



CENEX/QUINCY SITE

PERIODIC REVIEW

QUINCY, WA

EASTERN REGIONAL OFFICE

TOXICS CLEANUP PROGRAM

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## 1.0 INTRODUCTION

This report documents the WA Department of Ecology's (Ecology) periodic review of the on-going remedial action at the Cenex/Quincy Site (Site), located in Quincy, Washington. This review is required under the Model Toxics Control Act (MTCA), Chapter 70.105D of the Revised Code of Washington (RCW). The purpose of the periodic review is to ensure that the cleanup remedy implemented at the site remains protective of human health and the environment.

The cleanup remedy was implemented under a Consent Decree and in compliance with the Final Cleanup Action Plan (FCAP), dated February 22, 2001. The remedy is on-going and consists of a groundwater micro-sparge system (MS) coupled with a soil vapor extraction system (SVE). Both systems have been operational since December 2001.

When evaluating whether human health and the environment are continuing to be protected, the following criteria under the Washington Administrative Code (WAC) 173-340-420 (4) are considered:

- The effectiveness of ongoing or completed cleanup actions;
- New scientific information for individual hazardous substances or mixtures present at the site;
- New applicable state and federal laws for hazardous substances present at the site;
- Current and projected site and resource uses;
- The availability and practicability of more permanent remedies; and
- The availability of improved analytical techniques to evaluate compliance with cleanup levels.

Notice of this periodic review will be published in the Site Register and an opportunity for public comment will be provided. The potentially liable persons known to Ecology will be notified of the results of this review.

## 2.0 SUMMARY OF SITE CONDITIONS

### 2.1 Site Description and History

The Site is a former rinsate pond and fumigant storage area located at 300 Division Street in Quincy, Washington. The former facilities lay south of the Burlington Northern Railroad tracks on the north side of Division Street E, between 4<sup>th</sup> Avenue SE and 6<sup>th</sup> Avenue SE (Figures 1 and 2). CHS Inc. (CHS), formerly known as Cenex Harvest States, is the current property owner. They leased the property from Burlington Northern Santa Fe Railway prior to purchase in 2004.

Western Farmers Cooperative originally established a liquid fertilizer and soil fumigant storage facility on the property in 1974. CHS acquired the cooperative in 1982 and continued operations. Allegedly, an undocumented, unaddressed 2000-gallon fumigant spill occurred at the fumigant storage facility just prior to CHS assuming ownership. CHS installed a concrete rinsate pad and concrete evaporation pond in 1986. Use of the pad and pond was discontinued in

1988. In 1990, the pond was emptied and the residue applied to agricultural land. The pad and pond were dismantled and backfilled in place. Facility operations ceased in 1991.

Ecology issued a Dangerous Waste compliance order in 1992 requiring CHS to develop a site assessment plan for the former treatment pond and surrounding area.

EPA conducted a limited site assessment of the former facility in 1993; elevated levels of several herbicides in soil were identified near the former rinsate pad. All remaining storage tanks at the former facility were removed under Ecology oversight in 1994 and 1995.

CHS began implementation of the site assessment plan in 1995. The work included removal of impacted soils and concrete, installation of groundwater monitoring wells, and soil and groundwater sampling.

The Site is underlain by approximately 50 feet of unconsolidated surficial deposits of intercalated gravel, sand, and silt atop a fractured basalt layer overlying competent basalt. A 3- to 10-foot variable thickness layer of caliche (carbonate cement) is present at approximately 12 feet below ground surface and acts as a relatively low permeability unit. The water table is encountered at about 16 feet below ground surface. The highest groundwater elevations are found during the summer, which are reflective of artificial groundwater recharge that occurs during the irrigation season. The seasonal groundwater elevation variation is approximately 1 foot. Groundwater flow direction across the Site is to the southeast.

Studies identified several dissolved volatile organic compounds (VOCs) in groundwater. The soil fumigant 1,2-dichloropropane (1,2DCP) is the principal chemical present. The dissolved VOC groundwater plume extends from the Site to at least 2000 feet in a southeasterly direction (Figure 2). Vertically, the plume generally extends from the top of the water table down to the top of the basalt.

Ecology and CHS entered into a MTCA Agreed Order in 1998. Actions completed under the order included a MS/SVE pilot study, installation of additional monitoring wells, and a draft feasibility study. The pilot study was operated for 10 months, beginning operation on November 4, 1998. A total of 125 pounds of VOCs were removed from soils by the SVE system during that period.

Both parties entered into a consent decree in 2000 and Ecology issued the Final Cleanup Action Plan (FCAP) in March 2001. Actions taken under the FCAP included:

- Asphalt capping of site soils.
- Full installation and operation of MS and SVE systems to treat soil and groundwater near the former fumigant tank area, rinsate pad, and evaporation pond (operational since December 2001).
- Ongoing groundwater monitoring to evaluate the effectiveness of groundwater treatment systems.
- Implementation of institutional controls.

At the request of Ecology, CHS installed additional groundwater monitoring wells in March 2007 to further delineate the down-gradient extent of the dissolved VOC plume.

## 2.2 Cleanup Levels and Points of Compliance

Ecology's 2001 FCAP identified several VOCs in soil and groundwater as chemicals of concern for the Site. The most prevalent VOC present in groundwater is 1,2-dichloropropane (1,2-DCP). Soil vapor was determined not to be a medium of concern. The Site is zoned for industrial uses; however, it is in close proximity to residentially-zoned properties. Therefore, cleanup levels appropriate for residential (unrestricted) land use were selected.

The FCAP identified 3 VOCs in soil and 7 VOCs in groundwater as indicator hazardous substances for the Site. The associated unrestricted cleanup levels for each indicator substance are listed below:

Indicator Substance	Soil (mg/kg)	Groundwater (ug/l)
Chloroform	N/A	7.2 (Based on Method B)
1,2-Dibromoethane (EDB)	N/A	1.0 (Based on the PQL)
1,2-Dichloroethane	N/A	1.0 (Based on the PQL)
1,2-Dichloropropane	0.064 (Based on Method B)	1.0 (Based on the PQL)
1,1,2-Trichloroethane	0.076 (Based on Method B)	1.0 (Based on the PQL)
1,2,3-Trichloropropane	0.005 (Based on the PQL)	1.0 (Based on the PQL)
Vinyl Chloride	N/A	1.0 (Based on the PQL)

mg/kg = milligrams per kilogram or parts per million

ug/l = micrograms per liter or parts per billion

PQL=Practical Quantitation Limit

Point of Compliance means the point or points where cleanup levels established in accordance with WAC 173-340-720 through 173-340-760 shall be attained. The following Points of Compliance were established for the Site:

**Soil:** The soil cleanup levels are based on the protection of groundwater; therefore, the point of compliance for soils was established throughout the Site, regardless of depth.

**Groundwater:** A conditional point of compliance for groundwater was established at the down-gradient (southern) property boundary, extending to the outer boundary of the dissolved VOC plume.

### **3.0 PERIODIC REVIEW**

#### **3.1 Effectiveness of On-Going Cleanup Actions**

The effectiveness of the cleanup actions was evaluated through review of the following parameters:

- Treatment Systems Performance
- Groundwater Monitoring Data
- Contaminant Trends
- Contaminant Mass Comparisons
- Natural Attenuation Evaluation
- Institutional Controls

##### **3.1.1 Treatment Systems Operation and Performance**

The full-scale SVE/MS systems began operating in November 2001. The only contaminant detected in the SVE air stream (prior to carbon treatment) since full operation is 1,2-DCP. It has only been detected 3 times since system start-up: November 2001; January 2002; and August 2004. The system had been inoperative for 2 months prior to the August 2004 air sampling event, which may have allowed a slight build up of VOC concentrations for capture. The highest concentration ever detected was 1.3 ug/l. Effectively, no contaminant mass has been captured by the SVE system since full system operation began in November 2001. As previously described, 125 pounds of VOCs were captured by the SVE system during the 10-month pilot study (1998 – 1999). That effectiveness may have been reflective of the removal of the initial high concentrations of VOCs in the unsaturated zone. The subsequent inability to capture VOCs 2 years later and beyond may be representative of a lack of higher concentrations of VOCs in soil vapor, air sparging effectiveness, soil-vapor dilution by the sparging operation, reduction in vapor pore space due to the rising water table, and system down-times.

Down-time: SVE/MS systems were inoperative for approximately one-half of the operational period from November 29, 2002 to March 23, 2005. Since that time, system operational improvements implemented at the request of Ecology have decreased down-times to approximately 4% in 2005, 13% in 2006 (compressor failure), and 3% in 2007.

##### **3.1.2 Groundwater Monitoring Data Review**

The groundwater monitoring network at the site consists mainly of paired shallow (S) and deep (D) monitoring wells. The shallow wells monitor the groundwater near the top of the water table aquifer, and the deep wells monitor the bottom of the water table aquifer. These upper and lower monitoring zones are delineated by the screened intervals of the wells. Near the source area the shallow wells screen the interval from the top of the water table to approximately 5 feet below the water table. Farther down-gradient, the wells screen the interval from the top of the water table to 10 feet below the water table. The deep wells near the source area screen the 5-foot interval above the basalt. Farther down-gradient, the wells screen the 10 foot interval above the basalt.

Groundwater elevations have been gradually increasing due to irrigation recharge since 2001, with the highest levels measured in September 2006 (levels in 2007 were lower than in 2006). The average, overall groundwater level increase for the 6-year period has been approximately 4 feet. The highest groundwater levels are generally observed in September and the lowest in March, reflective of seasonal irrigation influences.

The average hydraulic gradient is 0.003 foot per foot. Groundwater flow direction is southeasterly. Hydraulic conductivity estimated from a single well pumping test (MW-3) ranged from 6.67 to 14.5 feet per day; groundwater velocity was calculated at 24 to 52 feet per year.

The VOCs presently detected in groundwater in excess of the cleanup levels include: 1,2-DCP; 1,1,2-trichloroethane; 1,2-dibromoethane; and 1,2,3-trichloropropane.

There is no “clean” down-gradient monitoring well. MW-38 (S) is currently the most down-gradient well and has averaged 18 times the cleanup level for 1,2-DCP since installation in March 2007. The well is located approximately 2000 feet from the contaminant source area. Travel time to the well using a groundwater velocity of 52 feet per year (the high-end estimate from a previous pumping test) is 38.5 years. Facility operations (under Western Farmers Association) began in 1973 (35 years ago). Cenex Harvest States installed the rinsate pond in 1988 (20 years ago). The earliest time that a release of contaminants to groundwater could have occurred would have been in 1973. Given that assumption, it appears that the overall groundwater velocity (and apparent contaminant velocity—not accounting for contaminant retardation) is greater than the high-end estimate derived from the pumping test. Such observations likely reflect a greater variability in groundwater parameters beyond the area evaluated during the pumping test.

The Remedial Action Work Plan, dated July 2, 2001, identifies shallow and deep well pairs MW-24/-9, MW-3/-8, MW-5/-16, and single wells MW-1 and MW-2 as conditional points of compliance monitoring wells. Review of the monitoring well sampling data provided from 2001 to present indicates that MW-8 (D) has not been included in the quarterly sampling. MW-8 (D) is a compliance monitoring point and should be included in the quarterly sampling schedule.

### **3.1.3 Contaminant Trends**

Groundwater monitoring conducted in December 2001 indicated the presence of a dissolved VOC plume that extended 1,100 feet down-gradient from the source area (near MW-24 (S)) to the farthest down-gradient monitoring wells at that time (MW-30 (S) and MW-31 (D)). The concentrations of 1,2-DCP in the former leading edge plume wells have increased over time. The December 2001 concentrations of 1,2-DCP in MW-30 (S) and MW-31 (D) were 4.4 ug/l and 1.1 ug/l, respectively. The concentrations measured in March 2008 were 54 ug/l and 8.2 ug/l, respectively.

One additional deep (MW-34) and four additional shallow (MW-35 - MW-38) monitoring wells were installed in March 2007 to further delineate the leading edge of the dissolved VOC plume. MW-34 (D) is currently the most down-gradient impacted deep well, located approximately 1500 feet from the source area. The 1,2-DCP concentrations in the well have remained relatively

stable since installation, averaging 0.3 ug/l. MW-38 (S) is the most down-gradient impacted shallow well, located approximately 2000 feet from the source area. The 1,2-DCP concentrations in this well have also remained relatively stable since installation, averaging 18 ug/l.

MW-24 (S), which monitors the shallow aquifer zone, historically contained the highest dissolved VOC concentrations of any of the wells. Concentrations have declined considerably since systems start-up, with the majority of the decline occurring during the first year of operation (Figure 3). Dissolved concentrations of 1,2-DCP in March 2001 were 19,200 ug/l; concentrations measured in March 2008 were 58 ug/l. As concentrations in MW-24 decreased, concentrations in the shallow wells immediately down-gradient increased (Figure 4).

The 1,2-DCP concentrations increased in the wells within and immediately down-gradient of the source area shortly after systems startup. Approximately a year later, the concentrations immediately down-gradient continued to increase while the source area decreased. The concentrations immediately down-gradient of the source remained high for the two years following and then began to decline. For the last three years, the concentrations in the deeper aquifer zone have remained relatively stable (Figure 5).

Two higher concentration dissolved VOC areas were originally identified within the main body of the plume. The first was located approximately 650 feet down-gradient of the source area, in the vicinity of MW-20 (S). The concentration of 1,2-DCP at MW-20 (S) declined steadily from 100 ug/l in December 2001 to 52 ug/l in March 2008. The second area originated near the source area. It increased in concentration with depth and extended 600 feet down-gradient to the vicinity of MW-25 (D). Subsequent monitoring to present indicates that the single higher concentration area has apparently either smeared or divided vertically into two hotspot lobes, one shallow and one deep. The apparent division may be reflective of actual plume separation, or may be an artifact due to the lack of monitoring information for the vertical interval between the upper and lower zones.

The shallow hotspot has migrated down-gradient from the vicinity of MW-7 (S) to its present location at MW-6 (S), approximately 175 feet down-gradient of the source area. As of March 2008, the concentration of 1,2-DCP at MW-6 (S) was at 300 ug/l. A rough estimate of 4 years travel time elapsed for the high concentration VOC peak to move the 100 foot distance from MW-7 to MW-6 (Figure 6). This travel time is reflective of the low-end estimate for groundwater (and contaminant) velocity calculated from the pumping test.

The deeper hotspot remains in the vicinity of MW-25 (D) (Figure 7). The concentration of 1,2-DCP measured in March 2008 at MW-25 (D) was 130 ug/l.

Measured Site-wide VOC concentrations do not change significantly in response to seasonal groundwater elevation changes. Only three shallow wells and two shallow/deep well pairs have shown slight seasonal response. The 1,2-DCP concentrations in these wells, however, varied from each other in both seasonal increase/decrease periods and lateral/vertical areas monitored within the plume. The inconsistencies are likely related to vertical VOC concentrations



variability within the plume, stratigraphic heterogeneity, monitoring well screened interval placement, and smear zone effects.

### 3.1.4 Contaminant Mass Comparisons

Contaminant mass comparisons of 1,2-DCP using the Theissen-Polygon Method were conducted by Farallon Consulting (environmental contractor for CHS) for the period from December 2001 to September 2007. They calculated the combined mass change for both the shallow and the deep aquifer zones 2 ways. The first approach was to use only the wells that were present since December 2001 (through MW-33). The second approach was to include the new wells that were installed in March 2007.

The first approach showed a combined shallow and deep aquifer mass reduction of 72%. The second approach showed a mass reduction of 70%.

Additional contaminant mass comparisons were conducted by Ecology using the Theissen-Polygon data provided by Farallon Consulting to evaluate mass changes occurring for both the shallow and deep aquifer zones. Comparisons included the yearly intervals since 2005.

Shallow Aquifer Zone: Using only the data from the wells present in December 2001, the shallow zone showed a 62% decrease in mass from December 2001 to September 2005. However, an apparent increase of 3% occurred between September 2005 and 2006 and 6% between September 2006 and 2007. Inclusion of the March 2007 well data indicated a 17% increase from September 2006 and 2007. Overall, the combined mass decrease for the shallow aquifer zone for the period from December 2001 to September 2007 (using all the shallow well data) was 55% (Figure 8).

Deep Aquifer Zone: Using only the data from the wells present in December 2001, the deep zone showed a 72% decrease in mass from December 2001 to September 2005 and a 15% and 27 % decrease for 2006 and 2007, respectively. Inclusion of the March 2007 well data resulted in no change for the period from September 2006 to 2007. The combined mass decrease for the deep aquifer zone from December 2001 to September 2007 (using all well data) was 83% (Figure 9).

The calculated mass reductions in both the shallow and deep aquifer zones within the first few years following systems startup were considerable. However, evaluation of the combined mass change in both the shallow and deep aquifer zones from 2005 to 2008 (using all well data) indicates that the reduction in mass rate has slowed considerably—at less than 2% over the last year (Figure 10). Calculations also indicate that the mass in both the shallow and deep monitored zones is continuing to move slowly along the groundwater flow path, effectively extending the plume farther from the source.

Comparison of the static water levels in shallow/deep well pairs along the plume axis does not indicate the presence of a vertical gradient. Any apparent variability of mass between the shallow and deep aquifer zones over time is likely attributed to other factors, such as a continually increasing water table, stratigraphic variability, and well screen interval placement.

Note: The Theissen-Polygon Method is an estimation tool that is influenced by a number of factors, including point density (number of sampling points both laterally and vertically), polygon size (area) that varies inversely with point density, and variability in volume estimates that are dependent on accurate aquifer depth measurements. Movement of higher concentration areas of contaminants between available monitoring points also yield apparent decreases or increases in concentration mass. These variables may overestimate or underestimate actual mass volumes. Additionally, some mass has migrated beyond the monitored area, which also affects estimates.

### **3.1.5 Natural Attenuation Evaluation**

Supplementary natural attenuation parameter groundwater sampling was conducted from December 2001 through June 2005 to assess the presence of VOC breakdown products that would indicate the occurrence of biodegradation. With the exception of low concentrations of methane detected in 2 monitoring wells, no breakdown/attenuation products were detected. Natural attenuation due to chemical alteration/destruction is not effectively occurring. Reductions in contaminant mass have likely been due to non-destructive natural attenuation mechanisms (advection, dispersion, dilution, diffusion, volatilization, and sorption). Apparent reductions in mass may also be due to the down-gradient migration of dissolved-phase VOCs beyond the current monitoring network.

Regardless of mechanisms, review of dissolved VOC concentration trends in groundwater since remedial systems operations began generally support mass calculation findings. Data indicates that the majority of the reduction of higher VOC concentrations in groundwater at the source area occurred within the first 3 years. Since that time, reduction progress within the overall, dissolved VOC plume has slowed considerably and now appears to have reached near static conditions.

### **3.1.6 Institutional Controls**

Institutional controls in the form of deed restrictions remain intact on those properties overlying the plume boundary extent that was identified in the FCAP and remain in place. The additional monitoring wells that were installed in March 2007, however, identified dissolved VOCs in groundwater beyond the previously defined boundary. Properties overlying the dissolved VOCs in groundwater beyond this boundary are not presently covered by deed restrictions.

## **3.2 New Scientific Information for Individual Hazardous Substances or Mixtures Present at the Site**

There is no new scientific information that affects the Site.

### 3.3 New Applicable State and Federal Laws for Hazardous Substances Present at the Site.

WAC 173-340-702 (12)(c) [November 2007 revision] provides that: “A release cleaned up under the cleanup levels determined in (a) or (b) of this subsection shall not be subject to further cleanup action due solely to subsequent amendments to the provisions in this chapter on cleanup levels, unless the department determines, on a case-by-case basis, that the previous cleanup action is no longer sufficiently protective of human health and the environment.”

The FCAP was issued in 2001 under the authority of the 2001 amended edition of MTCA. The regulation was again amended in 2007, which affected the methodology used to determine soil contaminant concentrations that are protective of groundwater. The previous version of MTCA derived Method B Formula Value soil cleanup levels for the protection of groundwater by using a value of 100 times the groundwater cleanup level. The 2007 version of MTCA uses a 3-phase model to predict contaminant concentrations remaining in soil that will be protective of groundwater. The change results in a methodology that more accurately assesses the soil to groundwater pathway and provides a substantially higher degree of protection for human health and the environment.

Use of the 3-phase model (MTCA4SGL 11.0) to derive Method B Formula Values will apply to the Site.

The model was run using standard default values for those indicator substances where Method B Formula Values were previously established in the FCAP. That process resulted in more restrictive Method B Formula Values.

The previous (2001) and the revised (2007) Method B Formula Values are listed in the following table:

Indicator Substance for Soil	Previous Method B Formula Value (mg/kg)	Revised Method B Formula Value (mg/kg)
1,2-Dichloropropane	$6.4 \times 10^{-2}$	$1.66 \times 10^{-4}$
1,1,2-Trichloroethane	$7.6 \times 10^{-2}$	$2.14 \times 10^{-4}$
1,2,3-Trichloropropane	$6.0 \times 10^{-4}$	$1.25 \times 10^{-6}$

mg/kg = milligrams per kilogram or parts per million

The 2007 amended version of MTCA also placed a requirement that contaminant-impacted properties undergo a terrestrial ecological evaluation to determine whether a release of hazardous substances to soil may pose a threat to the terrestrial environment (WAC 173-340-7490). Criteria are provided that, if met, allow exclusions from this evaluation.

That portion of the Site with contaminant-impacted soils is covered with asphalt capping, fenced, and carries an institutional control. This condition meets one of the exclusion criteria under the revised regulation. No further evaluation for terrestrial ecological protection is necessary.

### **3.4 Current and Projected Site and Resource Uses**

There has been no change in the current or projected Site use. The Site use remains industrial (manufacturing), located in close proximity to land zoned for residential and commercial use.

### **3.5 The Availability and Practicability of More Permanent Remedies**

There has been little change in permanent treatment options since acceptance of the preferred cleanup remedy under the FCAP. However, additional studies have been conducted related to the in situ treatment of chlorinated solvents. These studies, among any other identified treatment alternatives, should be explored as possible options to enhance the effectiveness of the existing treatment systems such that cleanup goals may be achieved within a reasonable restoration timeframe.

### **3.6 The Availability of Improved Analytical Techniques to Evaluate Compliance with Cleanup Levels**

There have been no changes in the federal or state maximum contaminant levels (MCLs) applicable to the Site.

The cleanup levels for both soil and groundwater in the FCAP were originally set at the practical quantitation limits (PQL) because the Method B Formula Values were below the PQL. These established PQLs for the site indicator hazardous substances were reviewed with the Ecology section of the state/federal Manchester Environmental Laboratory. The standard PQL for VOCs in groundwater has not changed and remains at 1 ug/l. The PQL for VOCs in soil, however, has changed and has been lowered from 0.005 mg/kg to 0.001 mg/kg. This change will apply to the Site.

## **4.0 CONCLUSIONS**

There are presently 2 VOC hotspots, one in the shallow water table aquifer zone and the other in the deeper water table aquifer zone. Both areas now appear relatively stable in concentration and act as on-going dissolved VOC source areas as they migrate slowly down-gradient.

The reasonable restoration timeframe estimates identified in the FCAP for achieving compliance with cleanup levels was 3 years for soil and 10 years for groundwater. As previously described, no VOCs have been detected in the SVE extracted airstream since August 2004. This may indicate that either the soil cleanup levels in the unsaturated soil zone have been achieved, or that the system may have reached asymptotic levels with respect to its ability to further remove VOC vapors from soil pore spaces. Actual soil sampling would be necessary to verify compliance with soil cleanup levels in the active treatment area.

The 10 year restoration time-frame estimate for groundwater will not be achieved. Continuous quarterly groundwater monitoring indicates that present concentrations and mass of dissolved VOCs in groundwater are relatively unchanging and are continuing to migrate slowly down-

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The 10 year restoration time-frame estimate for groundwater will not be achieved. Continuous quarterly groundwater monitoring indicates that present concentrations and mass of dissolved VOCs in groundwater are relatively unchanging and are continuing to migrate slowly down-

gradient. The existing treatment systems were installed to primarily address VOCs in soil and groundwater at the source area. Secondary treatment of the dissolved VOCs in groundwater down-gradient of the source area was expected through enhanced biodegradation via groundwater oxygenation from the MS system. This secondary treatment has not been realized. Studies subsequent to the FCAP have shown that chlorinated VOCs in groundwater, such as present at the Site, are better suited for destructive biodegradation in anaerobic groundwater conditions.

The down-gradient extent of the dissolved VOC plume has not been fully delineated. In addition, there are properties overlying dissolved VOCs in groundwater that are beyond the presently identified deed restriction boundaries.

Amendments to MTCA and improvements in laboratory methods have not resulted in any changes to the groundwater cleanup levels for the indicator hazardous substances at the Site. The groundwater cleanup levels remain unchanged at 1.0 ug/l..

The revisions, however, have resulted in the lowering of both the Method B Formula Values and the PQLs for the indicator hazardous substances in soil. These changes affect the soil cleanup levels previously established for the Site. Because the revised Method B Formula Values are lower than the PQL, the cleanup levels will default to the new PQL.

The revised soil cleanup levels in mg/kg for each indicator substance are listed in the following table:

Indicator Substance	Revised Method B Formula Value (mg/kg)	PQL (mg/kg)	Revised Cleanup Level (mg/kg)	Basis for Cleanup Level
1,2-Dichloropropane	$1.66 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	PQL
1,1,2-Trichloroethane	$2.14 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	PQL
1,2,3-Trichloropropane	$1.25 \times 10^{-6}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	PQL

mg/kg = milligrams per kilogram or parts per million

## 5.0 RECOMMENDATIONS

Additional remedial action measures will be required to achieve the originally stated goals in the FCAP and to insure that the VOC plume does not continue to migrate down-gradient. The evaluation of new and alternate technologies, in particular those related to the in situ treatment of chlorinated VOCs in groundwater, will be required. The performance of supplemental bench-scale, field, or pilot studies to evaluate improved technology options will be needed.

gradient. The existing treatment systems were installed to primarily address VOCs in soil and groundwater at the source area. Secondary treatment of the dissolved VOCs in groundwater down-gradient of the source area was expected through enhanced biodegradation via groundwater oxygenation from the MS system. This secondary treatment has not been realized. Studies subsequent to the FCAP have shown that chlorinated VOCs in groundwater, such as present at the Site, are better suited for destructive biodegradation in anaerobic groundwater conditions.

The down-gradient extent of the dissolved VOC plume has not been fully delineated. In addition, there are properties overlying dissolved VOCs in groundwater that are beyond the presently identified deed restriction boundaries.

Amendments to MTCA and improvements in laboratory methods have not resulted in any changes to the groundwater cleanup levels for the indicator hazardous substances at the Site. The groundwater cleanup levels remain unchanged at 1.0 ug/l..

The revisions, however, have resulted in the lowering of both the Method B Formula Values and the PQLs for the indicator hazardous substances in soil. These changes affect the soil cleanup levels previously established for the Site. Because the revised Method B Formula Values are lower than the PQL, the cleanup levels will default to the new PQL.

The revised soil cleanup levels in mg/kg for each indicator substance are listed in the following table:

Indicator Substance	Revised Method B Formula Value (mg/kg)	PQL (mg/kg)	Revised Cleanup Level (mg/kg)	Basis for Cleanup Level
1,2-Dichloropropane	$1.66 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	PQL
1,1,2-Trichloroethane	$2.14 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	PQL
1,2,3-Trichloropropane	$1.25 \times 10^{-6}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	PQL

mg/kg = milligrams per kilogram or parts per million

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Additional monitoring wells should be installed to fully delineate the down-gradient extent of the dissolved VOC plume. Once delineated, additional restrictive covenants should be pursued and enacted on any properties overlying the plume that are not presently covered.

One domestic residence on a private well was observed down-gradient of the plume, across the West Canal, during a recent Site visit. That well and any other domestic wells located within one-quarter mile of the presently-defined down-gradient extent of the plume should be included in the next round of groundwater sampling to check for the presence of indicator substances.

MW-8 (D) is a conditional point of compliance monitoring well and must be included in the quarterly sampling schedule. Sampling should begin with the next scheduled sampling event.

The appropriateness of a revised Cleanup Action Plan needs to be determined following additional data gathering and the remedial technologies feasibility study.



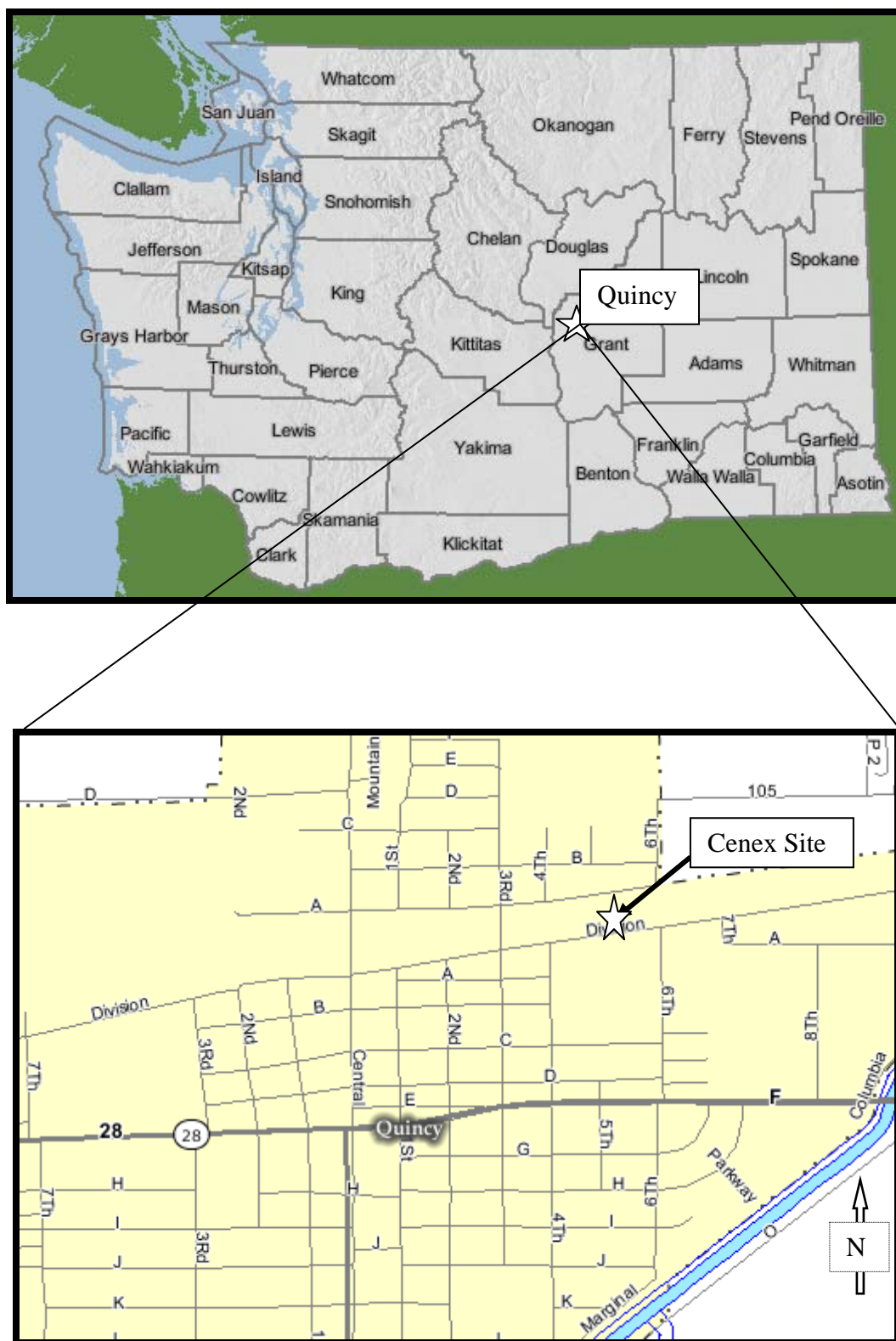
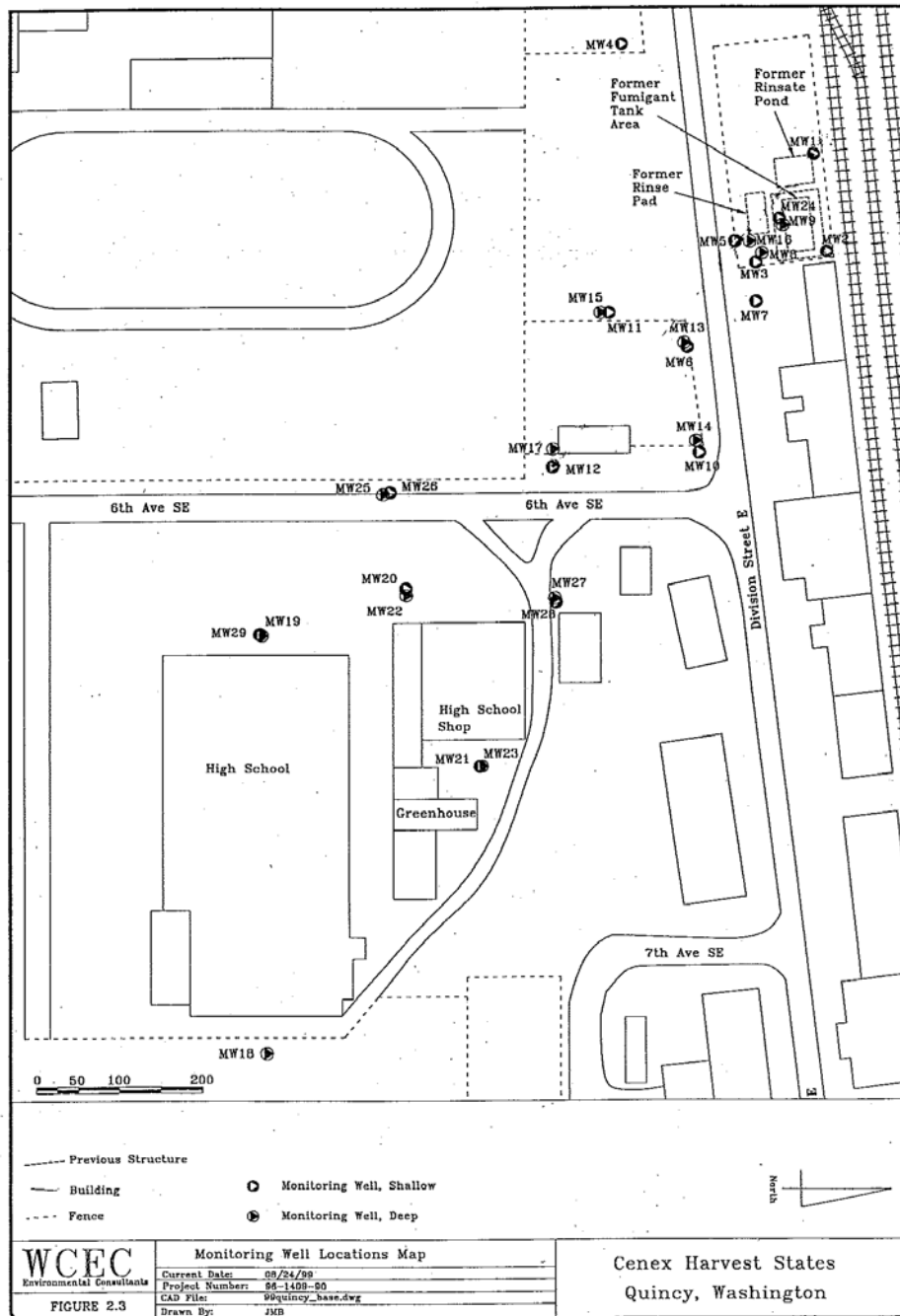
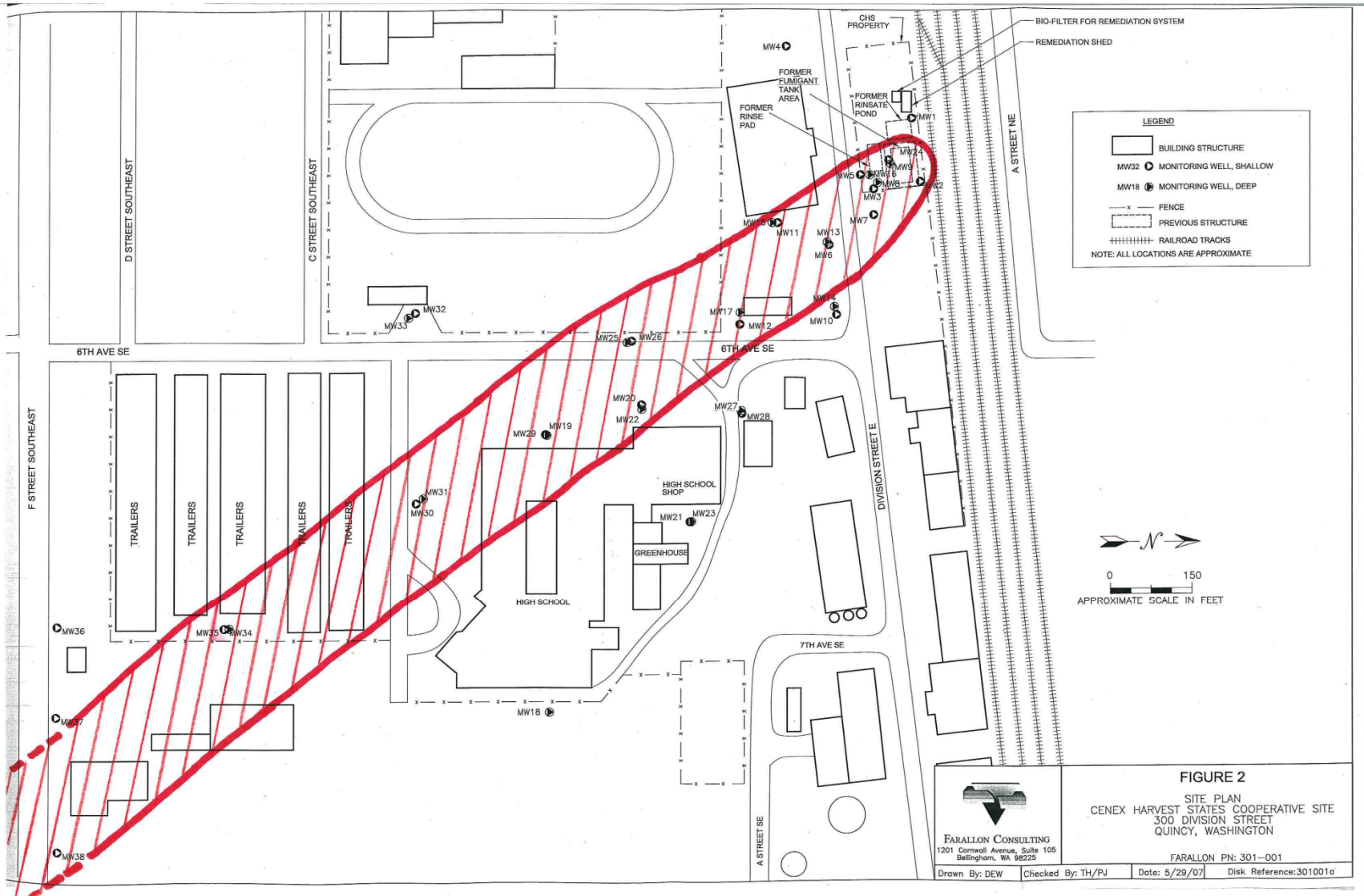


Figure 1: Site Location



**Figure 2: Site Close-up**

Note: Cross-section line removed from original diagram for clarity



**Figure 3: 1,2-DCP Plume Outline**

Note: Plume Drawn on Farallon Base Map

Figure 4: 1,2-DCP Trends—Shallow Wells Along Plume Axis

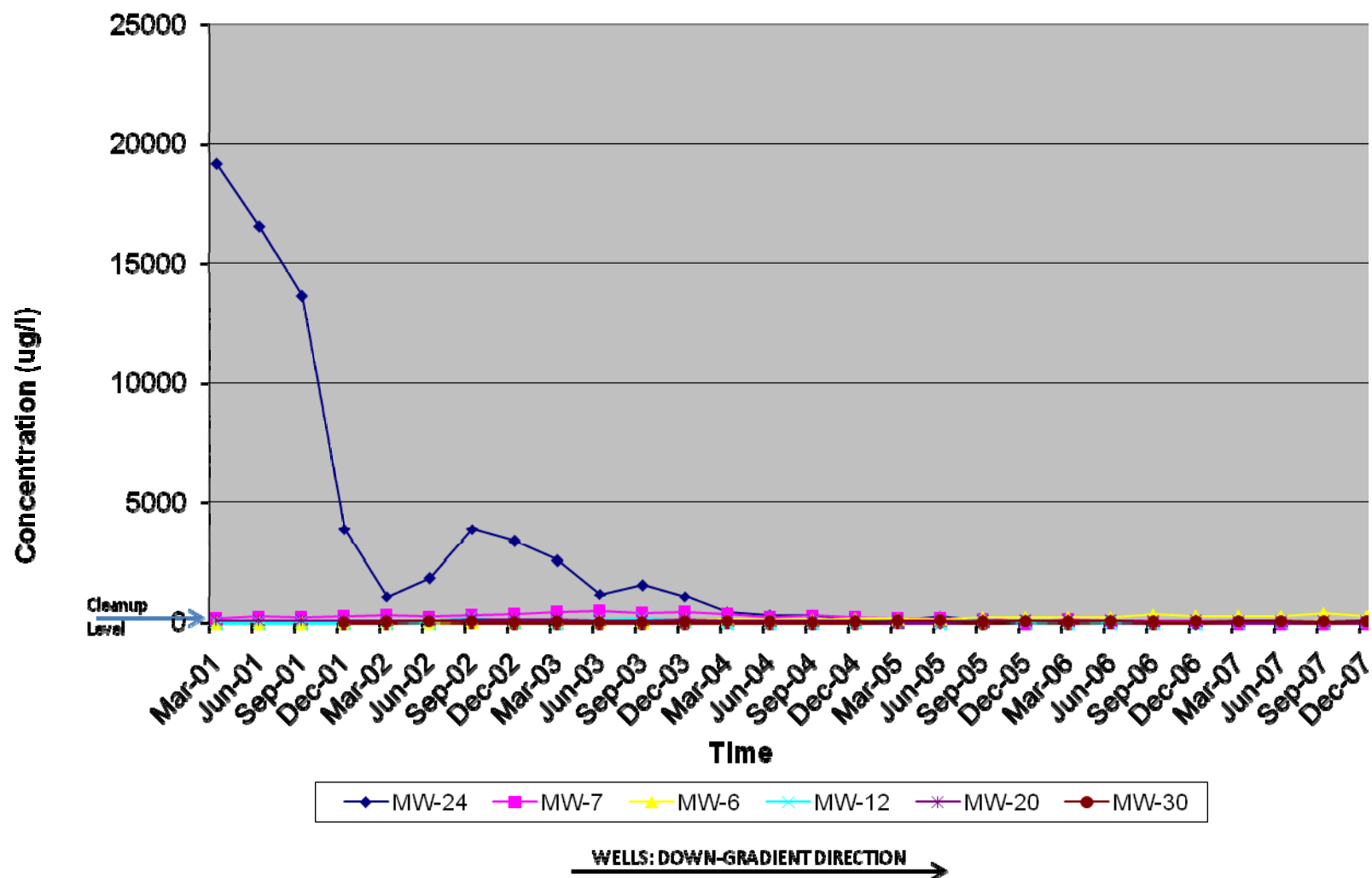
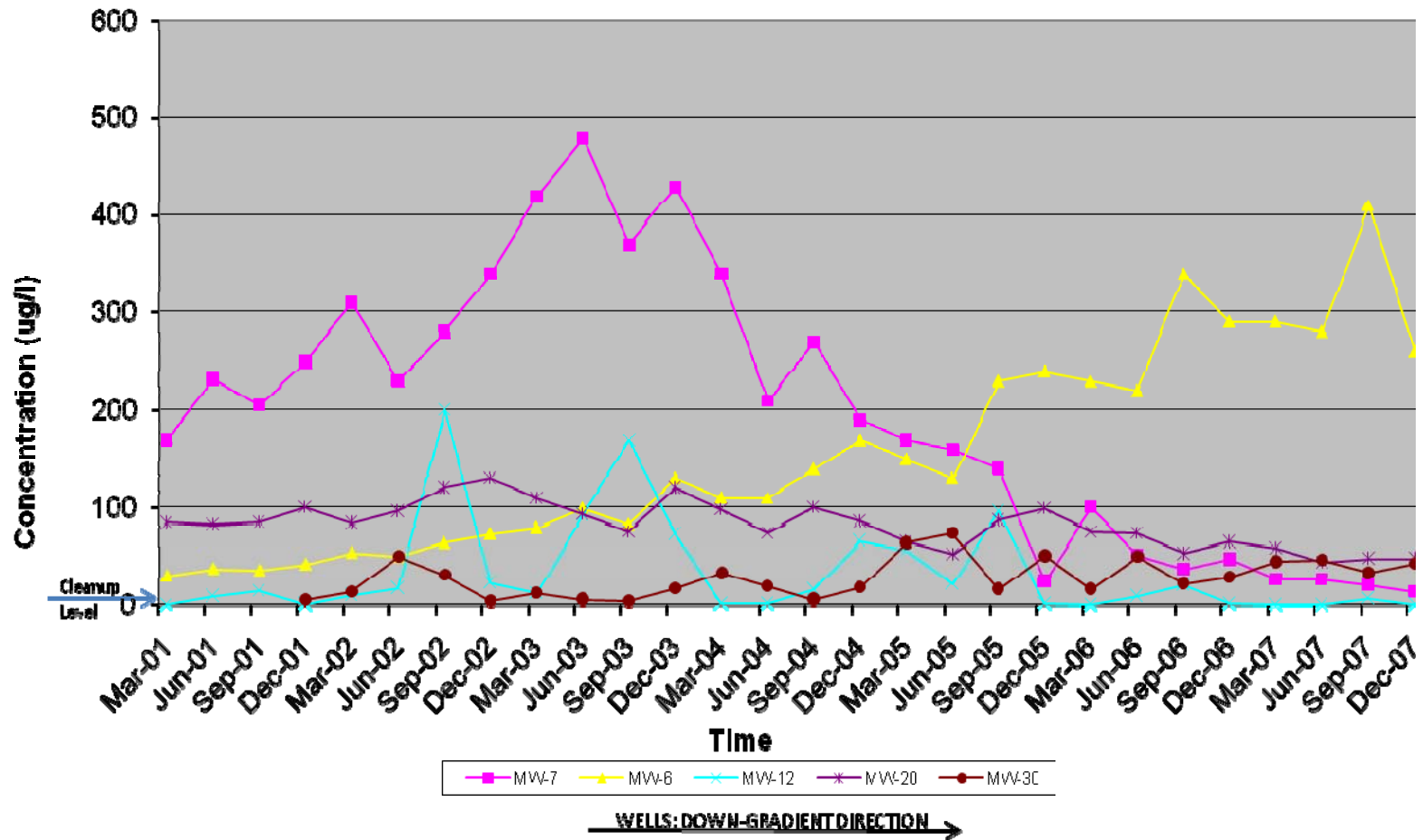
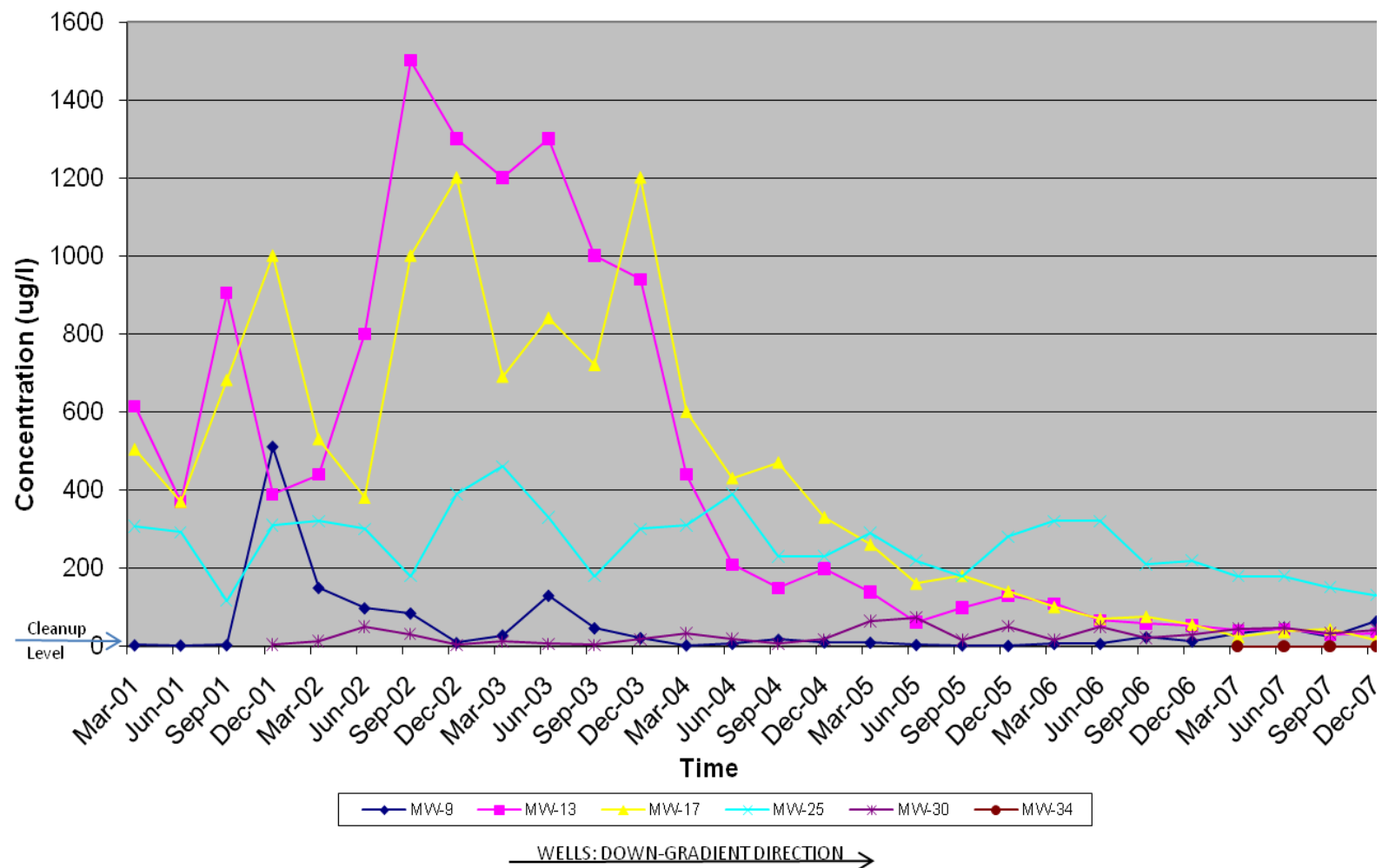


Figure 5: 1,2-DCP Trends—Shallow Wells Along Plume Axis—Without MW-24



**Figure 6: 1,2-DCP Trends—Deep Wells Along Plume Axis**



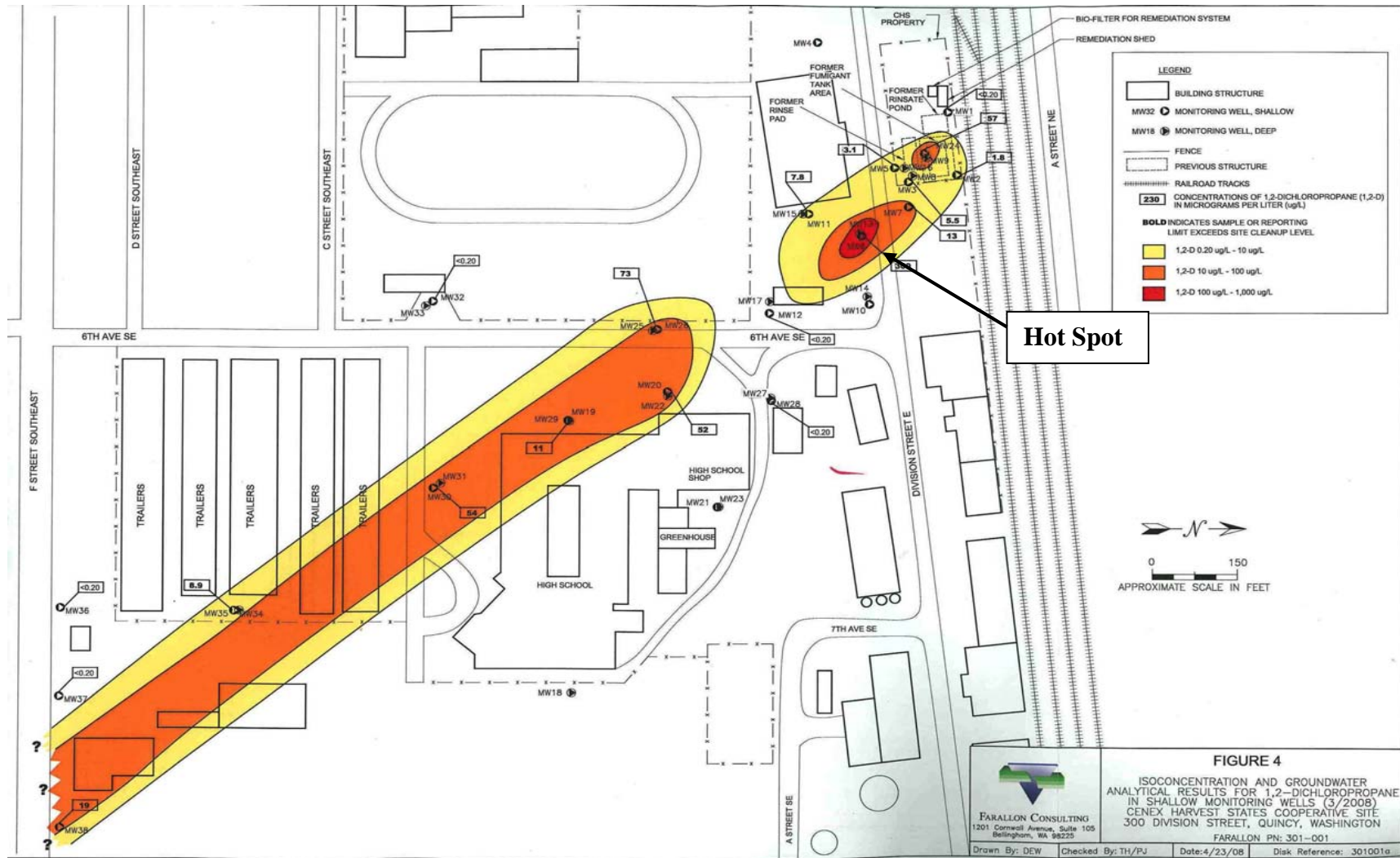


Figure 7: Hot Spot in Shallow Aquifer Zone

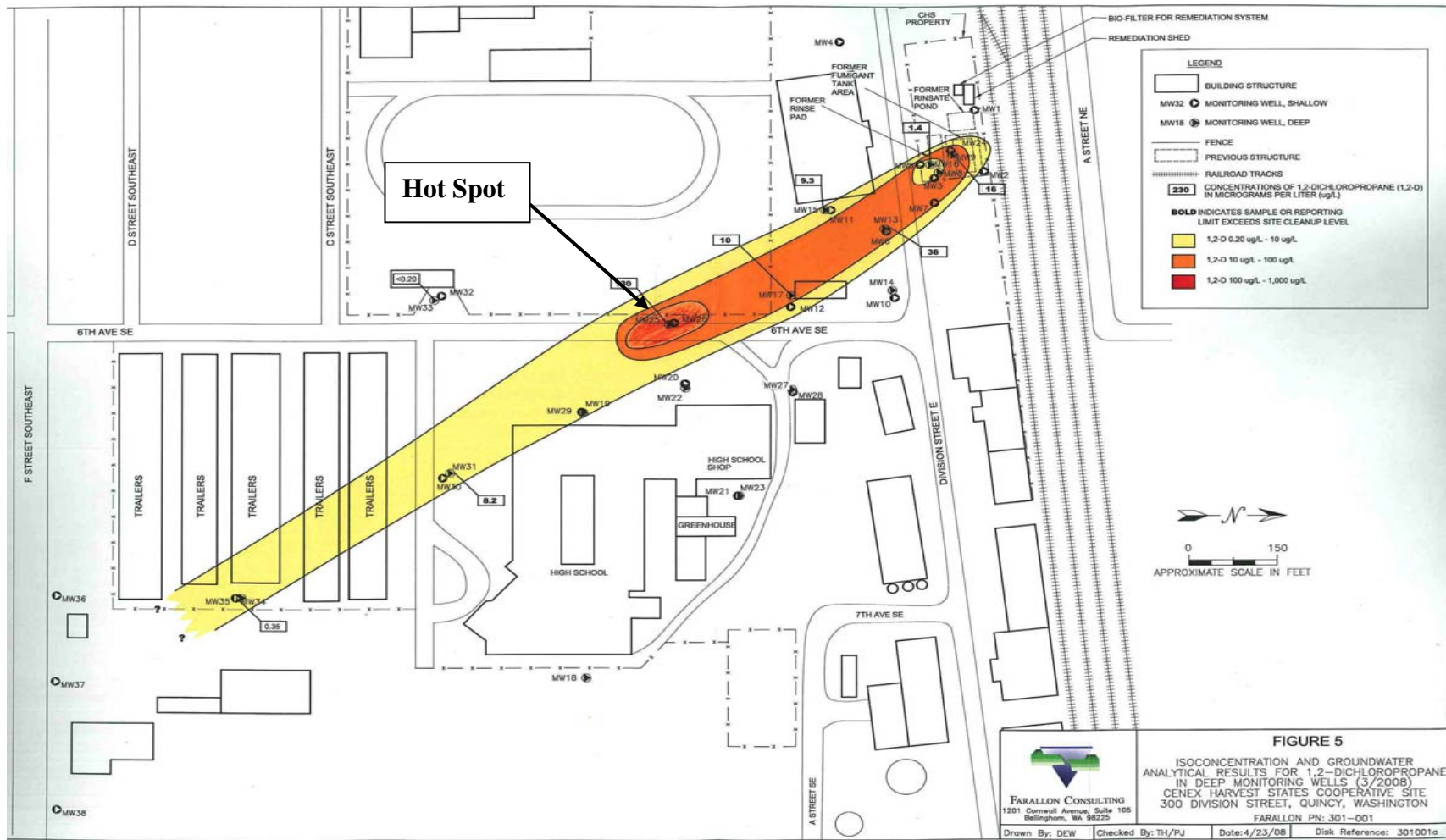
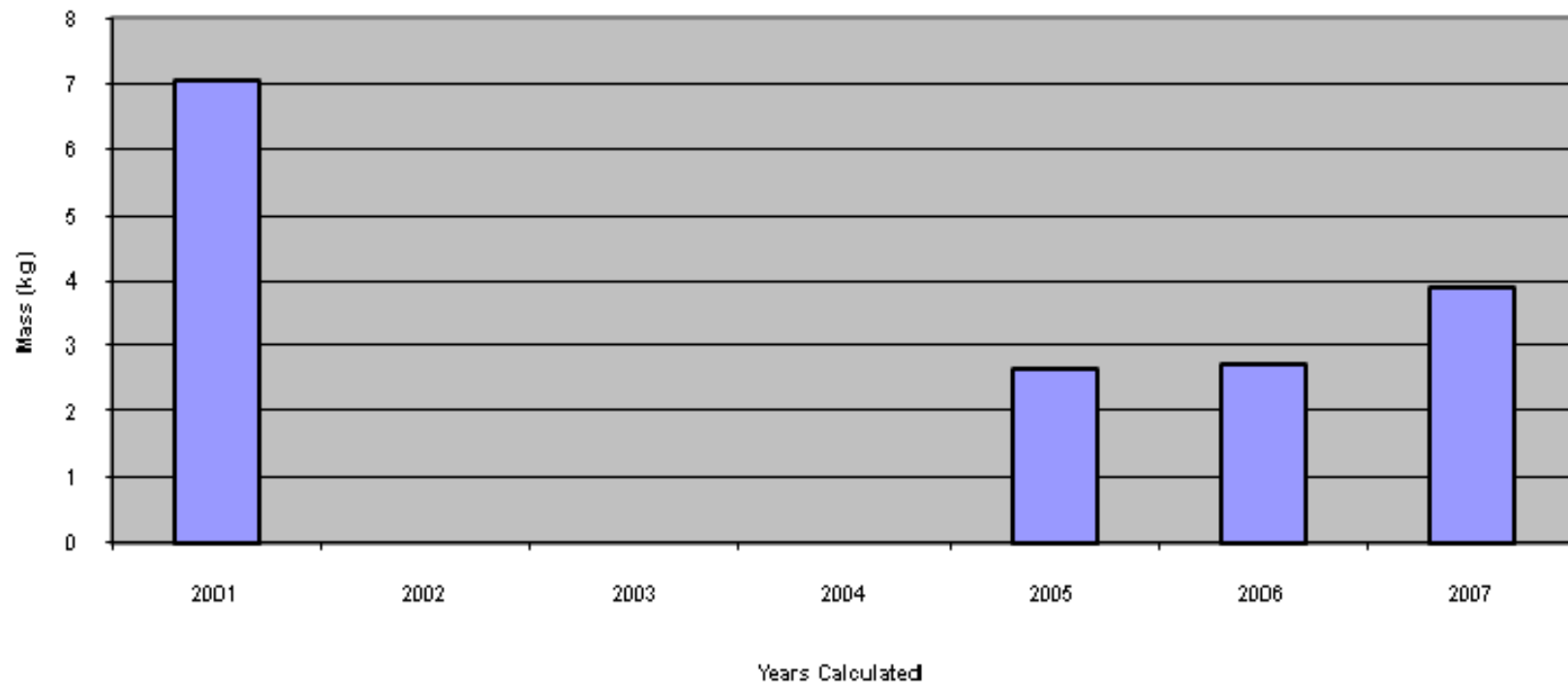


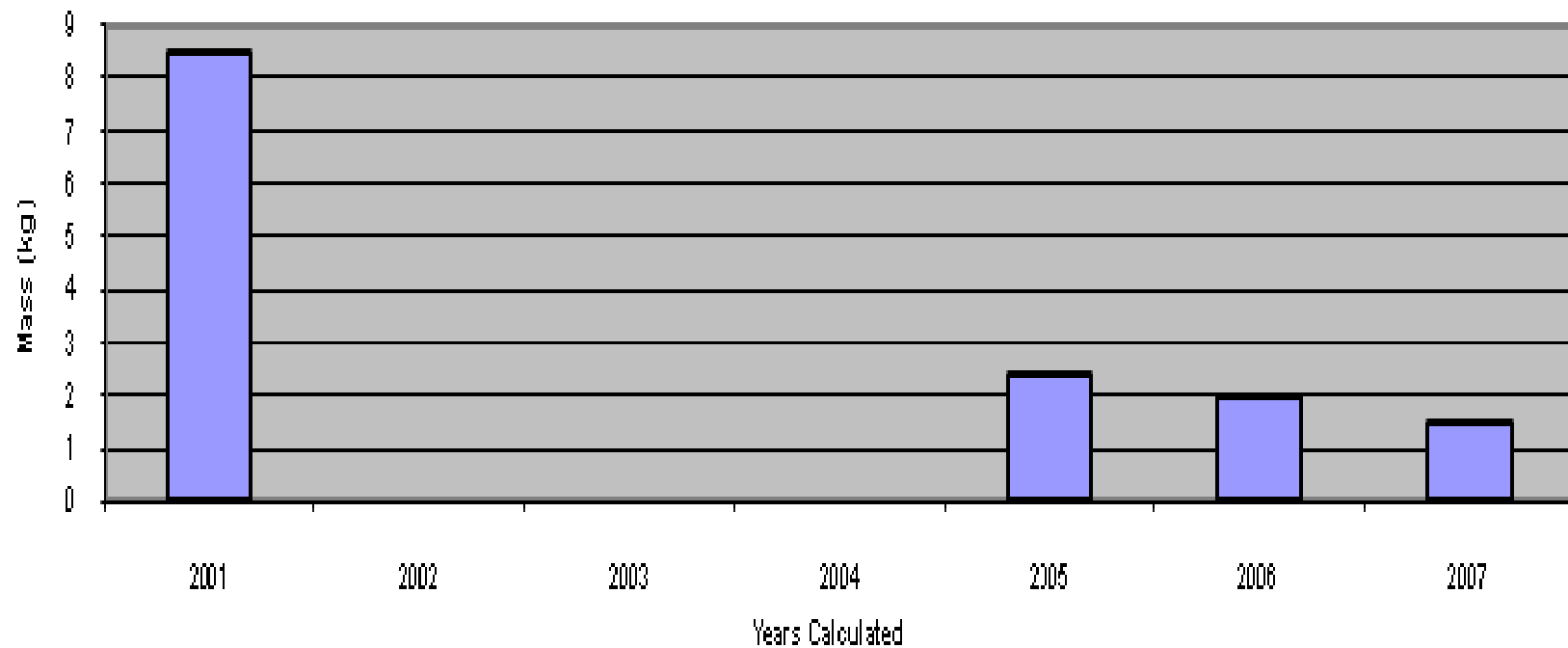
Figure 8: Hot Spot in Deep Aquifer Zone



**Figure 9**  
**Shallow Aquifer Zone Dissolved 1,2-DCP Mass Measured--Using All Well Data**



**Figure 10**  
Deep Aquifer Zone Dissolved 1,2-DCP Mass Measured--Using All Well Data



**Figure 11**  
Total Dissolved 1,2-DCP Mass Measured--Using All Well Data

