11 J µg/L, 1Q2009). The "J" qualifier indicates that the detection is an estimated value. The remaining detections were equal to or less than 0.5 µg/L with a "J" qualifier.

1,2-Dichloropropane

1,2-dichloropropane was detected in 1Q2009 and 3Q2009. Detections were reported at Wells MW1A, MW20A, MW20B, MW8C, MW8D, and OW1B. No detection exceeded the California Primary MCL of 5 µg/L except MW20A, at 5.1 µg/L in 3Q2009.

1,2,3-Trichlorobenzene

1,2,3-Trichlorobenzene was only detected in the 1Q2009 sampling event. Detection was reported at Well MW1A (0.5 J µg/L), MW6 (0.5 J µg/L), MW8B (0.5 J µg/L), MW8C (0.5 J µg/L), MW8D (0.5 J µg/L), MW10 (0.5 J µg/L), and MW24A (0.13 J µg/L). EPA and California currently do not have a screening level for this compound.

1,2,4-Trichlorobenzene

1,2,4-Trichlorobenzene was detected at six wells: MW1A, MW8B, MW 8C, MW8D, MW6, and MW10, at a concentration below the California Primary MCL of 5 µg/L. The detections were all reported in the 1Q2009 sampling event, with the same 0.5 J µg/L concentration. The "J" qualifier indicates the result is estimated below the detection limit.

1,2-Dibromo-3-Chloropropane (DBCP)

1,2-Dibromo-3-Chloropropane (DBCP) was detected at five wells in the 1Q2009 sampling event. The California Primary MCL is 0.2 µg/L and detections were reported at Wells MW1A (0.5 J µg/L), MW8B (0.5 J µg/L), MW8C (0.5 J µg/L), MW8D (0.5 J µg/L), and MW6 (0.5 J µg/L).

1,4-Dichlorobenzene

1,4-Dichlorobenzene was only detected at Wells MW1A, MW6, MW8B, MW8C, MW8D, MW10, and OW1B in the 1Q2009 sampling event. The maximum concentration was reported at OW1B (1.4 J µg/L) and was below the California Primary MCL of 5 µg/L.

Bromochloromethane

Bromochloromethane was detected at a few wells in 1Q2009 and 3Q2009 sampling events. The maximum concentration was detected at Well OW7 (1.2 µg/L, 3Q2009) and was below the EPA Primary MCL of 80 µg/L.

Bromodichloromethane

Bromodichloromethane was only detected at two wells in the 1Q2009 sampling event. Detections were reported at Wells MW8C (0.5 J µg/L) and MW8D (0.5 J µg/L). EPA and California currently do not have a screening level for this compound.

Carbon Tetrachloride

Carbon tetrachloride was detected at a few wells in each sampling event. The maximum detection was reported at Wells MW1A (0.5 J µg/L) and MW8C (0.5 J µg/L) in the 1Q2009 sampling event. The remaining detections were below the California Primary MCL of 0.5 µg/L.

Chlorobenzene

Chlorobenzene was only detected in the 2009 sampling events. Wells MW1A (0.5 J µg/L), OW8A (2.7 J µg/L), MW8C (0.5 J µg/L) and MW8D (0.5 J µg/L) were detected in the 1Q2009 sampling event. 3Q2009 has only one detection, at OW1A, of 6.8 J µg/L. All detections were below the California Primary MCL of 70 µg/L.

Chloroethane

Chloroethane was detected in 1Q2009 and 3Q2009 sampling events. Only Wells MW12 (0.31 J µg/L, 3Q2009), MW8C (0.5 J µg/L, 1Q2009), and MW8D (0.5 J µg/L, 1Q2009) were detected and all detections were below the California Primary MCL of 16 µg/L.

Chloroform

Chloroform was detected at most wells in each sampling event. The maximum detection was reported at Well OW9 (1,100 µg/L, 3Q2009 and 1Q2009). The other detections greater than 100 µg/L were also reported at Wells OW8A (770 µg/L, 1Q2009), MW1A (210 µg/L, 3Q2009), and OW5 (120 µg/L, 1Q2008). These values exceed the EPA Primary MCL of

80 µg/L, which applies to total trihalomethanes (these include bromoform, bromodichloromethane, chloroform and dibromochloromethane).

Cis-1,2-Dichloroethene (Cis-1,2-DCE)

Cis-1,2-DCE was detected at most EPA wells in each sampling event. The California Primary MCL is 6 µg/L and detections greater than 100 µg/L were reported at Wells MW1A (170 J µg/L, 1Q2009), MW17A (170 J µg/L, 1Q2008), and MW12 (110 µg/L, 3Q2009). The remaining detections were generally less than 40 µg/L.

Cis-1,3-Dichloropropene

Cis-1,3-Dichloropropene was either non-detected or detected at a few wells in each sampling event. The California Primary MCL is 0.5 µg/L and the maximum concentrations were reported at Wells MW1A (0.5 J µg/L) and MW8D (0.5 J µg/L) in the 1Q2009 sampling event. There was no detection in the 3Q2009 sampling event.

Dibromochloromethane

Dibromochloromethane was detected at a few wells in 1Q2009 and 3Q2009 sampling events. The maximum concentration was detected at Well OW7 (1.2 µg/L, 3Q2009) and was below the EPA Primary MCL of 80 µg/L.

Dichlorodifluoromethane (F12)

Dichlorodifluoromethane (F12) was detected at a few wells in each sampling event. The maximum concentration was reported at Well MW15 (2.9 µg/L) in the 1Q2009 sampling event. No detections exceeded the California Notification Level of 1,000 µg/L.

Methylene Chloride

Methylene chloride was detected at a few wells in each sampling event. Maximum concentrations were reported at Well OW8A (1,200 BD µg/L) in the 1Q2009 sampling event. Detections greater than 100 µg/L were also reported at Wells OW1A (480 J µg/L, 1Q2008) and OW8A (140 µg/L, 1Q2008). Detections at remaining wells were at or below 100 µg/L. Detections exceeding the California Primary MCL (5 µg/L) were reported at Wells OW1B (16 µg/L), OW1A (33 J µg/L, 3Q2009), and MW3A (5 J µg/L, Q801).

Trans-1,2-DCE

Trans-1,2-DCE was detected at a few wells in each sampling event. Detections exceeding the California Primary MCL (10 µg/L) were reported at Wells MW2 (20 J µg/L, 1Q2008), MW23A (56 J µg/L, 1Q2008), MW23C (53 J µg/L, 1Q2008), MW24A (34 J µg/L, 1Q2008), MW27B (21 J µg/L, 1Q2008), OW1A (11 µg/L, 3Q2009), and OW8A (49 J µg/L, 1Q2009).

Trans-1,3-Dichloropropene

Trans-1,3-Dichloropropene was detected at three wells in the 1Q2009 sampling event. Detections were reported at estimated values of MW1A (0.5 J µg/L), MW8C (0.5 J µg/L), and MW8D (0.5 µg/L). The California Primary MCL is 0.5 µg/L.

Dichlorotrifluoroethane

Dichlorotrifluoroethane was detected at one well in the 1Q2008 sampling event. Detection was reported at Well OW1B (4.2 J µg/L) and EPA and California currently do not have a screening level for this compound.

Vinyl Chloride

Vinyl chloride was detected at two or three wells in each sampling event. Detections were reported at MW27 and MW8 cluster wells, with the maximum detection at Well MW27A (2.8 µg/L, 3Q2009). The California Primary MCL is 0.5 µg/L.

3.2.1.2 Other VOCs

1,4-Dioxane was detected at one or more wells in each quarterly sampling event. The California Notification Level is 3 µg/L and the concentrations higher than 1,000 µg/L were reported at Wells OW8A (1,000 J µg/L, 1Q2009) and OW9 (1000 µg/L, 1Q2009). Other than OPOG and EPA detections, Phibro-Tech, Inc. has reported concentrations ranging from non-detection to 63 µg/L in the 3Q2009 sampling event (Iris, 2010), former Angeles Chemical Company has reported concentrations ranging from non-detection to 12,200 µg/L in the 1Q2009 sampling event and to 31,000 µg/L in the 3Q2009 sampling event (Clean Soil Inc., 2009a and 2009b), and McKesson Corporation has reported concentrations ranging from non-detection to 120 µg/L in the 1Q2009 sampling event (GeoSyntec, 2009). 1,4-Dioxane plume maps of 1Q2008, 1Q2009, and 3Q2009 are presented in Figures 3-11a, 3-11b, and 3-11c, respectively. The 1,4-Dioxane plume is continuous over OU2.

Nonchlorinated VOCs detected at OU2 include 2-Hexanone, benzene, bromoform, carbon disulfide, ethylbenzene, isopropylbenzene, m,p-Xylenes, methyl cyclohexane, methyl isobutyl ketone, MTBE, o-Xylene, styrene, and toluene. Detections of nonchlorinated VOCs were all below screening levels except benzene at OW1A (6.2 µg/L, 3Q2009) and OW1B (21 J µg/L, 1Q2009). Screening levels for 2-Hexanone and methyl cyclohexane have not been set.

2-Hexanone was only detected at Wells MW1A (5 J µg/L), MW8C (5 J µg/L), and MW1D (5 J µg/L) in the 1Q2009 sampling event. No MCL has been established for 2-Hexanone.

Benzene was detected at a few wells in each sampling event. Maximum detections were reported at Well OW1B (21 J µg/L, 1Q2009), and another detection that exceeded the California Primary MCL (1 µg/L) was at Well OW1A (6.2 µg/L). The remaining detections were all below the California Primary MCL and included MW5, MW8C, MW8D, MW15, MW23A, MW25B, MW26A, MW26B, MW27A, MW27B, and OW3A.

Bromoform was detected from non-detection to trace in a few wells in each sampling event. The maximum concentration was reported at Well OW7 (0.99 J µg/L, 1Q2009) and no detections exceeded the EPA Primary MCL of 80 µg/L.

Carbon disulfide was detected at Wells MW1A (7.3 J µg/L, 3Q2009), MW8C (0.5 J µg/L, 1Q2009), and MW8D (0.5 J µg/L, 1Q2009). No detections exceeded the California Notification Level of 160 µg/L.

Ethylbenzene was detected at a trace level in the 1Q2009 sampling event. Detections were reported at Wells MW1A, MW8C, MW8D and OW1B. The maximum reported concentration was 1.5 J µg/L (Well OW1B), which is below the California Primary MCL of 300 µg/L.

Isopropylbenzene was detected at a trace level in the 1Q2009 sampling event. Detections were reported at Wells MW1A, MW8C, MW8D and OW1B. The maximum reported

concentration was 2.3 J µg/L (Well OW1B), which is below the California Notification Level of 770 µg/L.

m,p-Xylene was detected at a trace level in the 1Q2009 sampling event. Detections were reported at Wells MW1A, MW8C, MW8D and OW1B. The maximum reported concentration was 1.1 J µg/L (Well OW1B), which is below the California Primary MCL of 1,750 µg/L.

Methyl cyclohexane was detected at Well MW27A (0.31 J µg/L, 1Q2009), MW27B (1.1 µg/L, 1Q2009), MW1A (0.5 J µg/L, 1Q2009), MW8C (0.5 J µg/L, 1Q2009), MW8D (0.5 J µg/L, 1Q2009), and MW27A (13 µg/L, 3Q2009). No MCL has been established for methyl cyclohexane.

Methyl isobutyl ketone was detected at a trace level in the 1Q2009 sampling event. Detections of 5J µg/L were reported at Wells MW1A, MW8C, and MW8D. This is below the California Notification Level of 120 µg/L.

MTBE was detected at trace levels in each sampling event. All detected concentrations were below the California Secondary MCL (13 µg/L). The maximum concentration was reported at Well MW30 (3.9 µg/L).

o-Xylene was detected at a trace level in the 1Q2009 sampling event. Detections were reported at Wells MW1A, MW8C, MW8D and OW1B. The maximum reported concentration was 1.2 J µg/L (Well OW1B), which is below the California Primary MCL of 1,750 µg/L.

Styrene was detected at trace levels in the 1Q2009 sampling event. Detections were reported at Wells MW1A, MW8C, and MW8D at a concentration of 1.2 J µg/L for these three wells, which is below the California Primary MCL of 100 µg/L.

Toluene was detected at a few wells in each sampling event. No detections exceeded the California Primary MCL (150 µg/L), and the maximum concentration was reported at Well OW1B (38 J µg/L) in the 1Q2009 sampling event. The remaining toluene detections were below 10 µg/L except Well OW8A (37 J µg/L, 1Q2009).

3.2.1.3 Ratios of F113 and F11

The ratios of concentrations of F113 and F11 were evaluated to identify indications of potential sources of Freons other than the former Omega facility.

The calculated narrow ratio range seems to be indicative of Omega OU1 being a single source of the two Freons found at OU2. It is noted, though, that because of the limitations of this analysis, only a substantial change in F113/F11 ratio resulting from a substantial release of Freon(s) to groundwater could be detected. The results are summarized below and the limitations of the analysis are discussed in Appendix H.

Both F11 and F113 are stable compounds that do not degrade in groundwater. Their sorption characteristics are similar; furthermore, sorption is not substantial in the sandy aquifer materials present at OU2. These characteristics support the expectation of a (relatively) constant F113/F11 ratio in a plume resulting from a single source at OU2. The

ratio of their concentrations would be expected to remain constant in the absence of sampling, analytical, and any other variation.

It can be reasonably expected that the source at Omega OU1 is well-mixed and the Freon ratio at OU1 was fairly uniform over time as a result of the release of mixed waste into soil. If there is another substantial source of either F11 or F113 somewhere at OU2 downgradient from OU1, the ratio of F113/F11 in groundwater is expected to be different downgradient of that source. A source of both F11 and F113 but with a different mix than OU1 would have a similar effect.

Table 3-4 summarizes the statistics for the F113/F11 ratios calculated for each well using the entire historical record (with NDs removed). Wells with insufficient records (for example, MW31, MW30, and MW29) are not included in the table.

The median ratios calculated from historical concentration data are shown in Figure 3-12. The spatial pattern does not indicate clustering or trends in the ratios over OU2. The variability in the ratios may be entirely attributable to the limitations listed in Appendix H.

3.2.2 Data Quality Assessment

The chemical data quality for Omega first quarter 2008, first Quarter 2009, and third quarter 2009 data was managed through the following tools and processes:

- Data quality objectives process as documented in the QAPP (CH2M HILL, 2004d)
- Project QA plans to define procedures and functional policies for data of known and appropriate quality along with FSPs (CH2M HILL, 2004c and 2004d)
- Laboratory QA through audits
- Data validation and QA

Following is a description of the analytical methodology and the data validation/ assessment methodology/findings. The validation reports and tables summarizing the QA are included in Appendix G.

3.2.2.1 Analytical Program/Methodology

The analytical parameters and the associated methods, the standard EPA analytical method references are contained in the QAPP (CH2MHILL, 2004d).

Analyses were performed through the EPA Contract Laboratory Program (CLP); the analyses were based on CLP methodology modified for lower detection where needed and QC procedures. Table G-1 shows the analytes for first quarter 2008, second and third quarters 2009, and the associated measurement performance criteria.

The QAPP identifies the following method-specific QC requirements directly or by reference:

- Level of effort (frequency of QC checks) for each QC procedure
- Quantitative acceptance limits for QC data

- Corrective action requirements for the laboratories for QC data that are outside the acceptance limits
- The detection limit requirements

These requirements (also EPA Regional and CLP standard operating procedures) have been followed as the project analytical requirements by the laboratory. The analytical laboratory has established method detection limits (MDLs) in accordance with Title 40, Part 136, Appendix B, of the *Code of Federal Regulations* (CFR) before start of the work to ensure that laboratory-specific limits complied with the QAPP specifications.

3.2.2.2 Data Validation and Findings

Data Validation Methodology

All data (100 percent) have been evaluated independent of the laboratory by project chemists per EPA National Functional guidelines.

Sample data have been reviewed outside the laboratories by EPA QAO for the QC specifications identified in the project QAPP for each specific parameter and are flagged in accordance with the project QAPP.

Reporting

Sample and parameter-specific data validation reports are in Appendix G. Data validation findings and qualifications/flags are summarized in Table G-2.

Each report has subsections that correspond to the internal QC check requirements for that specific method as identified in the project QAPP and EPA data validation functional guidelines. If laboratory data were found to deviate from the specifications, the subsection provides quantitative details for the QC data deviation and the associated affected samples and provides flags according to defined conventions.

Flagging Conventions, Data Validation Findings

QAPP criteria and EPA data validation functional guidance were used to determine flagging conventions. Data validation flags have been entered into the database that were used for project reports. Data validation findings and qualifications/flags are summarized in Table G-2.

Over 90 percent of data were found to be within criteria as seen in Table G-2. Systematic laboratory errors were not observed; no significant data biases are noted. The only rejected data were for ND 1,2-dibromo-3-chloropropane results due to calibration and internal standard deviations. Additional rejected data were for semi-volatiles (non-target compounds in the analysis for 1,4-dioxane) for ND results for two samples due to surrogate recoveries expected to be a result of sample matrix effects. These compounds are not COCs. The causes for the rejected data are noted to be isolated occurrences and not a systematic bias. These rejected data have not impacted project decisions as can be seen in this report.

Data reported in this report include validation flags.

Data Storage

Backup information for the data evaluation and validation findings includes the following:

- Laboratory hard-copy packages, assembled in SDG units, which include all QC data. These packages are stored at the EPA Region 9 Laboratory and EPA CLP
- Laboratory electronic databases, which includes all sample concentration data with laboratory data flags and a subset of laboratory QC data
- Chain-of-custody (COC) forms and tracking records in project files, as well as at the laboratory
- Laboratory bench records and sample custody logs maintained by the laboratory
- Project electronic databases to include validation flags stored with project files; electronic data base structure/content are per project/program specifications

3.2.2.3 Data Quality Assessment and Quality Control Data

Data quality objectives have been prescribed in the QAPP in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. The following is a description of the assessment for each parameter. Associated data for the PARCC parameters are in laboratory hard copy packages and a subset of these parameters are found in laboratory as well as project electronic databases. Tables G-2 through G-5 present the following data associated with the PARCC evaluations: precision (field duplicates Table G-3), accuracy (surrogates Table G-5, field blank Table G-4), representativeness (field blanks Table G-4), completeness (data validation summary Table G-2). Accuracy and precision data as represented by MS and laboratory control standard recoveries and MSD relative percent deviations are available in laboratory hard copies and the evaluation of these data can be seen in the appended data validation reports (Appendix G).

Accuracy measurement data include laboratory control sample and MS recovery data for both organic and inorganic analytical parameters, as well as surrogate recovery data for organic parameters. Surrogate recoveries are summarized in Table G-5. MS and laboratory control standard recoveries are available in laboratory hard copies and the evaluation of these data can be seen in the appended data validation reports (Appendix G). Recoveries are found to be within limits at large (over 90 percent) and do not indicate any significant bias.

Precision measurement data include laboratory and field duplicate data expressed as relative percent deviation (RPD). Field duplicate measurements are shown in Table G–3. The evaluation of lab duplicates can be seen in the appended data validation reports (Appendix G). Laboratory duplicate data were found to be within acceptance criteria at large as seen in the validation reports and Table G–2; thus, no significant lab precision bias is noted. Field duplicate relative percent recoveries (Table G–3) also do not indicate significant field bias. The larger deviations noted for fluorocarbons (freons) and ethylenes are intrinsic to the limitations of the measurements. Data users have taken these findings into consideration in their decision processes. Thus overall project precision targets are met and no significant biases are noted.

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the sampled media. Representativeness is assessed in both qualitative and quantitative terms. The project report discusses the qualitative aspects of representativeness in terms of design of the FSP, sam-

pling techniques, sample handling protocols, and associated documentation. Quantitative measures of representativeness include field and laboratory blank measurements to identify if contamination was introduced through field or laboratory operations. Field duplicate measurements (Table G-3) are used to establish variability. Field blank results and associated evaluations are shown in Table G-4. For sample results where the sample result is less than five times the associated field blank detection, the sample results are qualified as NDs. These field blank qualifications have not impacted project decisions and not affected the needed representativeness. Similarly samples have been qualified for laboratory blanks through the validation reports where again no significant bias has been noted.

Comparability expresses the confidence with which one data set can be compared to another. Comparability of data has been established through use of following:

- Standard analytical methods and QC procedures established in the project QAPP
- Consistent reporting units for a specified procedure
- MDLs for all analytical parameters that were established in accordance with 40 CFR Part 136, Appendix B, before the start of the analyses to meet the project requirements

All comparability factors have been met for this set of data.

Completeness in this report is assessed as a measure of the amount of valid data obtained from the analytical measurements. Field activity completeness is assessed within the context of the overall sampling design. Data validation summaries are presented in Table G–2. Data completeness was found to be above 90 percent at large, and meets project needs.

3.3 Trend Analysis

Statistical trend analyses were conducted to help in assessing the temporal concentration changes of the various contaminants in groundwater at the Omega Site. All historical concentration measurements taken from the 64 Omega monitoring wells were included in the analysis. All contaminants of concern with sufficient detectable values were included in the trend analysis. Table 3-5 shows the matrix of the trend analysis conducted on concentration data collected from the 64 Omega monitoring wells for 37 detected VOCs. A total of 2,368 well and chemical compound concentration pairs were analyzed. Trends could not be statistically analyzed for 1,833 data pairs mainly because of the presence of NDs and short monitoring records. Of the 535 monitoring well and chemical compound concentration pairs with sufficient data to perform trend analysis, 119 pairs showed significant decreasing trends, 51 showed significant increasing trends, and the remaining 365 exhibited no significant trend. The plots of the concentration time series for selected compounds for all wells are presented in Appendix I.

Figures 3-13 through 3-20 show the spatial distribution of the trends for selected chemical compounds including PCE, TCE, F11, F113, chloroform, 1,1-DCE, 1,4-dioxane, and cis-1,2 DCE, respectively:

- PCE (Figure 3-13): among the 64 wells, 13 showed an increasing trend, 9 showed a decreasing trend, 38 exhibited no significant trend, and the other 4 had insufficient data. Wells with increasing trend appear randomly distributed in the northern portion of OU2

(upgradient of Well Cluster MW17); wells with decreasing trend are concentrated in an area downgradient of the Omega facility and upgradient of AMK; and wells with no significant trends appear to be randomly scattered throughout OU2.

- TCE (Figure 3-14): among the 64 wells, 12 showed an increasing trend, 10 showed a decreasing trend, 38 exhibited no significant trend, and the other 4 had insufficient data. Both wells with increasing trend and wells with decreasing trend appear randomly distributed in the northern portion of OU2 (upgradient of Well Cluster MW17); and wells with no significant trends appear to randomly scattered throughout the entire OU2.
- F11 (Figure 3-15): among the 64 wells, five showed an increasing trend, nine showed a decreasing trend, 22 exhibited no significant trend, and the other 28 had insufficient data. Increasing trends were detected at four wells situated at two locations away from the Omega Site: MW1A and MW1B, and MW16B and MW25A. OW1B also showed an increasing PCE trend. This well is located on the Omega facility but it is screened in the aquifer unit beneath the water table aquifer. Wells with decreasing concentrations are concentrated in a relatively small area between the Omega facility and Slauson Avenue. Wells with no significant trends appear to be randomly scattered throughout the entire OU2 area.
- F113 (Figure 3-16): among the 64 wells, seven showed an increasing trend, 11 showed a decreasing trend, 28 exhibited no significant trend, and the remaining 18 had insufficient data. Increasing trends were detected at three locations away from the Omega Site: MW1A and MW1B, MW8B and MW8C and MW23B, and MW16B and MW25A. Wells with decreasing concentrations are concentrated in a relatively small area between the Omega facility and Slauson Avenue. Wells with no significant trends appear to be randomly scattered throughout OU2.
- Trichloromethylene (Figure 3-17): among the 64 wells, six showed an increasing trend, seven showed a decreasing trend, 31 exhibited no significant trend, and the other 20 had insufficient data. Increasing trends were detected at several locations away from the Omega Site: MW4C, MW23B, MW16B and MW17B, and one well located on the Omega facility (OW2). Wells with decreasing concentrations are concentrated in a relatively small area between the Omega facility and Slauson Avenue. Wells with no significant trends appear to be randomly scattered throughout OU2.
- 1,1-DCE (Figure 3-18): among the 64 wells, five showed an increasing trend, eight showed a decreasing trend, 36 exhibited no significant trend, and the other 15 had insufficient data. Increasing trends were detected at several locations away from the Omega Site: MW4C, MW23B, MW16B and MW17B, and one well located on the Omega facility (OW2). Wells with decreasing concentrations are concentrated in a relatively small area between the Omega facility and Slauson Avenue. Wells with no significant trends appear to be randomly scattered throughout OU2.
- 1,4-DCE (Figure 3-19): among the 64 wells, three showed an increasing trend, 10 showed a decreasing trend, 16 exhibited no significant trend, and the other 35 had insufficient data. Increasing trends were detected at three wells located at two locations away from the Omega Site: MW1A and MW1B, and MW4C. Wells with decreasing concentrations

are concentrated in a relatively small area between the Omega facility and Slauson Avenue. Wells with no significant trends appear to randomly scattered throughout OU2.

- cis-1,2-DCE (Figure 3-20): among the 64 wells, none of the wells showed an increasing trend, nine showed a decreasing trend, 32 exhibited no significant trend, and the other 23 had insufficient data. Wells with decreasing concentrations are concentrated in a relatively small area between the Omega facility and Slauson Avenue. Wells with no significant trends appear to be randomly scattered throughout OU2.

Overall, most compounds show a decreasing trend. A notable exemption is PCE, which shows an increasing trend at 13 wells and decreasing trend at nine wells. There are only slightly more wells with decreasing than increasing trends for TCE and chloroform (12 and 10, and seven and six, respectively).

In general, a decreasing trend was observed for the majority of contaminants (except PCE, which showed an increasing trend at some locations) at the wells located in the close vicinity of and immediately downgradient of the Omega facility, including the following:

- MW2 has decreasing trends for seventeen chemical compounds including PCE, TCE, F11, F113, 1,1-DCE, and 1,4-dioxane
- MW5 has decreasing trends for sixteen chemical compounds including PCE, TCE, F11, F113, 1,1-DCE, and 1,4-dioxane
- MW4B has decreasing trends for twelve chemical compounds including PCE, TCE, F11, F113, 1,1-DCE, and 1,4-dioxane
- MW15 has decreasing trends for eleven chemical compounds including PCE, TCE, F11, F113, 1,1-DCE, and 1,4-dioxane
- OW6 has decreasing trends for eight chemical compounds including TCE, F11, F113, 1,1-DCE and 1,4-dioxane; PCE concentration has been relatively stable and showed no significant trend
- OW1A has decreasing trends for seven chemical compounds including F11, F113, 1,1-DCE and 1,4-dioxane; TCE concentration has been relatively stable and showed no significant trend; PCE is the only chemical compound that showed an increasing trend
- OW4A has decreasing trends for six chemical compounds including F11, F113, 1,1-DCE and 1,4-dioxane; TCE concentration has been relatively stable and showed no significant trend; PCE is the only chemical compound that showed an increasing trend
- OW3A has decreasing trends for five chemical compounds including F11, F113, 1,1-DCE and 1,4-dioxane; TCE and 1,4-dioxane concentrations have been relatively stable and showed no significant trends; PCE is the only chemical compound that showed an increasing trend
- OW8A has decreasing trends for five chemical compounds including F11, F113, 1,1-DCE and 1,4-dioxane; PCE, TCE, and 1,4-dioxane concentrations have been relatively stable and showed no significant trends

Increasing concentration trends were observed at several monitoring wells, most of which are located downgradient of the wells with decreasing trends and at locations closer to the AMK facilities:

- MW16B has increasing trends for six chemical compounds including PCE, TCE, F11, F113, and 1,1-DCE; no significant trend was observed for 1,4-dioxane
- MW1A has increasing trends for six chemical compounds including PCE, TCE, F11, F113, 1,1-DCE, and 1,4-dioxane
- MW1B has increasing trends for six chemical compounds including PCE, TCE, F11, F113, 1,1-DCE, and 1,4-dioxane
- MW4C has increasing trends for five chemical compounds including PCE, TCE, 1,4-dioxane and 1,1-DCE; F11 and F113 showed no significant concentration trend
- MW25A has increasing trends for four chemical compounds including PCE, 1,1-DCE, F11 and F113; TCE showed no significant concentration trend and 1,4-dioxane data are not sufficient for trend analysis at this well
- MW8B has increasing trends for three chemical compounds including PCE, TCE, and F113; 1,1-DCE showed no significant concentration trend and 1,4-dioxane and F11 data are not sufficient for trend analyses at this well
- MW8C has increasing trends for three chemical compounds including PCE, TCE, and F113; 1,1-DCE showed no significant concentration trend and 1,4-dioxane and F11 data are not sufficient for trend analyses at this well
- MW8D has increasing trends for PCE and TCE; F113, F11, and 1,1-DCE showed no significant concentration trend and 1,4-dioxane does not have sufficient data for trend analyses at this well
- MW9A has increasing trends for PCE and TCE; F113, F11, and 1,1-DCE showed no significant concentration trend and 1,4-dioxane does not have sufficient data for trend analyses at this well

Wells situated in the southern portion of OU2 generally showed no significant concentration trend; these wells include Well Cluster MW17, MW20, MW26, and MW27, and monitoring Wells MW29 and MW30. It is noted that these wells generally have shorter monitoring records than wells located in the northern portion of OU2, and future monitoring may reveal temporal concentration trends at these wells.

The trend analysis leads to the following interpretations:

- PCE showed increasing trend at multiple locations, including the Omega Site and other facilities, suggesting that the mass of PCE in groundwater at OU2 is increasing and/or moving with groundwater flow. TCE trends are similar although less pronounced.
- F11 and F113, in contrast to PCE and TCE, showed decreasing trend near the Omega facility and increasing trend downgradient of the wells, with decreasing trend between Slauson Avenue and AMK. These trends may suggest that there is currently no

substantial release of Freons into the aquifer at OU1. The center of the mass of the Freon plume may currently be at the locations where the Freon concentrations are increasing.

- cis-1,2-DCE showed decreasing trend at all locations, suggesting degradation of PCE and TCE is not significant at OU2.
- Although MW23D data were not sufficient for statistical trend analysis or they resulted in no significant trend, visual inspection of the time series charts shows increasing apparent trends for most detected compounds. Such increasing trends at MW23D would be significant, suggesting that downward migration of contamination into the deeper aquifer units is currently occurring.

3.4 Vertical Distribution of Contaminants

The change in the vertical distribution of contaminants over time is shown for the three sampling events for PCE and Freon 113 in Figures 3-12 (a, b, and c) and 3-22 (a, b, and c), respectively.

The Cross-Sections AA′, BB′, and CC′ depicted in Figures 3-21 and 3-22 are identical to the cross-sections developed for the RI/FS (CH2M HILL, 2010) and show more-permeable, coarse-grained units and less-permeable, fine-grained units. The contamination is expected to migrate predominantly via the coarse-grained units while the fine-grained units act as partial barriers to groundwater flow as indicated by the differences in piezometric heads and contaminant distribution.

As seen on Cross-Section AA′, the zone of high PCE concentrations (over 100 µg/L) in the shallow groundwater downgradient of the Omega property continues to MW23A. This zone is separated from the lower concentration zone in the underlying aquifer by a fine-grained unit. The zone of PCE concentrations exceeding 500 µg/L appears discontinuous on Cross-Section AA′ because it has likely shifted laterally.

Separate zones of high concentrations exist in the units penetrated by the screen of MW23D and MW17A. The high concentration zone at MW23D could be an indication of a vertical conduit in this area that allows contaminant migration from the shallow groundwater into this deeper zone. The high concentrations at MW17A are associated with the AMK facilities.

In 1Q2008 and 1Q2009, samples from all the deep screens had PCE concentrations below its MCL. However, in 3Q2009 samples from MW23D and MW27D had PCE concentrations over the MCL.

The Freon 113 distribution is similar to that of PCE except that no high concentration zone is associated with the AMK facilities. A zone of high Freon 113 concentrations (over 150 µg/L) is present in the shallow groundwater between the former Omega property and extends past MW23A; this zone is also separated by the fine-grained unit from the lower concentrations in the underlying aquifer. As for PCE, a zone of high Freon 113 concentrations is present in the unit screened by MW23D.

Both PCE and Freon 113 concentrations have increased between first quarter 2008 and third quarter 2009 (and also since 2007; CH2M HILL, 2010) at Well MW23D. PCE concentrations have also increased at Well MW27D over the same period. These increases in the deep wells

indicate downward movement of the plume at the two locations. Question marks on Figures 3-12 and 3-22 indicate where the extent of the plume is uncertain.

The vertical slice through the plume is also indicative of the plume lateral shifts over time. Cross-Section AA' was constructed so that it was oriented along the high concentration zone between the Omega property and MW23 for the PCE (and other VOC) distribution in 2007. In 2008 and 2009, Cross-Section AA' no longer appears to follow the high concentration zone in this area, indicating that the main contaminant transport pathway has shifted over time and that the high concentration zone marking this pathway is rather narrow. The lateral shift of the high concentration (over 500 µg/L) zone in this area is also apparent on the plume maps (Figures 3-6 to 3-9).

4. Summary of Findings

The following summarizes the major findings from the three sampling events conducted in 1Q2008, 1Q2009, and 3Q2009:

4.1 Groundwater Flow

- Depth to water measurements were collected at the OPOG and EPA monitoring wells during the three sampling events to calculate the water level elevations at these monitoring wells. Hydrographs of the OPOG and the EPA wells were prepared to reveal the temporal water level variations at the Omega Site. The hydrographs of these monitoring wells indicate that water levels at the Omega Site generally decreased between 2002 and 2004, followed by a fairly quick recovery in the first half of 2005 in response to high precipitation that year, then remained relatively constant during the period between mid-2005 and mid-2007, and declined again after mid- 2007. The water levels declined during the reporting period of 2008-2009.
- Vertical gradients were calculated at locations where wells screened in different depth intervals are collocated. The majority of the 32 well screen pairs exhibited downward vertical gradients as expected at OU2 where regional groundwater flow is driven by recharge and deep aquifer pumping. Downward vertical gradients greater than 0.1 ft/ft were calculated for 12 well screen pairs. Upward gradients of small magnitude calculated for five well screen pairs could be attributable to local piezometric head variations caused by heterogeneity of the aquifer or to measurement precision.
- Water table contour maps were prepared for the three sampling events using the water levels measured at the water table wells. In addition, horizontal groundwater gradients were calculated at three locations to show the spatial variations in the shallow groundwater flow regime at the Omega Site. Although the horizontal gradients changed over time, the general shallow groundwater flow regime remained constant, as indicated by the similarities among the groundwater contours for the three sampling events.

4.2 VOC Detections

- PCE was detected at most monitoring wells at concentrations above the California Primary MCL of 5 µg/L in each sampling event. PCE concentrations over 1,000 µg/L were reported for Wells OW1A (240,000 µg/L in 3Q2009), OW2 (4,000 µg/L in 1Q2009), OW3A (3,200 µg/L in 3Q2009), OW5 (1,400 µg/L in 1Q2008), and OW8A (33,000 µg/L in 1Q2009).
- TCE was detected at most monitoring wells at concentrations above the California Primary MCL of 5 µg/L in each sampling event. TCE concentrations over 1,000 µg/L

were reported for Wells OW1A (3,300 µg/L in 1Q2008) and OW8A (1,400 µg/L in 1Q2008), OW9 (1,200 µg/L in 1Q2009), and MW31 (1,000 µg/L in 3Q2009).

- F11 was detected at a few wells in each sampling event. Detections above the California Primary MCL (150 µg/L) were reported for Wells OW2 (190 µg/L in 1Q2008), OW5 (180 µg/L in 1Q2008), OW8A (360 µg/L in 1Q2008), OW9 (280 µg/L in 1Q2009), MW1A (150 µg/L in 1Q2009 & 3Q2009), MW5 (210 µg/L in 1Q2008), MW14 (150 µg/L in 1Q2008), MW15 (370 µg/L in 1Q2008), MW23A (170 µg/L in 1Q2008), and MW23C (160 µg/L in 3Q2009).
- F113 was detected in samples from a few wells in each sampling event. Detections over 500 µg/L were reported for Wells OW2 (1,100 µg/L in 1Q2009), OW5 (540 µg/L in 1Q2008), OW9 (930 µg/L in 1Q2008), MW5 (580 µg/L in 1Q2008), MW15 (1,000 µg/L in 1Q2008), and MW23A (750 µg/L in 1Q2008).
- Cis-1,2-DCE was detected at most wells in each sampling event. The California Primary MCL is 6 µg/L and detections greater than 100 µg/L were reported at Wells MW1A (170 J µg/L in 1Q2009), MW17A (170 J µg/L in 1Q2008), and MW12 (110 µg/L in 3Q2009). The remaining detections were generally less than 40 µg/L.
- 1,1-DCE was detected at most wells in each sampling event, generally at concentrations above the California Primary MCL (6 µg/L). 1,1-DCE concentrations over 500 µg/L were reported for Wells OW9 (1,600 µg/L in 3Q2009), OW8A (750 µg/L in 1Q2009), OW1A (730 µg/L in 1Q2008), OW3A (600 µg/L in 3Q2009), and OW2 (550 µg/L in 1Q2009).
- 1,1-DCA was detected at more than 20 wells in each sampling event. The California Primary MCL for 1,1-DCA is 5 µg/L and the maximum concentrations were detected at Well MW17A (100 µg/L in 1Q2008), Well OW8A (74J µg/L in 1Q2009), and Well OW9 (46J µg/L in 3Q2009).
- Chloroform was detected at most wells in each sampling event. Chloroform concentrations over 100 µg/L were reported for Well OW9 (1,100 µg/L in 3Q2009 and 1Q2009), OW8A (770 µg/L in 1Q2009), MW1A (210 µg/L in 3Q2009), and OW5 (120 µg/L in 1Q2008). These values exceed the EPA Primary MCL of 80 µg/L, which applies to total trihalomethanes (these include bromoform, bromodichloromethane, chloroform, and dibromochloromethane).
- Other chemical compounds were detected at only a few monitoring wells, with generally lower concentrations.

4.3 Plume Extent for Main Contaminants

- For each sampling event, plume maps were prepared for PCE, TCE, F11, F113, 1,4-dioxane, and 1,2-DCA to show the lateral extent of contamination at the Omega Site for these chemical compounds.
- The PCE plume is continuous over OU2. The distribution of PCE for these three quarters remained generally the same. PCE concentrations greater than 5 µg/L extend west-

southwest downgradient from the former Omega property to near EPA Well MW29. Concentrations exceeding 500 µg/L are associated with the Omega property and with another source area identified as the AMK.

- The TCE plume is continuous over OU2. The distribution of TCE for these three quarters generally remained the same and is similar to the distribution of PCE.
- The Freon plumes are continuous over OU2. The distribution of F113 is similar to the distribution of F11.
- The distributions of 1,2-DCA were similar for the three sampling events. The 1,2-DCA plume is narrow and follows the main contaminant transport pathway from the former Omega property; the plume is collocated with the zone of high PCE and TCE concentrations. The plume appeared to be continuous over OU2 in 2008. In 2009, 1,2-DCA concentrations declined in the area between MW23 and OW9 to ND levels.
- The distributions of 1,4-dioxane were similar for the three sampling events. The plume appears to be continuous over OU2 but covers a smaller extent than PCE or TCE.

4.4 Freon Ratios

- The ratios of concentrations of F113 and F11 were evaluated to identify indications of potential sources of Freons other than the former Omega facility. The ratios fall within a narrow range of 1.1 to 4.1 with a few exceptions. The narrow ratio range of the Freon ratios is not indicative of another source of Freon contamination that is significantly different from that of the former Omega property. However, it is noted that because of the limitations of this analysis, only a substantial change in the F113/F11 ratio resulting from a substantial release of Freon(s) to groundwater could have been distinguished.

4.5 Temporal Concentration Trends

Statistical trend analyses were conducted to help in assessing the temporal concentration changes of the various contaminants in groundwater at the Omega Site, with the following findings:

- In general, a decreasing trend was observed for the majority of contaminants (except PCE, which showed increasing trend at some locations) at the wells located in the vicinity of and immediately downgradient of the Omega facility.
- Increasing VOC concentration trends were observed at several monitoring wells, most of which are located downgradient of the wells with decreasing trends, and at locations closer to the AMK properties.
- Wells situated in the southern portion of OU2 generally showed no significant VOC concentration trend. It is noted, however, that these wells generally have shorter monitoring records than wells located in the northern portion of OU2, which affects the trend determination.

- PCE showed increasing trend at multiple locations, including the Omega Site and other facilities. TCE trends are similar although less pronounced.
- F11 and F113, in contrast to PCE and TCE, showed decreasing trend near the Omega facility and increasing trend downgradient of the wells with decreasing trend (between Slauson Avenue and AMK). These trends may suggest that there is currently no substantial release of Freons into the aquifer at OU1. The center of the mass of the Freon plume may currently be at the locations where the Freon concentrations are increasing.
- Although MW23D data were not sufficient for statistical trend analysis, or they resulted in no significant trend, visual inspection of the time series charts shows increasing apparent trends for most detected compounds. Such increasing trends at MW23D would be significant, suggesting that downward vertical migration of the contamination into the deeper aquifer units is currently occurring.

4.6 Other Facility-Specific Data

Reports with groundwater analytical data were obtained for the following facilities located within the Omega OU2 area:

- Mission Linen Supply at 11904-11920 E Washington Boulevard, Whittier (CGC Environmental, 2009)
- Angeles Chemical Company at 8915 Sorensen Avenue, Santa Fe Springs (Clean Soil, Inc., 2009a and 2009b)
- McKesson Corporation at 9005 Sorensen Avenue, Santa Fe Springs (GeoSyntec Consultants, Inc., 2009)
- PhibroTech, Inc. at 8851 Dice Road, Santa Fe Springs (Iris Environmental, 2010)
- Techni-Braze, Inc. at 11845 Burke Street, Santa Fe Springs (LFR, 2008)
- Pilot Chemical Company at 11756 Burke Street, Santa Fe Springs (URS, 2010)
- Site C at 9120–9160 Norwalk Boulevard and 11925–11933 Los Nietos Road, Santa Fe Springs (URS, 2008)

The following is a summary of key VOC detections at these facilities:

- PCE and TCE were detected at the following facilities: Techni Braze, Inc. (PCE up to 6,100 µg/L, TCE up to 150 µg/L in 3Q2008), Pilot Chemical Company (PCE up to 140 µg/L, TCE up to 89 µg/L in 2009), Phibro-Tech, Inc. (PCE up to 130 µg/L, TCE up to 98 µg/L in 3Q2009), Site C (PCE up to 110 µg/L, TCE up to 85 µg/L in 2007), Mission Linen Supply (PCE up to 460, TCE up to 11 µg/L in 1Q2009), the former Angeles Chemical Company (PCE up to 344 µg/L, TCE up 305 µg/L in 1Q2009), and the former McKesson facility (PCE up to 1,100 µg/L, TCE up to 820 µg/L in 1Q2009).
- F11 was detected at Phibro-Tech, Inc. (up to 16 µg/L in 3Q2009), and the former McKesson facility (up to 84 µg/L in 1Q2009); F113 was also detected at Phibro-Tech, Inc. (up to 34 µg/L in 3Q2009).

- 1,2-DCA was detected at the following facilities: Techni Braze, Inc. (up to 0.64 µg/L in 3Q2008), Pilot Chemical Company (up to 500 µg/L in 2009), Phibro-Tech, Inc. (up to 19 µg/L in 3Q2009), Site C (up to 26 µg/L in 2007), the former Angeles Chemical Company (up 2.8 µg/L in 1Q2009), and the former McKesson facility (up to 5300 µg/L in 1Q2009).
- 1,4-DCE was detected at Phibro-Tech, Inc. (up to 63 µg/L in 3Q2009), the former Angeles Chemical Company (up 12,200 µg/L in 1Q2009) and the former McKesson facility (up to 120 µg/L in 1Q2009).

5. Recommendations

CH2M HILL recommends the following actions in 2010:

- Continue sampling for VOCs, including 1,4-dioxane. Sample EPA wells every first and third quarter concurrently with OPOG sampling. Collect split samples only from OPOG wells. It is assumed that OPOG will provide EPA with the analytical results for their well sampling.
- The 2010 annual report should include plume maps for the same compounds as this report, temporal trends and trend maps, and Freon ratio analysis.
- The interpretation of Freon ratios should be discontinued if the results for 2010 are inconclusive.
- EPA should confirm the existence of the remaining former Oil Field Reclamation Project (OFRP) Wells MW12, MW19, and MW21 and attempt to measure water levels and collect samples for VOC analysis. The sampling will be limited to collecting grab samples using disposable bailers without purging the wells.
- EPA should split-sample, or request analysis for F113 for former CENCO Refinery (CENCO) Wells MW101, MW105, MW201, MW603, MW605, and MW606.
- EPA should obtain analytical results and water levels from groundwater monitoring at Ashland; CENCO; Waste Disposal, Inc. (WDI); McKesson Chemical; Angeles Chemical Company; Phibro-Tech, Inc.; Techni Braze, Inc.; Pilot Chemical Company; Foss Plating; Mission Linen; Sites B, C, I, J, and K; and water levels for Golden West Refinery through interagency data sharing and include them in future monitoring reports.

6. References

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Tables

Figures

Appendix A
Monitoring Well Purge Forms
(on CD only)

This appendix located on attached CD.

Appendix B
Chain-of-Custody Forms
(on CD only)

This appendix located on attached CD.

Appendix C
Data Needs and Uses
(on CD only)

This appendix located on attached CD.

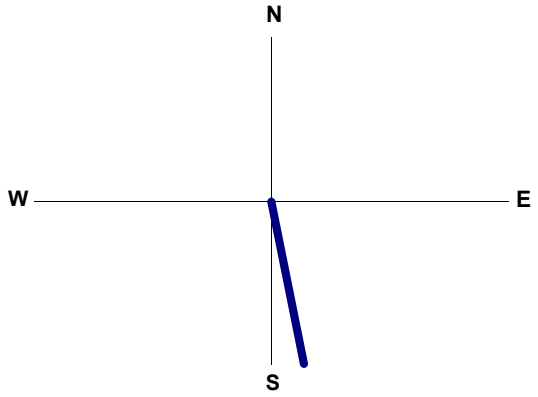
Appendix D
OU2 Shallow Groundwater Gradient Calculations

Groundwater Flow Gradient

Date: 1Q2008

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW30	401820.19	3753277.41	3.54
Cenco-MW-606	401299.00	3754238.00	6.43
Cenco-MW-607	401650.00	3754450.00	6.89

Gradient: 0.0028 (dimensionless)

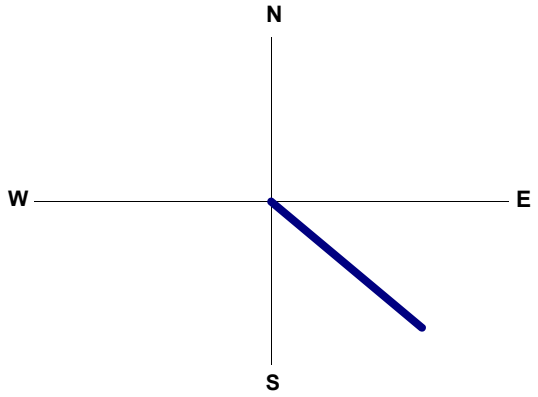


Groundwater Flow Gradient

Date: 1Q2009

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW30	401820.19	3753277.41	2.58
MW29	400888.76	3753618.89	6.22
Cenco-MW-607	401650.00	3754450.00	6.89

Gradient: 0.0043 (dimensionless)

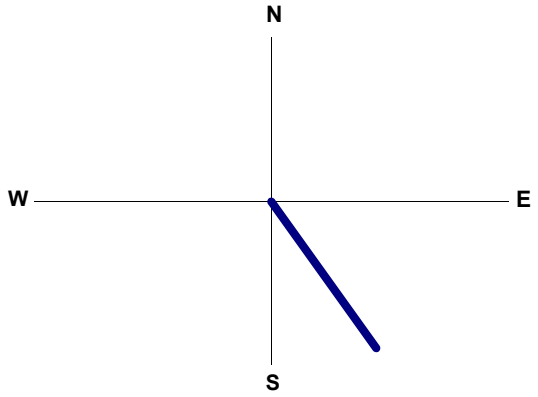


Groundwater Flow Gradient

Date: 3Q2009

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW30	401820.19	3753277.41	1.35
MW29	400888.76	3753618.89	5.43
Cenco-W-4	401686.00	3754886.00	9.86

Gradient: 0.0057 (dimensionless)

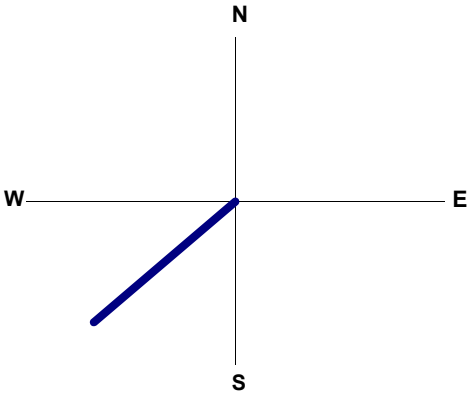


Groundwater Flow Gradient

Date: 1Q2008

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW19	401687.06	3756760.85	27.57
MW20A	400670.84	3756601.72	20.63
MW27A	400902.97	3755901.78	17.52

Gradient: 0.0086 (dimensionless)

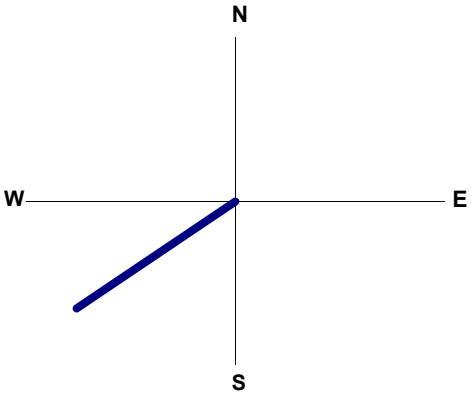


Groundwater Flow Gradient

Date: 1Q2009

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW19	401687.06	3756760.85	25.83
MW20A	400670.84	3756601.72	18.09
MW27A	400902.97	3755901.78	15.60

Gradient: 0.0089 (dimensionless)

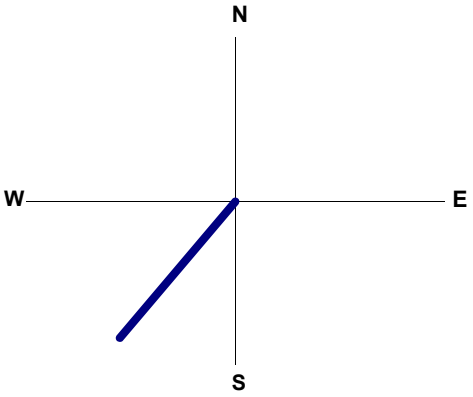


Groundwater Flow Gradient

Date: 3Q2009

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW26A	401270.06	3757125.16	21.48
MW20A	400670.84	3756601.72	17.19
MW27A	400902.97	3755901.78	14.64

Gradient: 0.0056 (dimensionless)

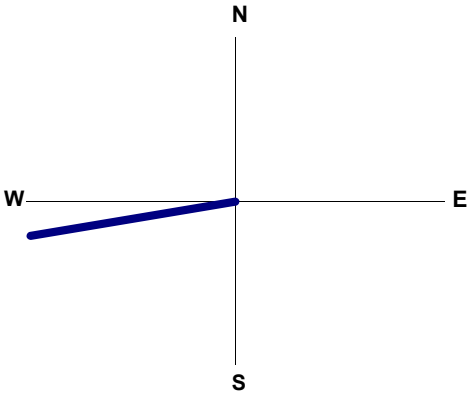


Groundwater Flow Gradient

Date: 1Q2008

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW2	402799.48	3758870.16	36.43
MW3	402931.54	3758376.49	36.47
MW5	402519.71	3758707.96	35.95

Gradient: 0.0016 (dimensionless)

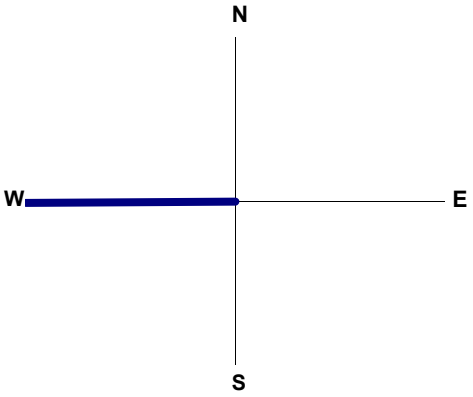


Groundwater Flow Gradient

Date: 1Q2009

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW2	402799.48	3758870.16	34.73
MW3	402931.54	3758376.49	35.05
MW5	402519.71	3758707.96	34.03

Gradient: 0.0025 (dimensionless)

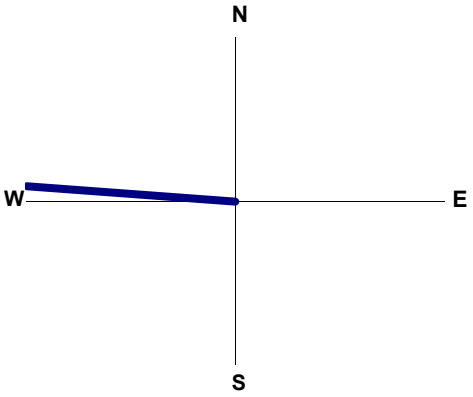


Groundwater Flow Gradient

Date: 3Q2009

Well ID	Easting, x (meters)	Northing, y (meters)	Groundwater Elevation (meters)
MW2	402799.48	3758870.16	33.99
MW3	402931.54	3758376.49	34.37
MW5	402519.71	3758707.96	33.41

Gradient: 0.0022 (dimensionless)



Appendix E
VOC Detection Summary: 1Q2008, 1Q2009, and 3Q2009 (on CD only)

This appendix located on attached CD.

Appendix F
OU1 and OU2 Lab Reports
(on CD only)

This appendix located on attached CD.

Appendix G
Data Quality Assessment
(on CD only)

This appendix located on attached CD.

Appendix H
Statistical Plots

Appendix H
Freon Ratios

The ratios of concentrations of Freon 113 (F113) and Freon 11 (F11) were evaluated to identify indications of potential sources of Freons other than the former Omega facility.

Both F11 and F113 are stable compounds that do not degrade in groundwater. Their sorption characteristics are similar and, furthermore, sorption is not substantial in the sandy aquifer materials present at OU2. These characteristics support the expectation of a (relatively) constant F113/F11 ratio in a plume resulting from a single source at OU2. The ratio of their concentrations would be expected to remain constant in the absence of sampling, analytical, and any other variation.

It can be reasonably expected that the source at Omega OU1 is well-mixed and the Freon ratio at OU1 was fairly uniform over time as a result of the release of mixed waste into soil. If there is another substantial source of either F11 or F113 somewhere at OU2 downgradient from OU1, the ratio of F113/F11 in groundwater is expected to be different downgradient of that source. A source of both F11 and F113 but with a different mix than those at OU1 would have a similar effect.

Table 3-4 in Section 3 of the main text summarizes the statistics for the F113/F11 ratios calculated for each well using the entire historical record (with nondetects removed). Wells with insufficient records (for example, MW31, MW30, and MW29) are not included in the table.

Analysis of the J-qualified and unqualified Freon ratios (total data count N=788) provided the following results:

Parametric and non-parametric ANOVA tests indicate statistically significant differences in ratios among well locations.

Box-plots included in this appendix corroborate the differences. Sorting by median values shows which wells are particularly different.

The main limitations to this analysis are:

Inclusion of the J values was assessed for its potential effect. A box-plot compares the ratios over the paired qualifiers: Q1*Q2 where Q1 is the F113 qualifier and Q2 is the F11 qualifier. Possible combinations and record counts include: DD [N=646]; DJ [N=39]; JD [N=43]; JJ [N=61]. The results suggest that the J-qualified F11 results exhibit wider variability than the J-qualified F113 results; however, this is a soft conclusion given the overall variability of the results.

Record counts (that is, the number of data points) differ widely among the wells. The counts themselves are not so much the issue; rather, the different lengths of monitoring records for some wells may affect the representativeness of the results (the lengths of records depend on the time of the well installation, which varies from 1996 to 2009). As the monitoring at OU2 continues, eventually it will be possible to use the same record length for each well.

The limitations specifically related to using ratios of concentrations are briefly explained as follows:

The accuracy of a ratio is comparatively lower given measurement uncertainties in the quantification of both F113 and F11 concentrations. For example, if 15 µg/L can truly represent concentrations between 12 and 18, a ratio of 1 (F113 and F11 concentrations both reported at 15) means the ratio could actually be as low as 0.67 and as high as 1.5. That is not accounted for in the presented evaluation but is clearly a generic problem in the use of ratios.

The potential relationship of a ratio to the magnitude of the concentrations is also not accounted for above. If the laboratory method accuracy and precision vary as a function of concentration, the ratios are not independent of concentration.

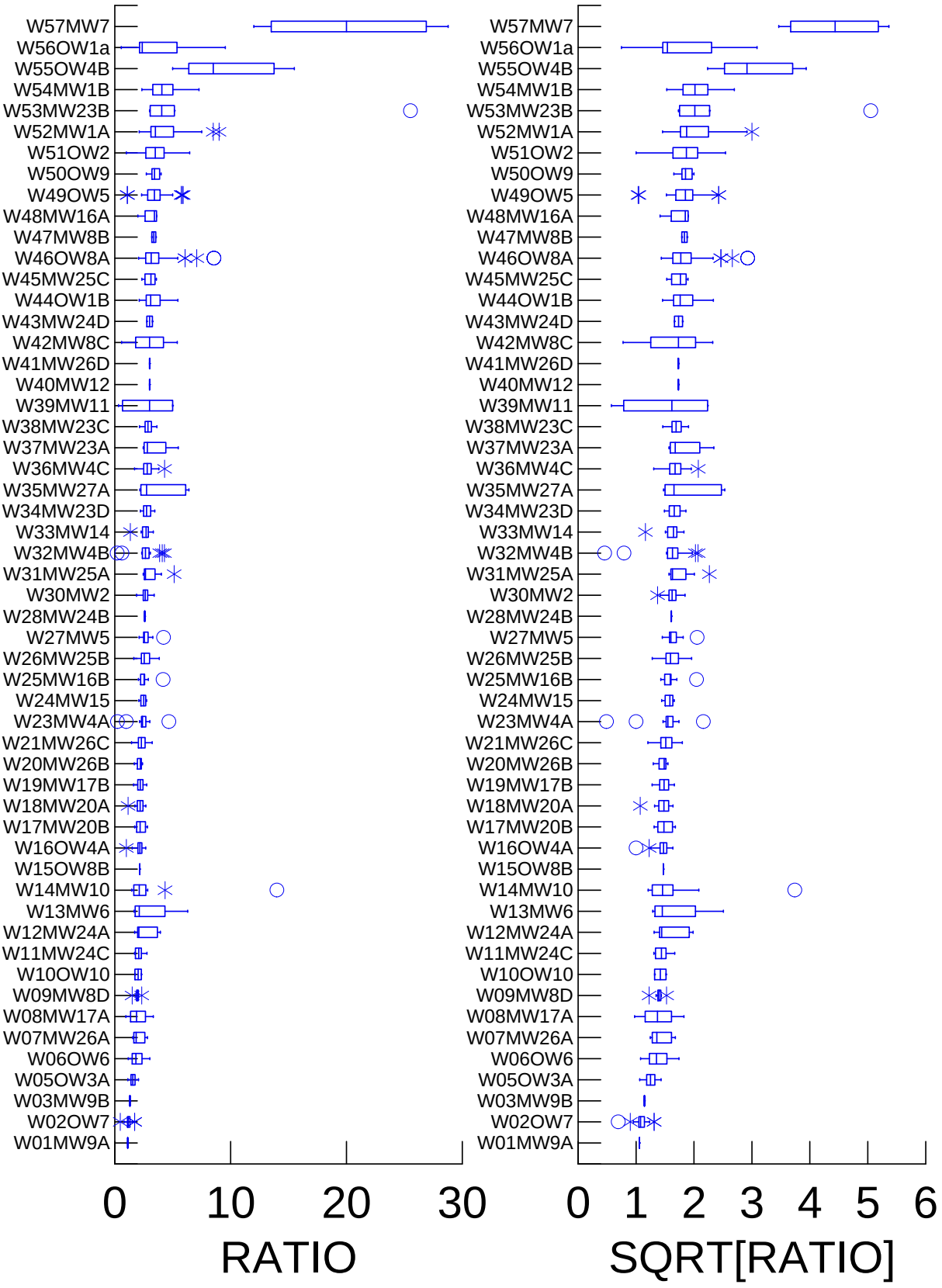
Ratios often give rise to unusual distributions (non-normal). Ratios of concentrations, which are typically not normally distributed, are expected to be non-normal.

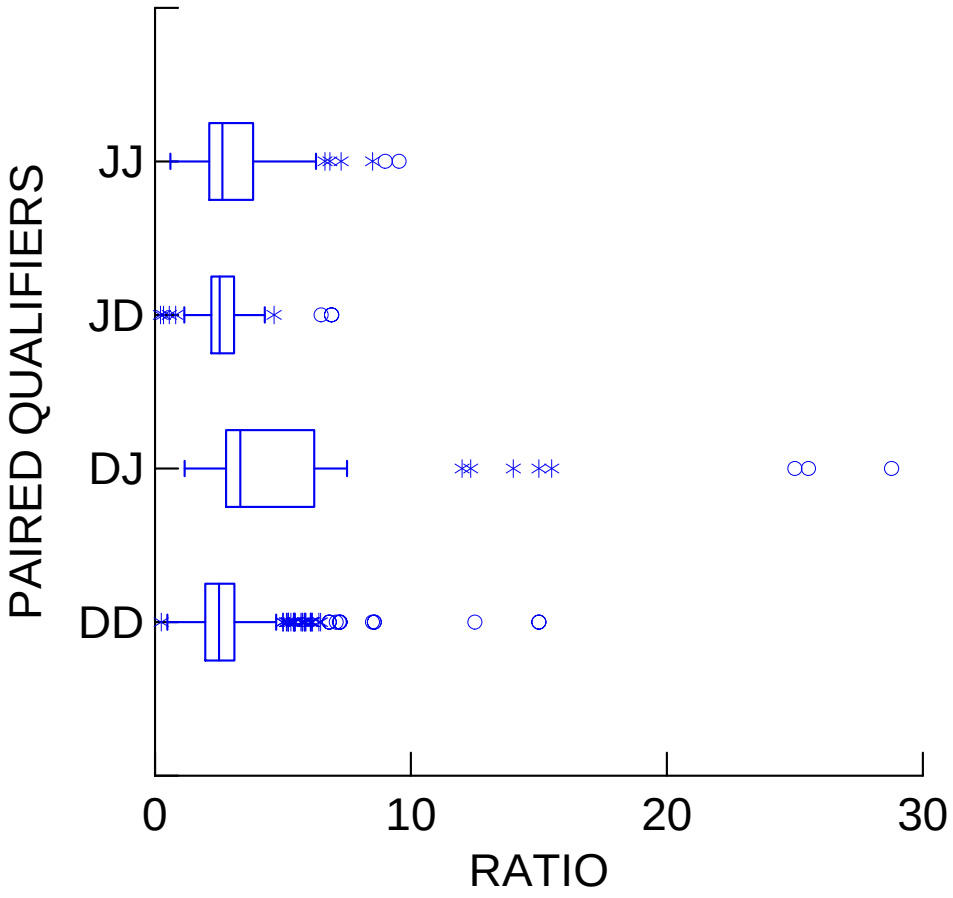
The median ratios calculated from historical concentration data are shown in Figure 3-12 in the main text of this report. The spatial pattern does not indicate clustering or trends in the ratios over OU2. The variability in the ratios may be entirely attributable to the limitations listed above.

The ratios fall within a narrow range of 1.1 to 4.1 except for wells MW7 (20), OW1A (9.5), and OW4B (8.5). MW7 is located at the plume margin and its median ratio may be considered an outlier as a result of low and J-qualified F11 concentrations. Similarly, the high ratios at OW4B are related to the low and J-qualified F11 concentrations (also noting that only two records are available). It is unlikely that another source of Freons is affecting only OW4B without affecting the shallower cluster well OW4A (ratio of 2.1). The high ratios for OW1A may be related to analytical results affected by high sample dilutions. This seems to be a likely explanation, considering the much lower ratio (3.1) at the nearby OU1 well OW1B, which is deeper and has much lower VOC concentrations.

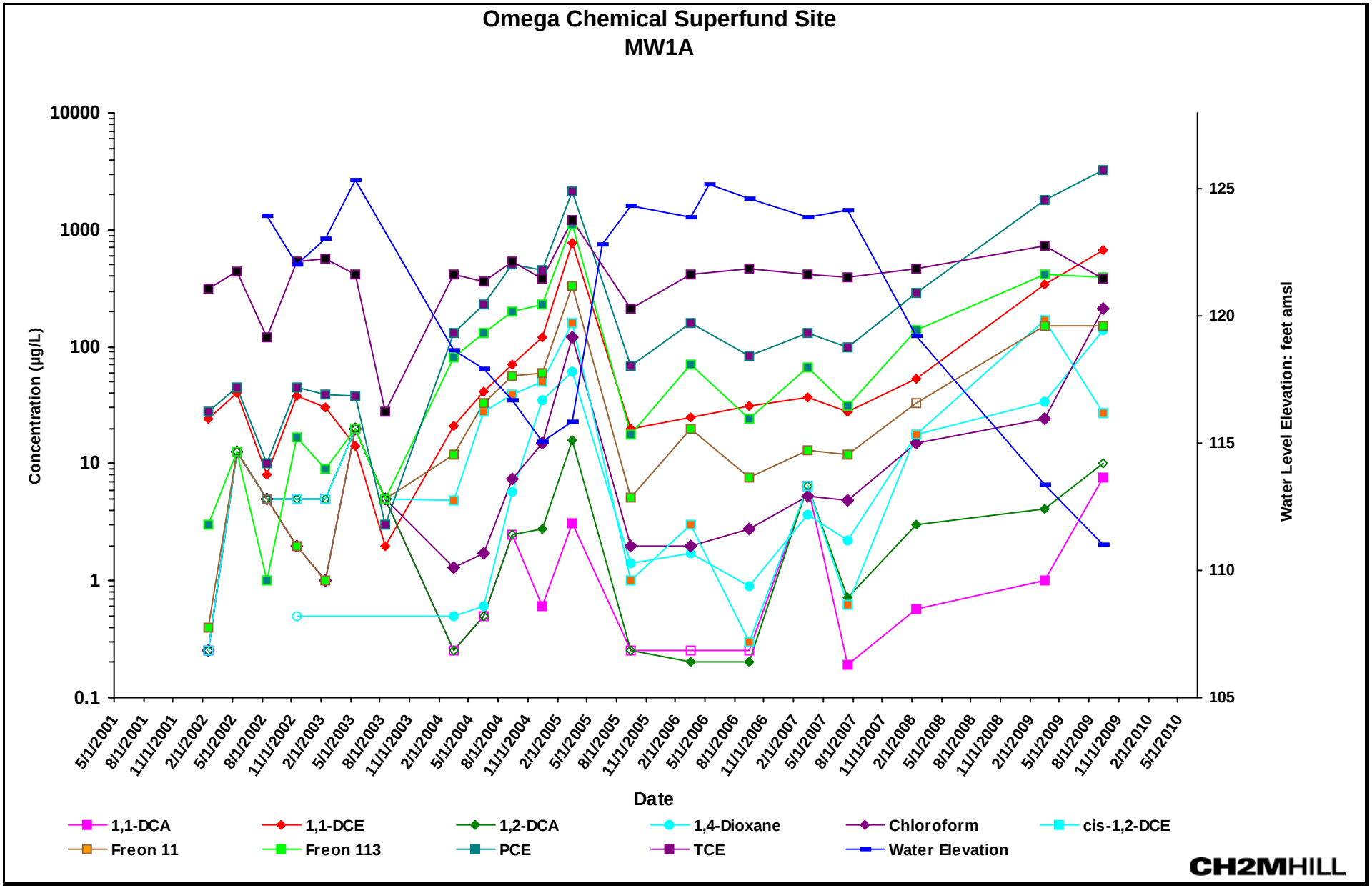
The narrow ratio range for the remaining wells seems to be indicative of Omega OU1 being a single source of the two Freons at OU2. However, it is noted that because of the limitations of this analysis, only a substantial change in the F113/F11 ratio resulting from a substantial release of Freon(s) to groundwater could be detected.

Box Plots for Freon Concentration Ratios (Freon 113/Freon 11)


W57MW7
W56OW1a
W55OW4B
W54MW1B
W53MW23B
W52MW1A
W51OW2
W50OW9
W49OW5
W48MW16A
W47MW8B
W46OW8A
W45MW25C
W44OW1B
W43MW24D
W42MW8C
W41MW26D
W40MW12
W39MW11
W38MW23C
W37MW23A
W36MW4C
W35MW27A
W34MW23D
W33MW14
W32MW4B
W31MW25A
W30MW2
W28MW24B
W27MW5
W26MW25B
W25MW16B
W24MW15
W23MW4A
W21MW26C
W20MW26B
W19MW17B
W18MW20A
W17MW20B
W16OW4A
W15OW8B
W14MW10
W13MW6
W12MW24A
W11MW24C
W10OW10
W09MW8D
W08MW17A
W07MW26A
W06OW6
W05OW3A
W03MW9B
W02OW7
W01MW9A
0
10
20
30
RATIO
0
1
2
3
4
5
6
SQRT[RATIO]

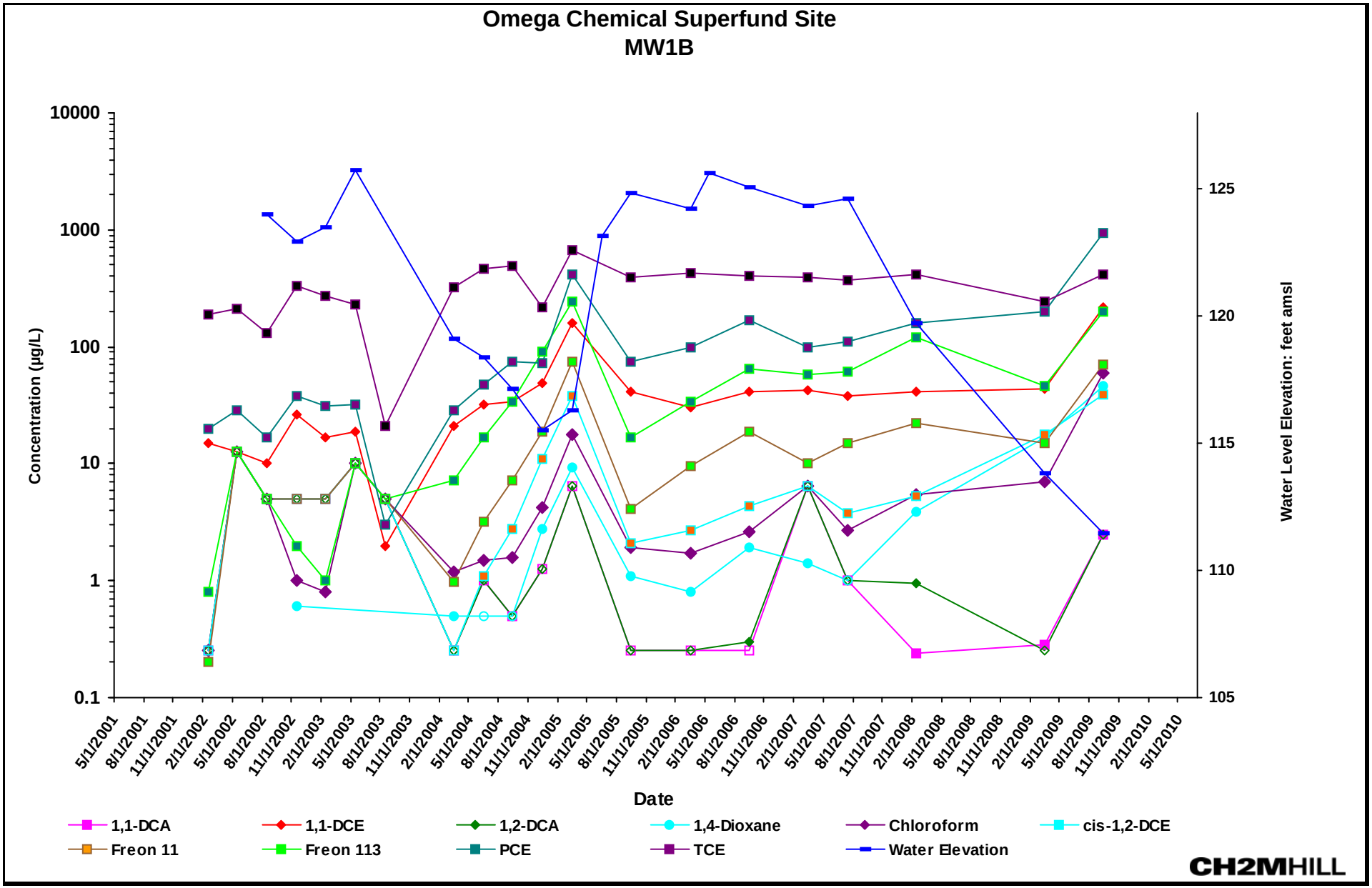

PAIRED QUALIFIERS
JJ
JD
DJ
DD
0
10
20
30
RATIO

Appendix I
VOC Time Series Plots



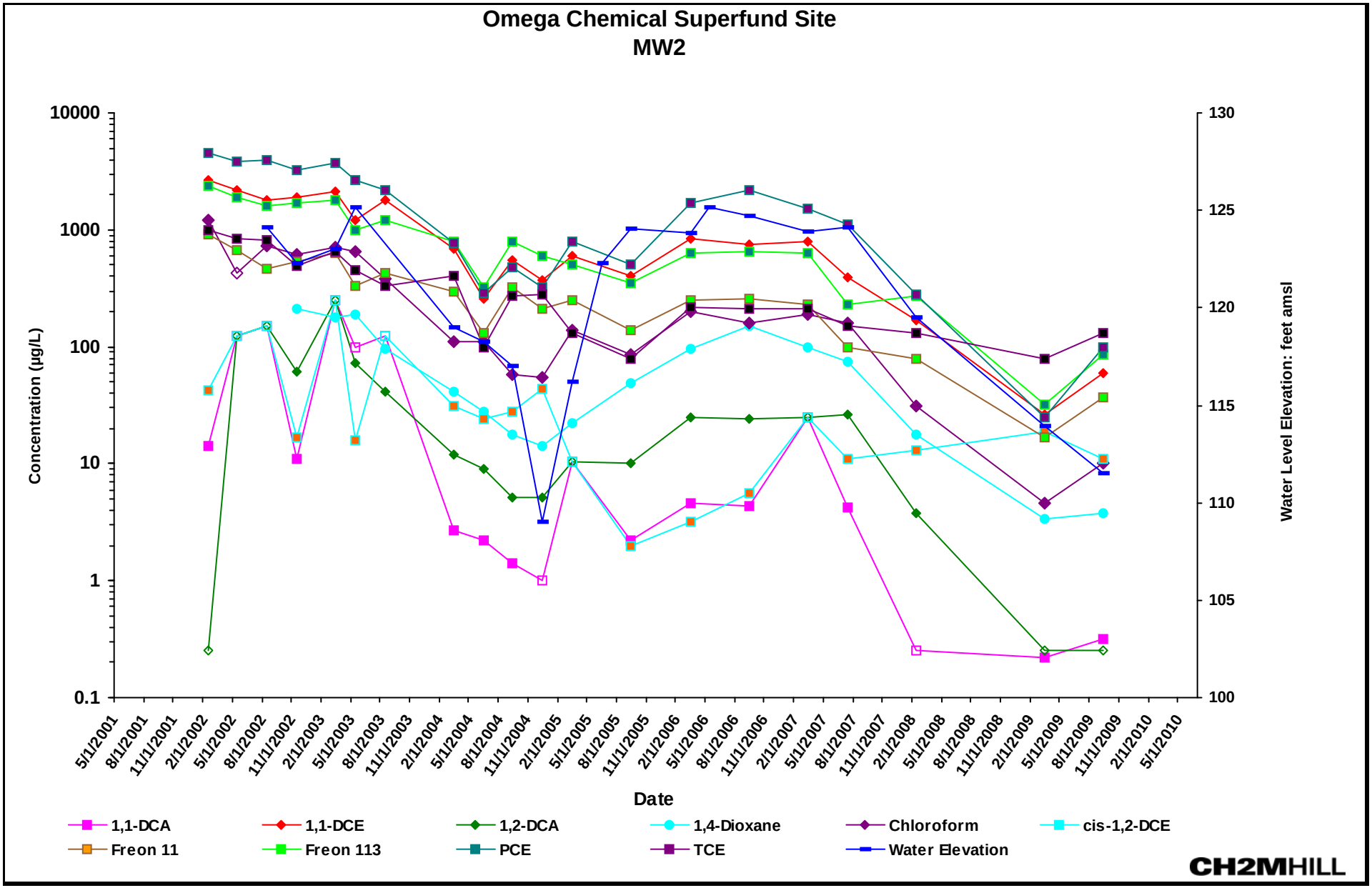
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



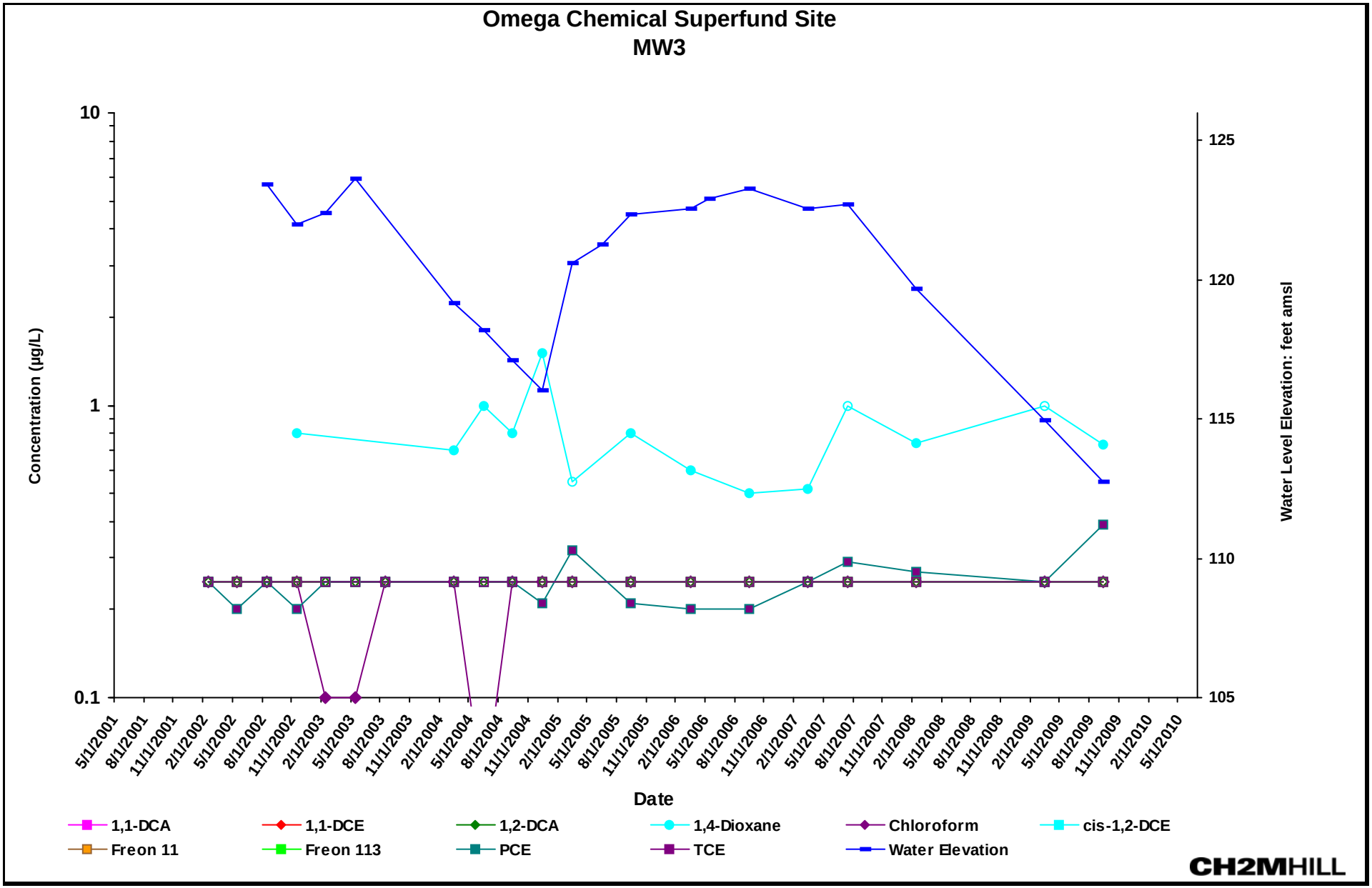
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

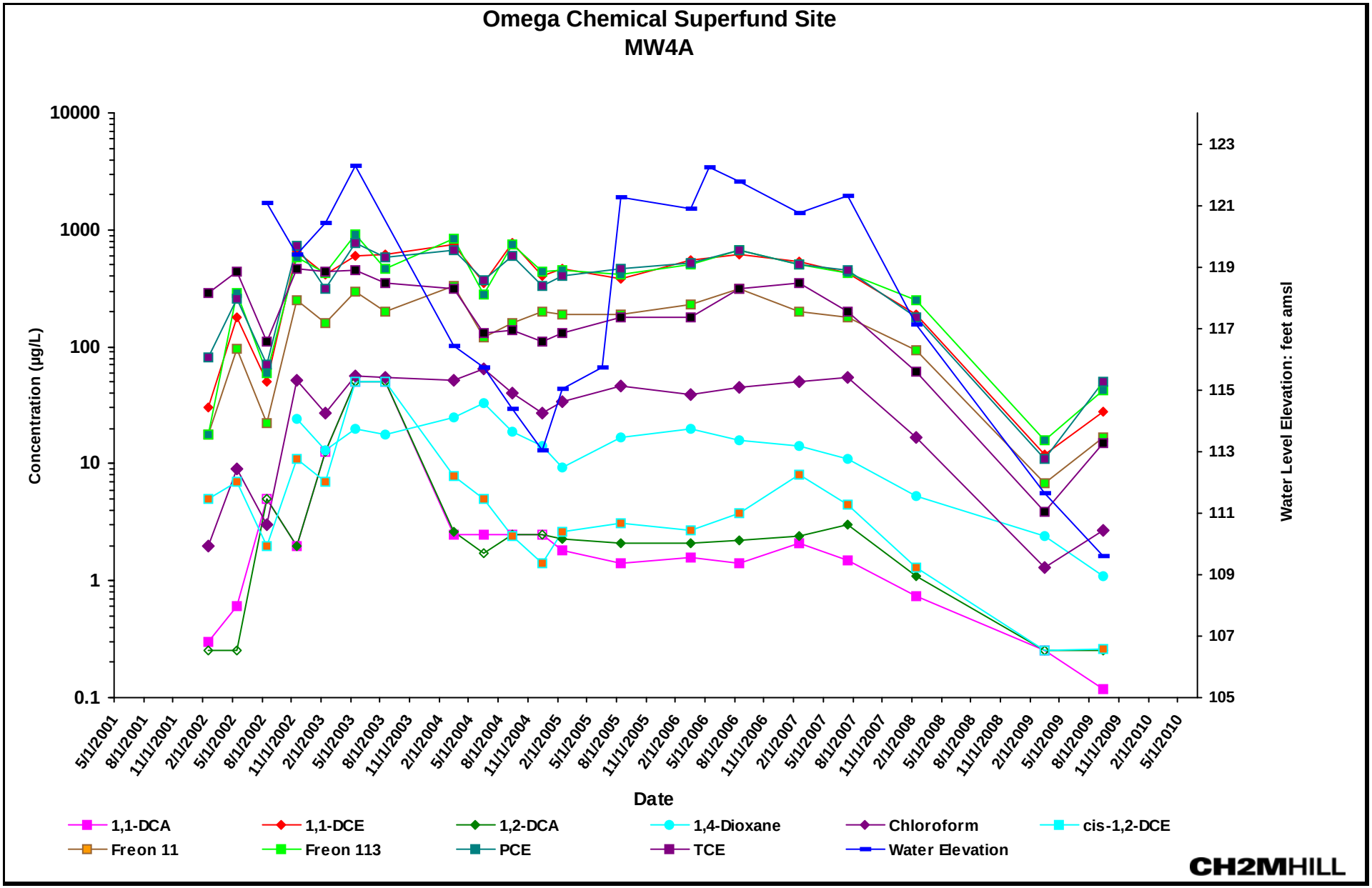


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

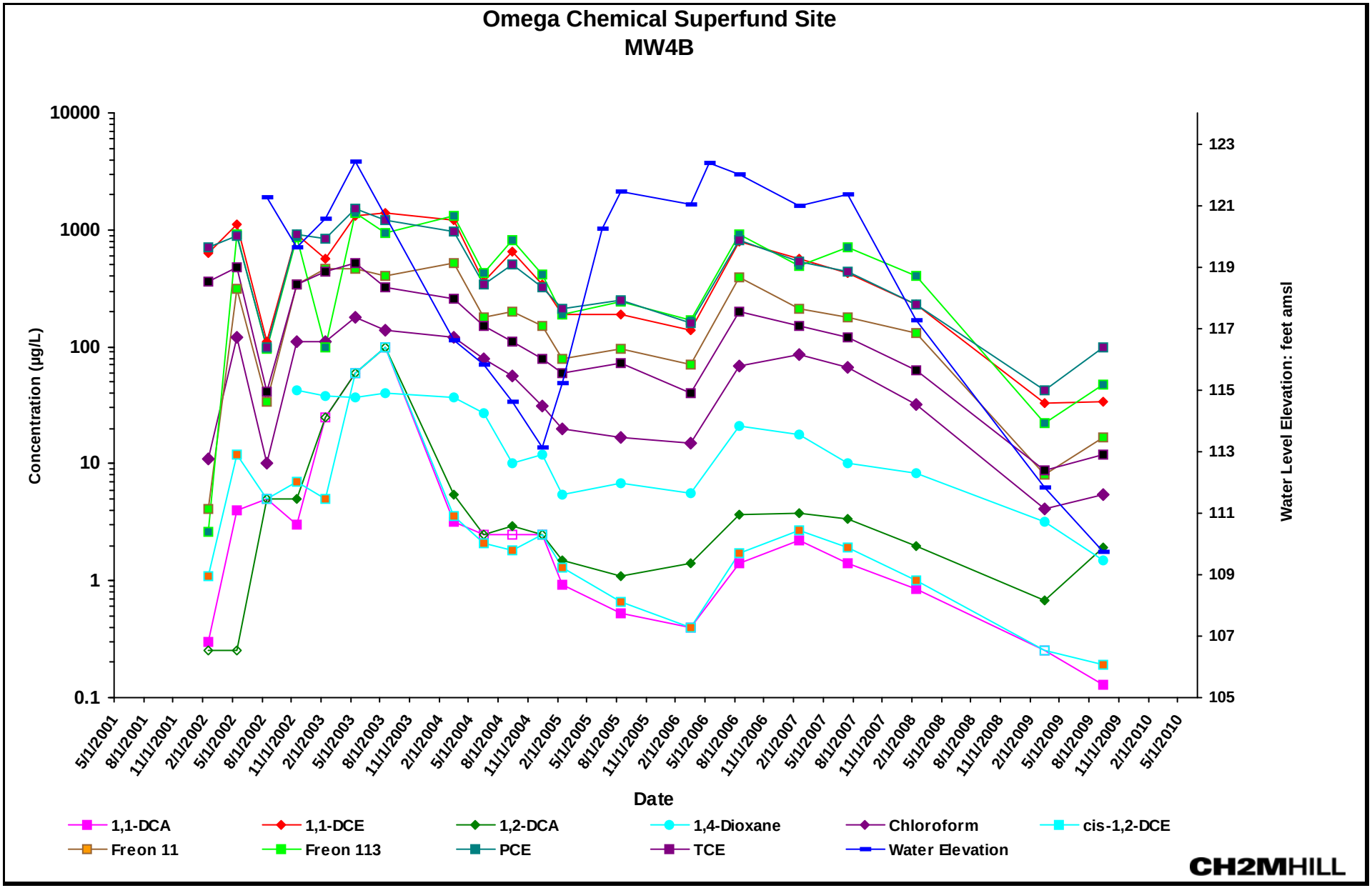


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



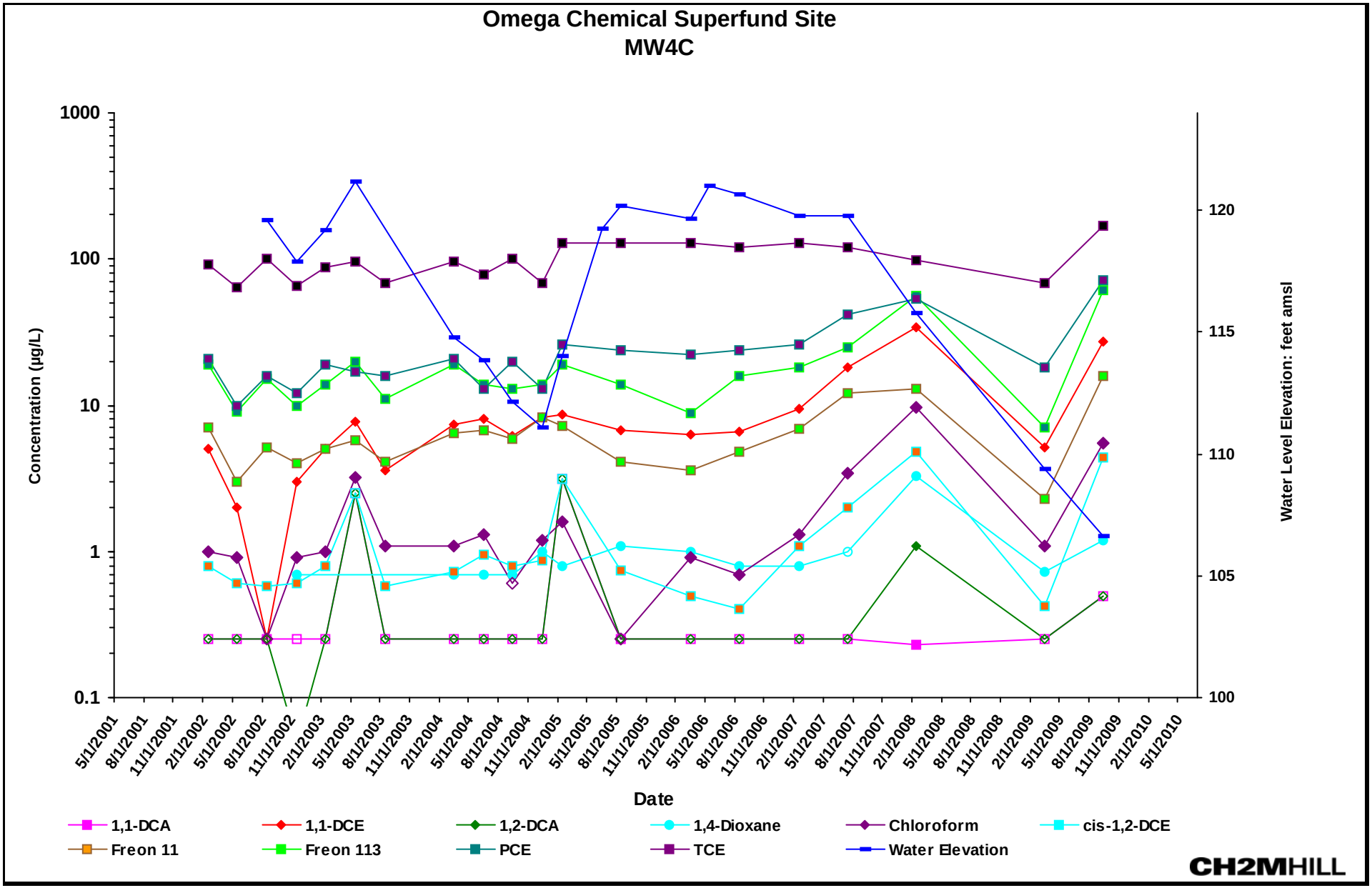
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



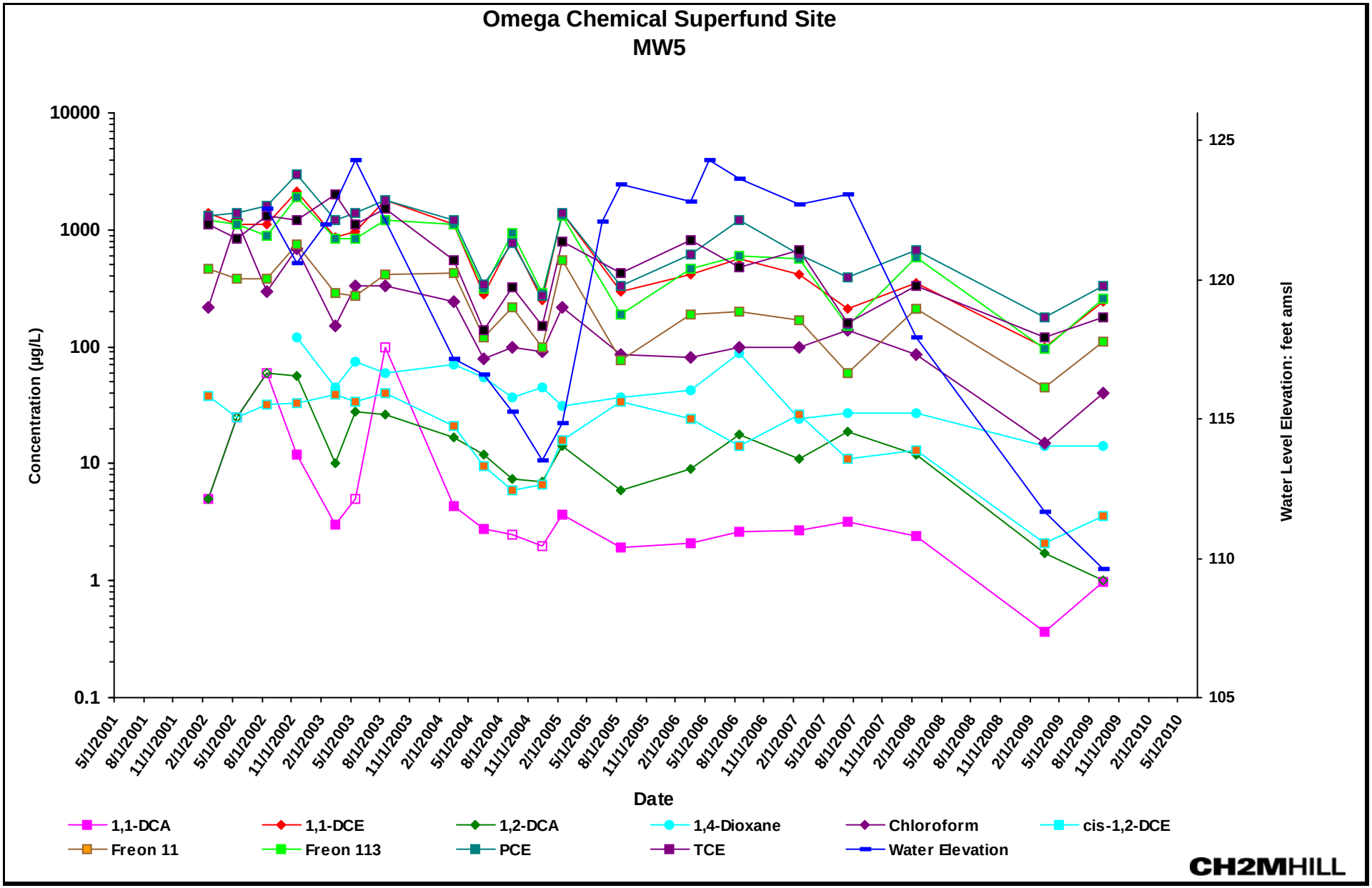
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



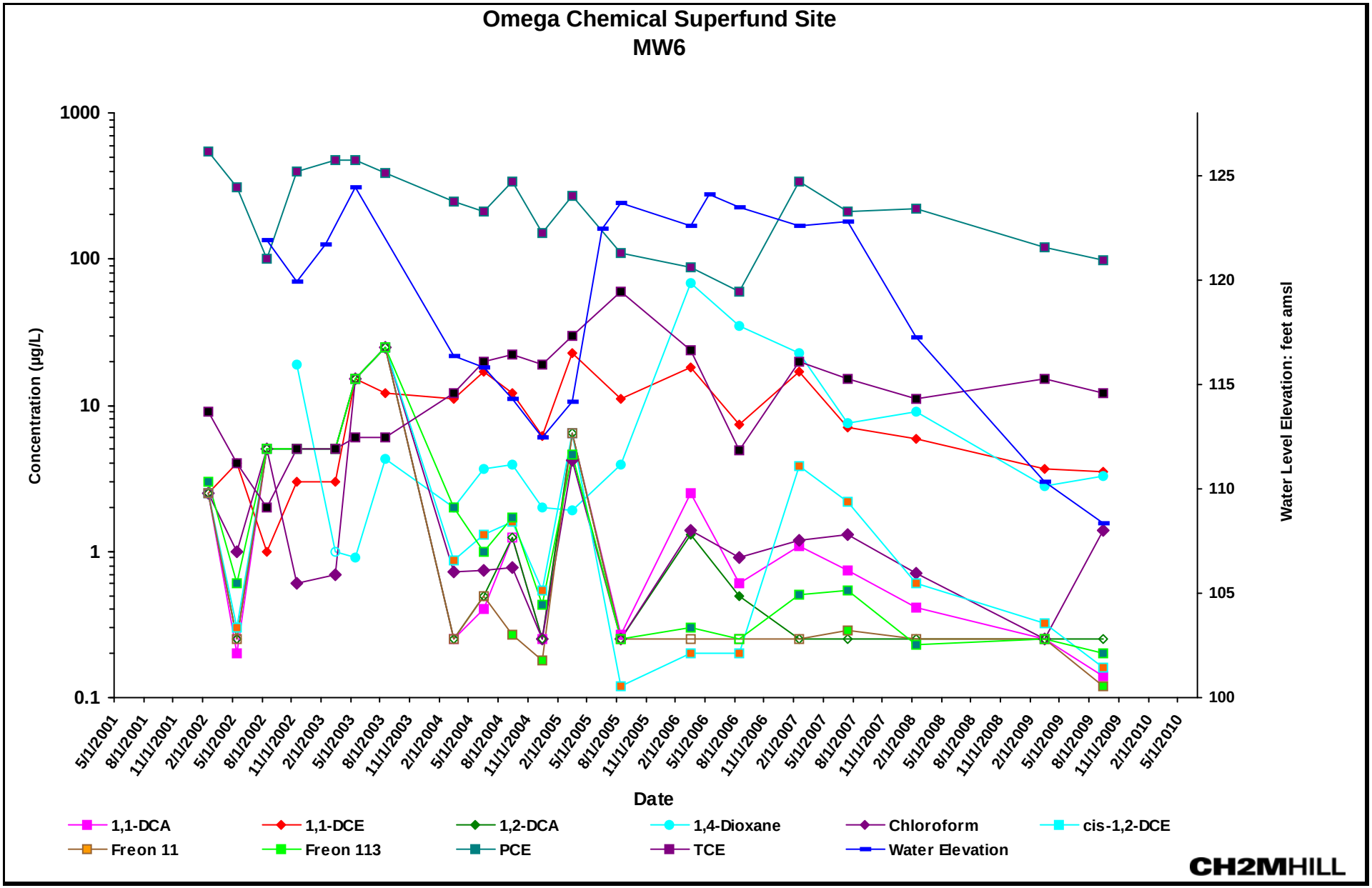
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:
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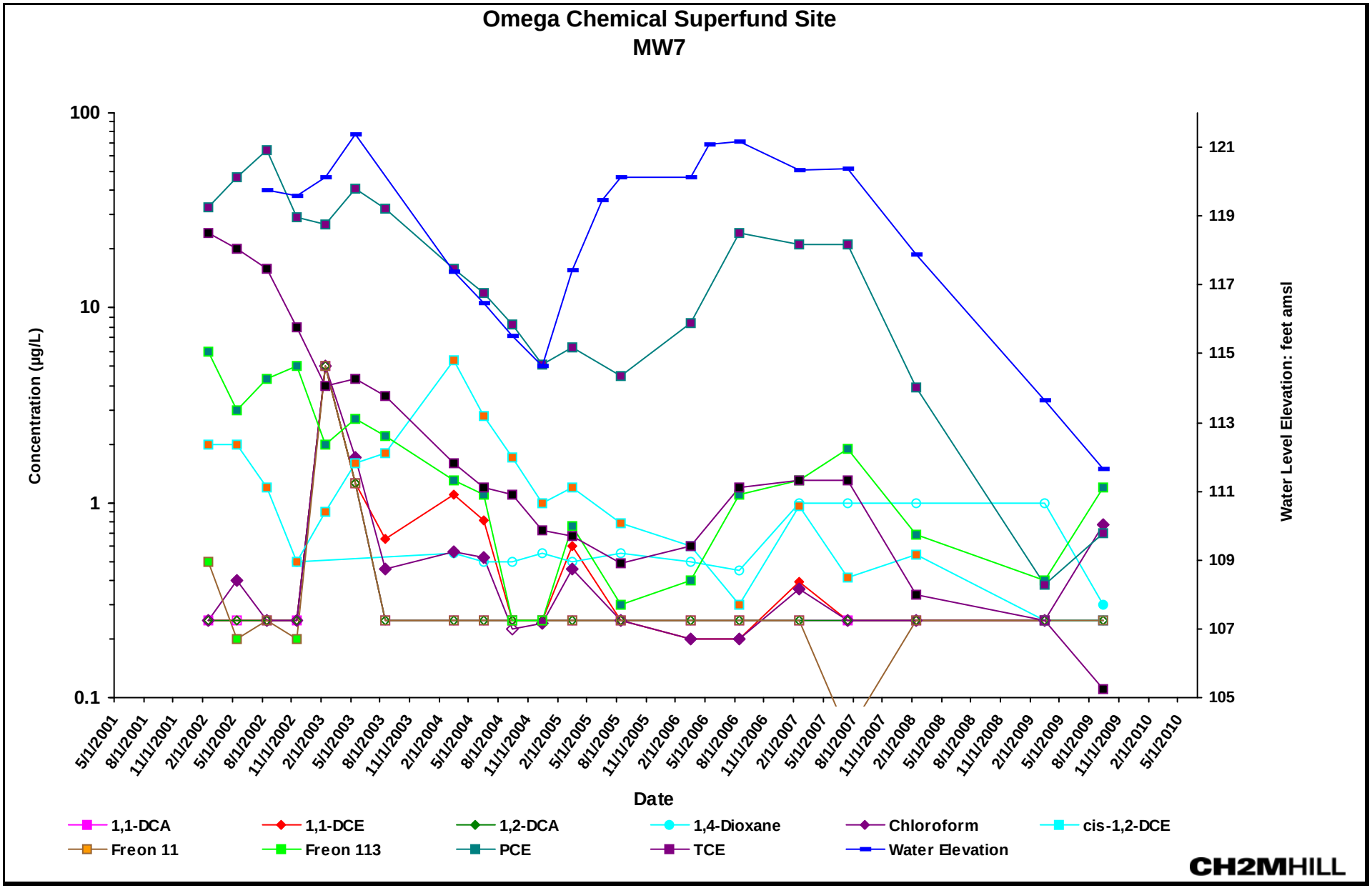
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

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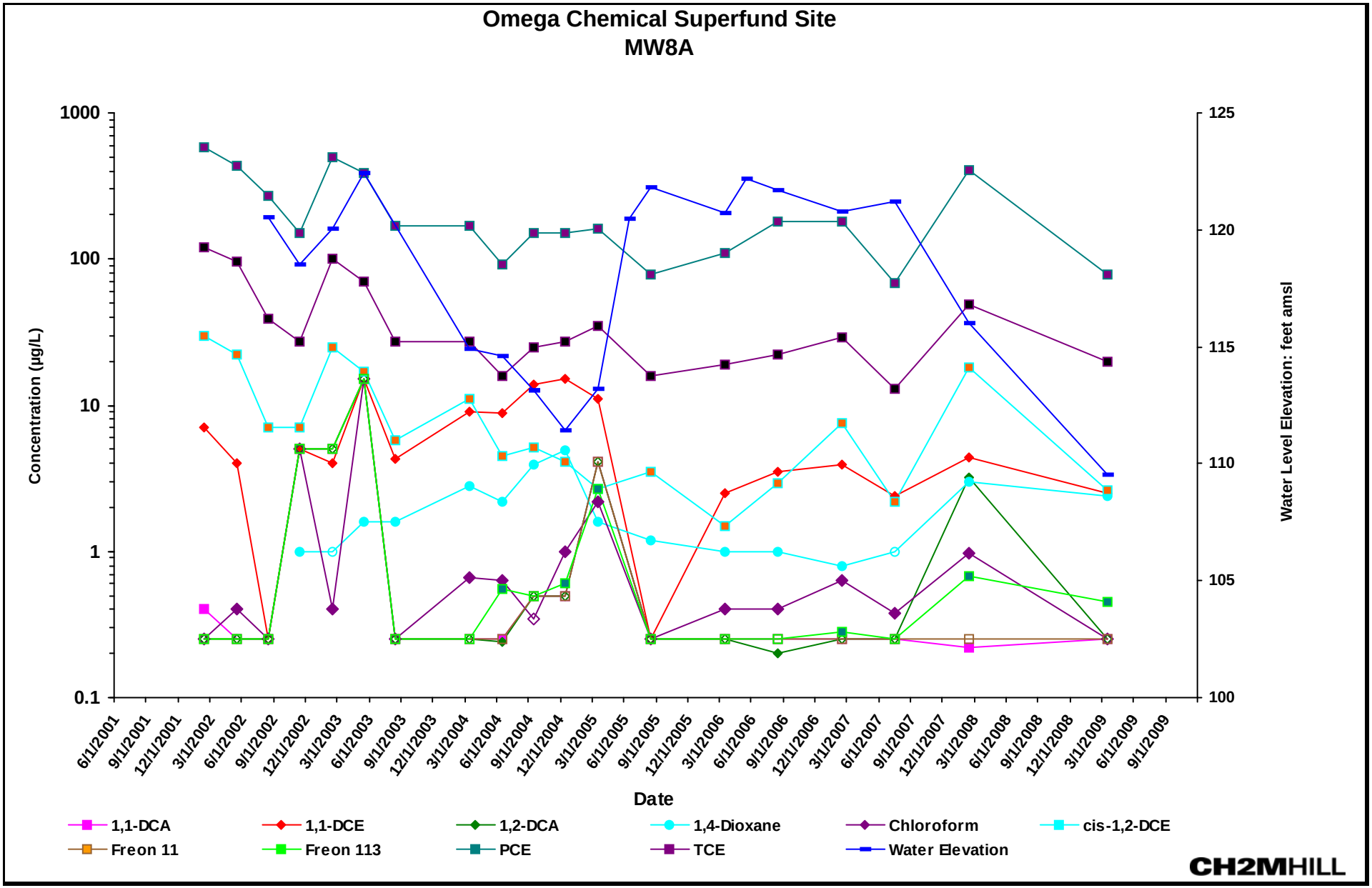
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

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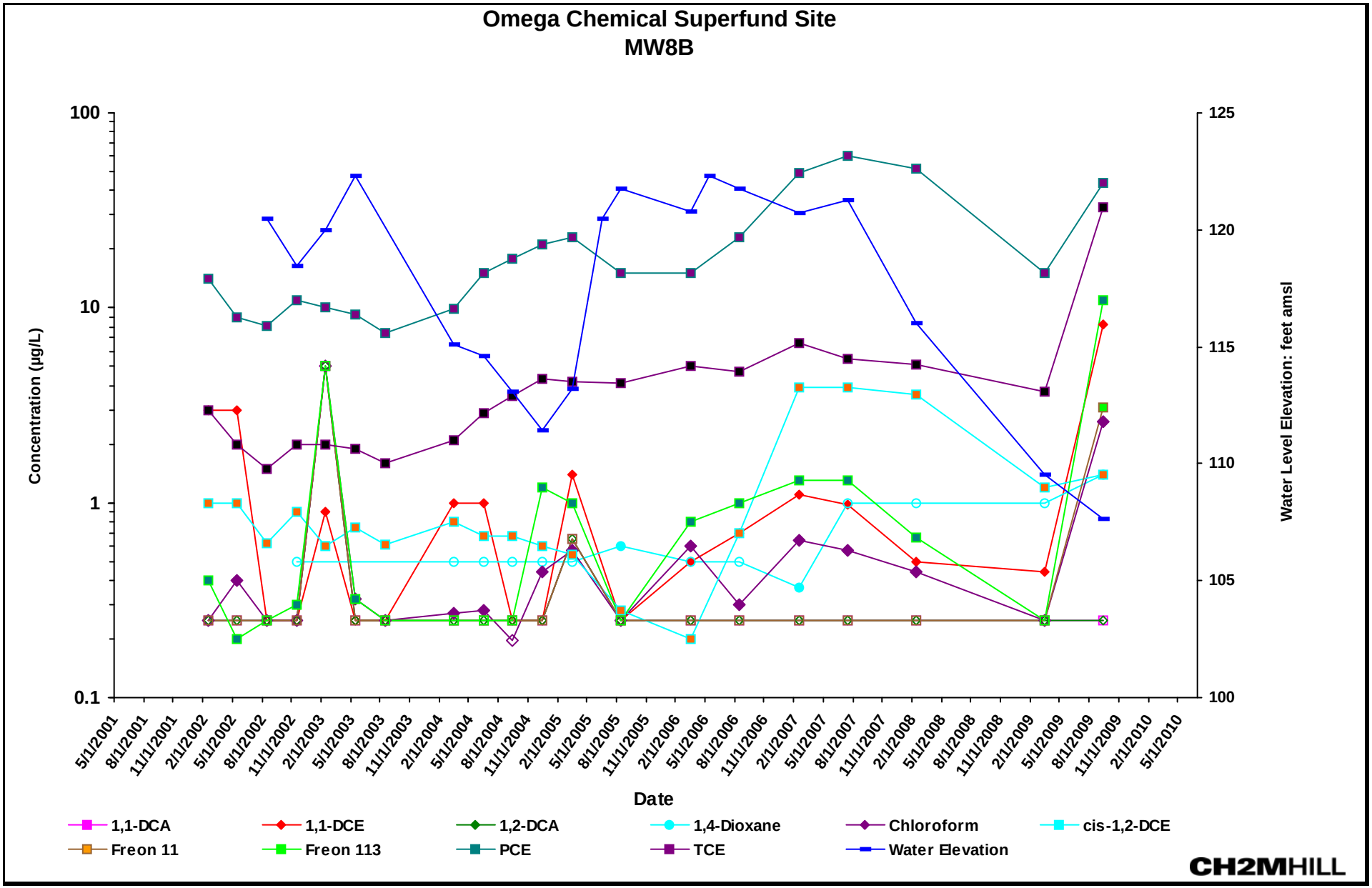
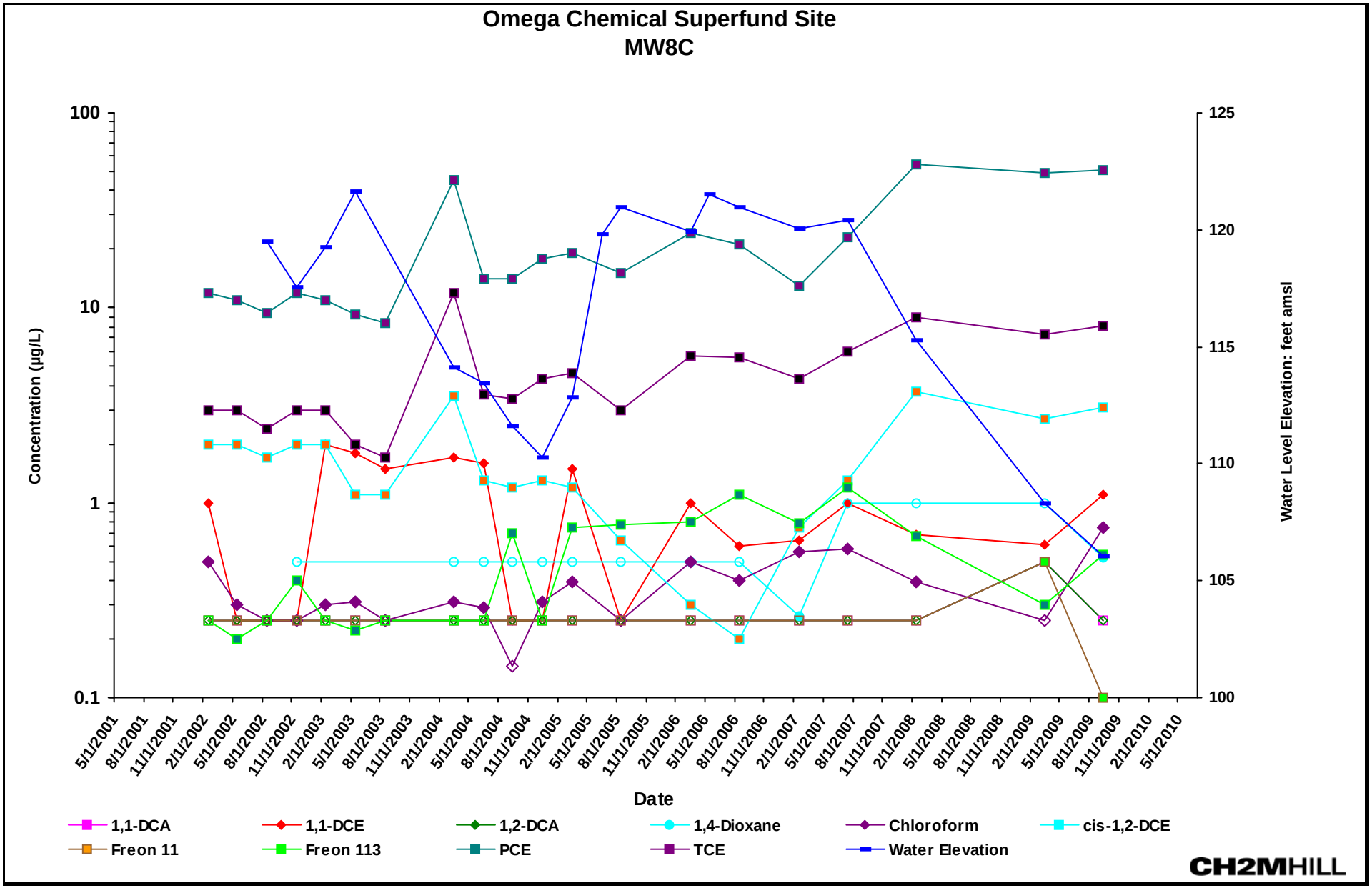
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

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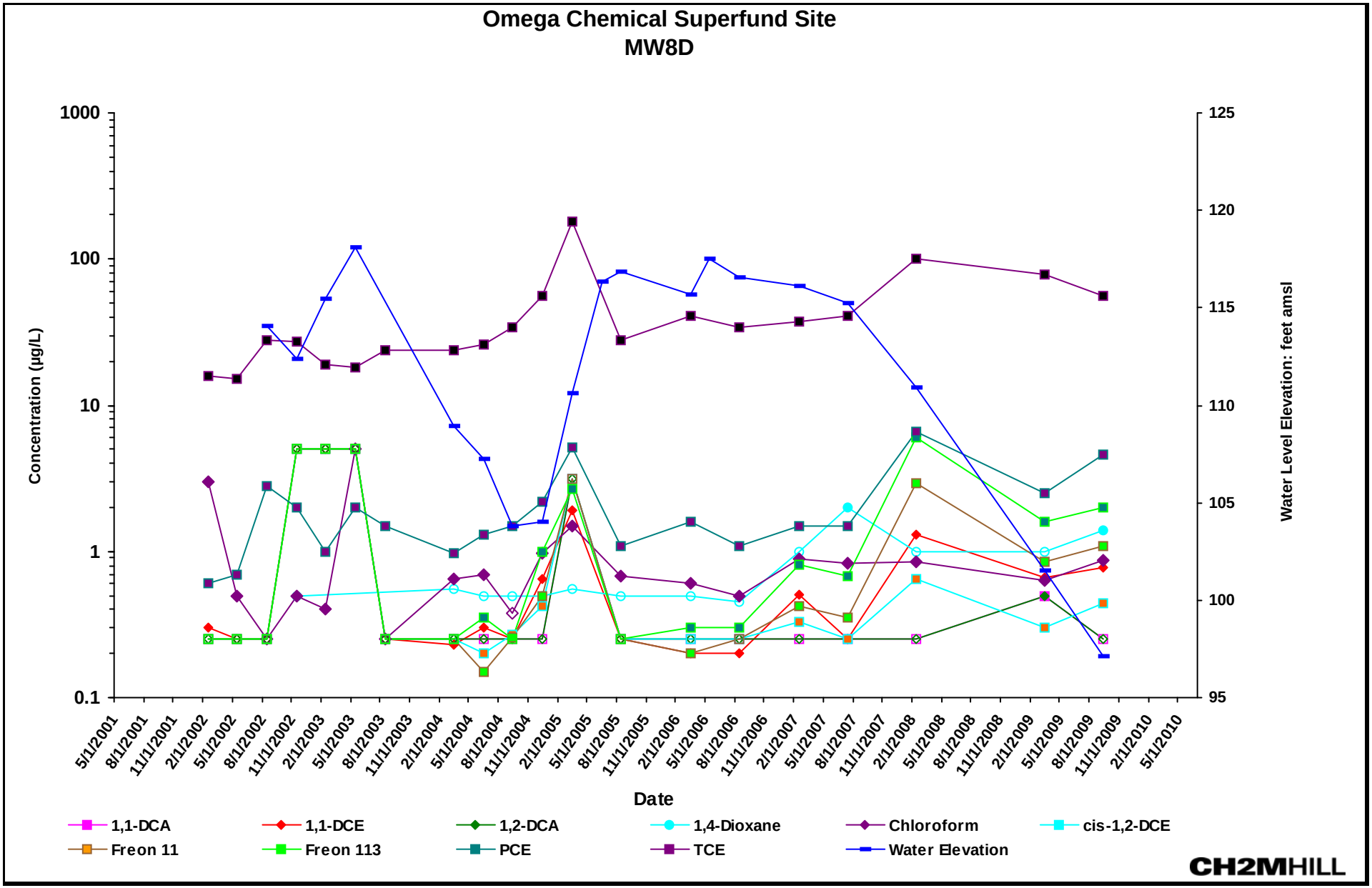
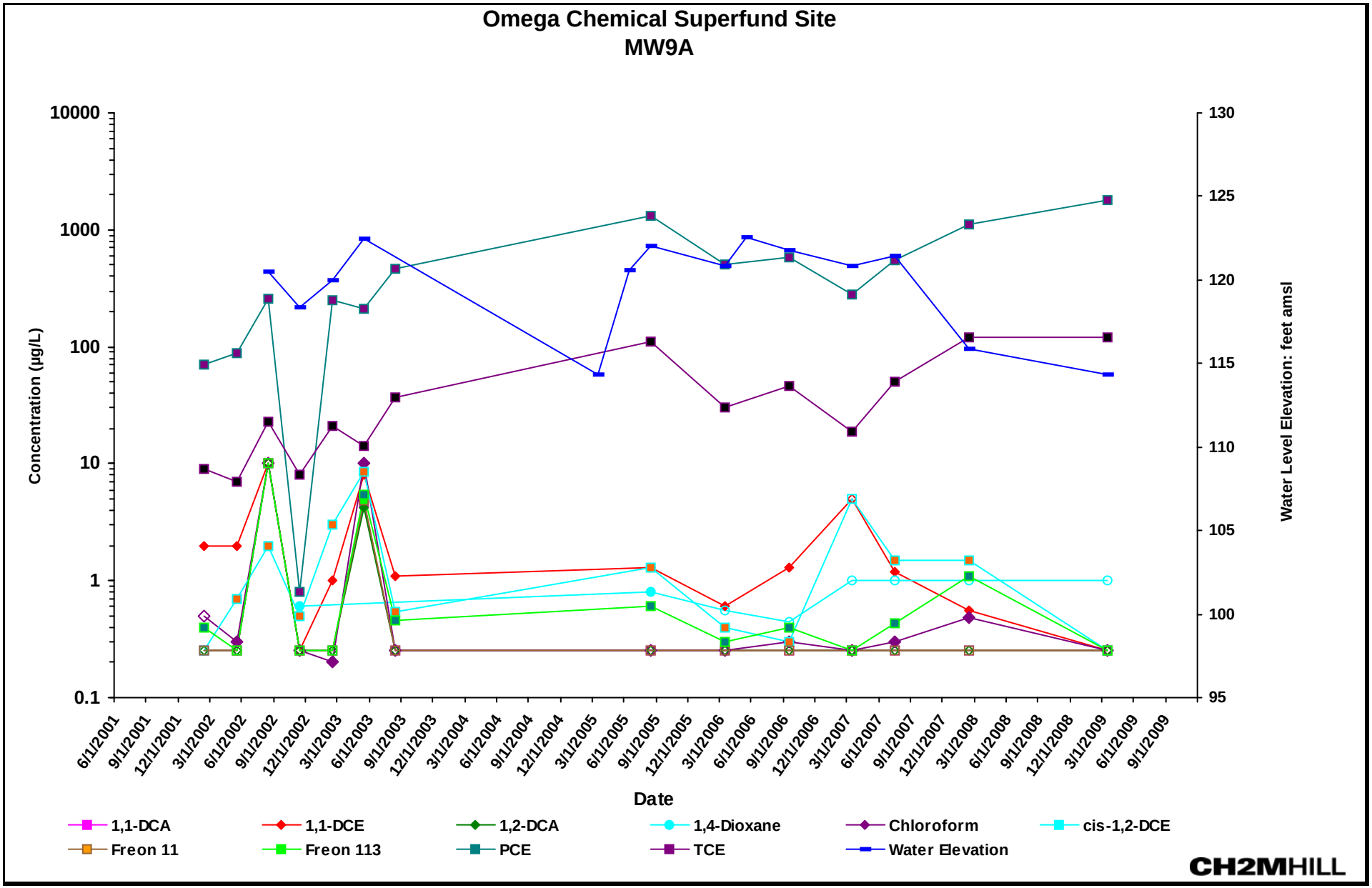
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

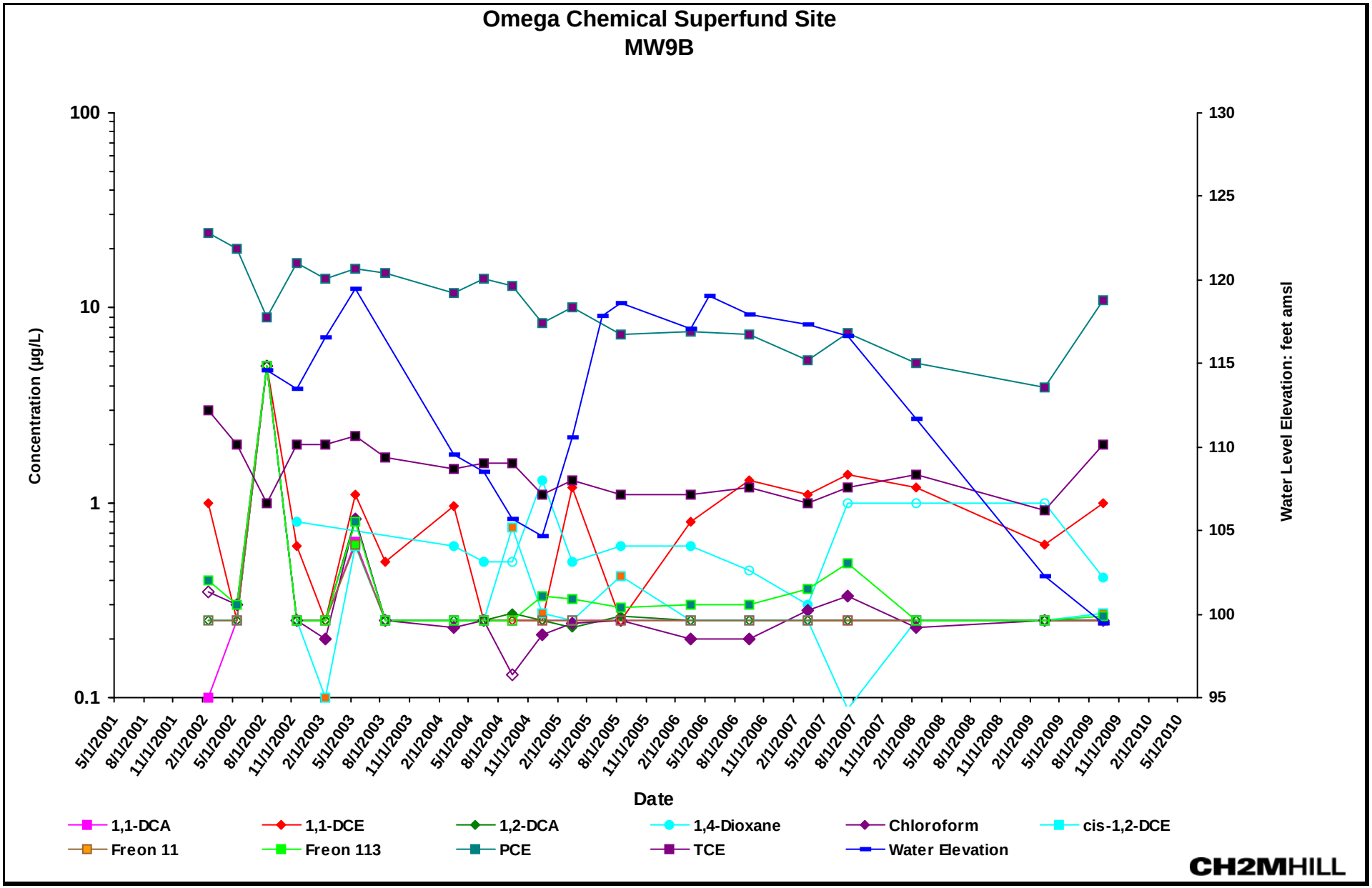


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

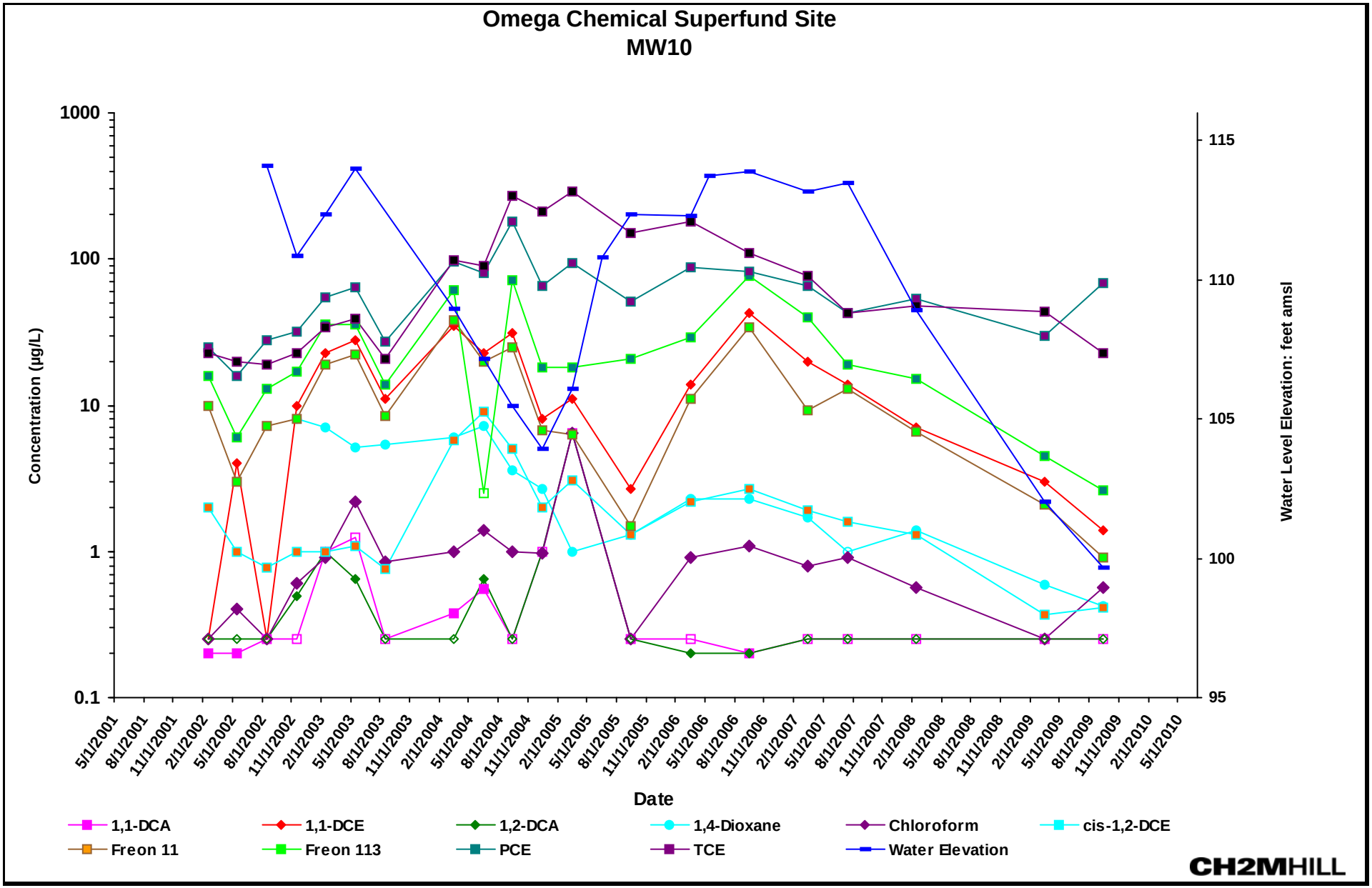


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



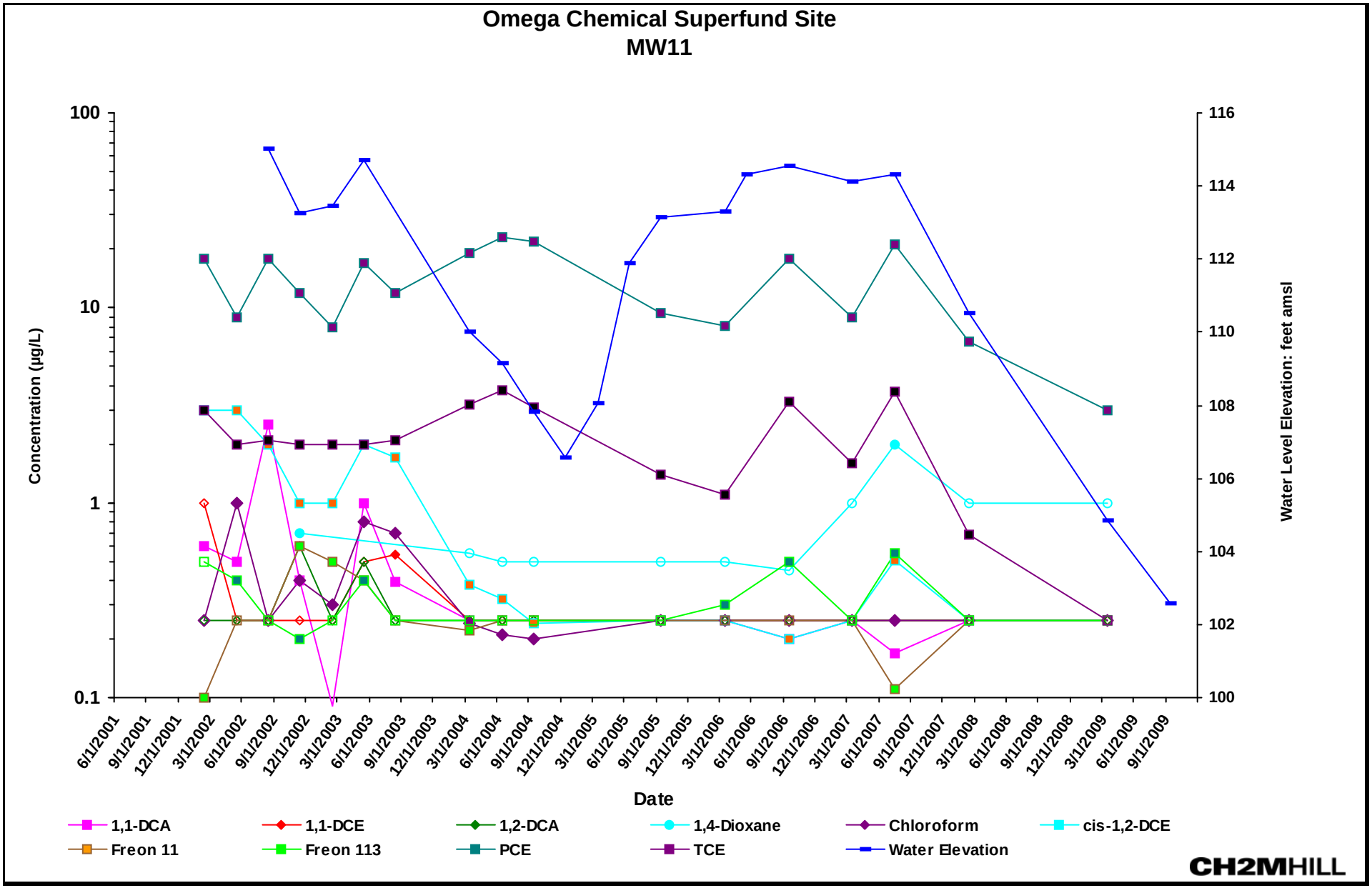
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



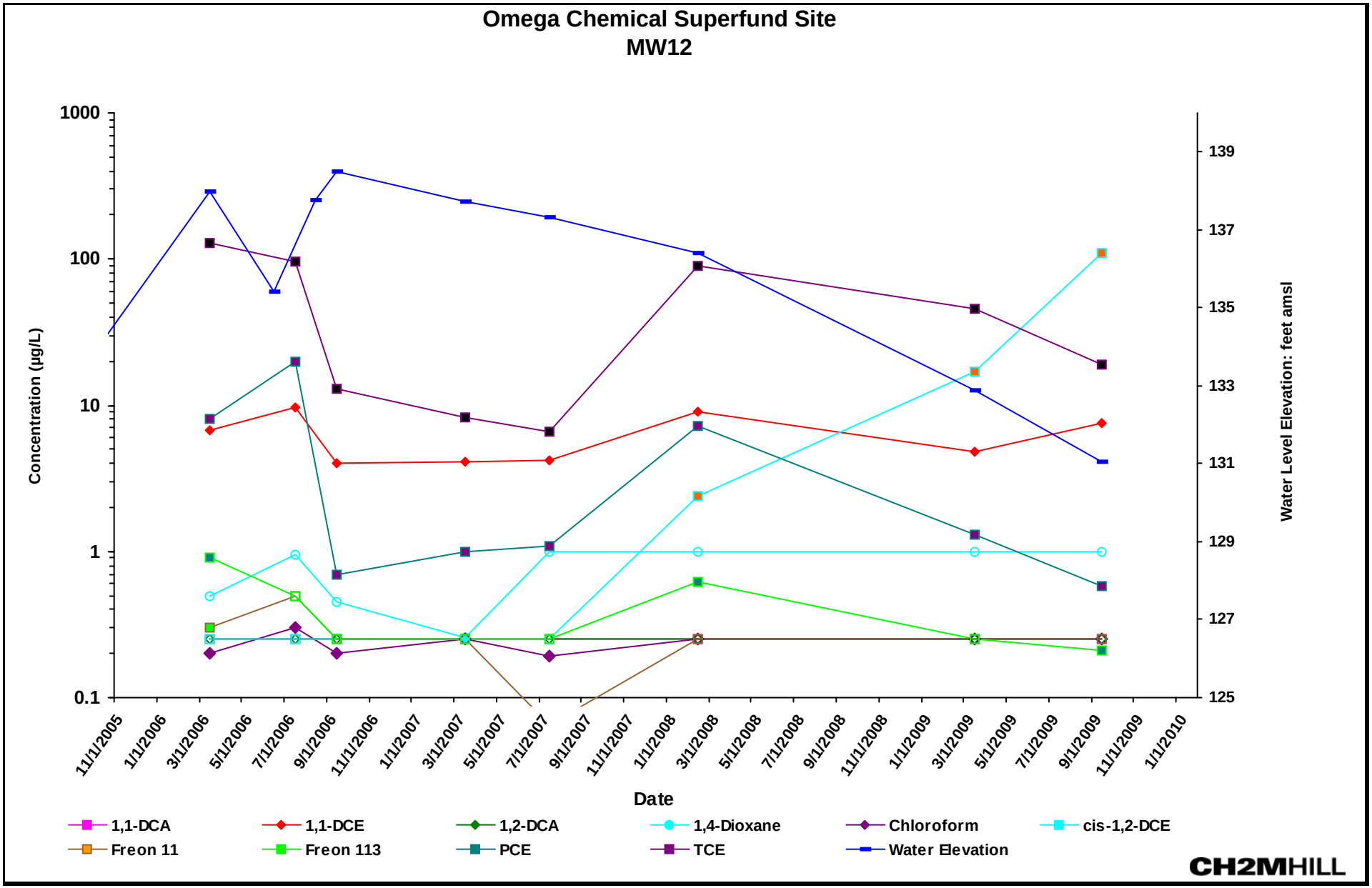
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

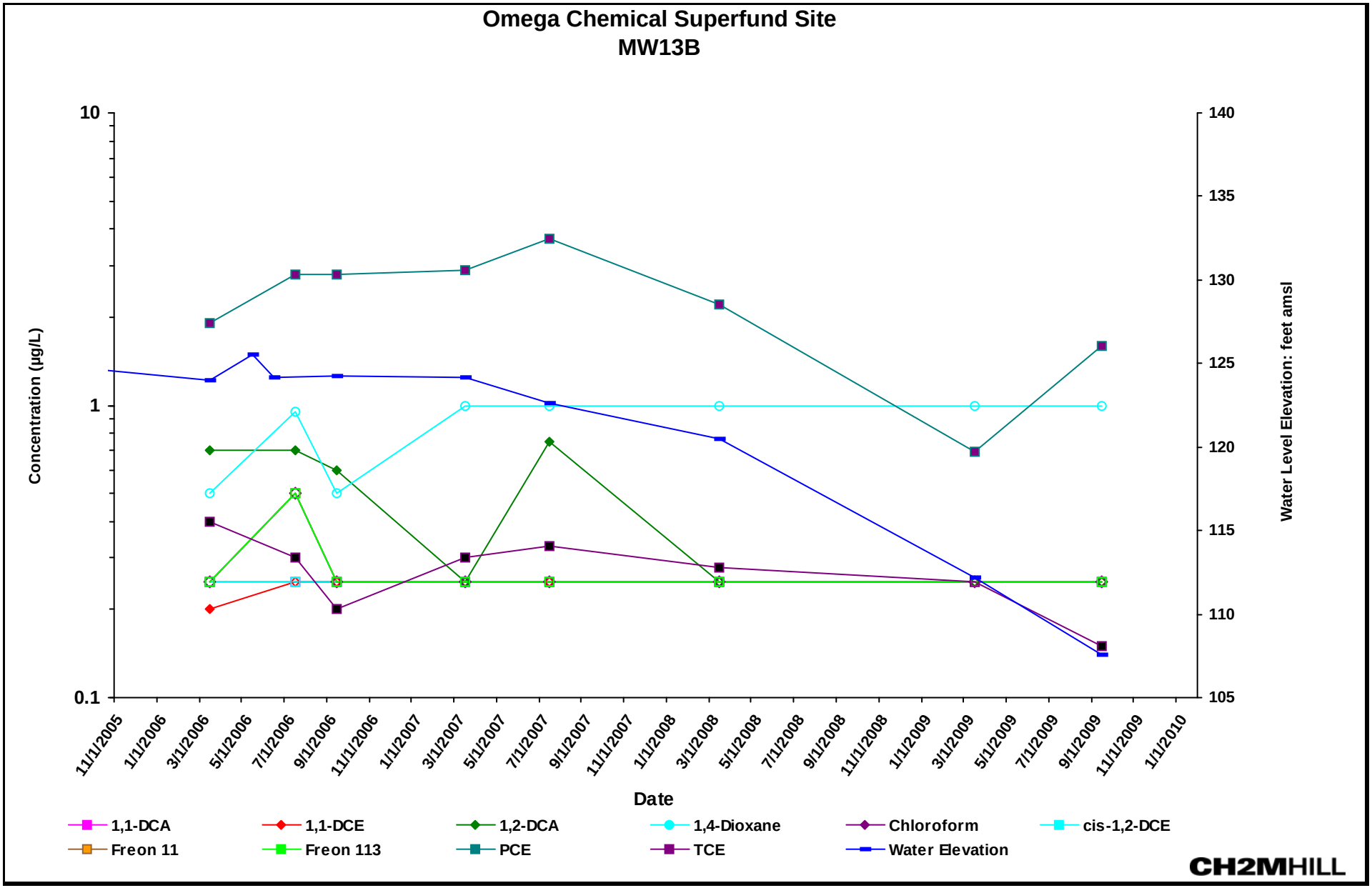


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

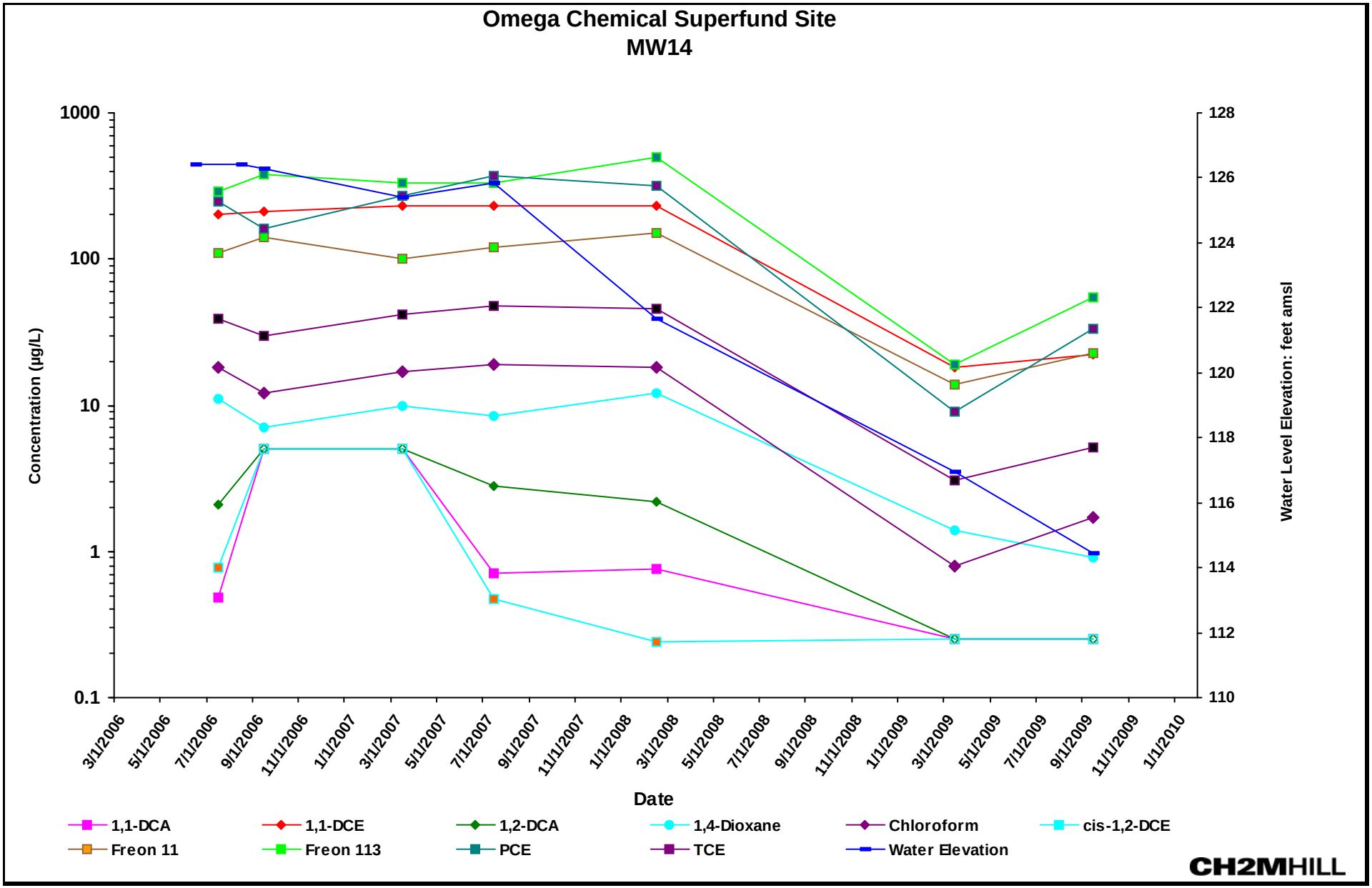


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



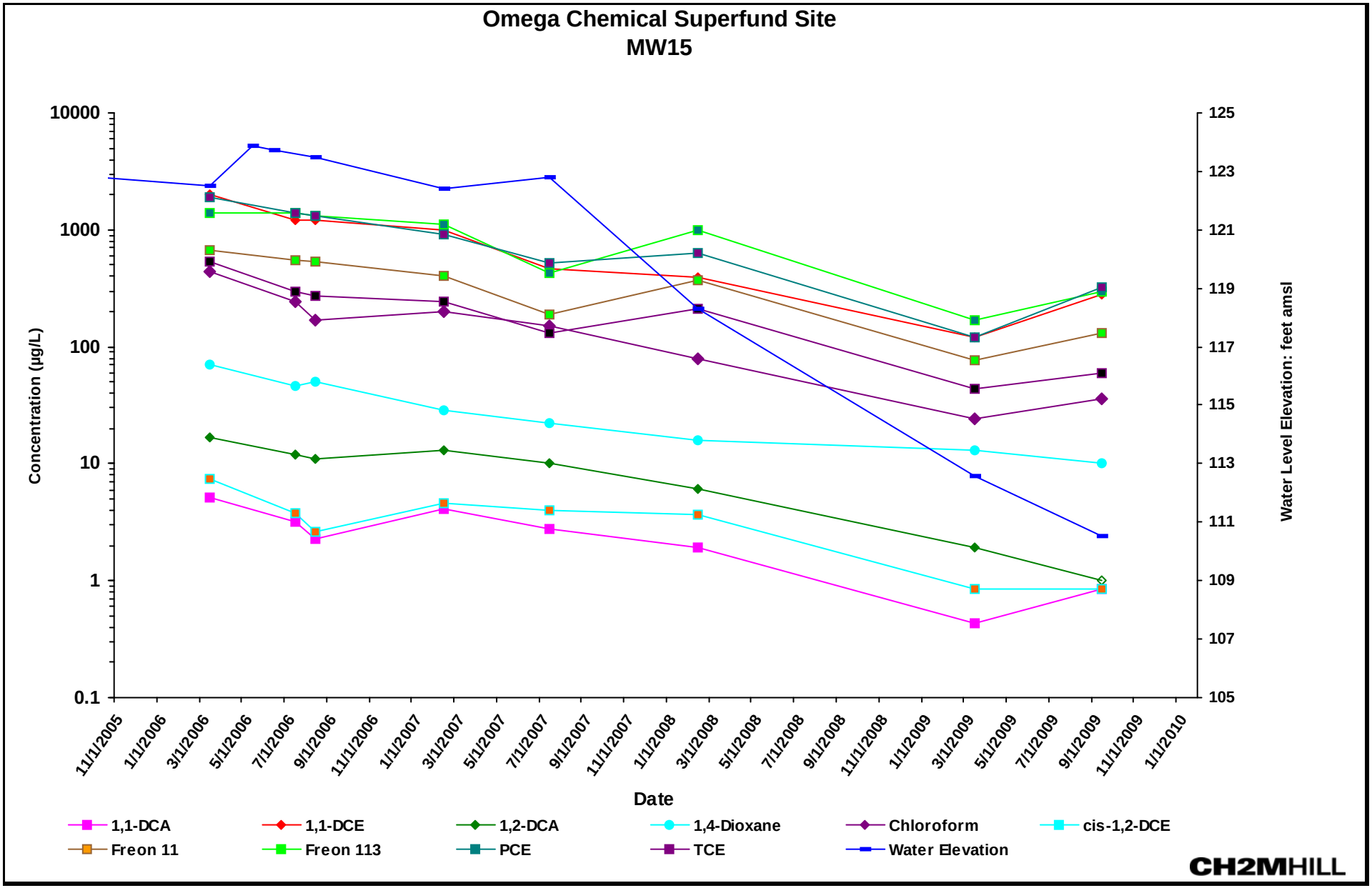
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



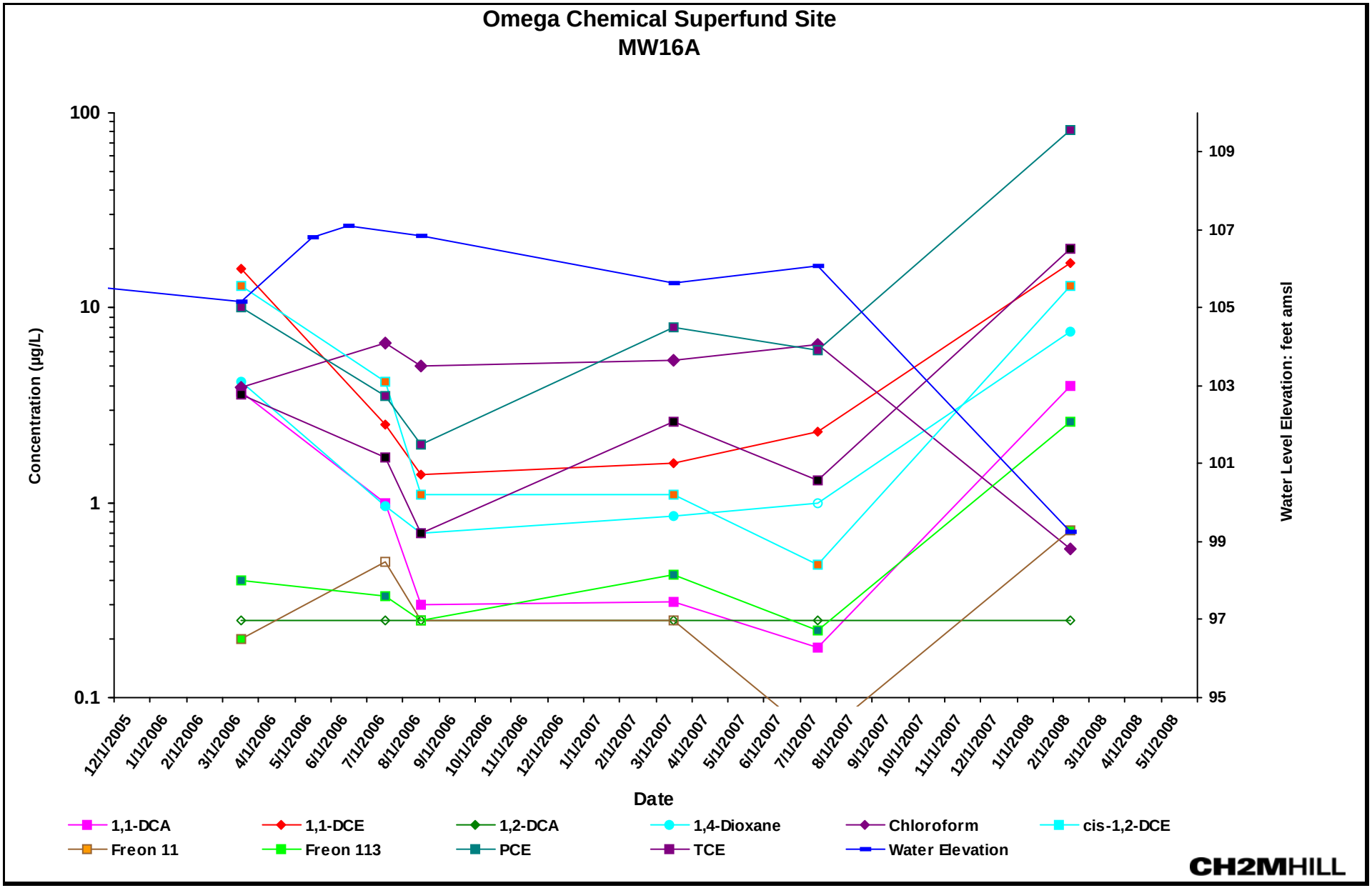
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



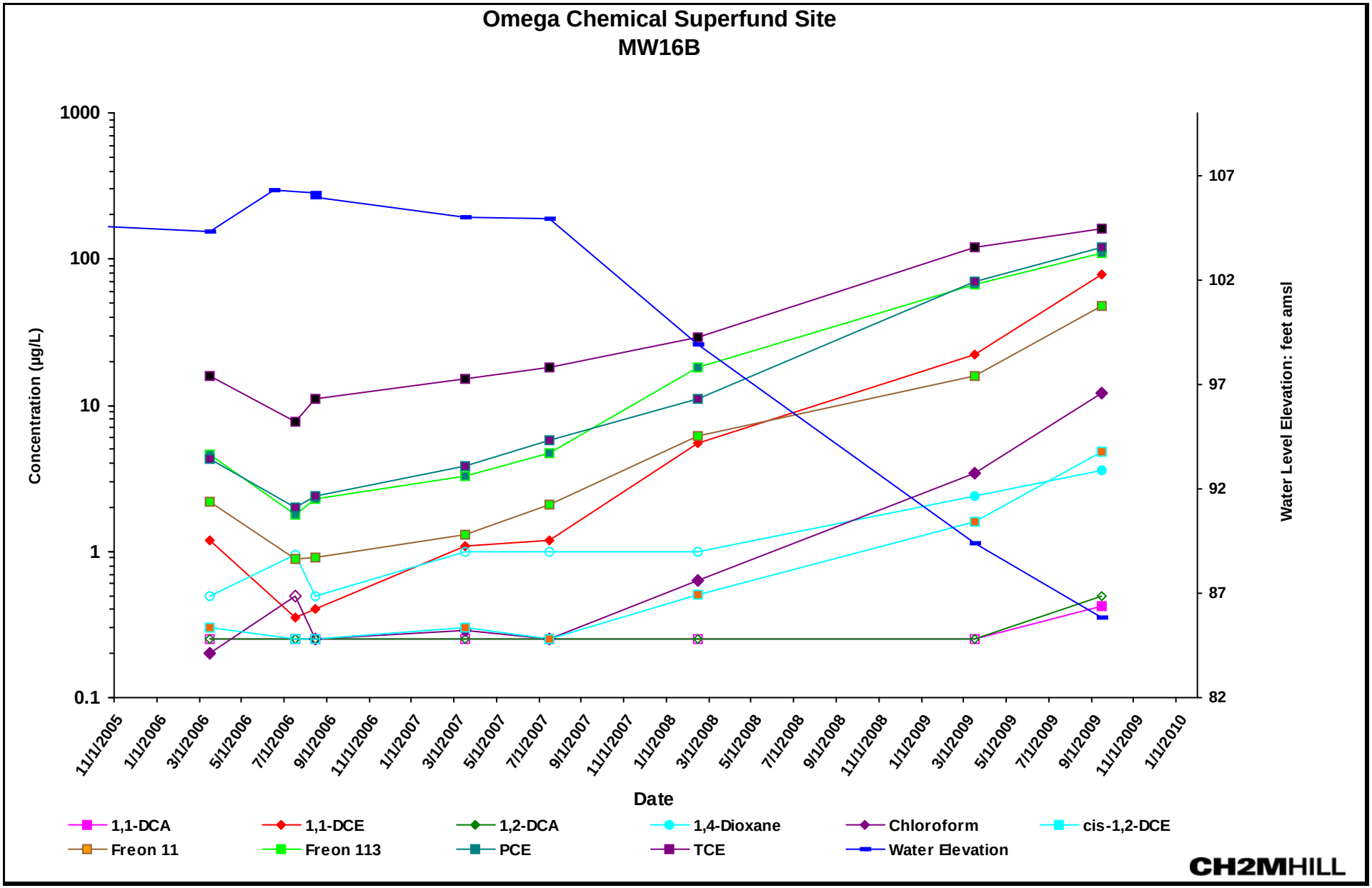
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

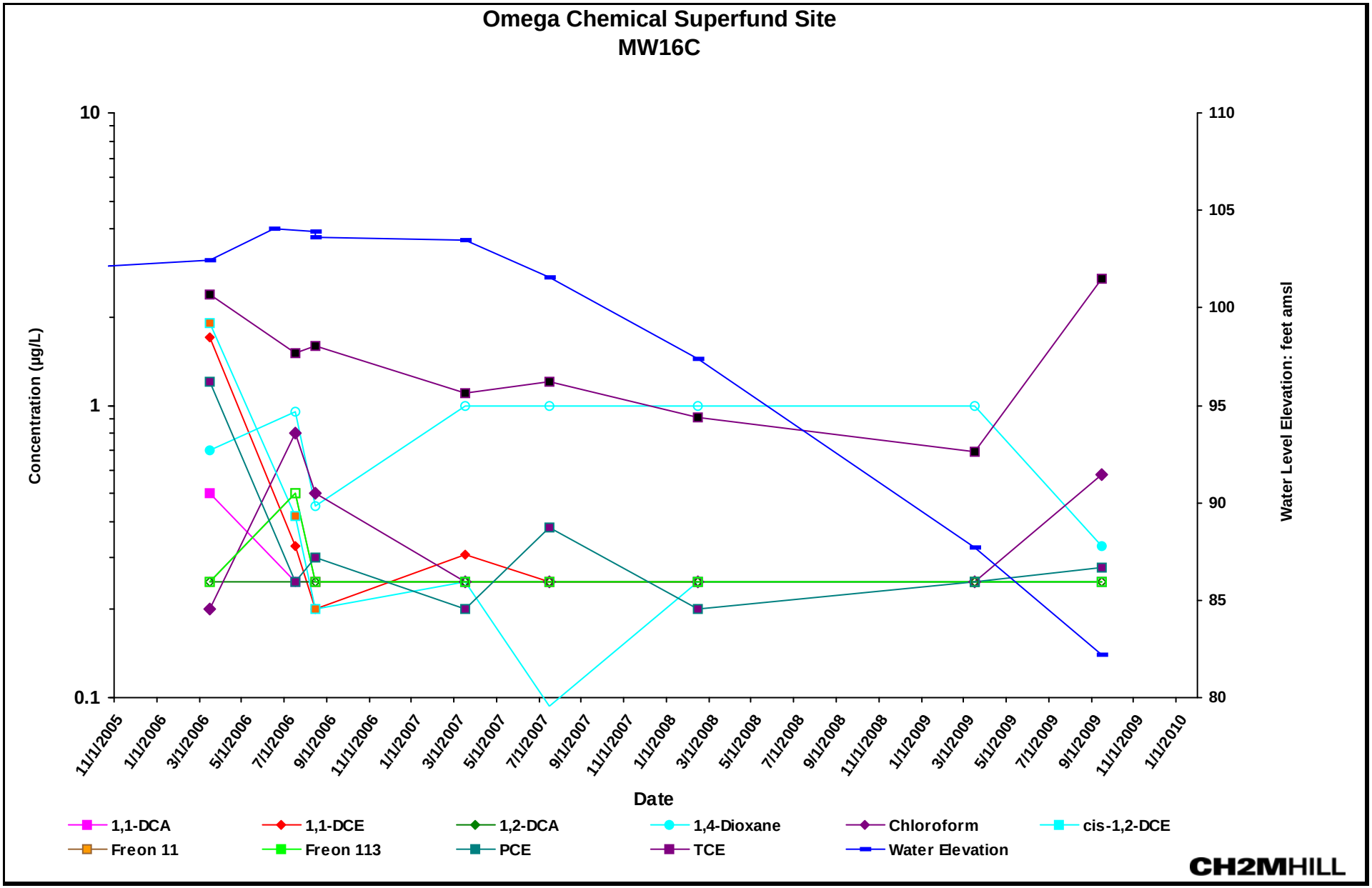


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

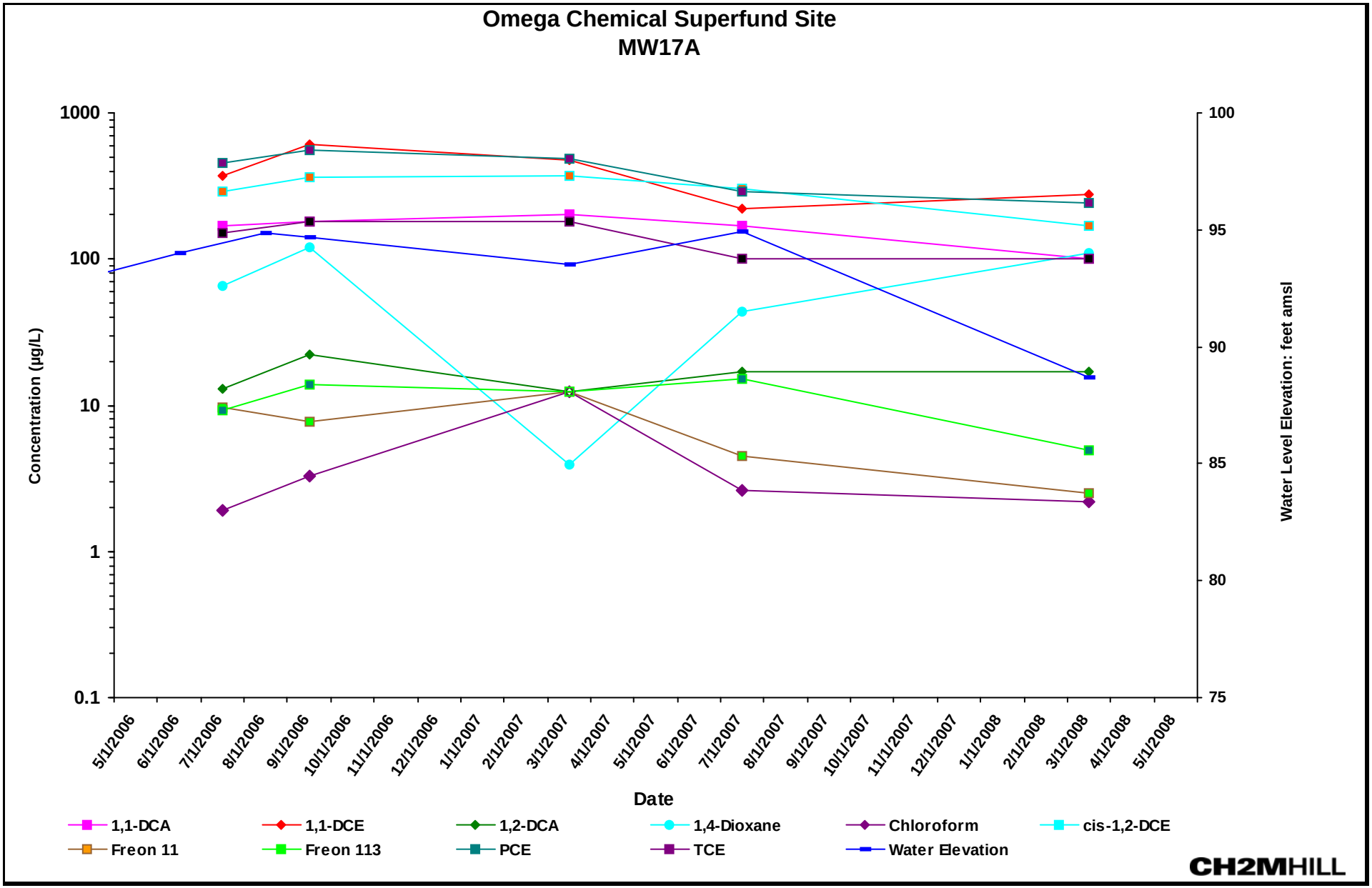


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



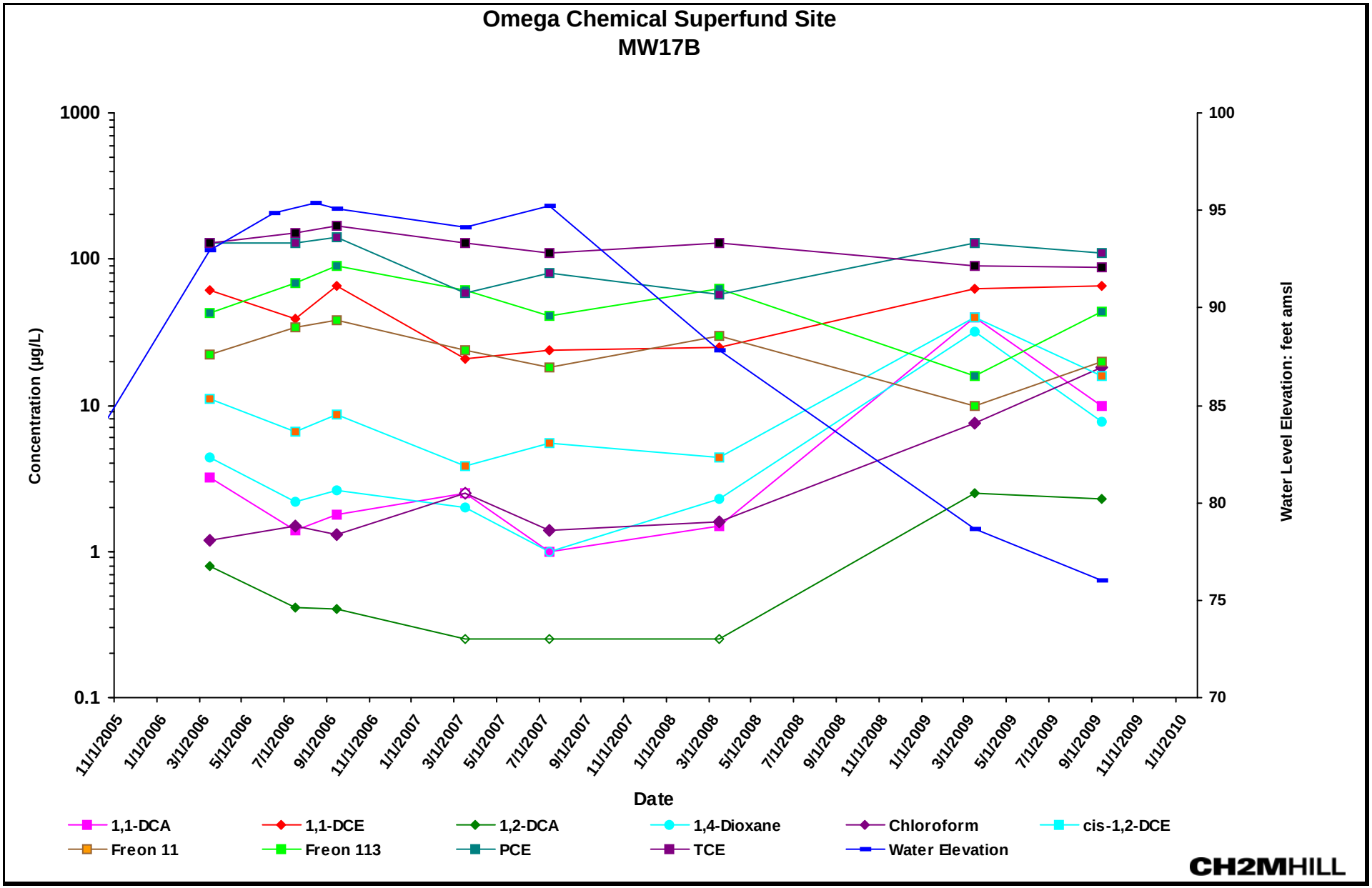
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



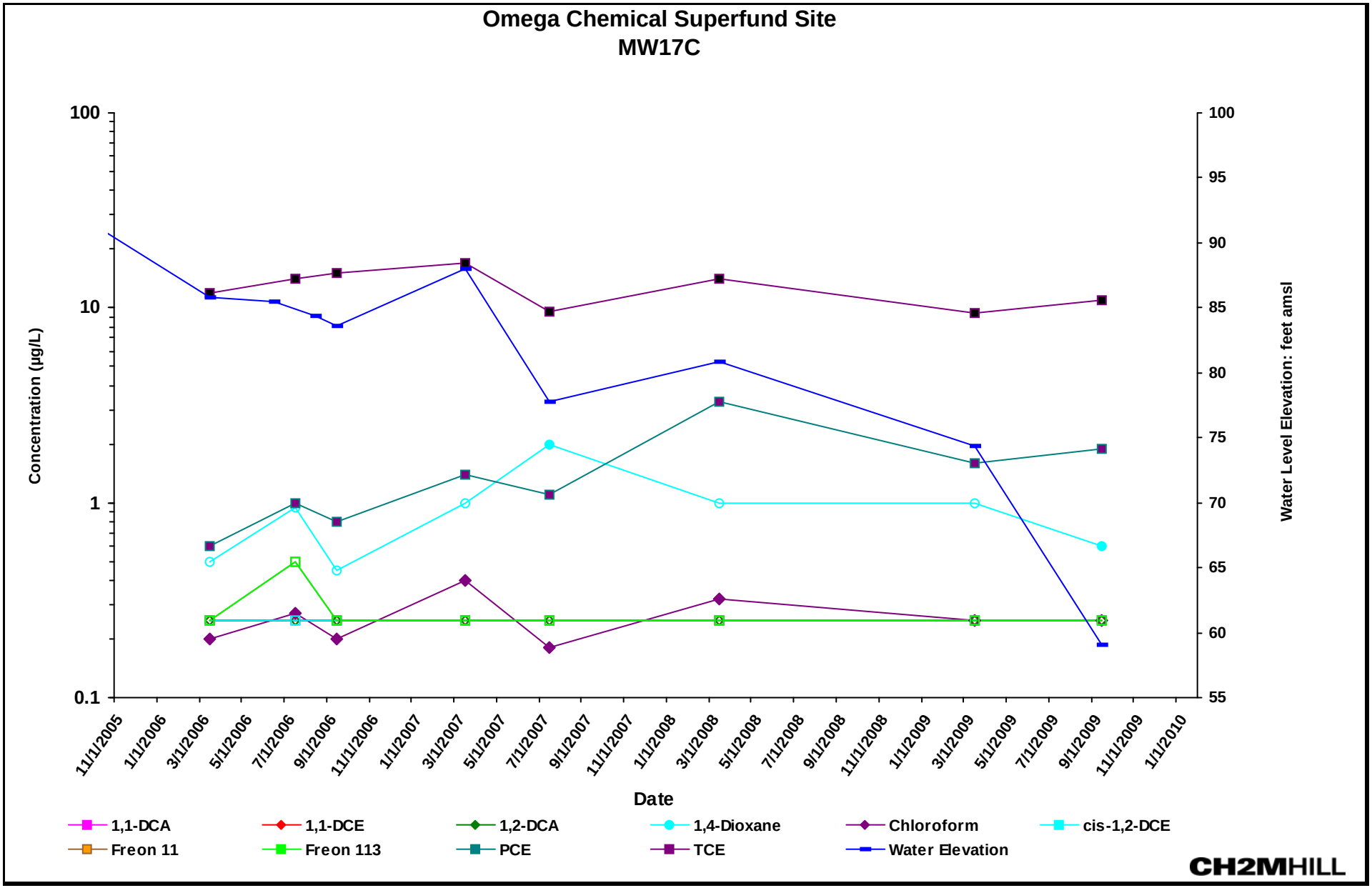
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



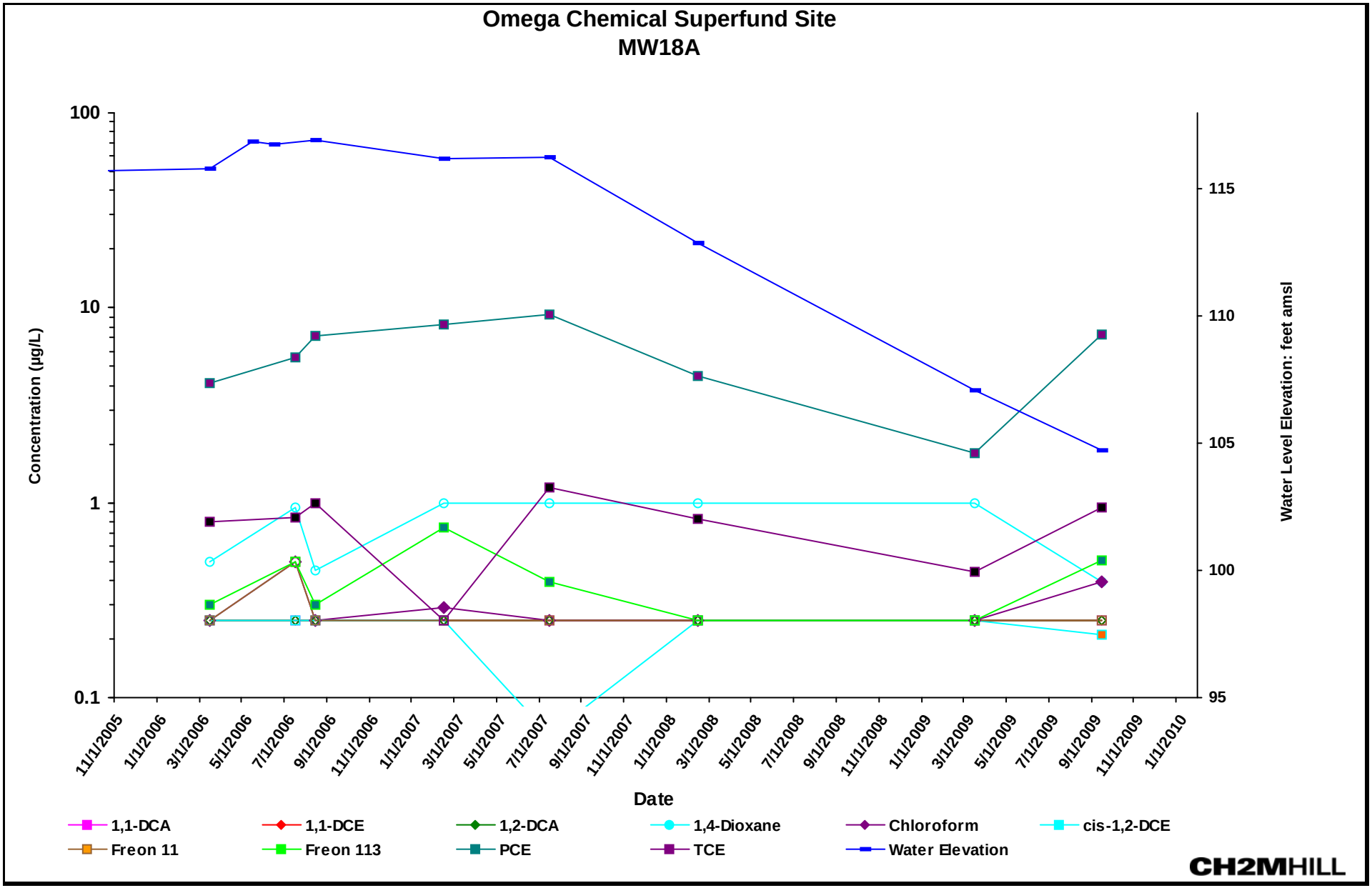
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



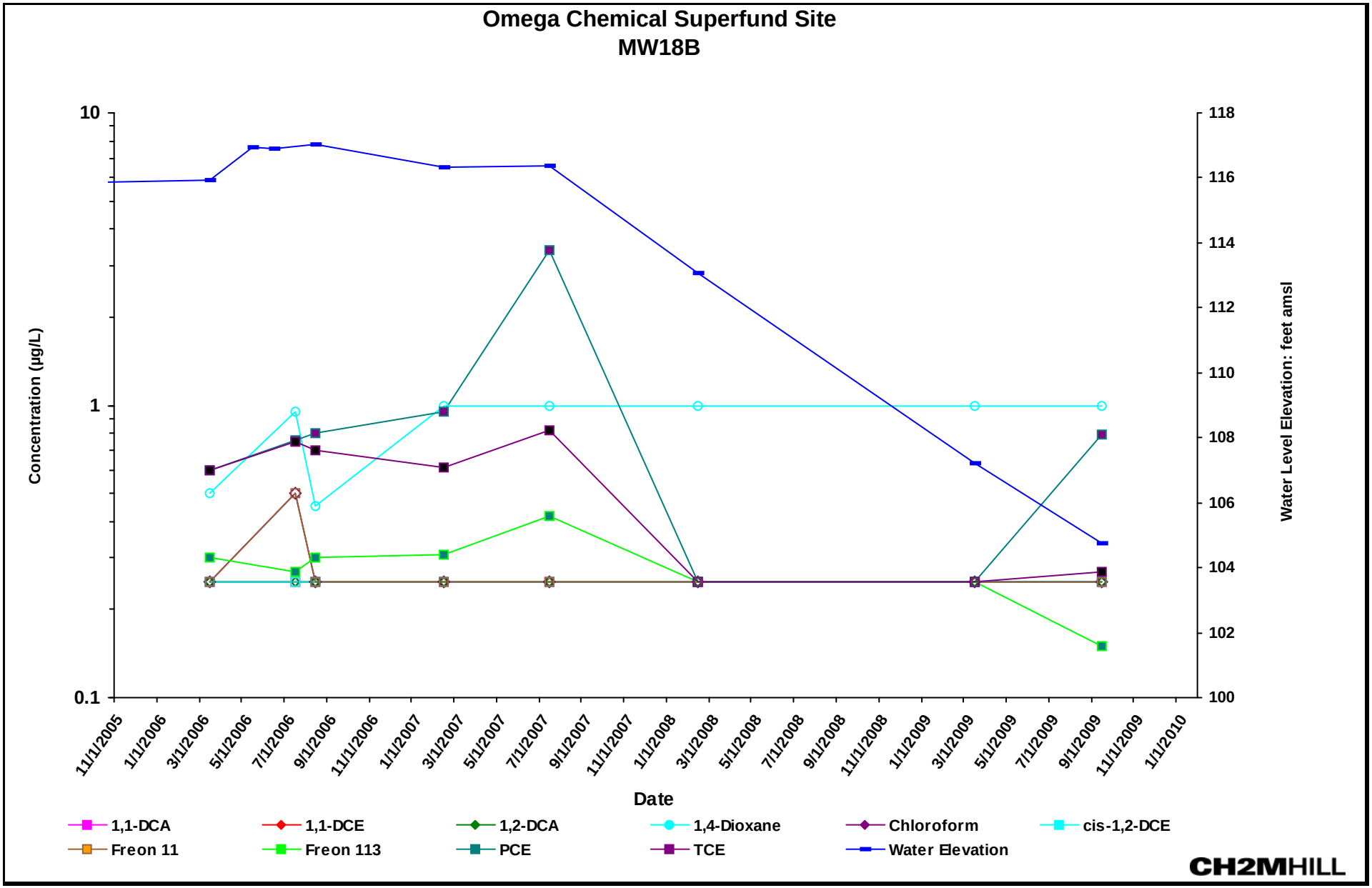
Notes:

1,1-DCA: 1,1-Dichloroethane
1,1-DCE: 1,1-Dichloroethene
1,2-DCA: 1,2-Dichloroethane
1,4-Dioxane: 1,4-Dioxane (p-dioxane)
cis-1,2-DCE: cis-1,2-Dichloroethene
Freon 11: Trichlorofluoromethane
Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane
PCE: Tetrachloroethene
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

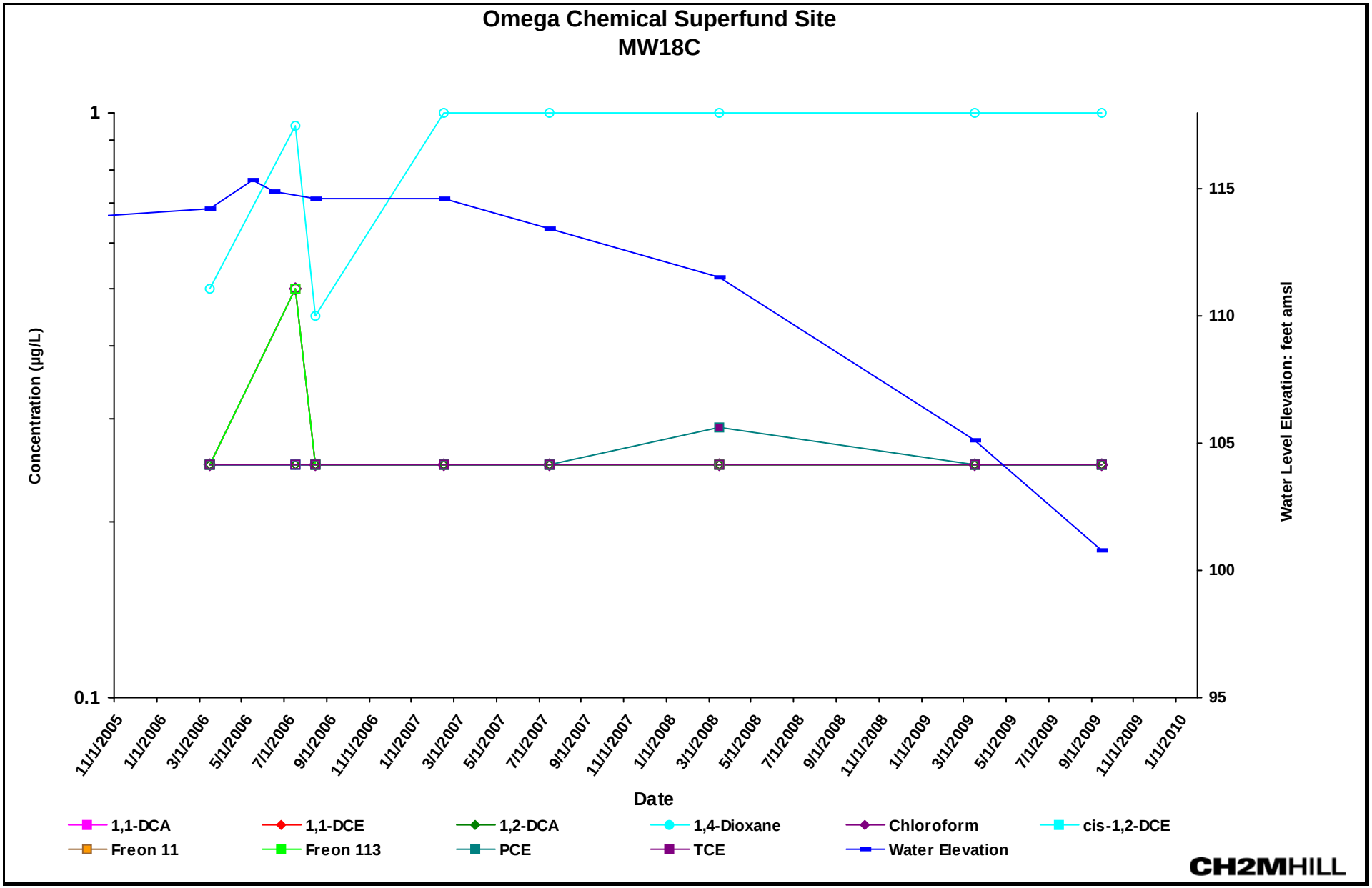


Notes:

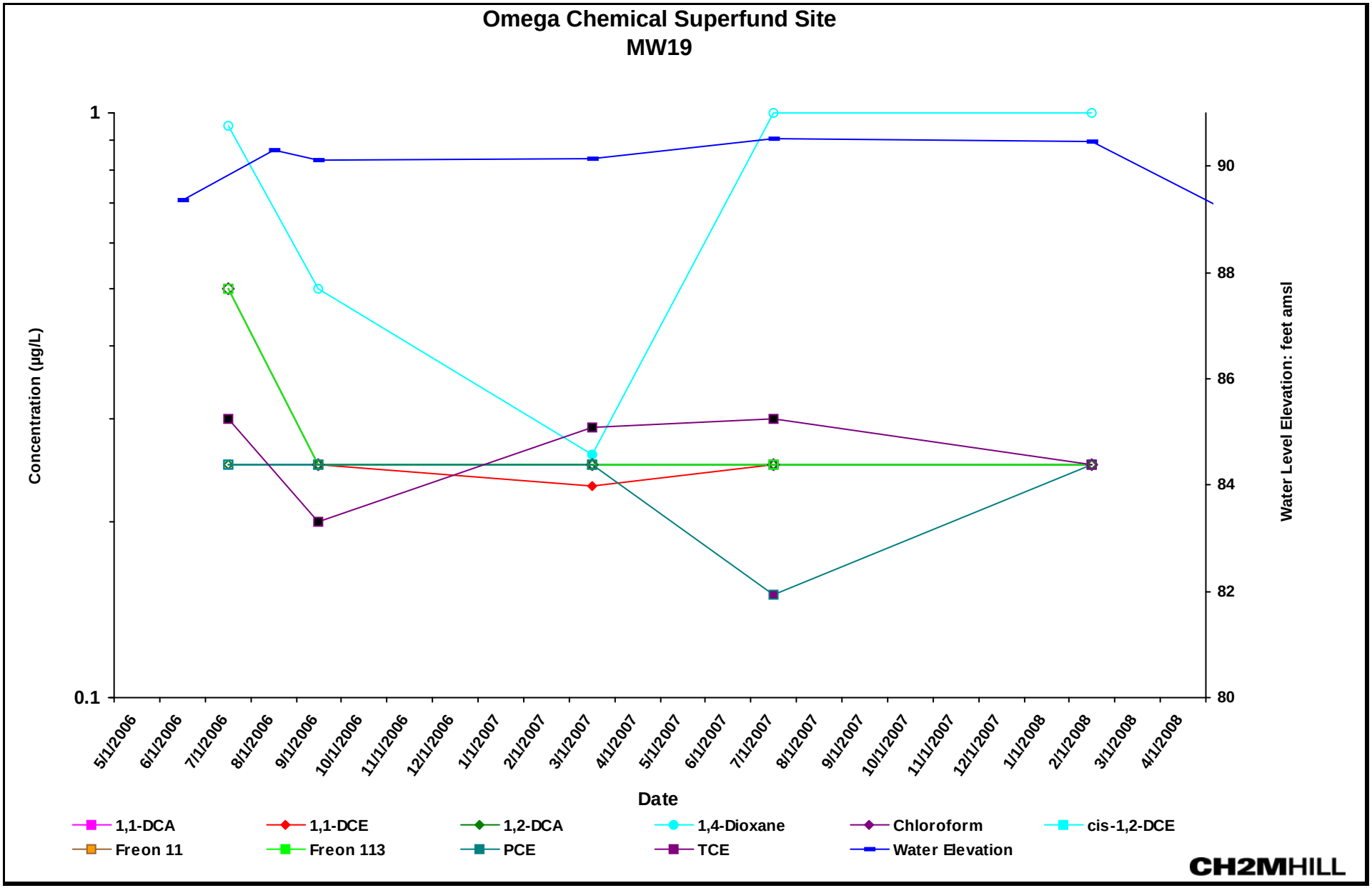
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

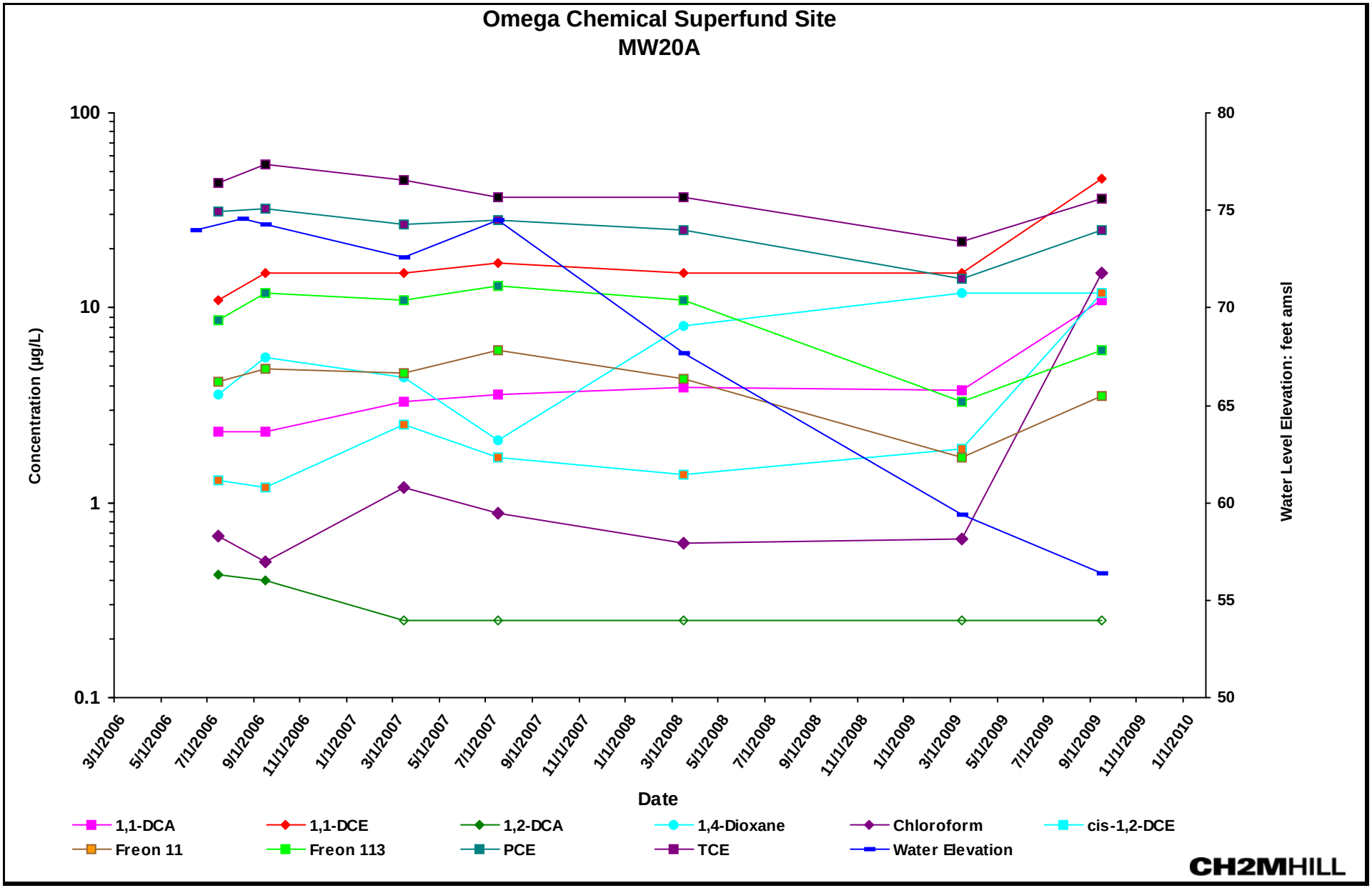


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



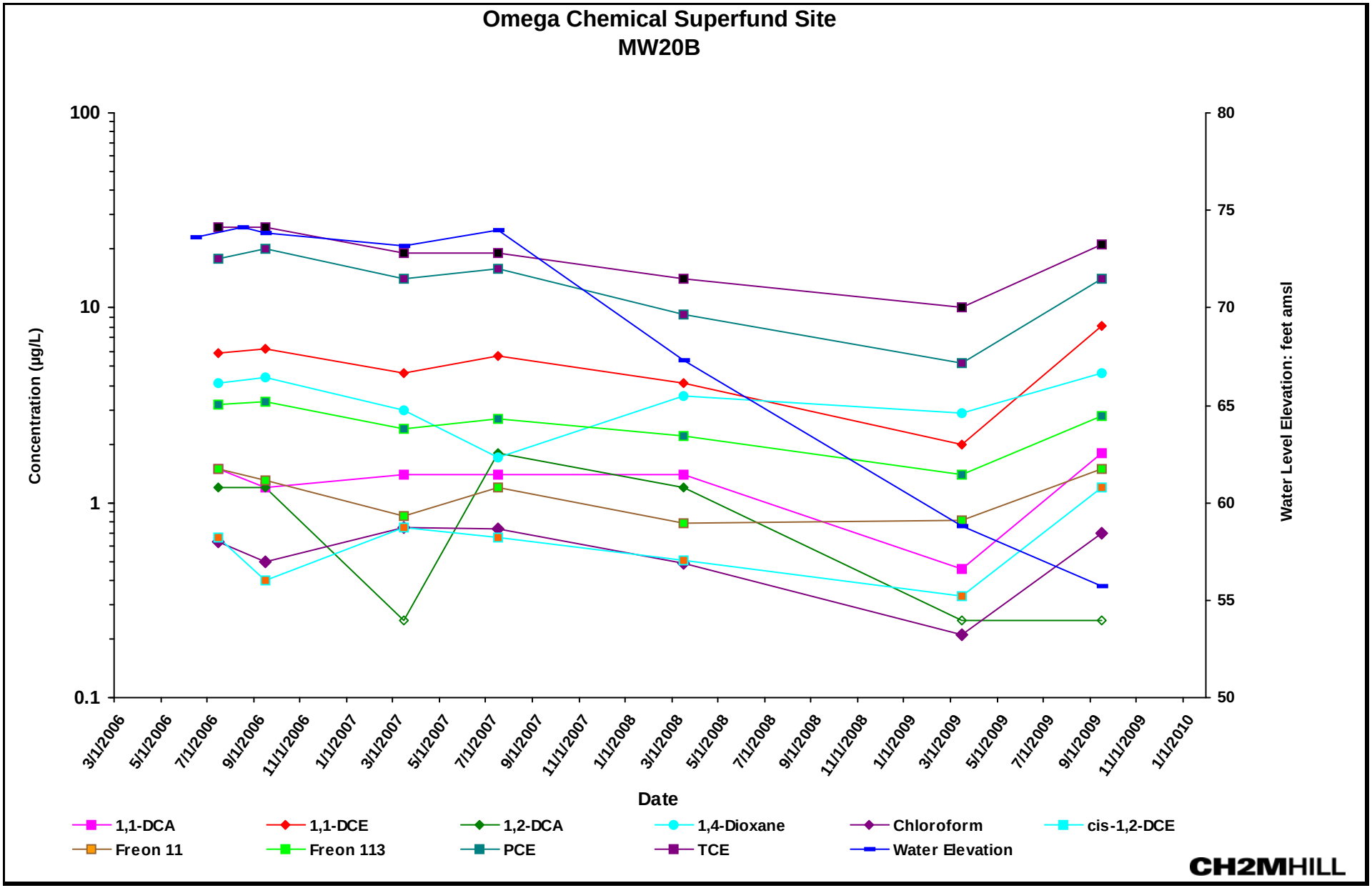
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



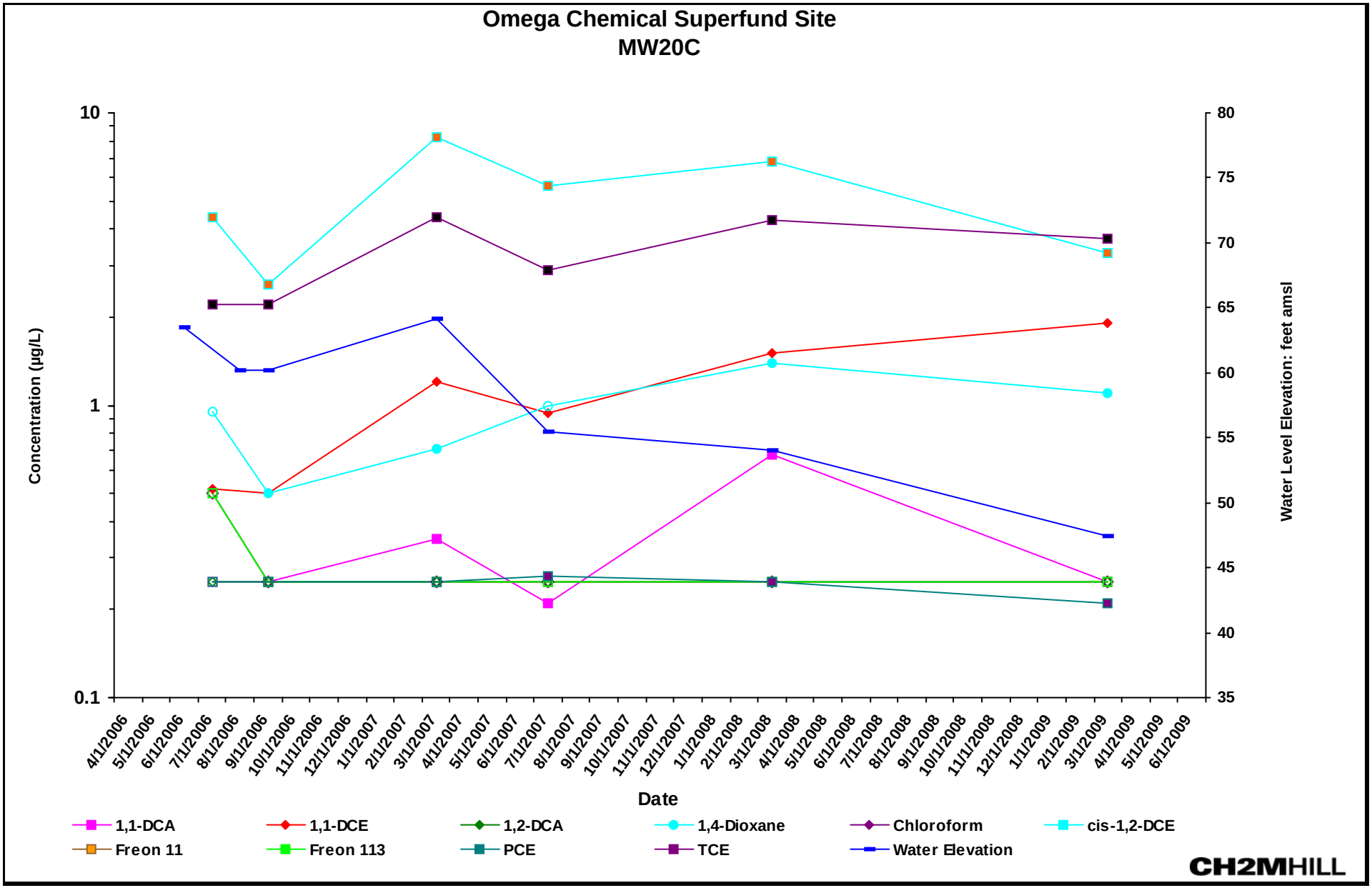
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



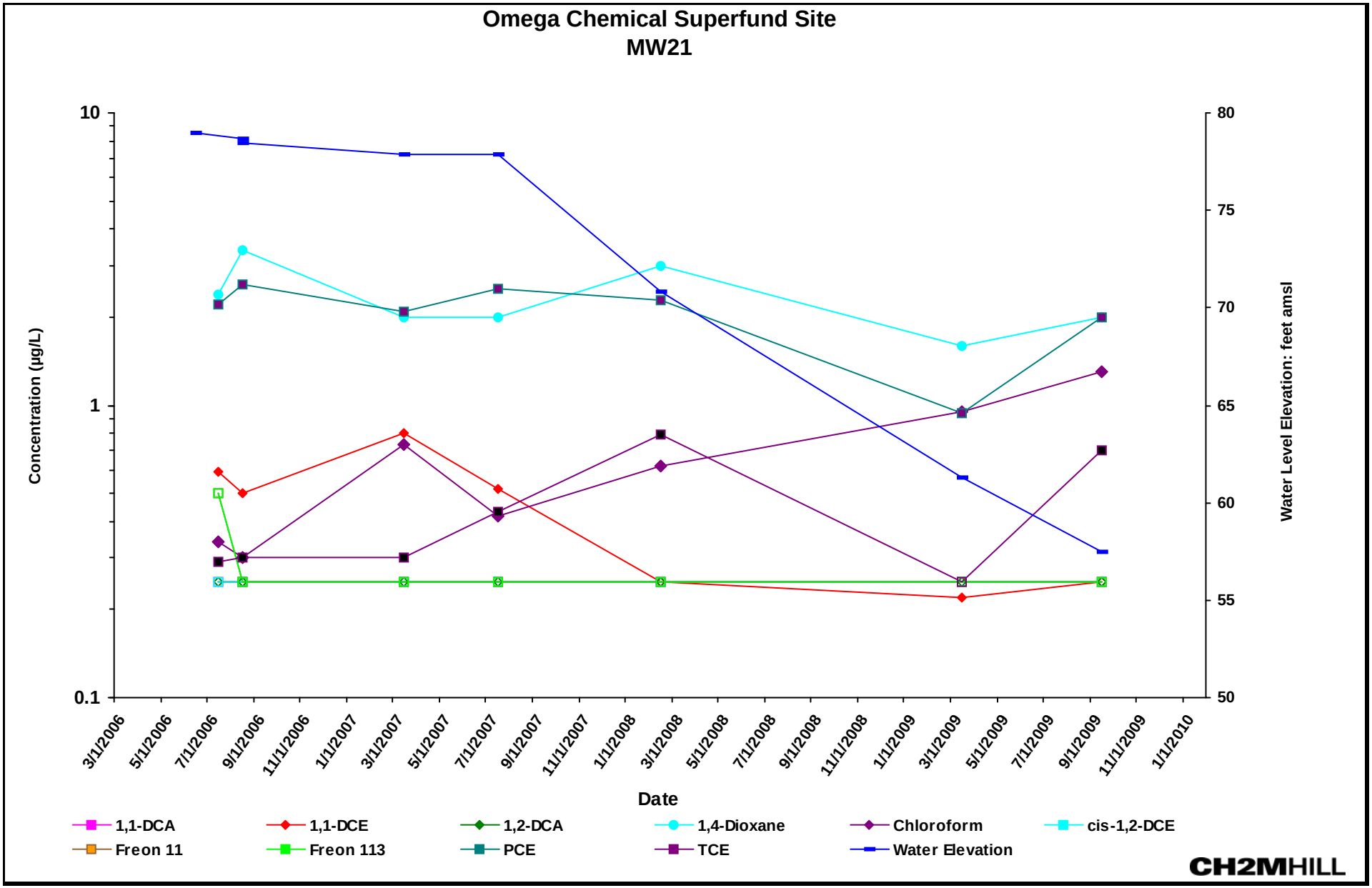
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



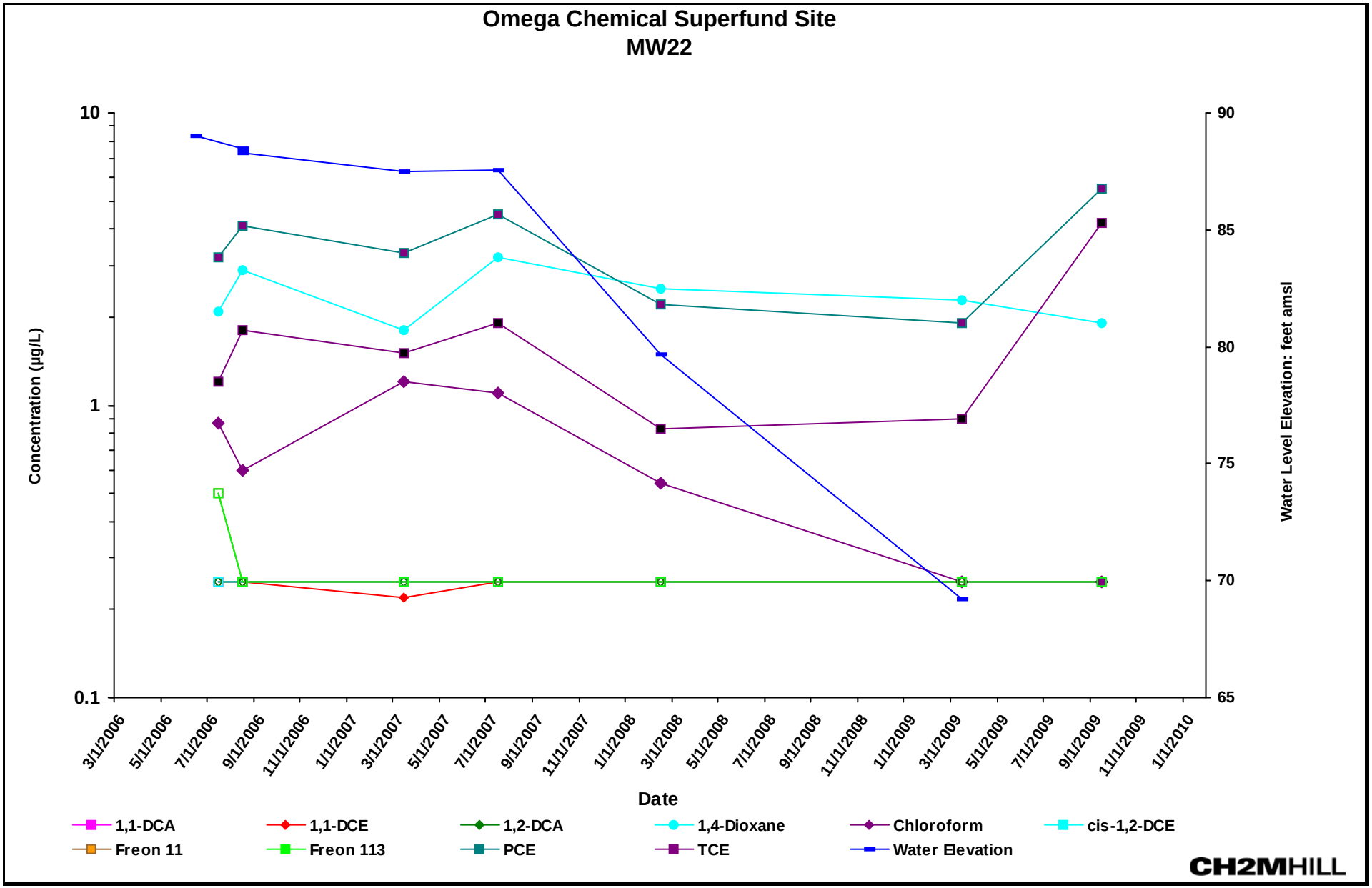
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

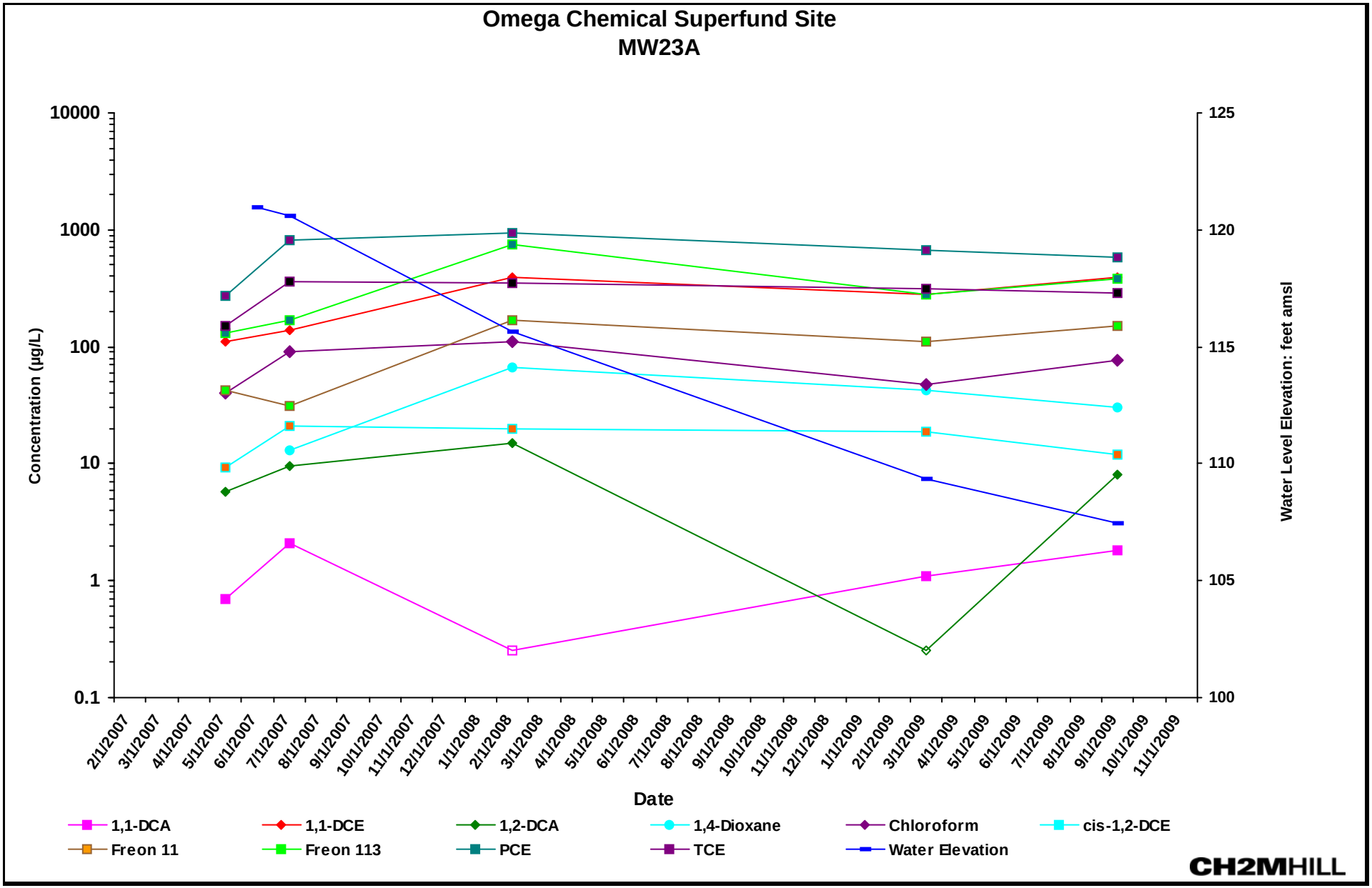


Notes:

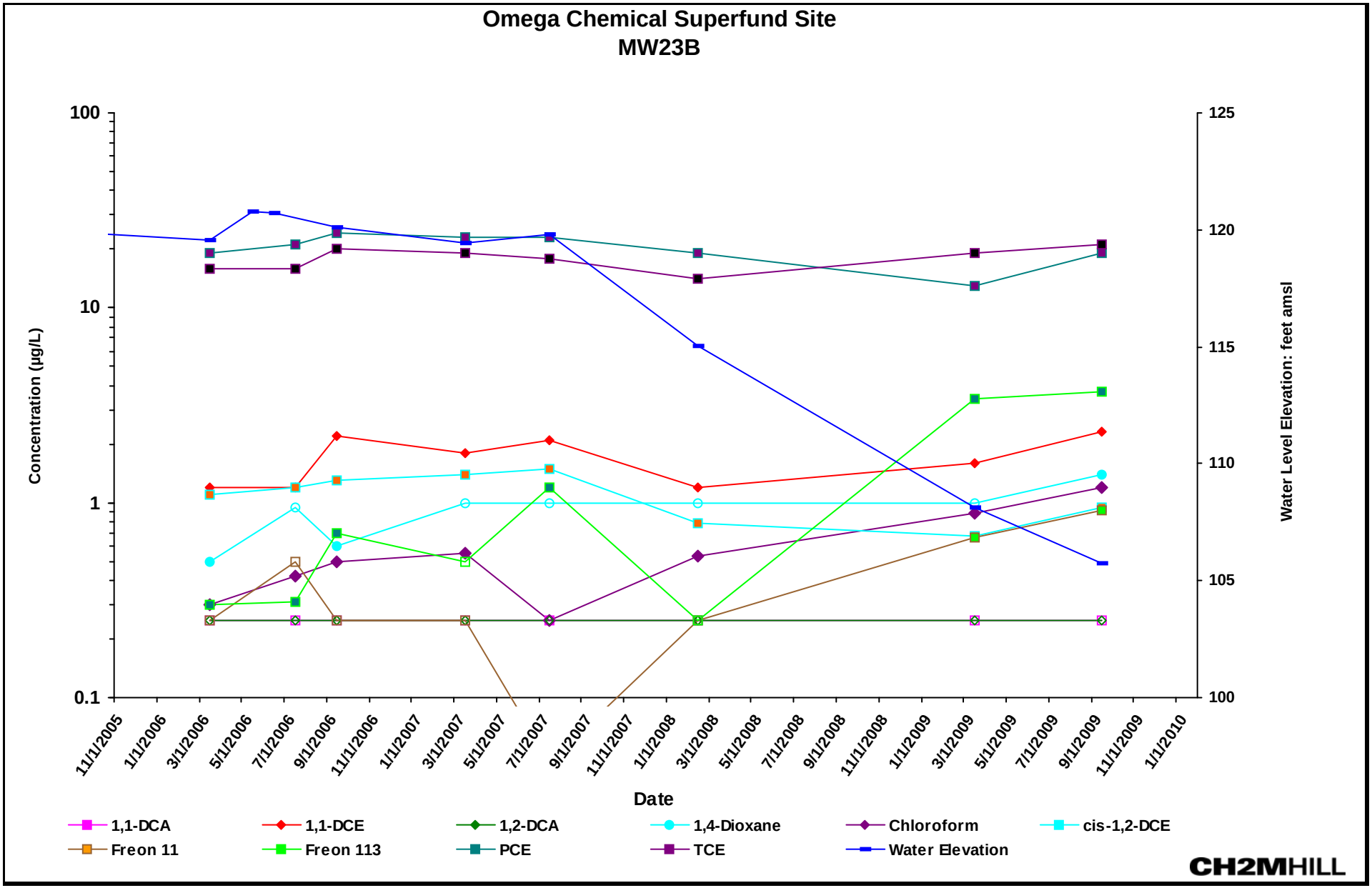
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

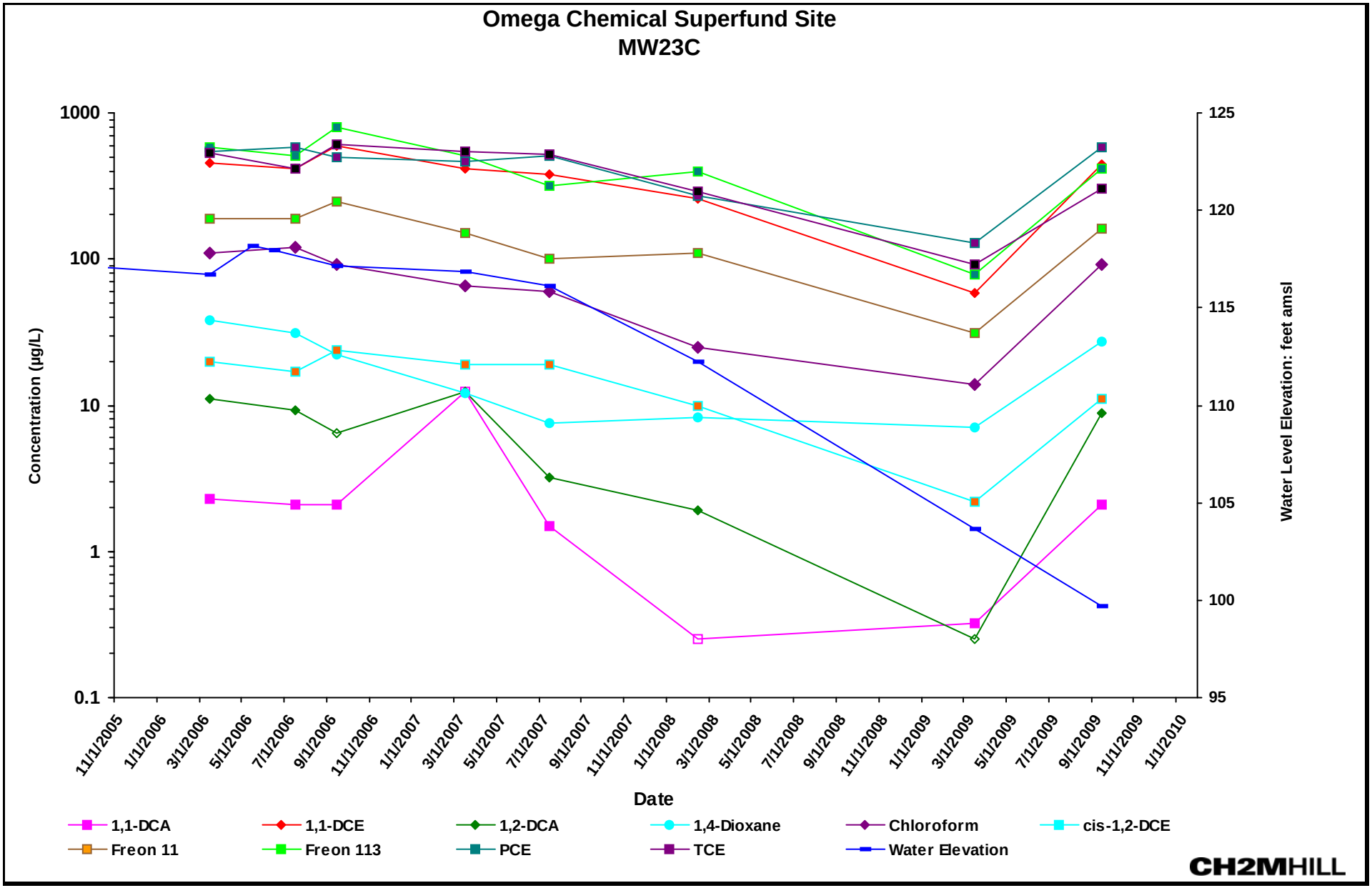


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



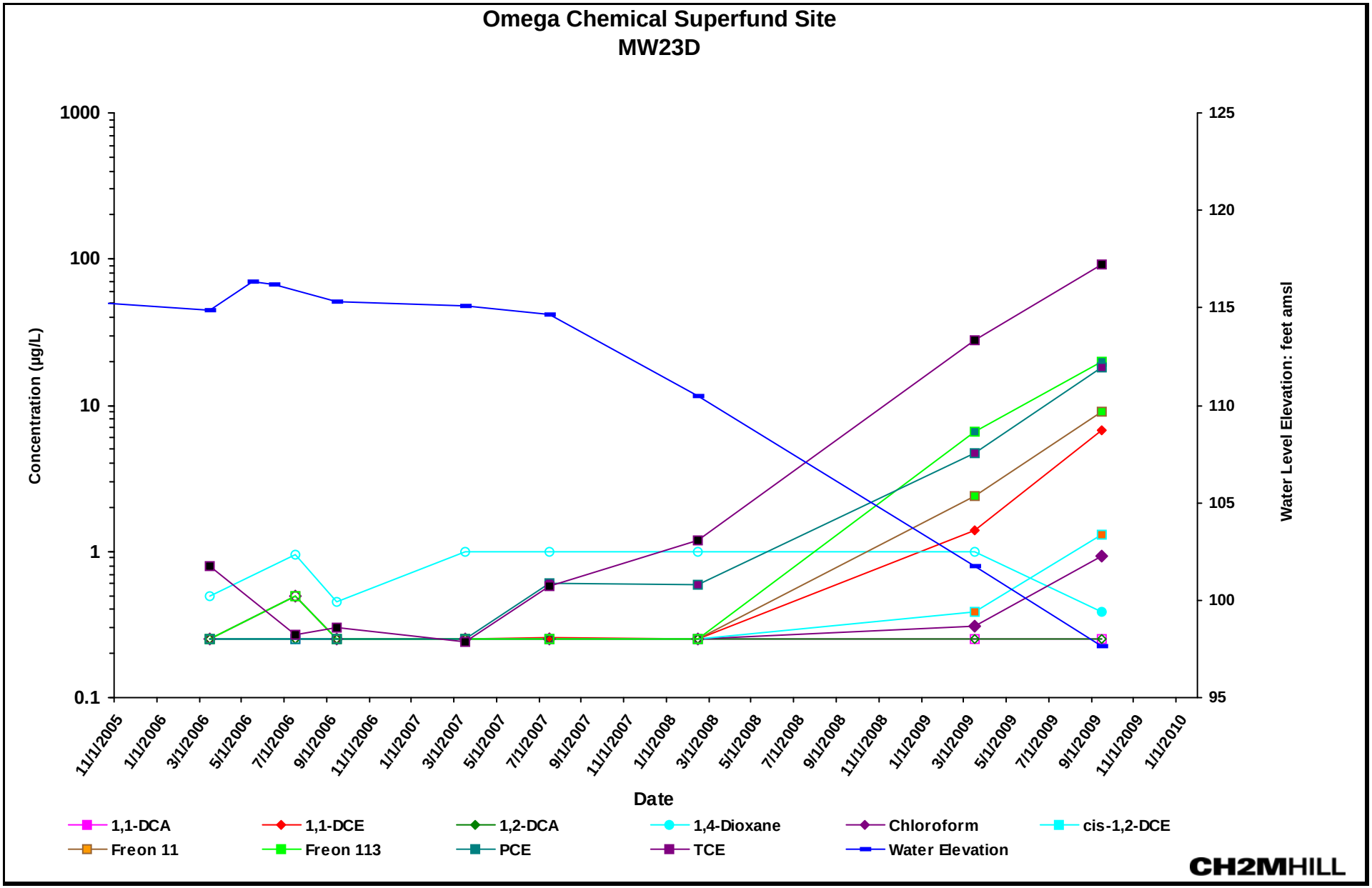
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



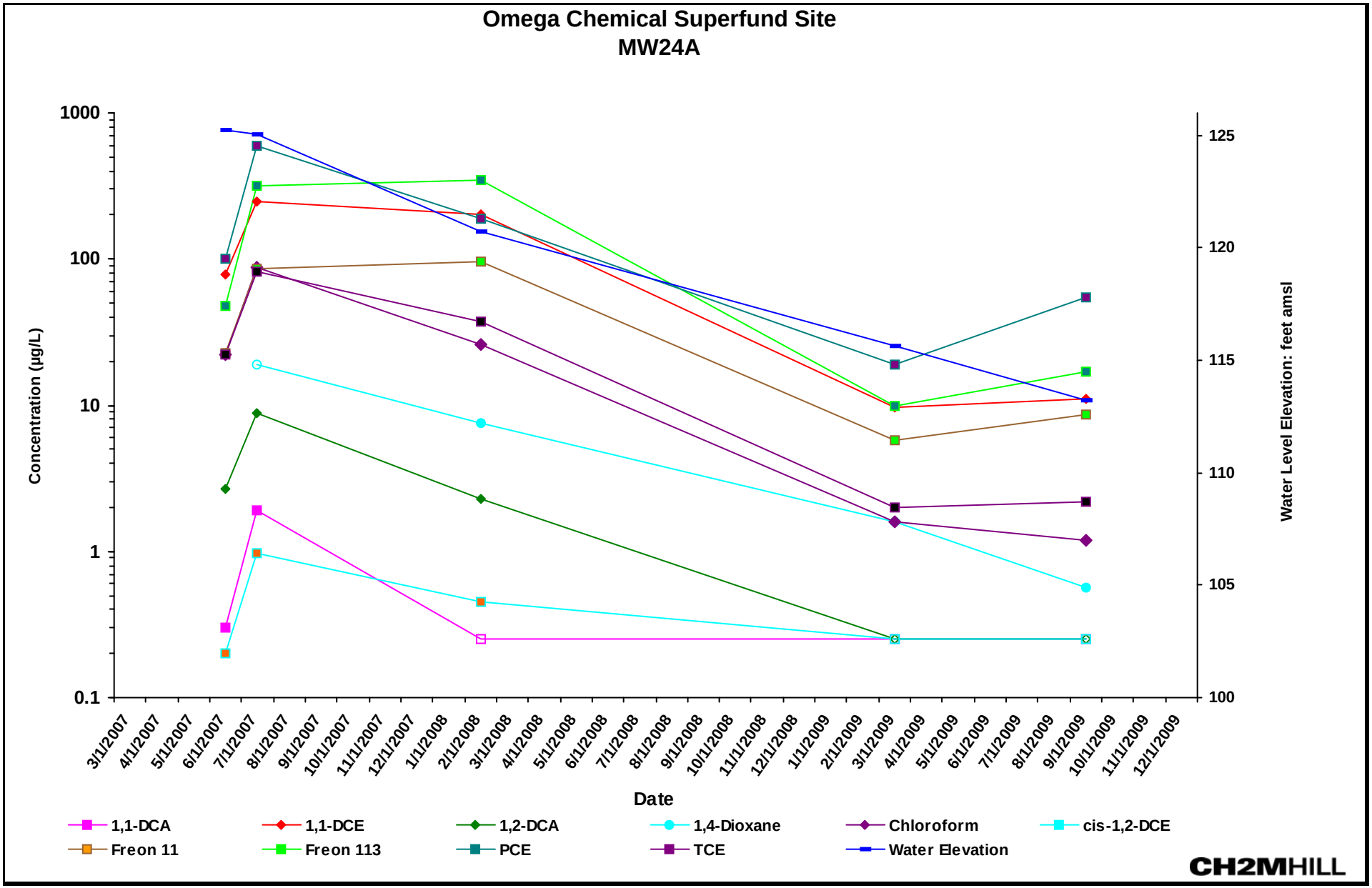
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

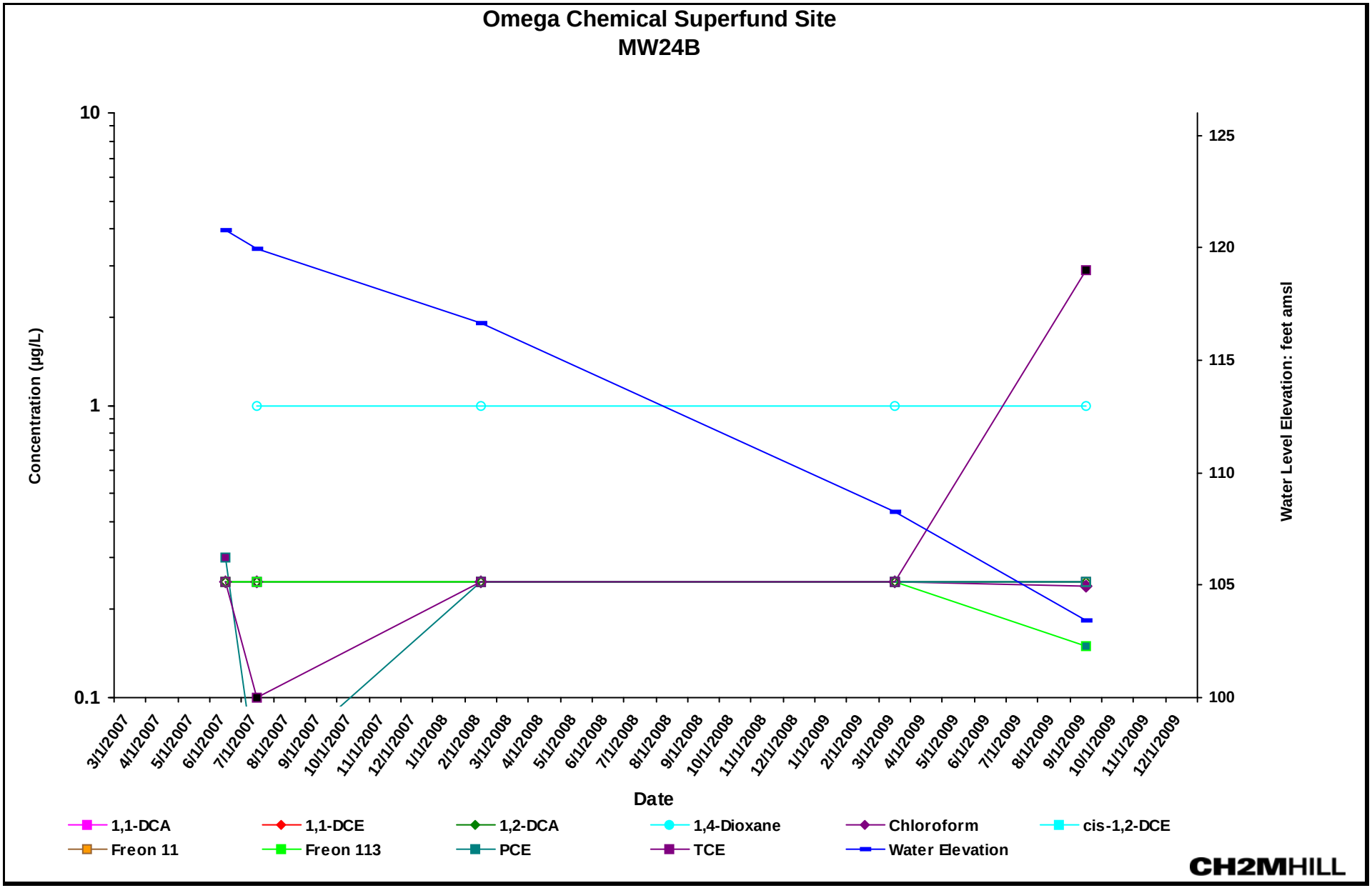


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

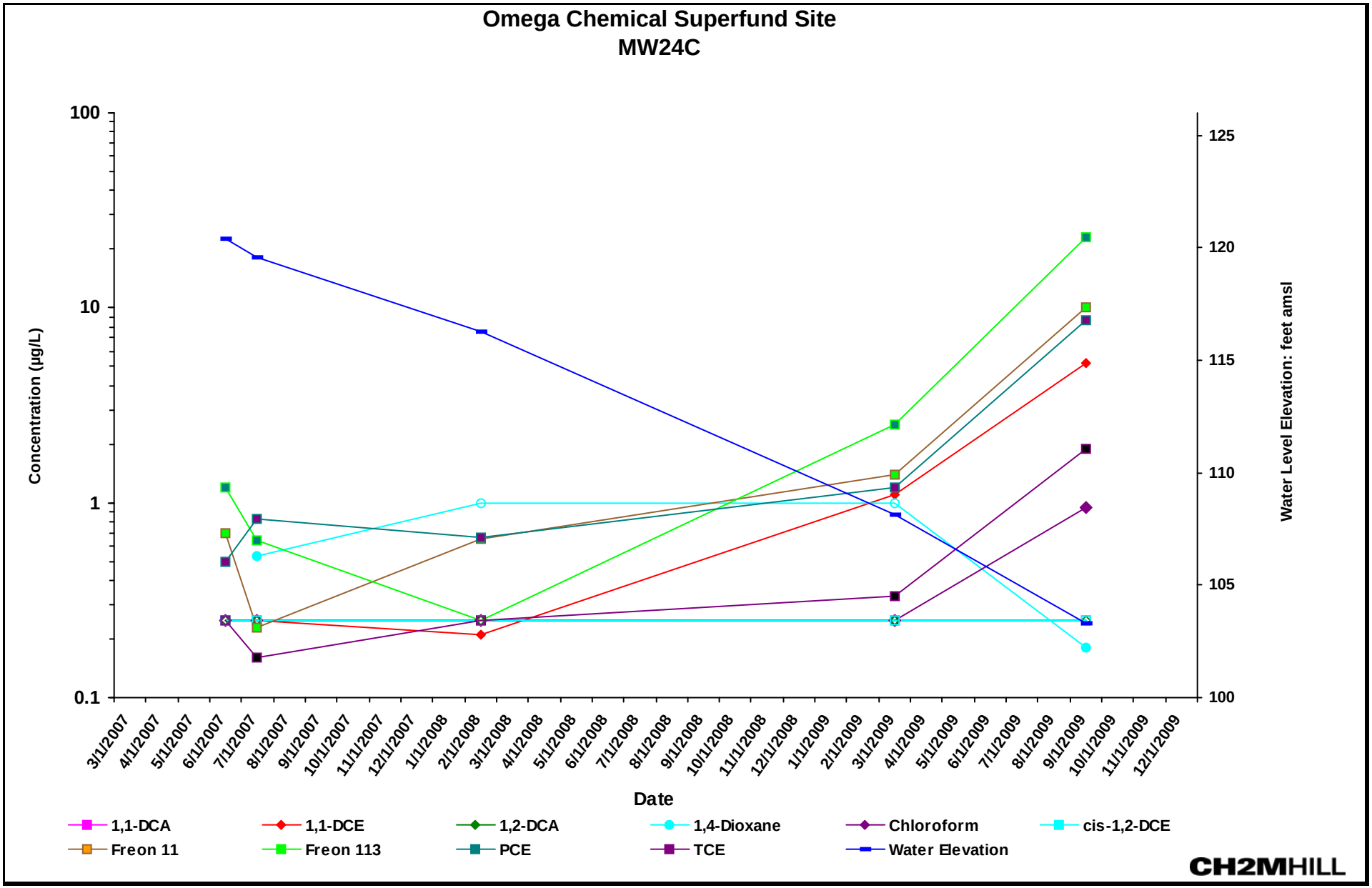


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



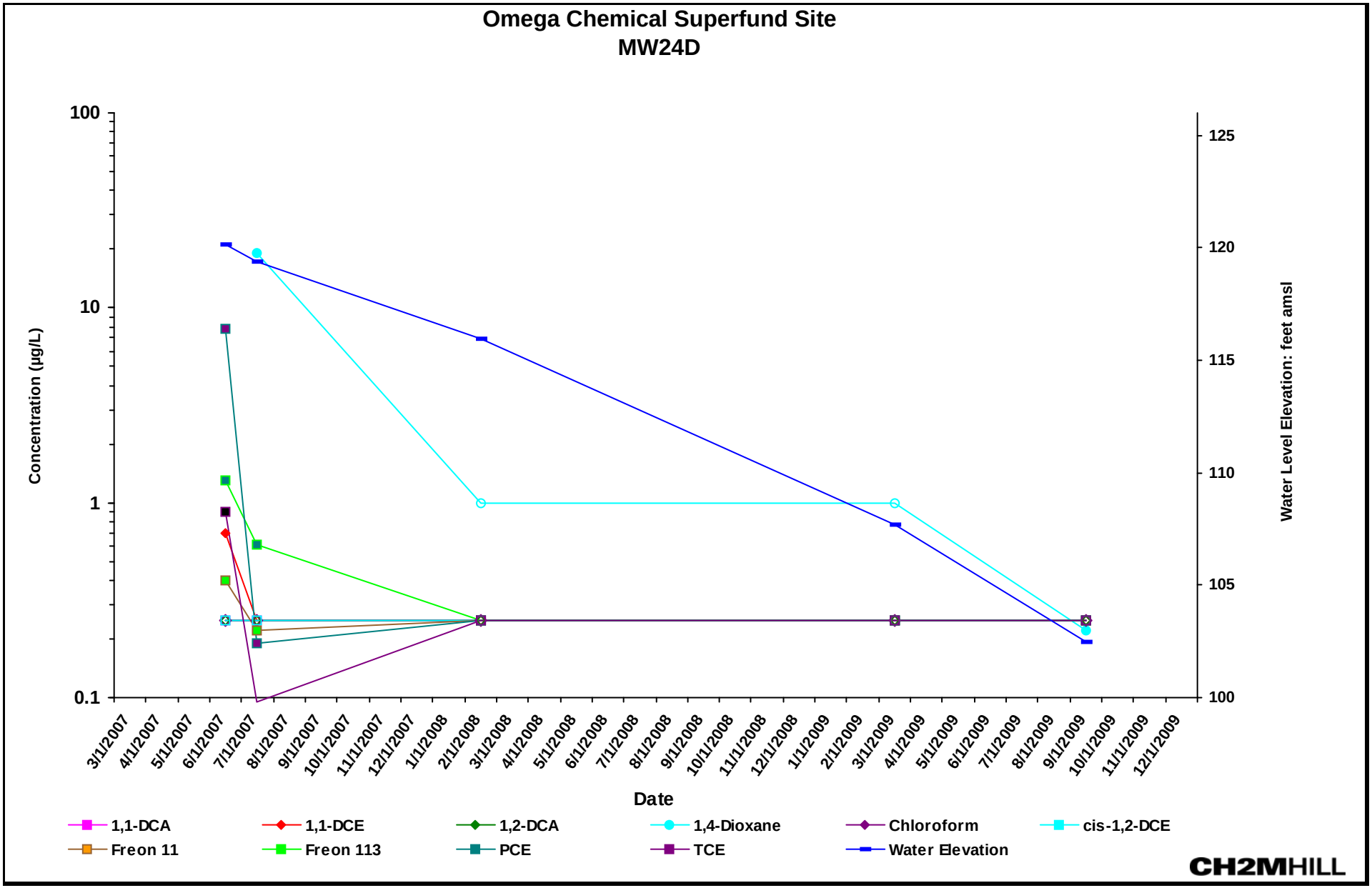
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



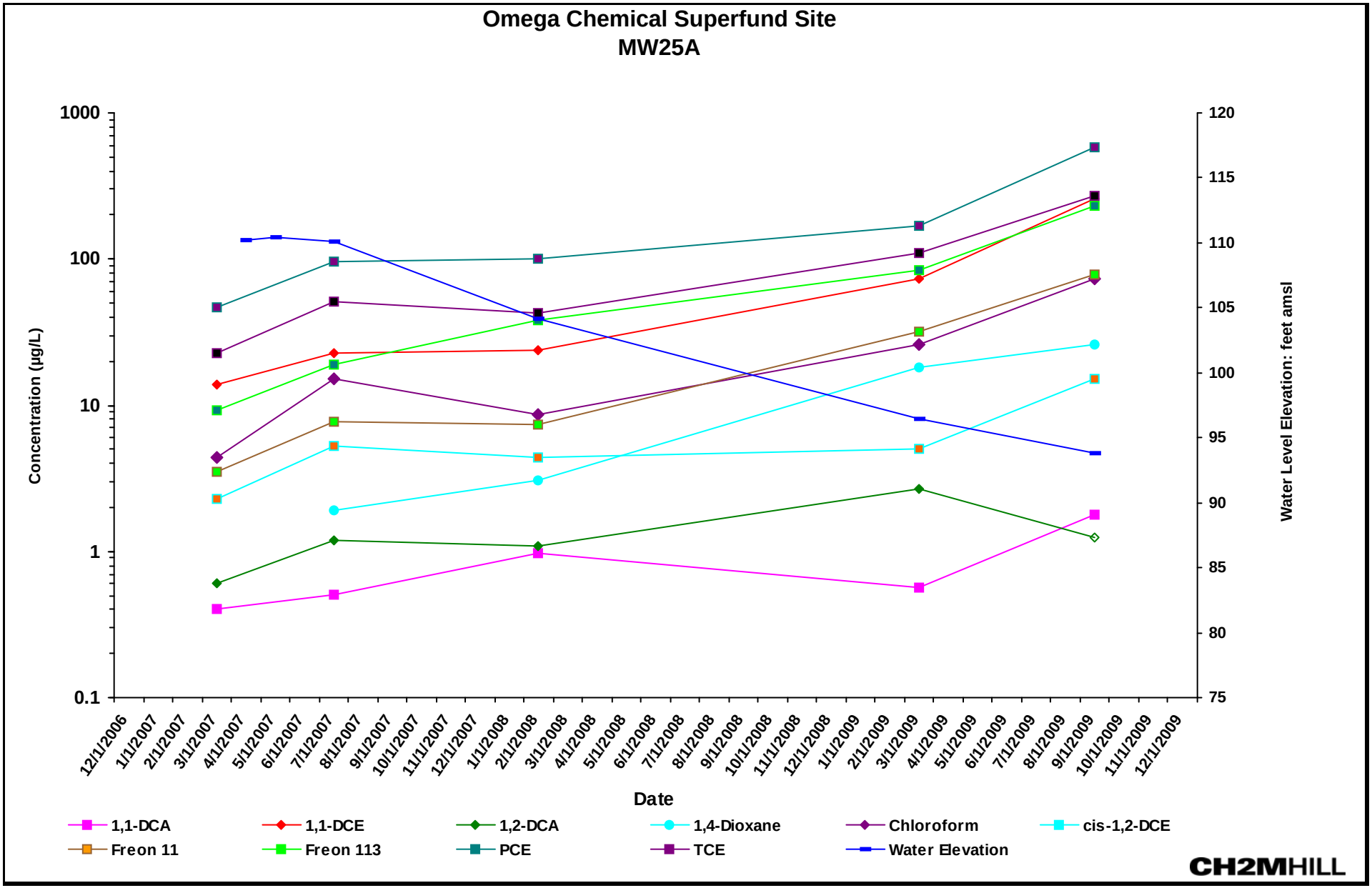
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



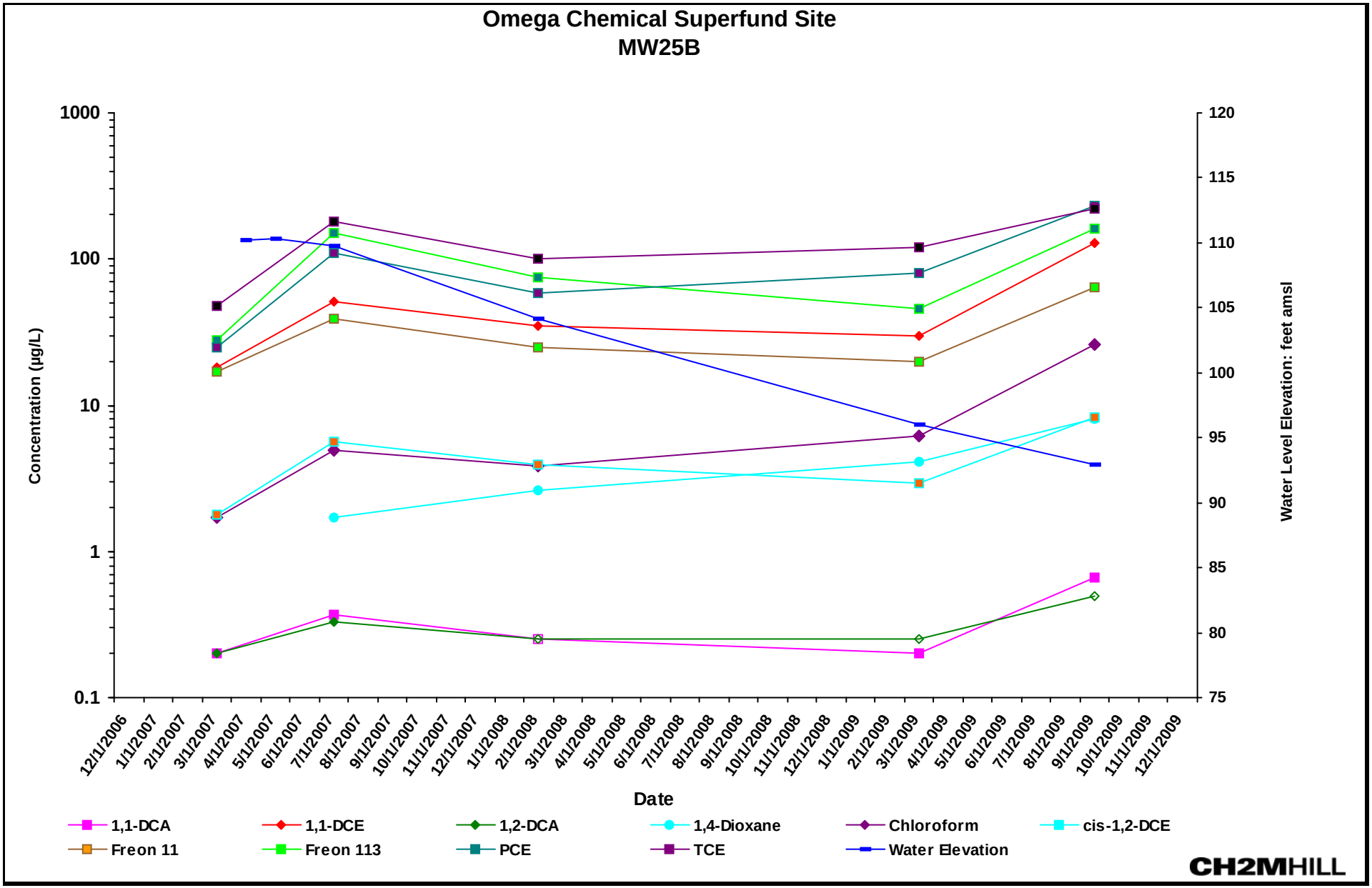
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



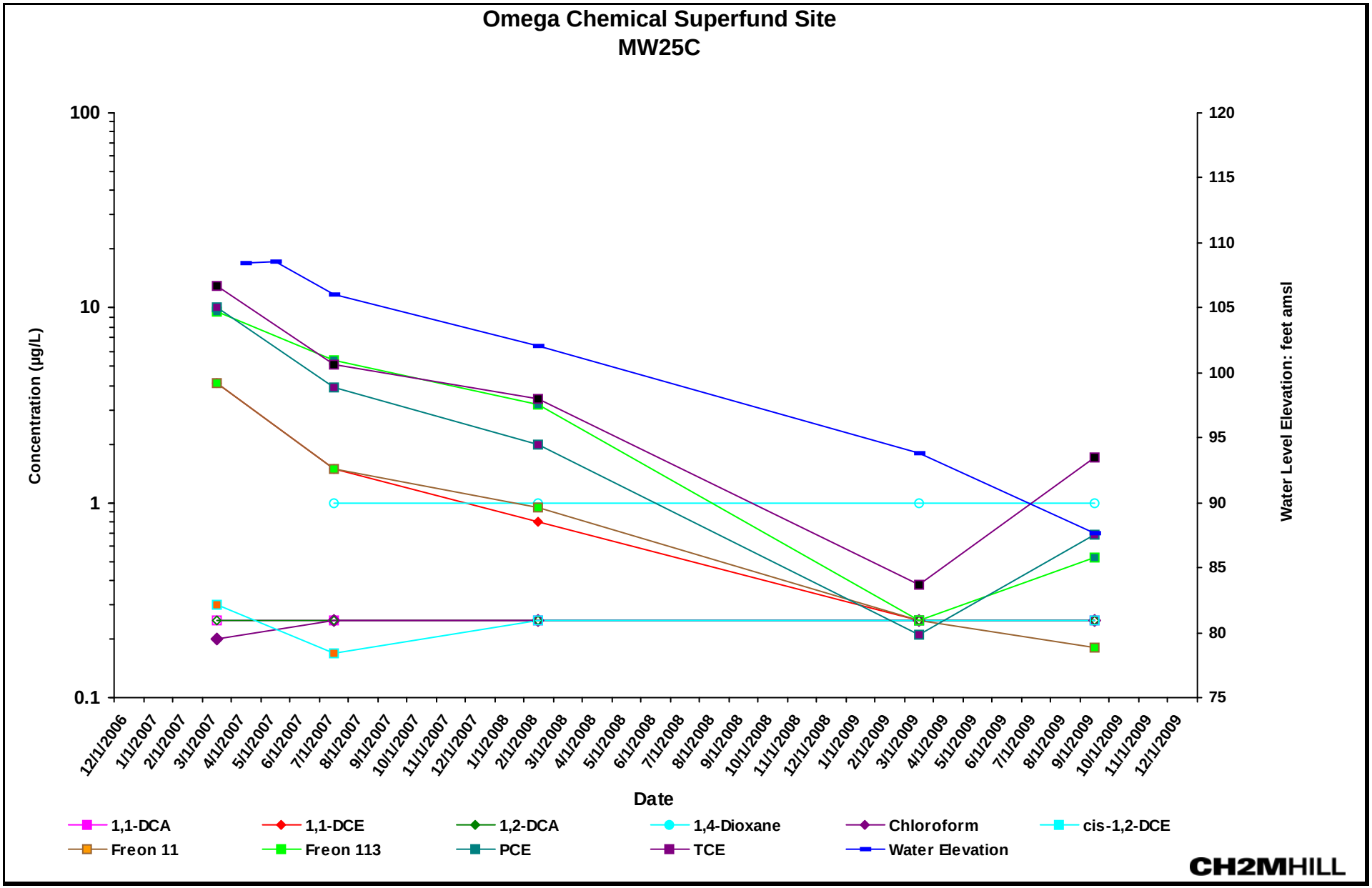
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



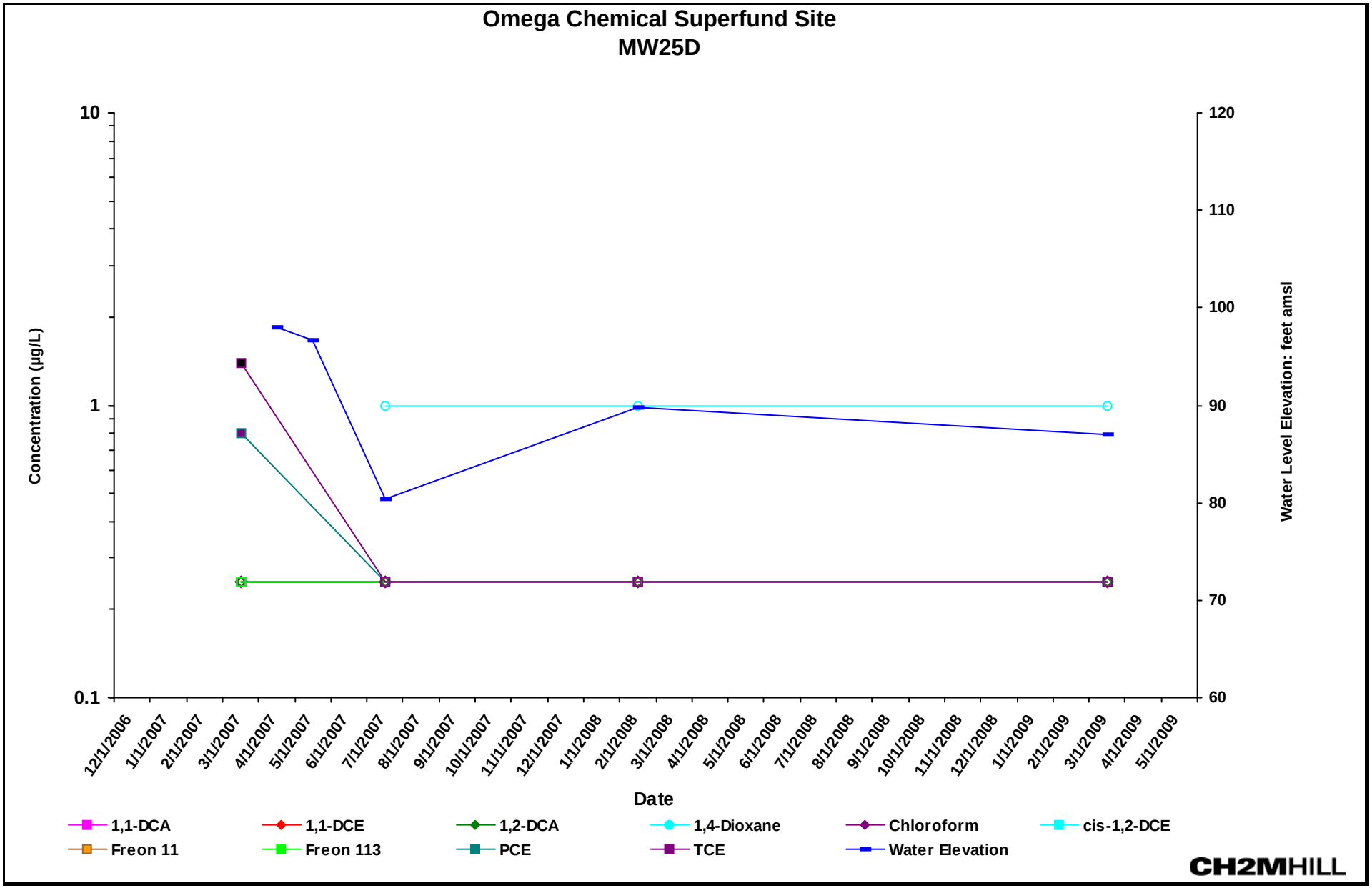
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



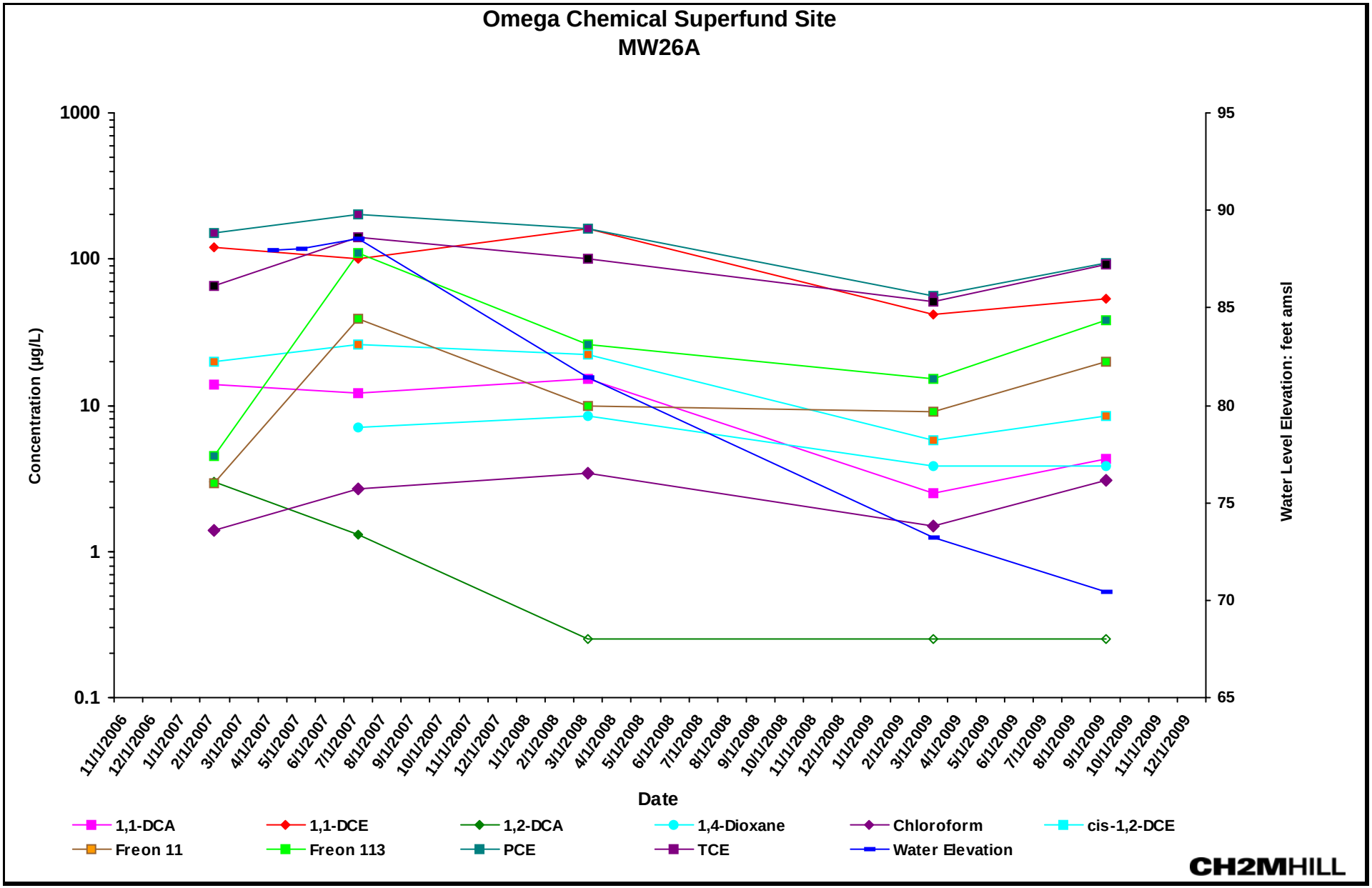
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



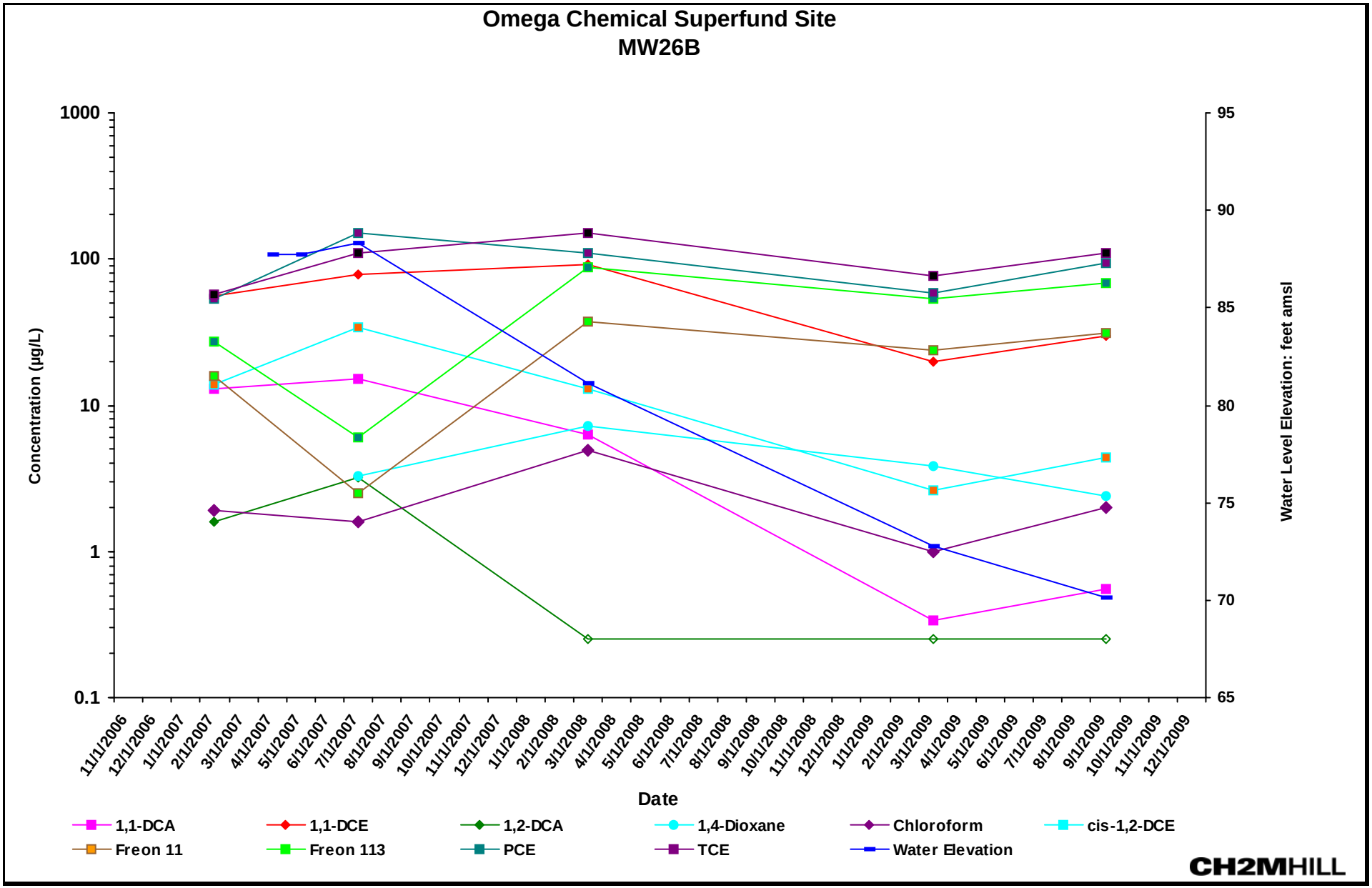
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



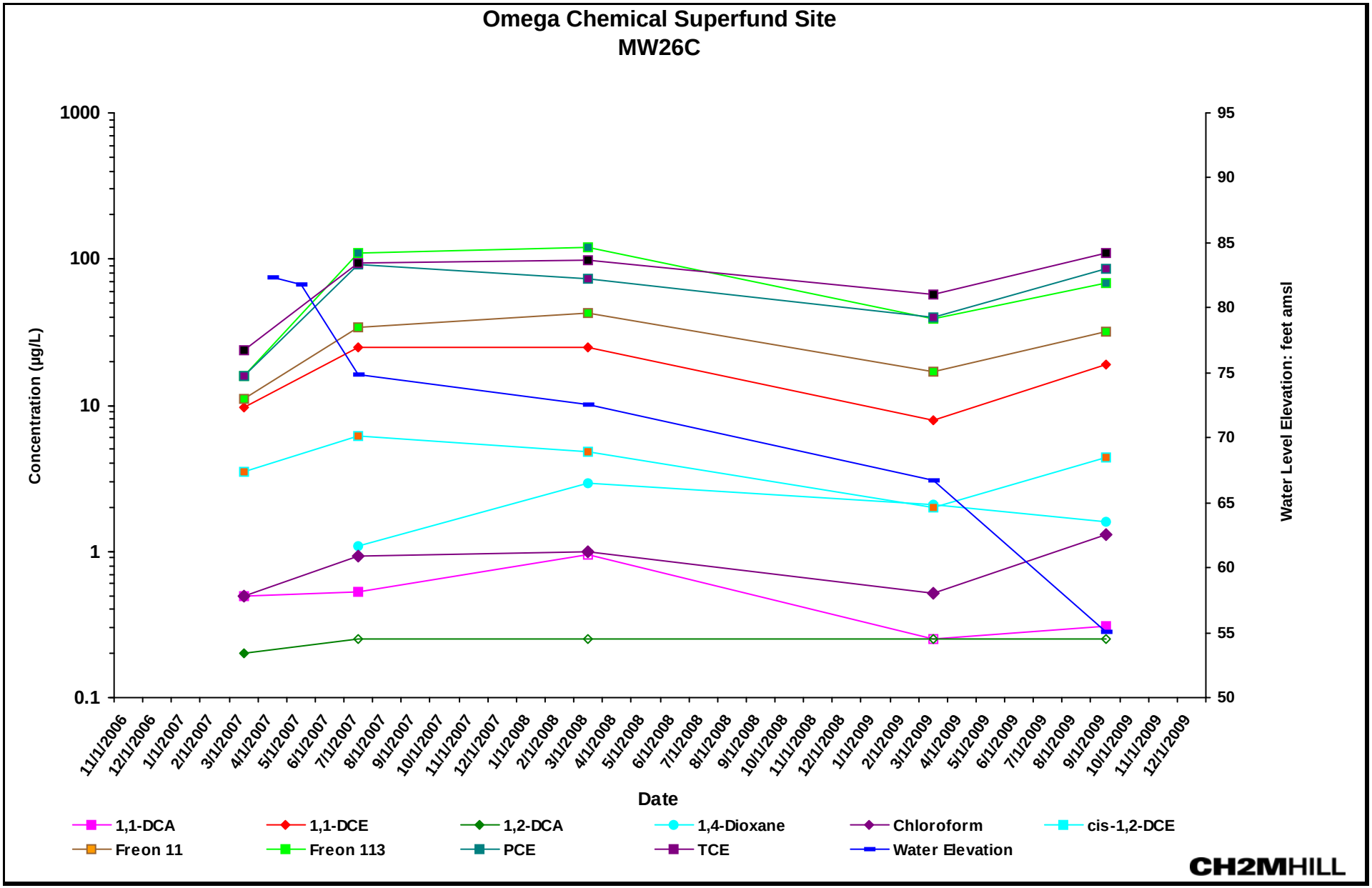
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



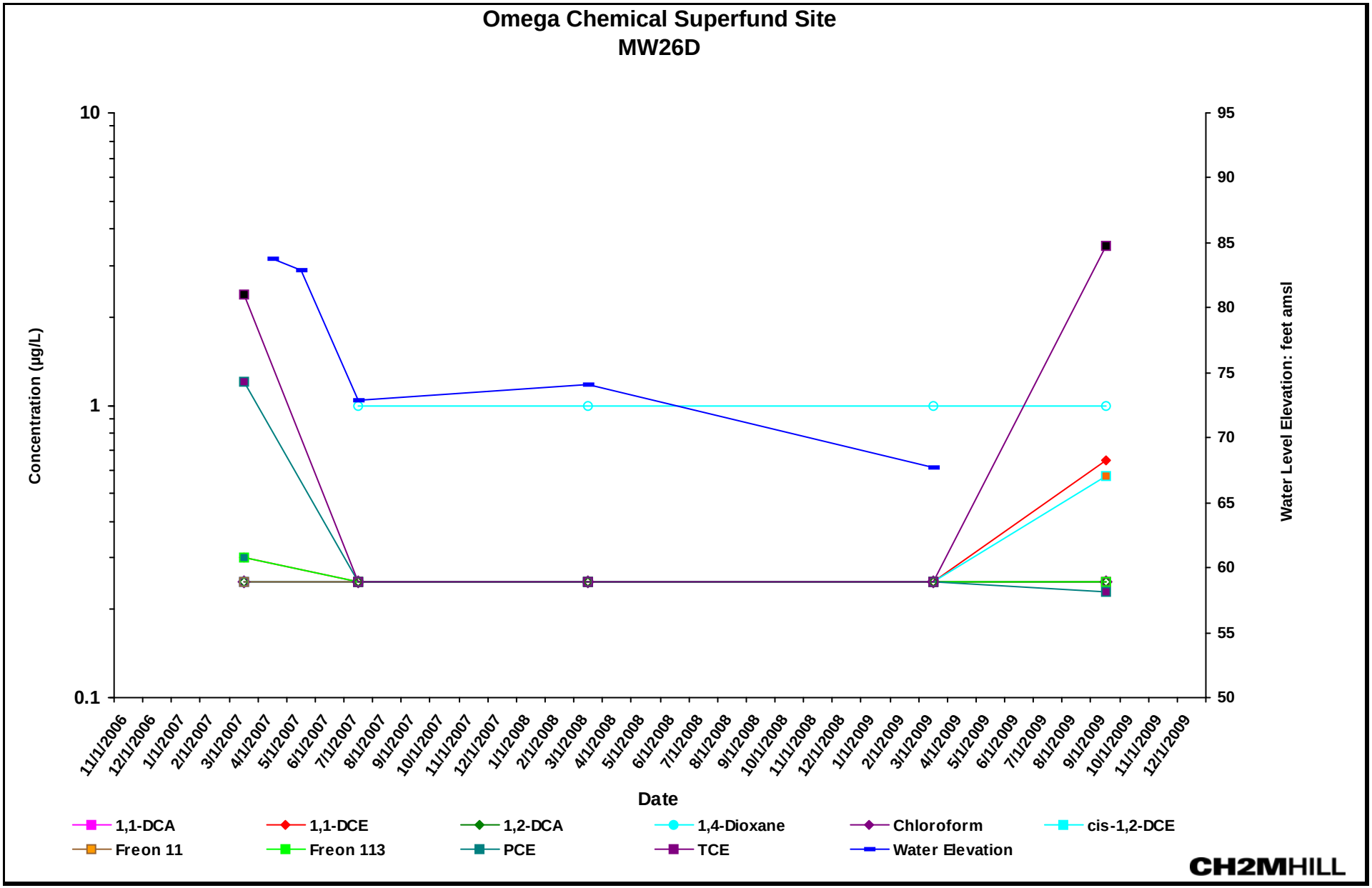
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



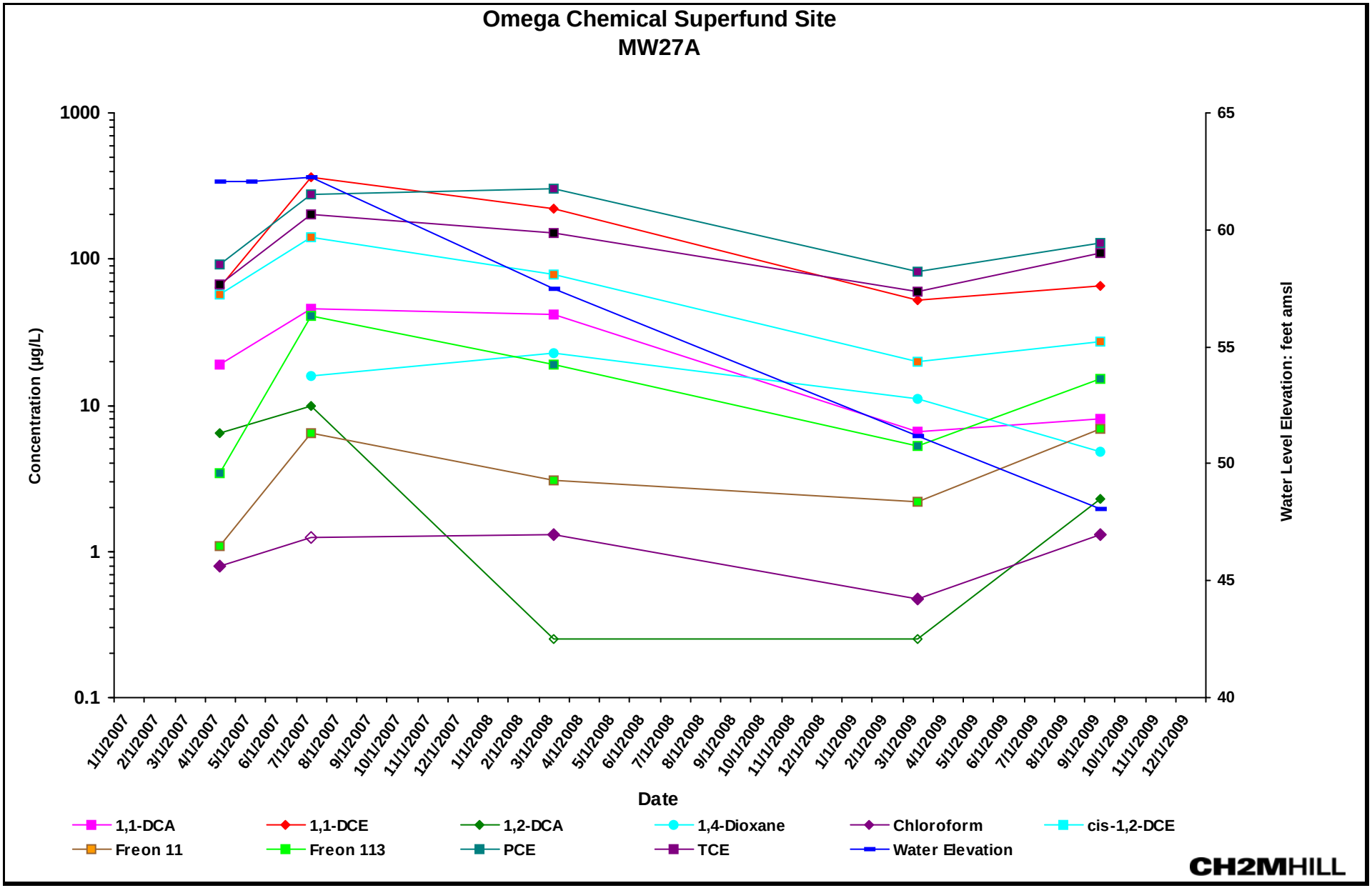
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



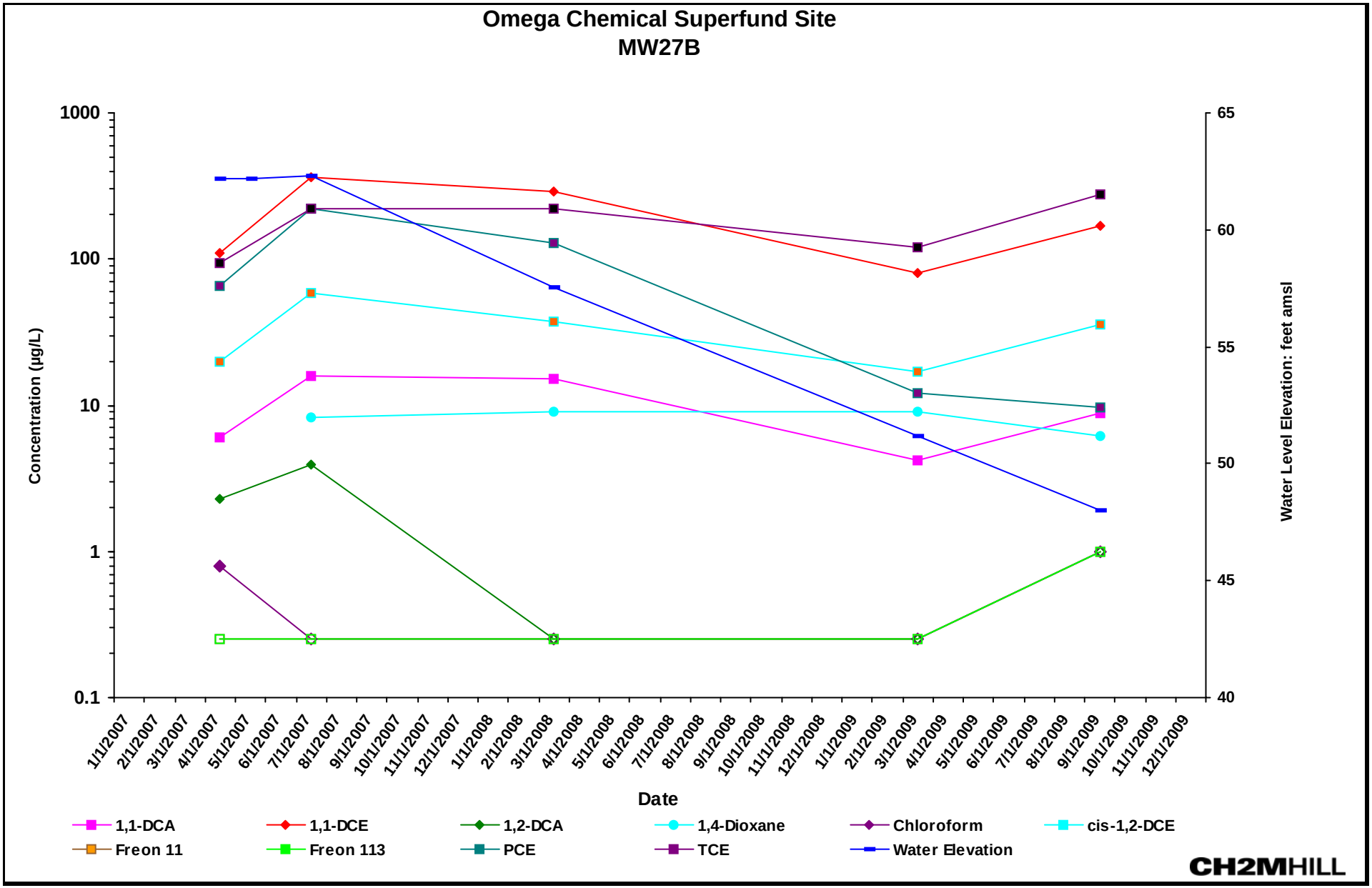
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



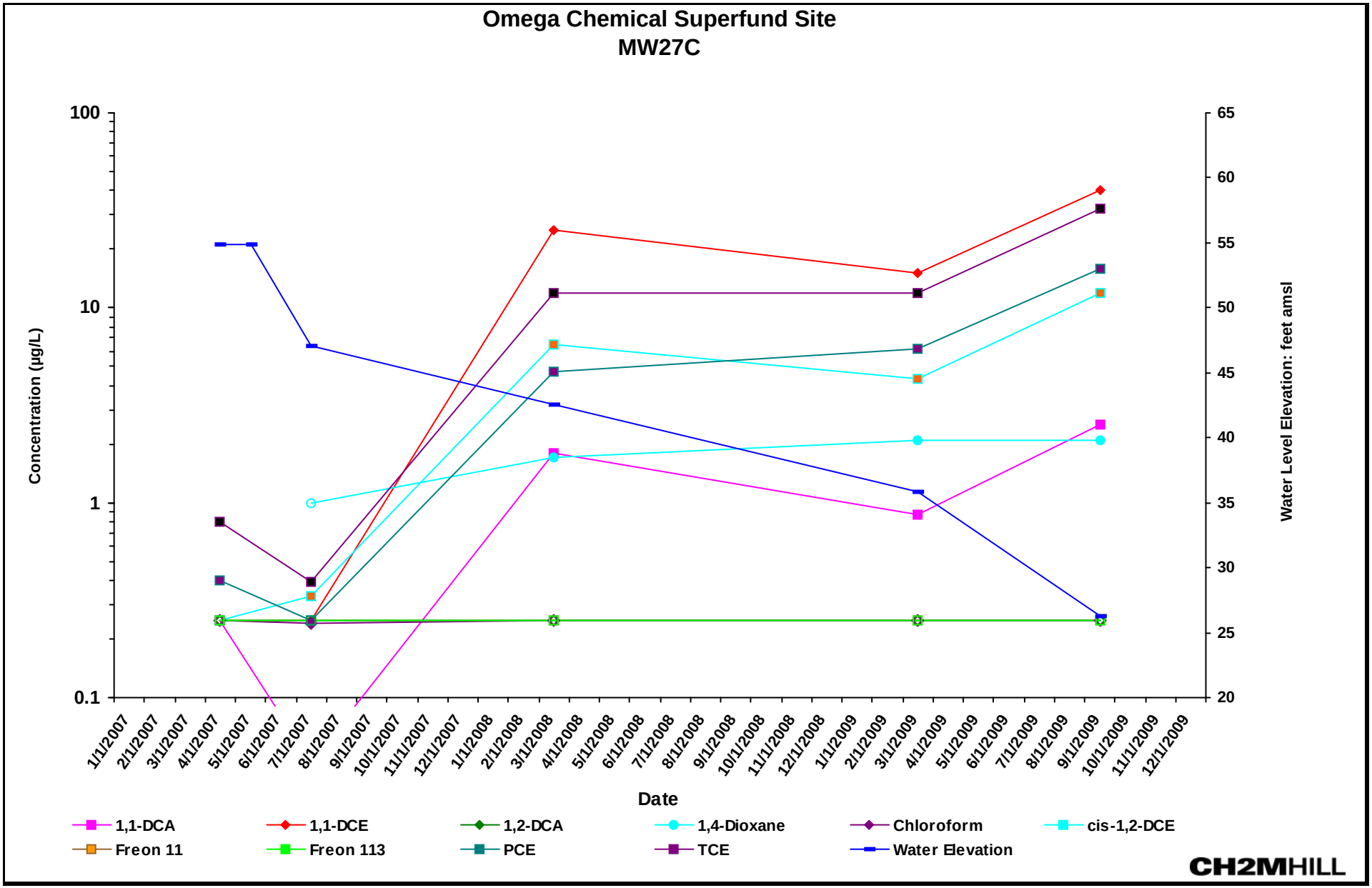
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



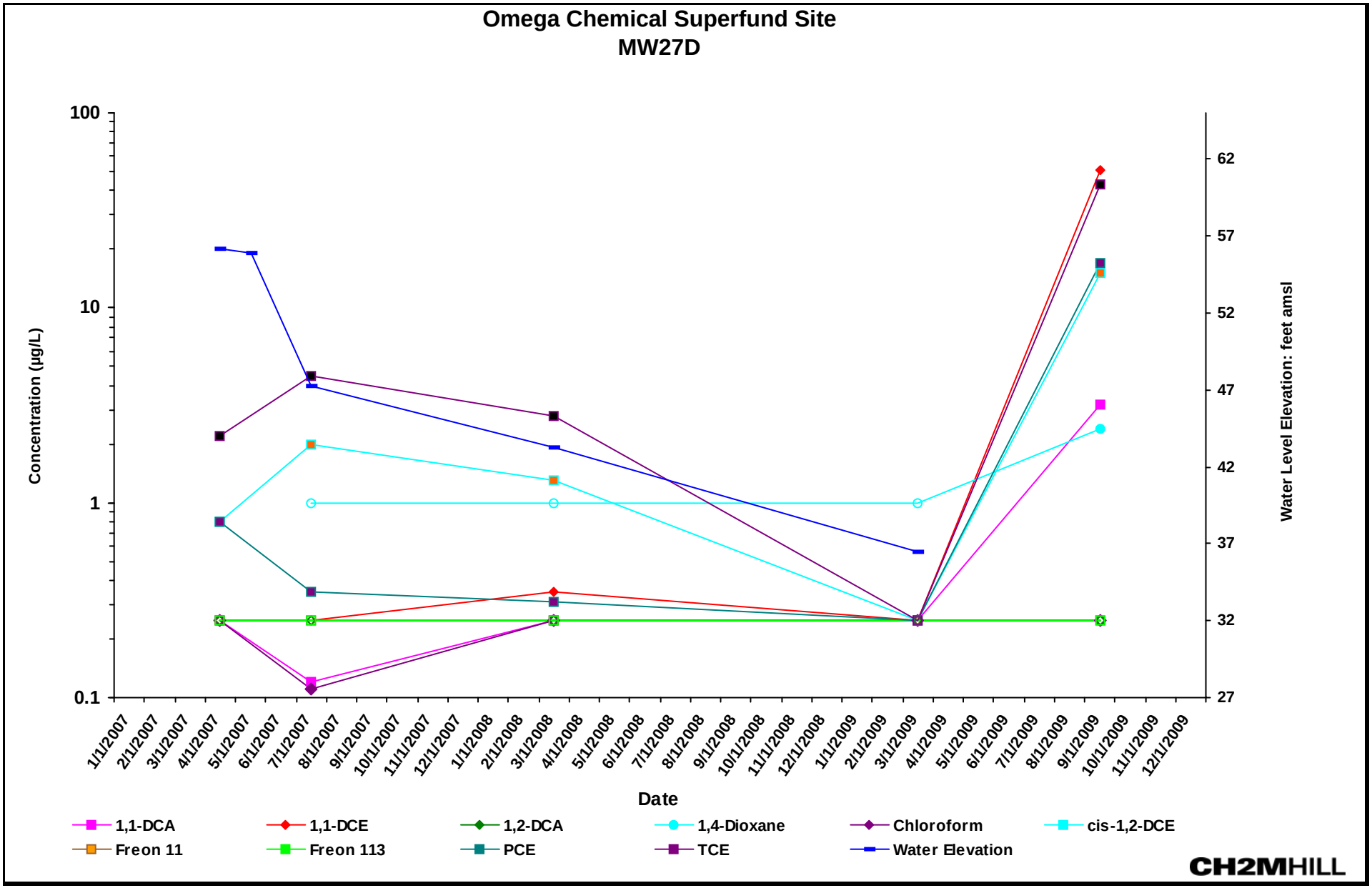
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



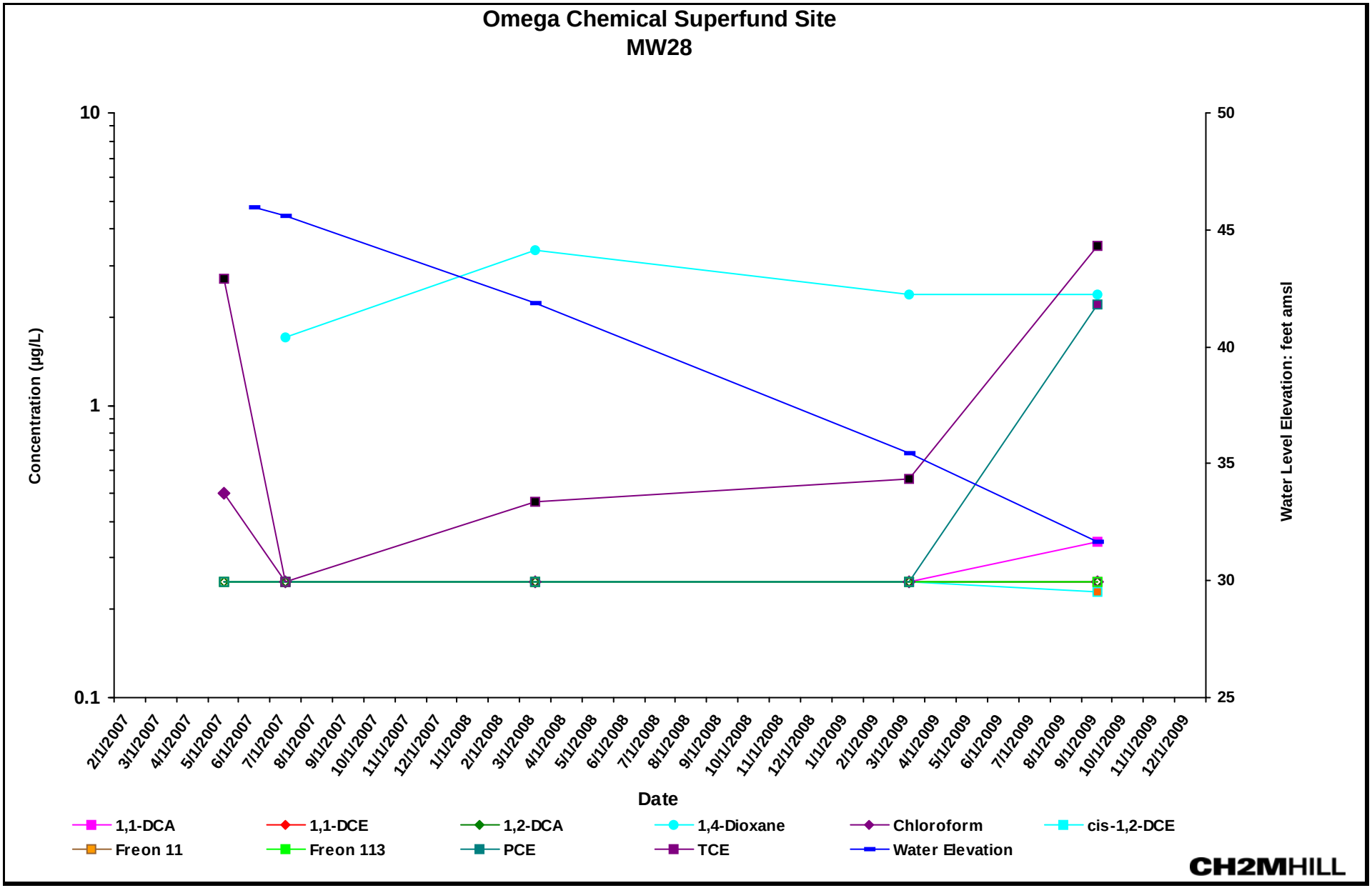
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

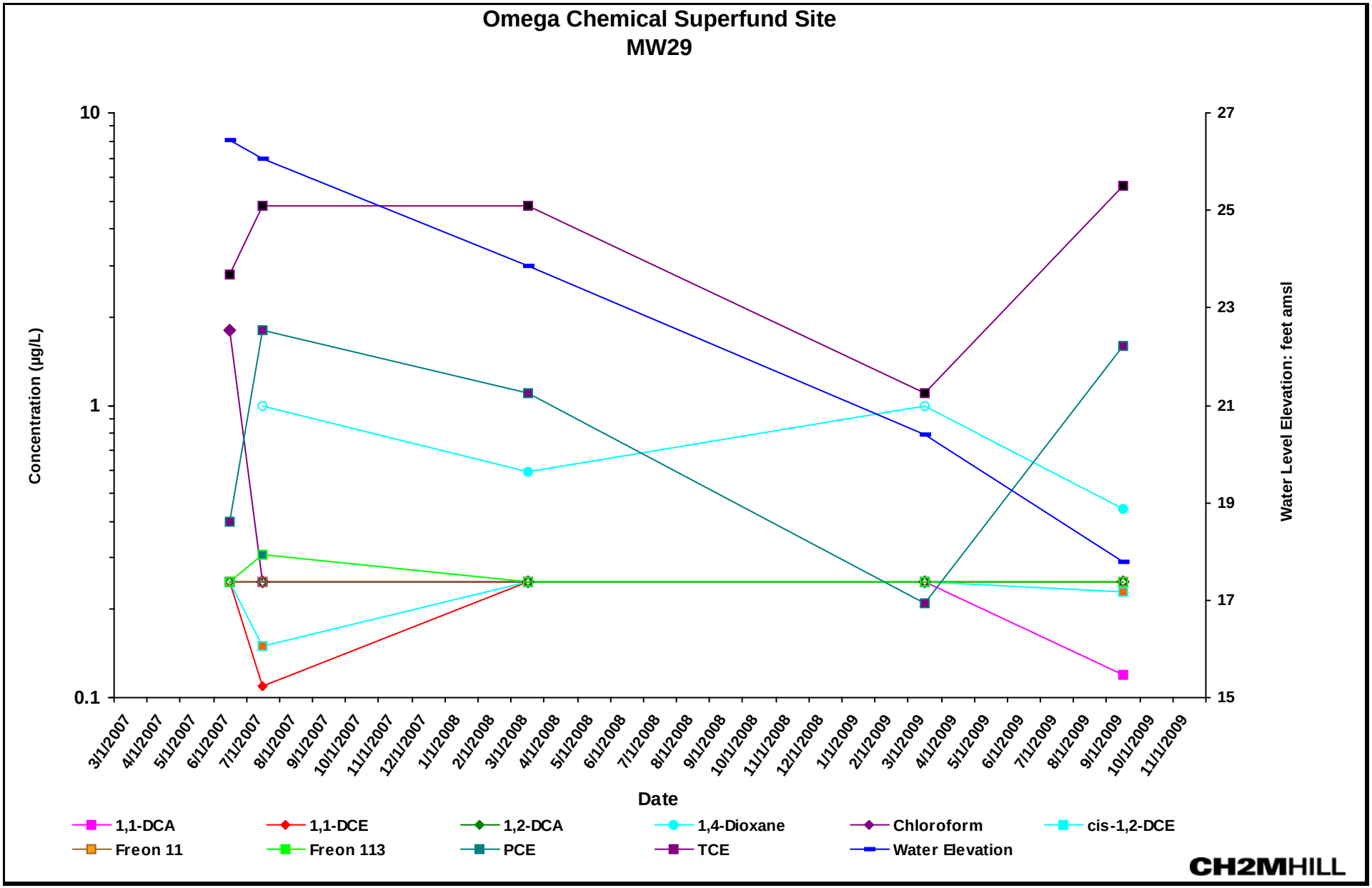


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

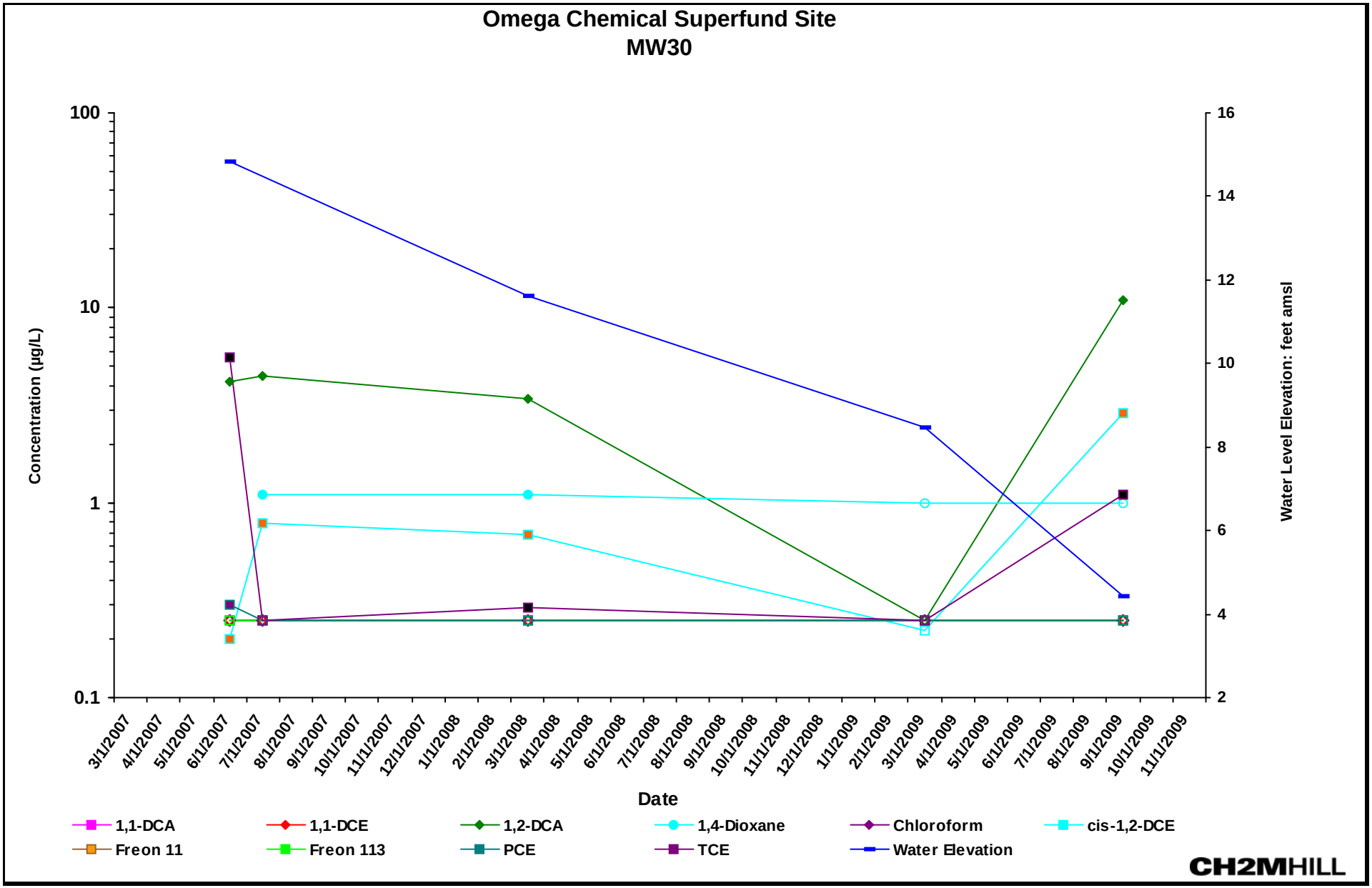


Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



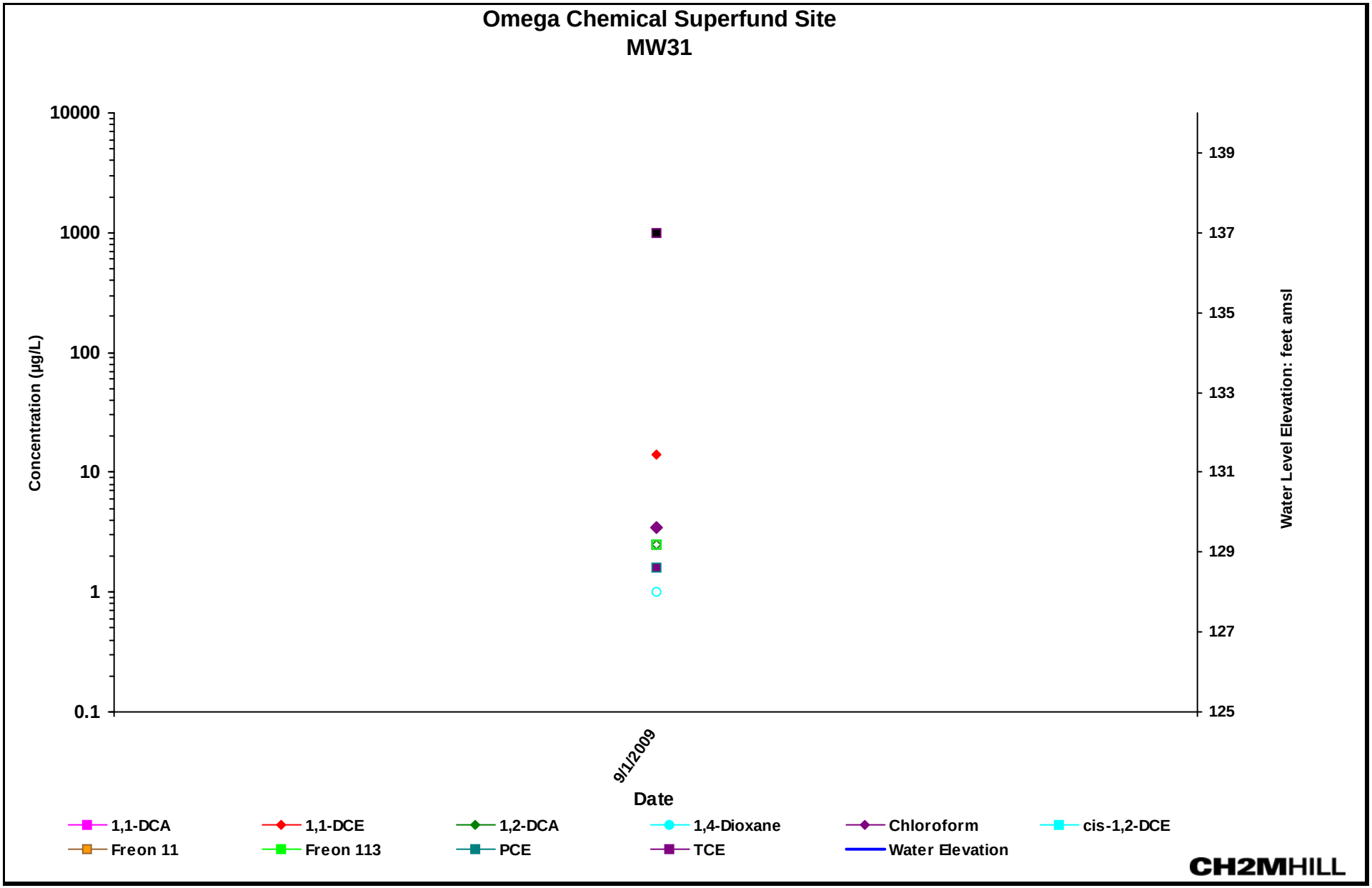
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

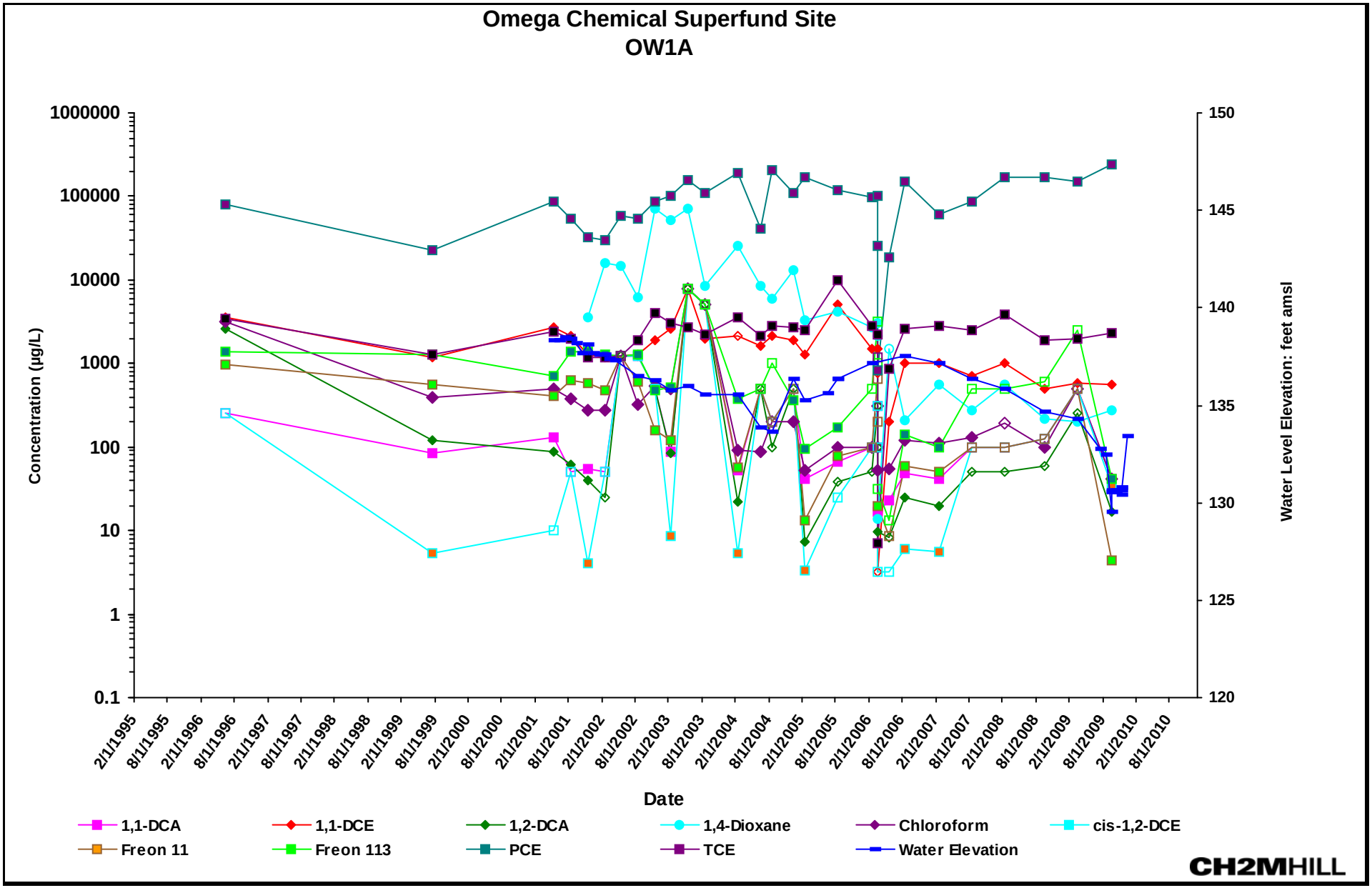


Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations

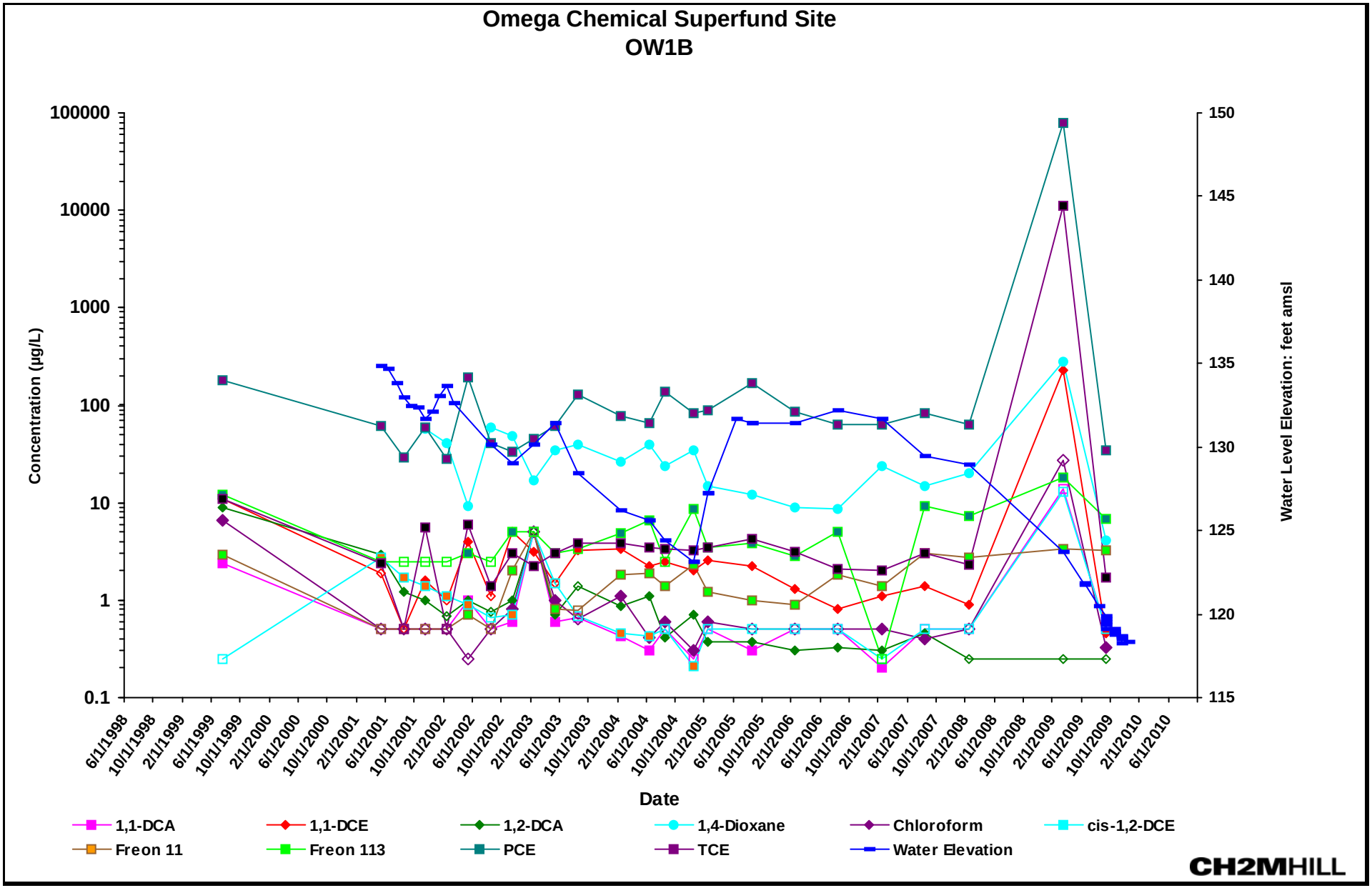


Notes:
1,1-DCA: 1,1-Dichloroethane
1,1-DCE: 1,1-Dichloroethene
1,2-DCA: 1,2-Dichloroethane
1,4-Dioxane: 1,4-Dioxane (p-dioxane)
cis-1,2-DCE: cis-1,2-Dichloroethene
Freon 11: Trichlorofluoromethane
Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane
PCE: Tetrachloroethene
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



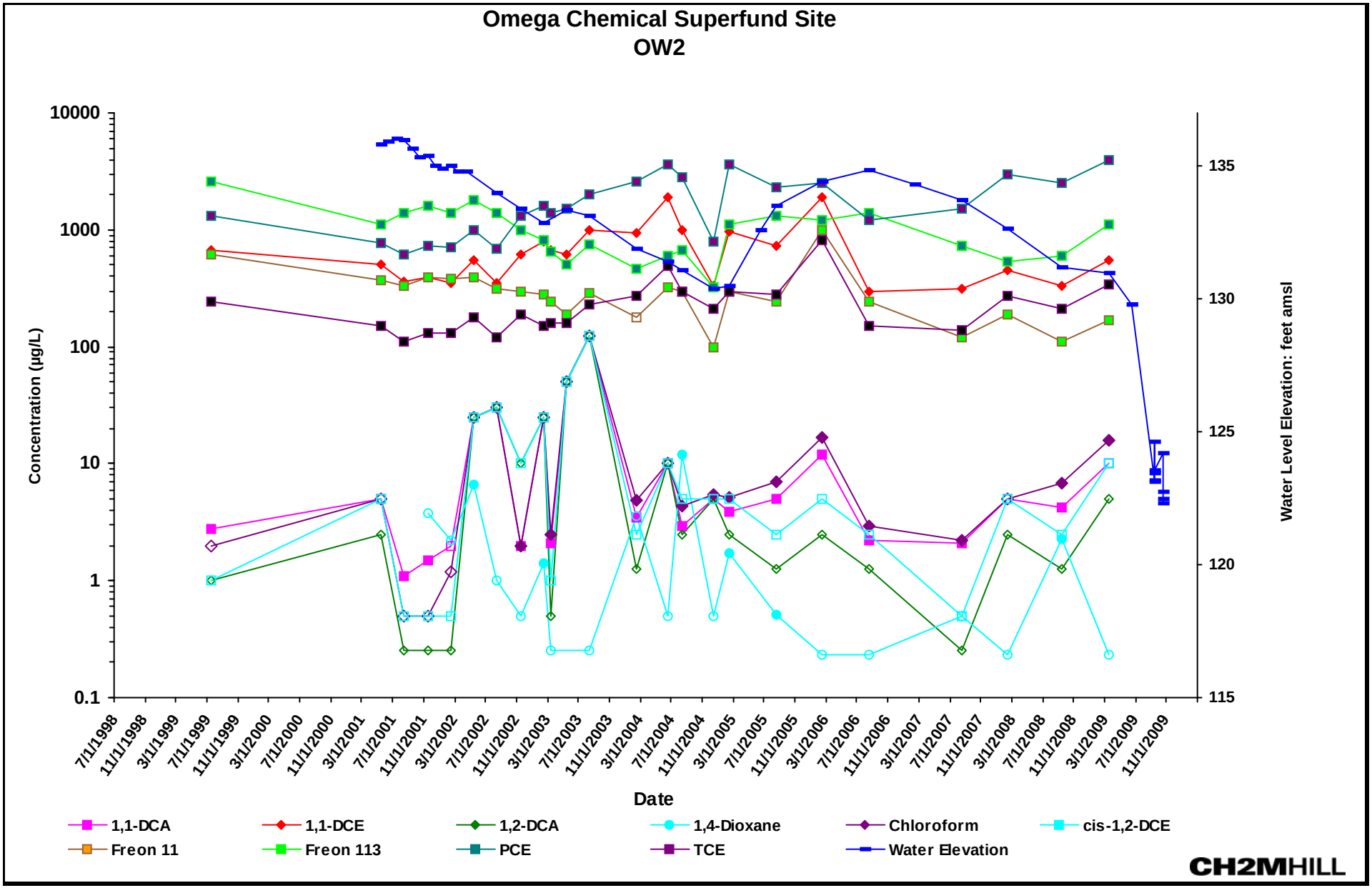
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
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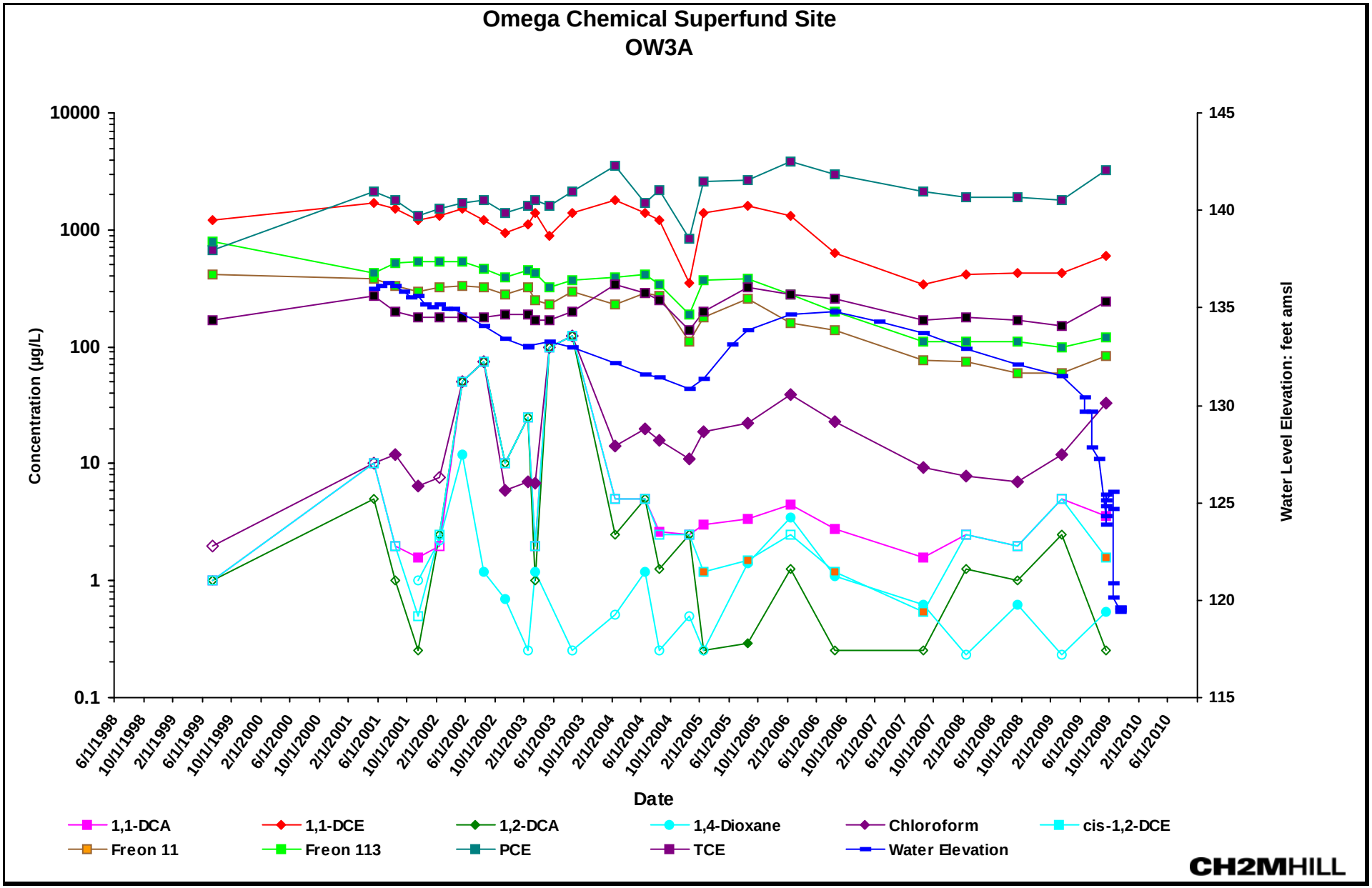

Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
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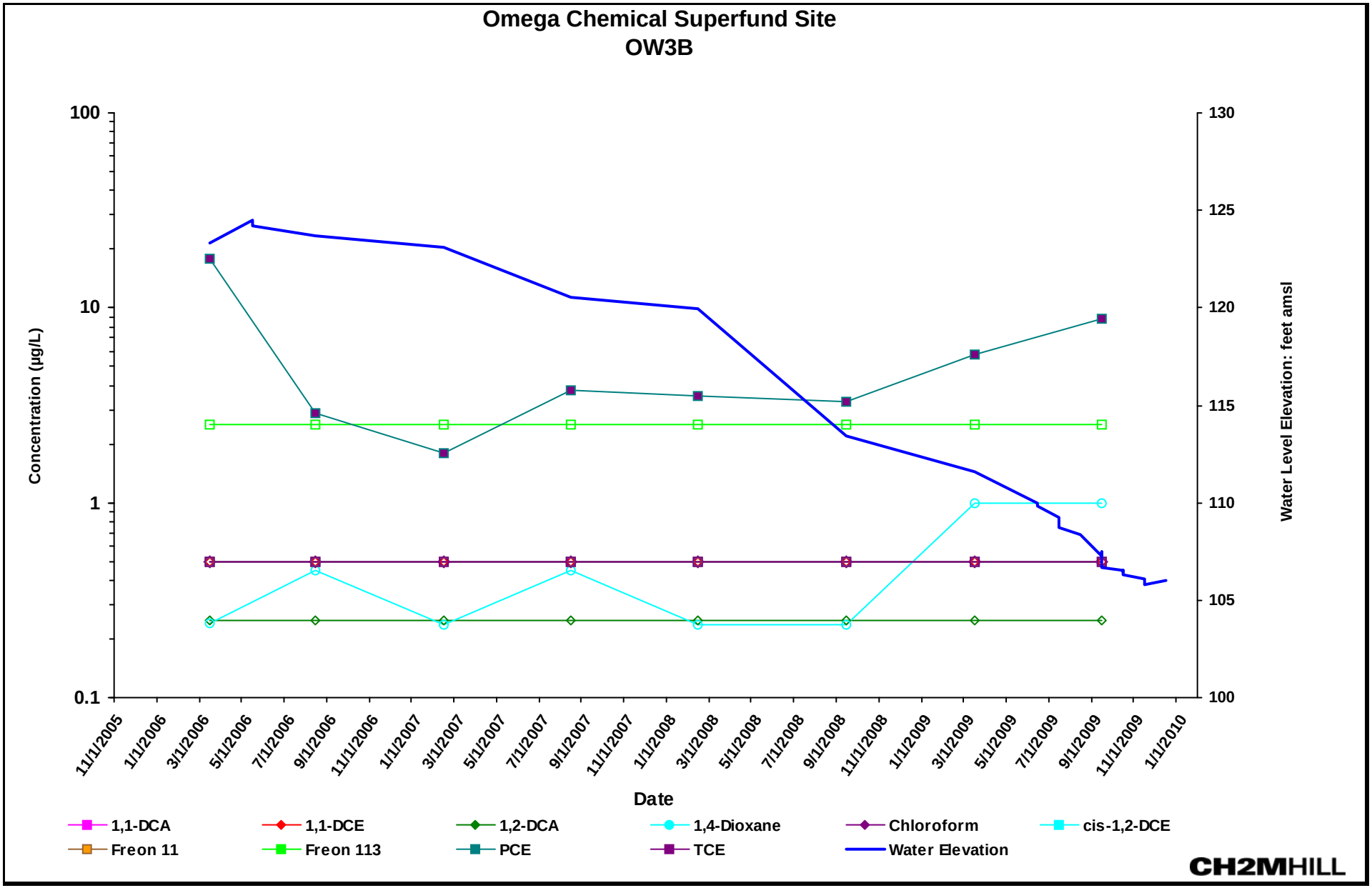
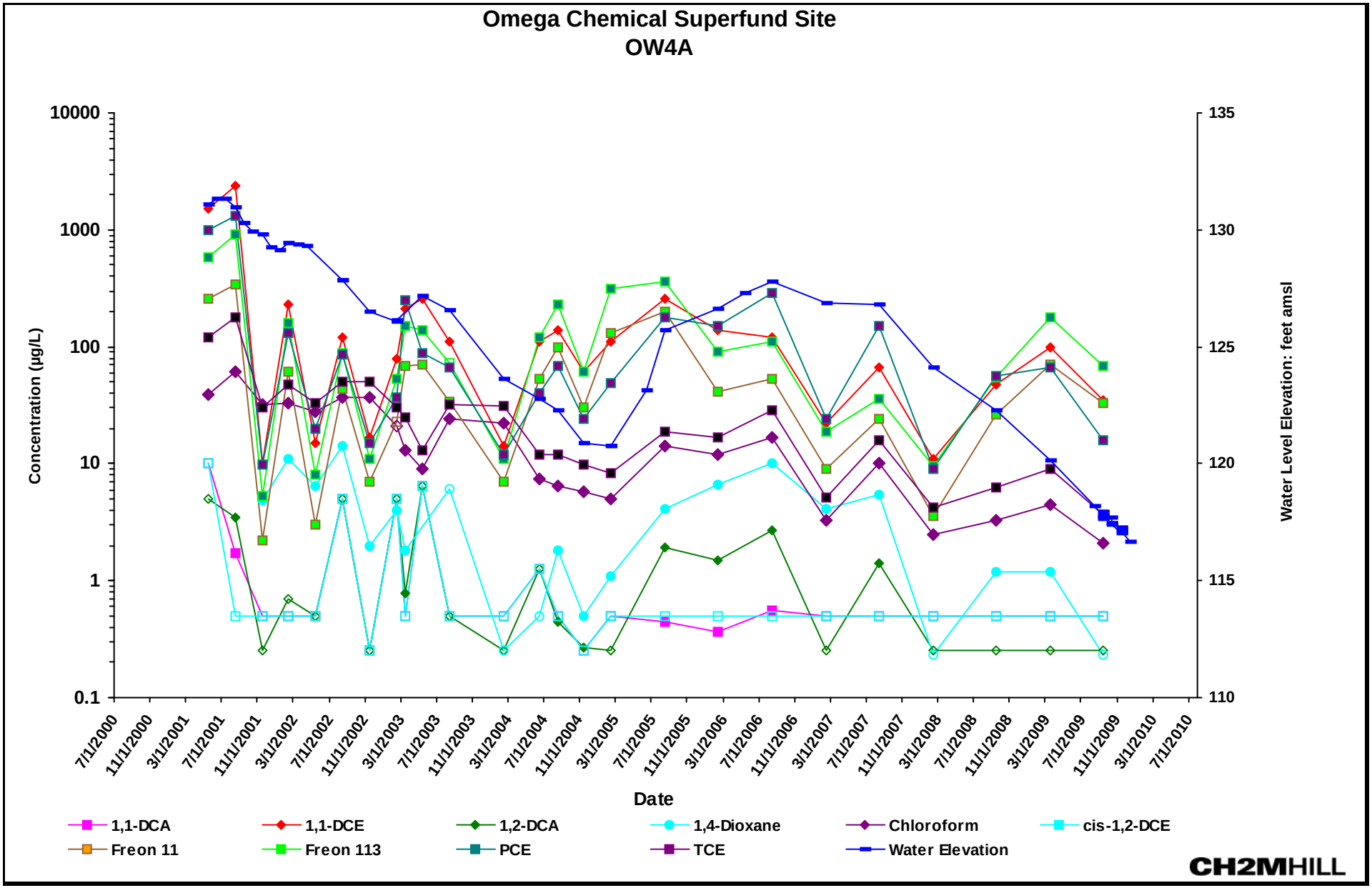
Open symbol indicates reporting limit for non-detected concentrations



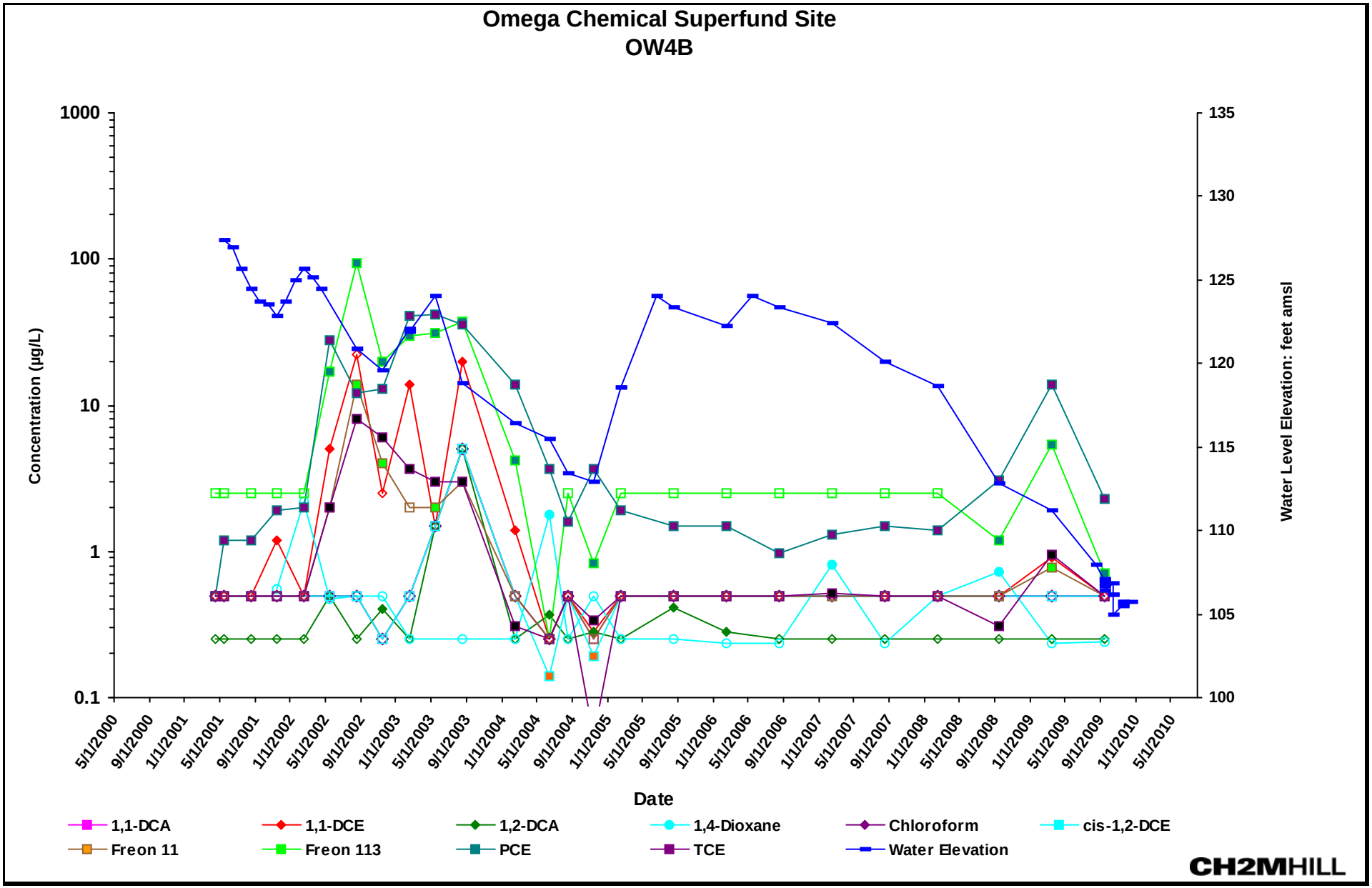
Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
TCE: Trichloroethene
Open symbol indicates reporting limit for non-detected concentrations



Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
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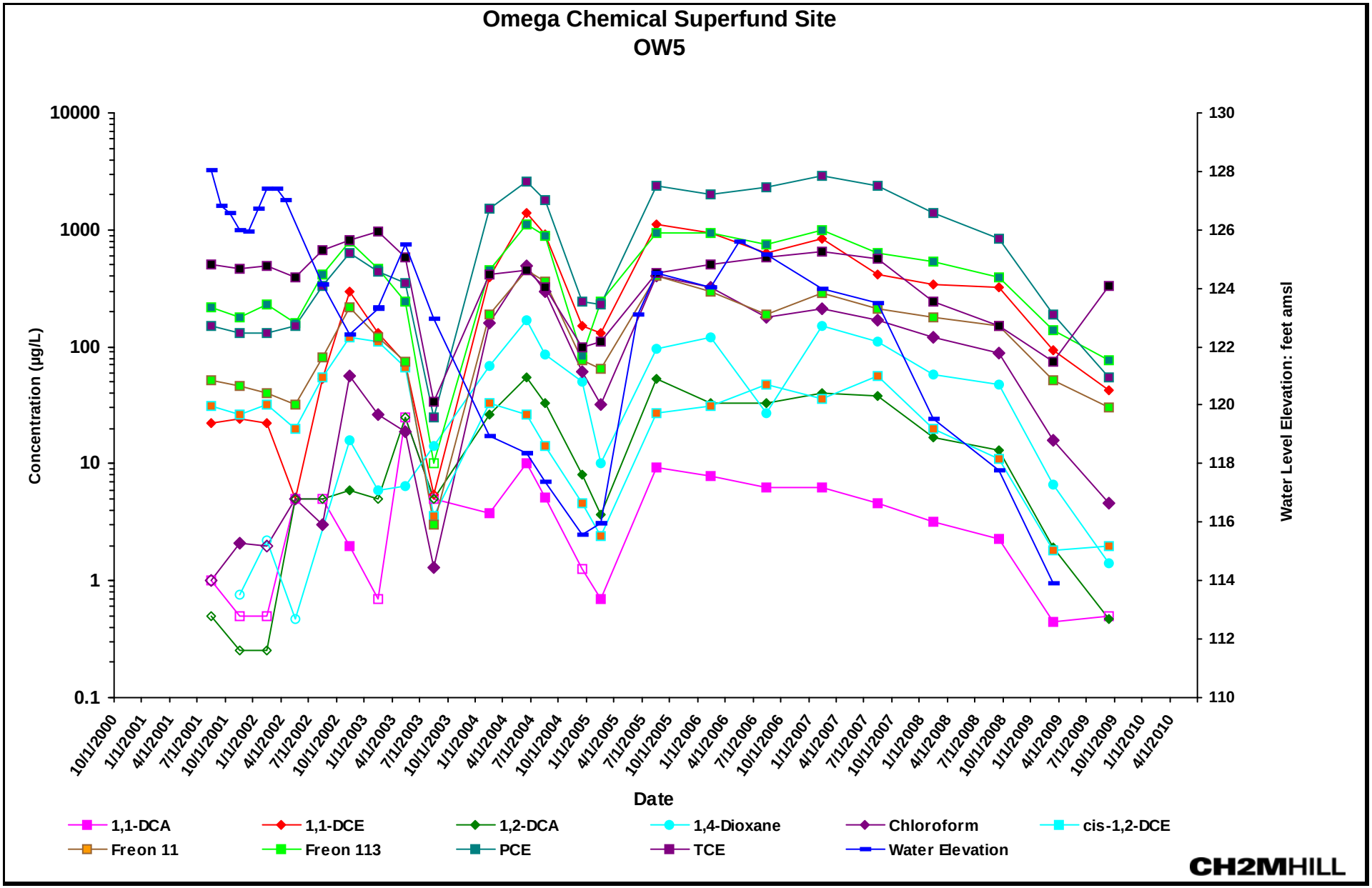

Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
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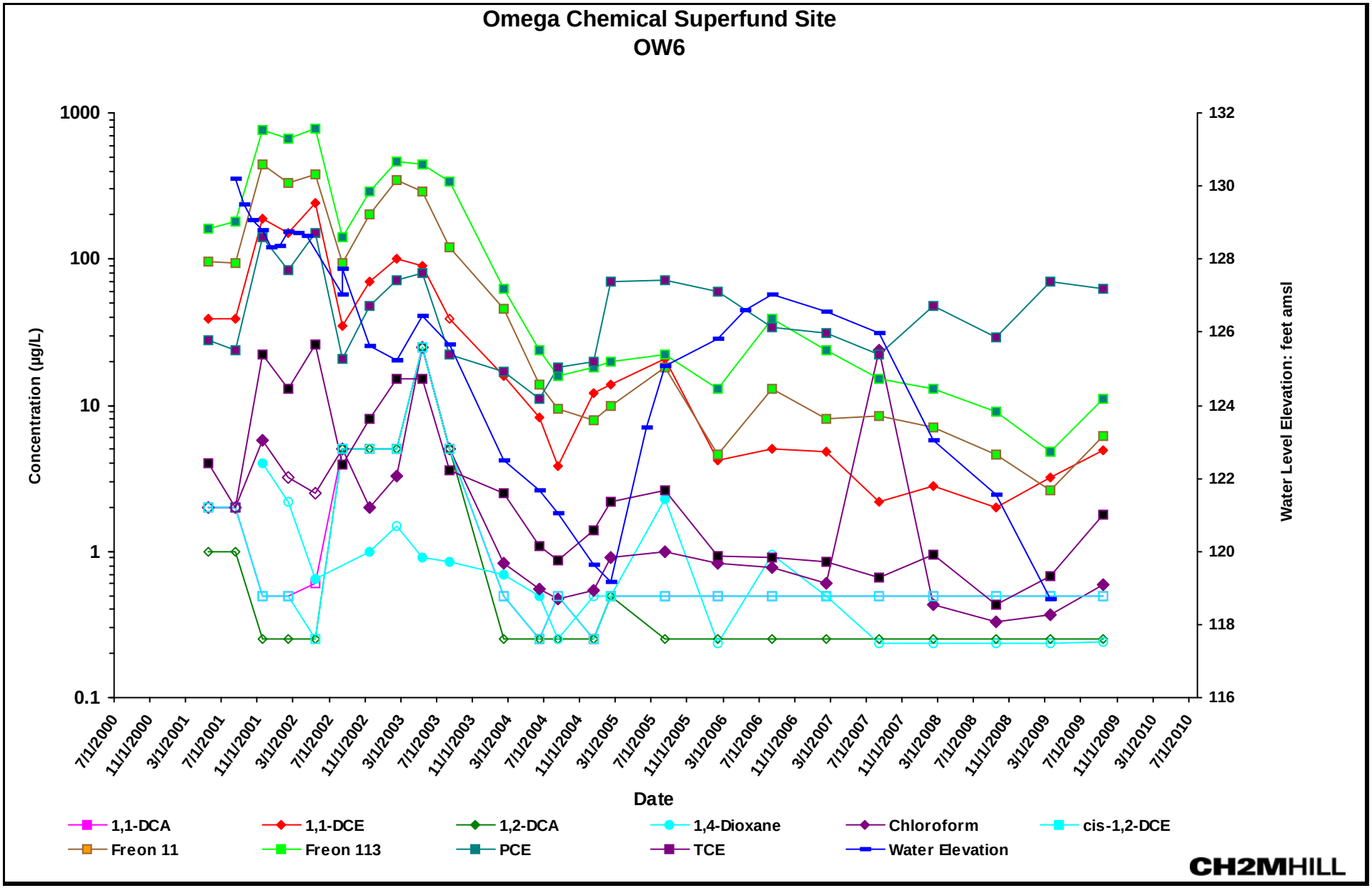

Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
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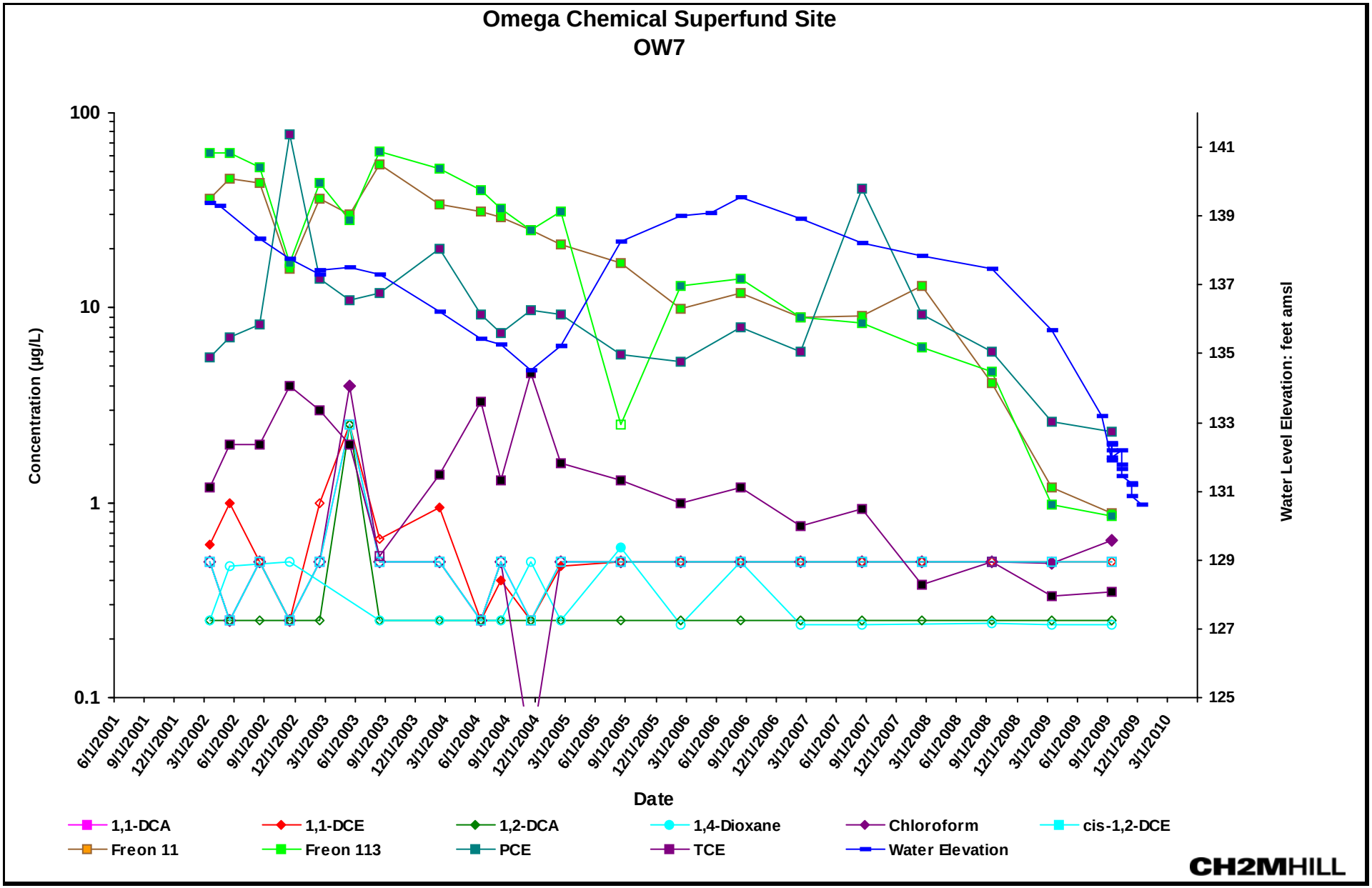

Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
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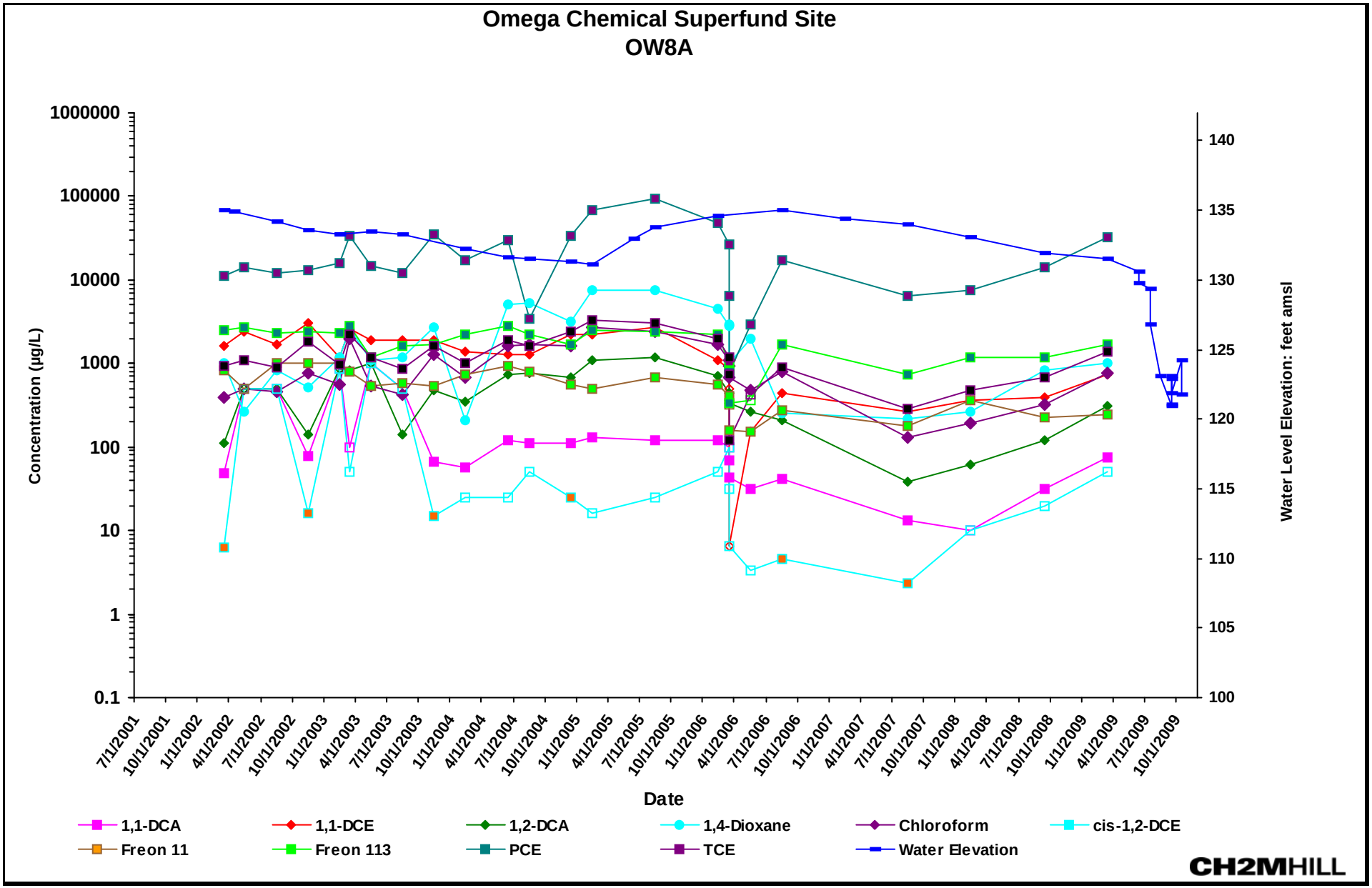

Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
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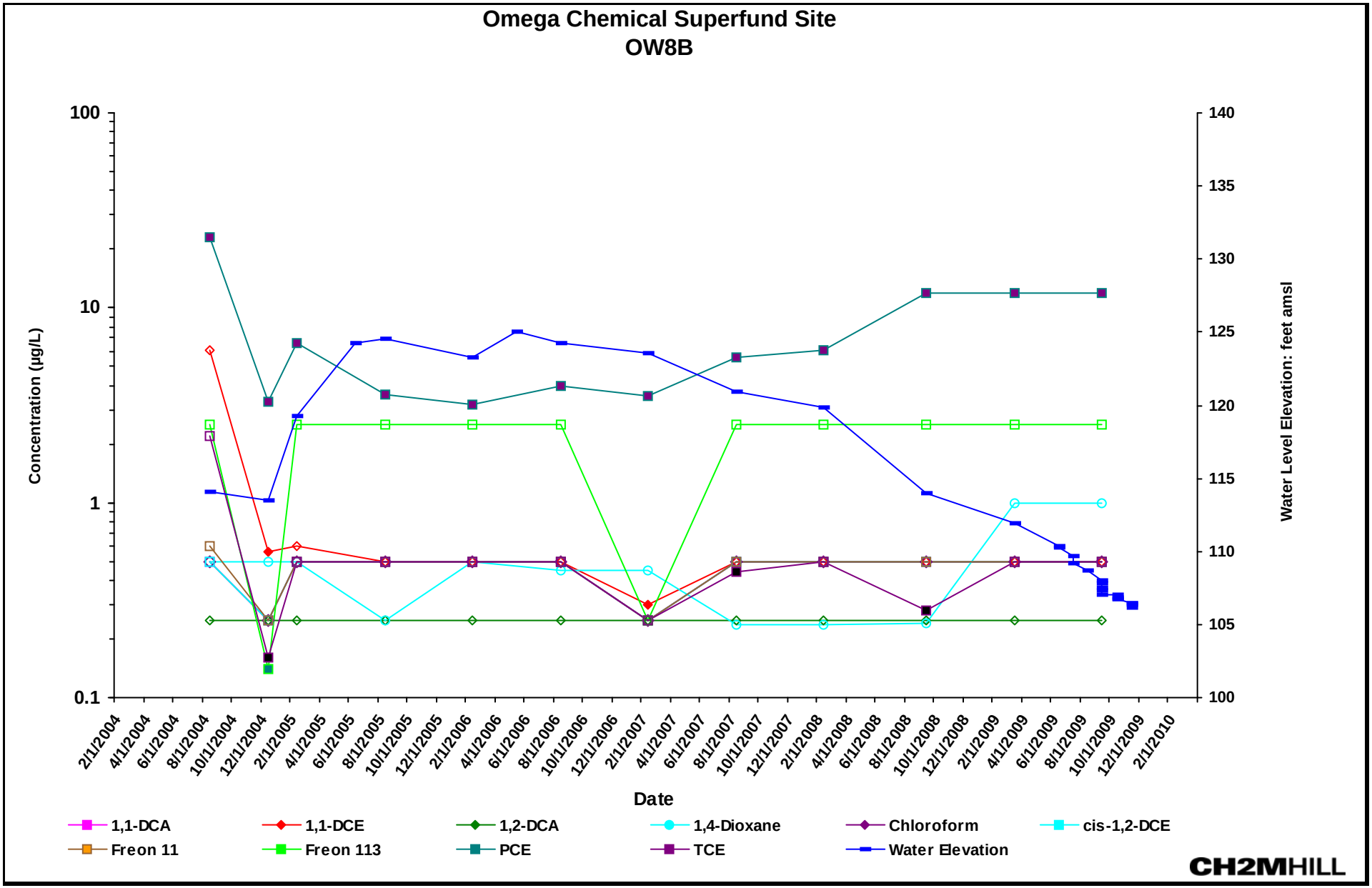

Notes:

1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
cis-1,2-DCE: cis-1,2-Dichloroethene **Freon 11: Trichlorofluoromethane** **Freon 113: 1,1,2-Trichloro-1,2,2-trifluoroethane** **PCE: Tetrachloroethene**
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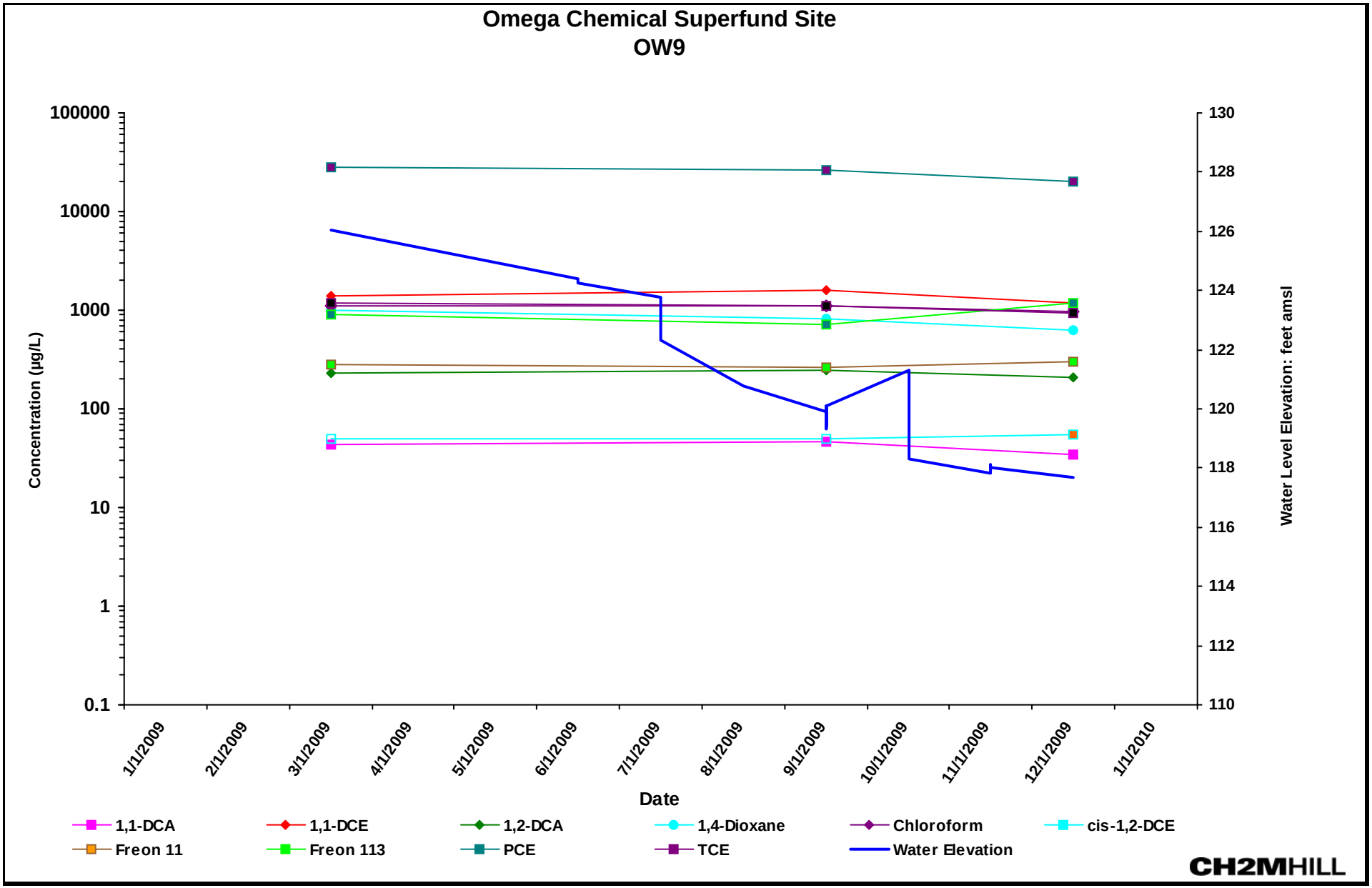

Notes:
1,1-DCA: 1,1-Dichloroethane **1,1-DCE: 1,1-Dichloroethene** **1,2-DCA: 1,2-Dichloroethane** **1,4-Dioxane: 1,4-Dioxane (p-dioxane)**
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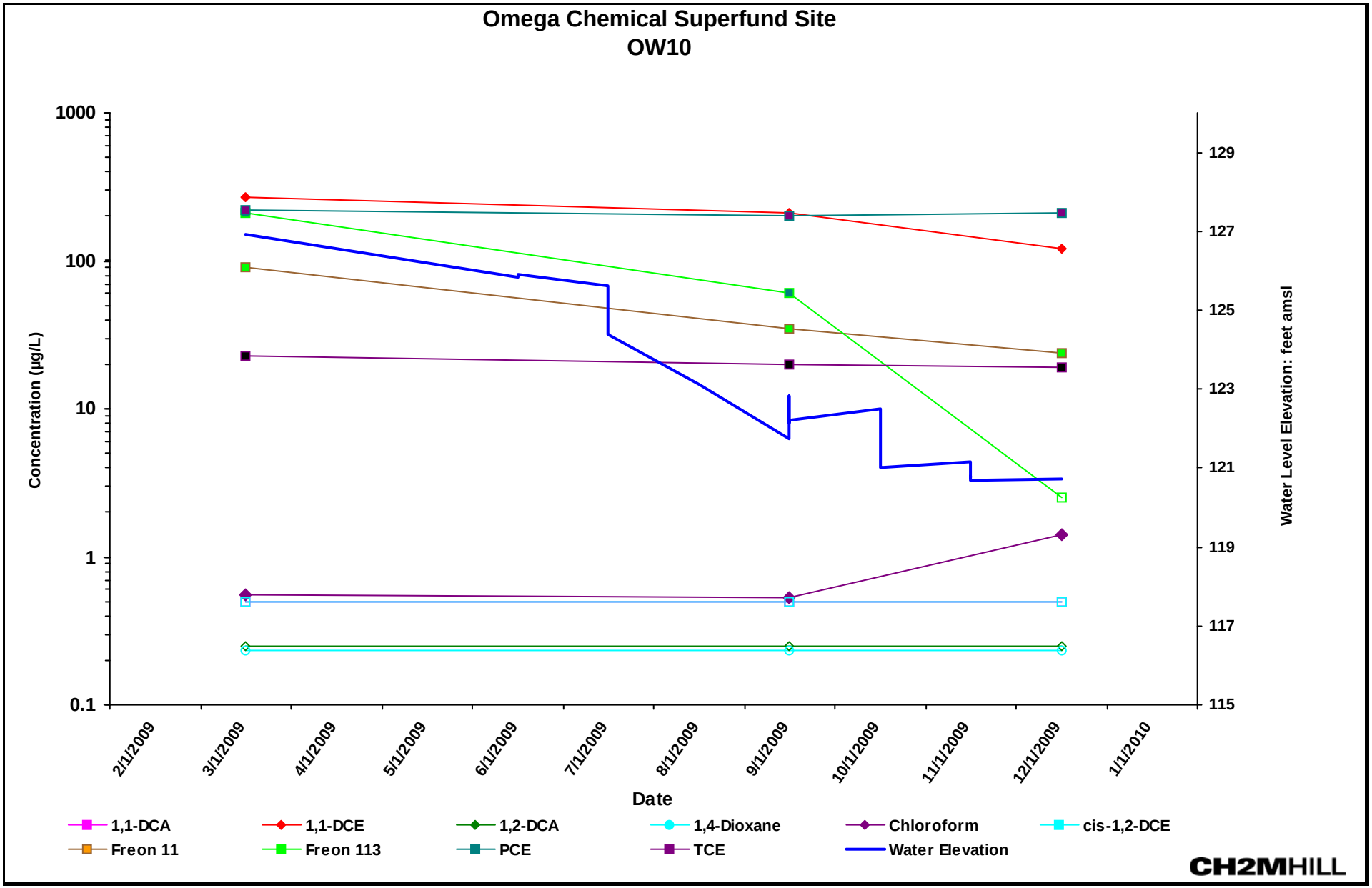

Notes:
1,1-DCA: 1,1-Dichloroethane
1,1-DCE: 1,1-Dichloroethene
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1,4-Dioxane: 1,4-Dioxane (p-dioxane)
cis-1,2-DCE: cis-1,2-Dichloroethene
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