AFFIDAVIT OF RICHARD MANDLE

I, Richard Mandle, being first duly sworn, attest as follows:

The facts stated in this Affidavit are based on my personal knowledge and I am competent to testify to them.

1) I am a Groundwater Modeling Specialist for the Remediation and Redevelopment Division (RRD) of the Michigan Department of Environmental Quality (MDEQ), in Lansing, Michigan, where I work in the RRD Executive Section. I have been employed by the MDEQ for more than eleven (11) years.

2) I received my Bachelor's degree in Geology from Michigan State University (MSU) in 1973. In 1975 I received a Master's degree in Geology with an emphasis in groundwater hydrology from MSU. I attended the University of Arizona (UA) in 1982-1983 as part of the U.S. Geological Survey Graduate School Training Program. While at UA I completed graduate coursework in groundwater modeling.

3) For the past 35 years, I have worked as a practicing groundwater hydrologist for the federal government, the consulting industry, and for the state of Michigan. While employed with the federal government (approximately 14 years) I worked on several groundwater resource investigations in a wide variety of hydrogeologic settings in Maryland, California, Wisconsin, Minnesota, Iowa, Illinois, Missouri, and Michigan. My primary responsibilities in these investigations were as the groundwater modeling specialist and hydrogeologist. I was employed as a groundwater hydrologist in the consulting industry in Michigan for approximately nine (9) years. In this capacity I worked on several groundwater

contamination investigations, ranging in size and complexity from small leaking underground storage tank sites to large Superfund sites. During the investigations of these sites I worked as the team member in charge of the application of groundwater modeling to design remediation systems, typically consisting of extraction wells. Other responsibilities included the design and testing of large capacity municipal water-supply wells. I also provided technical support for designing field data collection efforts and analysis of hydrogeologic and chemical field data. The largest site for which I utilized groundwater modeling in the design of an extraction well system was for the Kysor-Northernaire Superfund site in Cadillac, Michigan. This system consisted of 17 extraction wells pumping approximately 2,000 gallons per minute (gpm). I was responsible for the design, construction oversight, and testing of these wells.

4) I have been employed by the state of Michigan for the last eleven (11) years as the Groundwater Modeling Specialist. In this capacity I have provided groundwater modeling and hydrogeological technical support to all divisions within the MDEQ, as needed. The types of projects for which I provide support include evaluating the potential impacts to lakes and wetlands by quarrying or mining, estimating the impact of groundwater withdrawals from high capacity water extraction wells on surrounding hydrologic features, assessing the recharge areas for public drinking-water supply wells, investigating the impact of the migration of contaminated groundwater on the environment, and evaluating the effectiveness of groundwater remediation systems.

5) The groundwater models that I have developed or reviewed have ranged from very simple calculations using a pocket calculator to complex three-dimensional computer

models requiring the use of a high-powered computer, keeping in mind that all models, regardless of their complexity, are approximations of real-world conditions. I have consistently strived to objectively compare all model predictions to field data. The purpose of this comparison is to assess the accuracy and reliability of the model. Models for which comparisons to field data are poor are inaccurate and unreliable.

6) I have worked on the Pall Life Sciences (PLS) site in Ann Arbor on an intermittent basis for the last ten years. I have reviewed reports that have calculated or analyzed the capture effectiveness of the Evergreen System extraction wells (LB and AE series wells). I have written several reviews of these reports. A listing of these reviews is contained in Attachment 1. From my examination of the previous reports and the latest reports and data submitted for the Evergreen Subdivision area, I've arrived at the following observations and conclusions regarding the delineation and containment of the 1,4-Dioxane plume in the Evergreen area, beginning with a discussion of the method of plume delineation, the characterization of the contaminant plume in the Dupont area, the extraction well system at Evergreen and Allison Drives, and ending with the area near Maple Road:

a. Much of the delineation of the 1,4-Dioxane plume in the Evergreen Subdivision had been completed using groundwater samples collected from residential wells or wells that were not installed with the benefit of vertical aquifer sampling (VAS) methods. This characterization of the horizontal and vertical extent of 1,4-Dioxane was used to design the extraction well system along Evergreen Drive. The extraction well system at Evergreen Drive was not adequate to contain the contaminant plume as 1,4-Dioxane was detected in residential wells near Allison Drive. The sampling of residential wells or monitoring wells installed without the benefit of VAS was used to characterize the horizontal and vertical extent of 1,4-Dioxane and to design the extraction well system along Allison Drive. Sampling of recently installed monitoring wells in the vicinity of Maple

Road has detected 1,4-Dioxane in groundwater. This brings into question the capture effectiveness of the extraction well systems in Evergreen Subdivision.

b. The width and extent of a contaminant plume requiring containment must be fully delineated prior to designing a groundwater extraction system and monitoring well network. Otherwise, it is not possible to determine the number, placement, or pumping rates of extraction wells, or to be able to collect data demonstrating the capture effectiveness of the extraction well system. Industry standards are to use VAS techniques to fully delineate the vertical and horizontal extent of contamination. VAS is the collection of discrete groundwater samples at specified depths over the vertical saturated thickness of an aquifer or zone of investigation. The groundwater samples are typically collected using a well or sampling port that has been temporarily installed at discrete depth intervals during the drilling of a test boring. The predecessor to the MDEQ, the Michigan Department of Natural Resources (MDNR) started using VAS methods in the early 1980's. And, in 1994, the MDNR and the U.S. Environmental Protection Agency entered into a Memorandum of Understanding (MOU) between the two agencies requiring the utilization of VAS techniques at all Superfund sites in Michigan, where appropriate (see Attachment 2).

c. Since the discovery of 1,4-Dioxane in the Unit E zone PLS has used VAS, primarily for the Unit E investigation. However, the methodology employed by PLS (Simulprobe Method) is less than ideal as it commonly results in the introduction of several hundred gallons of water into the subsurface to prevent sand from heaving into the hollow stem augers. The introduction of this water results in a dilution of the groundwater being sampled and a reduction in 1,4-Dioxane concentrations, where present. This results in a misrepresentation of the contamination profile, making the decision as to where, or if, to place monitoring wells very difficult.

d. The methodology utilized for VAS must minimize the introduction of water or drilling fluids into the subsurface so as not to influence the chemical concentrations in the groundwater samples that are collected. Where fluids are introduced, the industry standards include removal of the volume of fluids introduced, plus additional volume to assure that the sample ultimately collected is representative of groundwater in the aquifer.

e. The origin and fate of the elevated concentrations of 1,4-Dioxane that have been detected in the Dupont area (465 Dupont Circle) is unknown. Available groundwater level data suggest that the source of this contamination is located to the west of the mapped western extent of the Evergreen plume and beyond the present Prohibition Zone (PZ) boundary. Figure 1 shows the location of the Dupont area, and the extent of 1,4-Dioxane concentrations exceeding 85 micrograms per liter (ug/L) as mapped by PLS. Presently, there are not an adequate number of VAS boreholes and monitoring well nests that have been completed west of this boundary to indicate the extent and possible migration direction of this contamination or to identify where this contamination is leaving the PLS property. This information is necessary in order to assess: 1) whether additional extraction wells are needed on the PLS property to prevent offsite migration to the north, 2) the extent to which additional response actions are needed, possibly including the need to expand the PZ boundary to the west or north from its present location, and 3) the capture effectiveness of the existing Evergreen System. Without this additional work, it is not clear that the present remedial actions are protective of residents in these areas.

f. The width and vertical extent of the plume containing 1,4-Dioxane concentrations that exceed 85 ug/L at Evergreen Street was not delineated using VAS prior to the installation of wells LB-1 or LB-2. The delineation of the contaminant width at these locations was estimated by sampling residential wells and monitoring wells that have not been vertically sampled. There is no indication that the sampled wells are screened in the zones of highest contaminant concentrations. If not, they give a false depiction of the extent of 1,4-Dioxane contamination. The only VAS borehole on Evergreen Street was completed at the time that well LB-3 was installed. The locations of the LB-series extraction wells and the completed vertical profile borings are shown on Figure 2. From an examination of this figure it is apparent that there were no vertical profile borings completed to the north or south of LB-3 that define the extent of the 1,4-Dioxane contamination exceeding 85 ug/L as mapped by PLS. As a result, there is no means of confirming that the LB-series wells are located properly along Evergreen Drive or that the well screens are placed at the correct depth. Both conditions are necessary to capture the center of mass of the contaminant plume.

g. Even though the pumping rate from well LB-3 is very similar to that of LB-2, the well it replaced, chemical data from the sampling of LB-2, LB-3, and selected monitoring wells located between Evergreen and Allison Drives show that well LB-2 was more effective in removing 1,4-Dioxane from the aquifer than the well that replaced it, LB-3, and that shutting down LB-2 has resulted in an increase in 1,4-Dioxane concentrations that have migrated to the east, past Evergreen Drive and toward Allison Drive. Figure 3 shows the location of monitoring wells between Evergreen Drive and Allison Drive that have been continuously monitored. There are only a few wells located downgradient of LB-1 and LB-3, none of which were installed using vertical profile sampling. Figure 4 shows the 1,4-Dioxane concentrations in wells at 456 Clarendon, MW-BE-1s, and 593 Allison Drive and the date on which well LB-2 stopped pumping. It is my opinion, the increase in 1,4-Dioxane concentrations from approximately 100 ug/L to almost 500 ug/L in wells MW-BE-1s and 593 Allison is the result of lack of capture by the LB-series extraction wells. The increase in 1,4-Dioxane concentrations at 456 Clarendon, while not as dramatic, also shows that the LB-series wells are unable to contain all contaminated groundwater having concentrations exceeding 85 ug/L. The change in 1,4-Dioxane concentrations after well LB-2 was removed from the extraction well system indicates that well LB-2 may have been located closer to higher 1,4-Dioxane concentrations than its replacement, well LB-3, and it was more effective in containing the 1,4-Dioxane plume. In hindsight, additional VAS boreholes along Evergreen near LB-2 and to the south of LB-2 along Evergreen Street, should have been completed to identify the area of highest 1,4-Dioxane concentrations in this area. As it was, the single VAS profile, (borehole at LB-3), was completed north of LB-1.

h. As long as the LB-series wells do not contain the contaminant plume and allow 1,4-Dioxane to migrate past Evergreen Drive at concentrations exceeding 85 ug/L, as evidenced by concentration trends shown in Figure 4, a properly designed extraction-well system must be operated and properly maintained downgradient of Evergreen Drive. Presently, there is only a single remaining active extraction well (AE-3) from the extraction well system at Allison Drive. The other extraction wells, AE-1 and AE-2, have been abandoned. PLS decided to replace AE-1 with a new well, AE-3, in 2004; however, no VAS borings were completed along Allison Drive to determine the optimum location or the depth of this well, or whether a replacement well was needed nearer the location of well AE-2 that had been abandoned.

i. Capture zone analysis performed by PLS in 2002 indicated that a pumping rate of 25 gpm from AE-1 would be adequate to contain the shallow contaminant plume when it was thought the 1,4-Dioxane was restricted to the D2 aquifer. Another capture zone analysis performed in 2004 indicated that a pumping rate of 25 gpm would be adequate to contain the contaminant plume in the area. My review of the 2004 capture zone analysis stated that the model should not be used to evaluate effectiveness of the existing extraction well system (LB-1, LB-3, and AE-1) in capturing the deeper contamination because the model was not calibrated and that the capture effectiveness of well AE-1 needed to be verified through the collection of field data. PLS decided to replace AE-1 with well AE-3 in 2004. There was no VAS boring completed prior to the installation of well AE-3 to aid in designing this well or to determine whether it was optimally located or should be screened at a greater depth. Since June 2007, this replacement well has pumped at a rate of approximately 15 gpm removing small amounts of 1,4-Dioxane from the aquifer. Part of the reason the well is not capable of pumping at a higher rate is because it is relatively shallow. There has been no evaluation of capture effectiveness of AE-3 since this well

AE-3 was installed or an assessment of the impact of reducing the pumping rate at Allison Drive to 15 gpm from 25 gpm on the ability of this well to capture the contaminant plume.

j. As at Evergreen Drive, the width of the 1,4-Dioxane concentrations that exceed 85 ug/L at Allison Drive has not been delineated using VAS, but has been estimated by sampling a handful of residential wells along Allison Drive. The AE-series wells were also located on the basis of the sampling of residential wells. In order to properly design a containment system, the width and depth of the contaminant plume must be determined. This would require that VAS boreholes located along Allison Street be completed; however, this work was never completed. The location of completed vertical profile borings in the vicinity of the AE-series extraction wells is shown in Figure 5. Because of the lack of data from vertical profile borings, it's not entirely certain that the remaining AE-series well, AE-3, is optimally located, screened at the correct depth, or pumped at the correct rate to capture any contamination exceeding 85 ug/L. It's my opinion that this well is too shallow and pumps at a rate that is not sufficient to capture the 1,4-Dioxane that is migrating past the LB wells. If vertical profile borings show that the plume is wider than mapped by PLS and that a higher pumping rate is needed to contain the plume, additional extraction wells should be installed.

k. The horizontal distribution of monitoring wells or the vertical placement of well screens along Allison Drive, or around AE-3, is not optimum for demonstrating hydraulic containment or monitoring the chemical quality of the groundwater. This is the direct result of not completing vertical profile borings in this area. The locations of wells that are used for monitoring in this area are shown in Figure 5. Most of these wells are residential wells having well screens that may not be at the appropriate depth for chemical monitoring. The only wells that may be used for monitoring containment (MW-47s and 47d) were installed without the use of VAS. Well MW-47s is very shallow and is not useful for monitoring the capture effectiveness of well AE-3. The remaining well, MW-47d, is slightly deeper, but it may be too shallow given there is a vertically downward head gradient at this location. The vertically downward head gradient, based on a higher groundwater level elevation measured in MW-47s than in MW-47d, is an indication that groundwater and 1,4-Dioxane will move vertically downward in this area to deeper parts of the aquifer. The measured groundwater elevations from other wells near AE-3 do not show evidence of a cone of depression around well AE-3 or hydraulic gradients pointed toward AE-3 indicating hydraulic capture of the contaminated groundwater. At a pumping rate of only 15 gpm, it is not likely that there will be significant drawdown in the aquifer or the establishment of hydraulic gradients that reflect containment.

I. The elevated (>85 ug/L) 1,4-Dioxane contamination detected at MW-101 located near Maple Road may be deeper contamination that has migrated from Evergreen and has not been captured by either the Evergreen or Allison Street extraction wells. PLS has mapped a break in contamination between the contaminant plume that they relate to the Evergreen area and contamination detected at MW-101; however, this apparent break in 1,4-Dioxane concentrations is not supported by VAS boring data or groundwater samples collected near the base of the aquifer. The location of this zone not having 1,4-Dioxane concentration above 85 ug/L is shown in map view on Figure 6. There are no deep monitoring wells located between wells AE-3 and MW-101. Figure-7 shows a cross section presented by PLS that shows the subsurface geology, the vertical placement of well screens, and the results of chemical analyses of groundwater. It is evident that there are no deep vertical profile borings or deep monitoring wells between LB-3 and MW-101. Deep vertical profile borings located between Evergreen Street and MW-101 are needed to establish the break in contamination between 1,4-Dioxane contamination that has been labeled "Evergreen" and the contamination at MW-101. It is possible that the two areas of 1,4-Dioxane contamination are connected. Additional VAS borings are needed to determine whether the contamination detected at MW-101 did migrate from the Evergreen area (see

m. Figure 8). If so, this area is well beyond the capture extent of the Evergreen extraction well system.

n. PLS has asserted that the 1,4-Dioxane present at MW-101 migrates toward this location from a location south of Valley Drive and not from Evergreen Street. Data collected during the vertical sampling of MW-117 and MW-107 do not support the northward migration of 1,4-Dioxane contamination from south of Valley Drive. Additional vertical sampling borings between MW-107 and Maple Road would be needed to determine whether the 1,4-Dioxane concentrations detected at MW-101 originate from south of Valley Drive and not from Evergreen. The area in question is shown in Figure 8.

o. If it is shown that additional VAS data show that the existing extraction wells have not contained the 1,4-Dioxane contamination, additional extraction wells may be needed to contain the contaminant plume in the Evergreen Subdivision. The need for additional wells should be based on the results obtained from the installation of VAS borings. However, the addition of another extraction well at Evergreen Drive or Allison Drive may result in a total system extraction rate that exceeds the present hydraulic capacity of the transmission pipeline that carries untreated groundwater to the PLS treatment facility (200 gpm).

Further Affiant sayeth not.

Richard J Mandle

Richard Mandle

Subscribed and sworn to before me
This 4th day of August, 2009.

Nancy E. Hart

Notary Public, Ingham County, Michigan,
Acting in Ingham County, Michigan
My Commission Expires: 7-10-2012

Attachment 1: Listing of Evergreen System review correspondence

DATE	DOCUMENT
11/24/1998	DEQ memo from R. Mandle to L. Lipinski [review of report on groundwater model, conducted by Dave Fongers (DEQ)]
1/8/1999	DEQ memorandum from R. Mandle to L. Lipinski [review of additional groundwater model conducted by Dave Fongers (DEQ)]
2/18/2004	Interoffice Communication from R. Mandle to S. Kolon (re: review of capture effectiveness)
7/13/2007	DEQ Interoffice Communication from R. Mandle to S. Kolon (re: Evergreen System Review)
7/16/2007	DEQ response to May 2007 Evergreen System Review
6/19/2008	Interoffice Communication from R. Mandle to S. Kolon (re: Valley Report and AE-3 Capture Analysis)
6/23/2008	Interoffice Communication from J. Coger to S. Kolon (re: Dupont Report)
6/23/2008	Letter from S. Kolon to F. Fotouhi et. al. w/attachments (re: Evergreen System and site wide issues)
4/21/2009	Interoffice Communication from R. Mandle to S. Kolon (re: Report on Water Level Testing)
6/15/2009	DEQ June 2009 Evergreen memo (Mandle to Kolon)

Attachment 2: Memorandum of Understanding Requiring the Utilization of VAS Techniques at All Superfund Sites in Michigan

VERTICAL AQUIFER SAMPLING

INTRODUCTION

The Michigan Department of Natural Resources (MDNR) and the United States Environmental Protection Agency (U.S. EPA) assembled a workgroup of experienced project managers and technical support staff in an effort to resolve recurring technical issues between the two agencies. The workgroup's objective is to facilitate an understanding and resolution of the various technical issues that confront the Agencies as they implement the Superfund program. The workgroup is also committed to communicating and disseminating information on the technical issues discussed and providing management with recommendations for use at Superfund sites in the state of Michigan.

This position paper communicates the results of the workgroup's discussions concerning the use of Vertical Aquifer Sampling (VAS) at Superfund sites in Michigan and disseminates the results of discussions regarding the frequency, utility, and cost effectiveness of utilizing VAS. VAS is one technique which can be used to help define the extent of contamination in groundwater. The VAS process involves obtaining groundwater samples at discrete intervals within a single borehole.

The recommendations within this paper have been reviewed and approved by both MDNR's and U.S. EPA's management. The recommendations within this paper should be followed when implementing VAS at a Superfund site.

This position paper discusses the following:

I. VAS definition
II. Benefits of VAS
III. VAS Data Uses
IV. Methodologies (mechanical methods)
V. Frequency
VI. VAS Data Requirements
VII. Cost
VIII. Summary and Recommendations

I. VAS DEFINITION

VAS is a generic term used to describe the process of obtaining groundwater quality samples at various depths within the same borehole. VAS involves the placement of a temporary sampling point (well screen or the equivalent) at specified intervals in an aquifer system in order to obtain a representative groundwater sample for analysis.

The objective of the hydrogeologic investigation and all existing information should be taken into consideration when making decisions regarding when and if VAS is utilized. If VAS is not performed, the extent of contamination must have been sufficiently characterized by other methods. Several factors must be considered to determine if sufficient data is available to rule out the use of VAS. These include: homogeneity of the aquifer; types and concentrations of contaminants present; vertical and horizontal extent of the aquifer characterized by wells; and knowledge of site geology and hydrogeology.

Unfortunately there are no hard and fast rules that apply to utilizing VAS at sites where appreciable effort has already gone into establishing the site characteristics. However, there must be compelling reasons not to use VAS at new sites.

When utilizing VAS, consideration needs to be given to the data use, Quality Assurance/Quality Control (QA/QC) requirements, methodology and frequencies. The remainder of this paper outlines the recommendations of the workgroup in each of these areas.

III. VAS DATA USES

The Workgroup identified five distinct uses for VAS:

1) Plume Mapping
2) Placing Well Screens
3) Risk Assessment
4) Remedial Design
5) Demonstrating Biodegradation

Because of the potential temporary nature of VAS sample locations it may not be possible to resample a specific location, QA/QC concerns must be considered. The QA/QC data quality requirements for each VAS objective is identified in section VI.

Plume Mapping

Using VAS to assess the extent and some of the characteristics of the contaminant plume without placing a monitoring well at that location.

Placing Well Screens

Using VAS to permit the placement of well screens at the optimal depth(s) for monitoring.

Vertical Frequency:

For initial site investigation, or at sites where there is little hydrogeologic or contaminant plume information, VAS intervals of five feet are recommended. For sites with thick, homogeneous aquifers and simple geology, where the contaminant plume is expected to be thick and diffuse, VAS intervals of ten feet are acceptable. For sites with complex geology, thin and/or heterogeneous aquifers, or narrow plumes, VAS intervals should be five feet. In addition to these sampling intervals, the VAS sampling should insure that a sample is collected directly above and directly below any confining units. It is also recommended to sample above and below significant changes in lithology. An example of a significant change in lithology is a change from sand to silt. While VAS sampling intervals smaller than five feet may be considered under extraordinary conditions, this sampling interval is not routine and requires special justification. Shorter sampling intervals than those described may be required when employing specialized sampling tools, since such tools sample a much smaller portion of the aquifer than the other methods.

Horizontal Frequency:

It is not possible to predict, with a high level of confidence, the number or lateral spacing of VAS boreholes. Sufficient boreholes are needed to characterize the vertical and horizontal extent of contamination. For a plume under simple conditions, as few as three VAS boreholes showing non detects (or non exceedences of regulatory standards with a clear spatial trend toward non detects) may be sufficient. For plumes under complex conditions, additional VAS boreholes showing non detects are required. Professional judgment, (considering issues which include type of contamination, history of contaminant release, geometry of the contaminant sources, stratigraphy and geology of the site, groundwater flow rates and hydraulic heads) is required to develop horizontal frequency requirements.

Exception

Because free-phase non-aqueous phase liquids (NAPL's) indicate complex conditions, these guidelines do not apply to NAPL sites. Considerations unique to NAPL characterization and transport may supersede these guidelines.

VI. Data Requirements

Because VAS may be temporary in nature and may not provide an opportunity to resample or confirm a specific location, it is prudent to provide additional QA/QC measures when conducting VAS. When VAS is combined with on-site gas chromatograph (GC) analysis, it is necessary to collect confirmational samples and

Risk Assessment

When VAS groundwater samples are collected from locations where monitoring well data is not available to support a risk assessment, confirmational samples are required. At a minimum, one confirmational sample from each VAS sampled borehole should be collected for laboratory analysis following QA/QC protocols for a DQO of level IV (CLP routine analytical services {RAS}). When more than ten VAS samples are collected from a single borehole, a minimum of one confirmational sample per every ten (or fewer) VAS samples are recommended.

Remedial Design

If VAS sampling is being done during design for the single purpose of designing the extraction and treatment system (not to characterize contaminant plume) there is more flexibility in determining sampling frequencies, and confirmational samples may not be necessary. When performing VAS for other uses, (e.g., plume mapping) during remedial design, use the QA/QC protocol for that activity.

Demonstrating Biodegradation

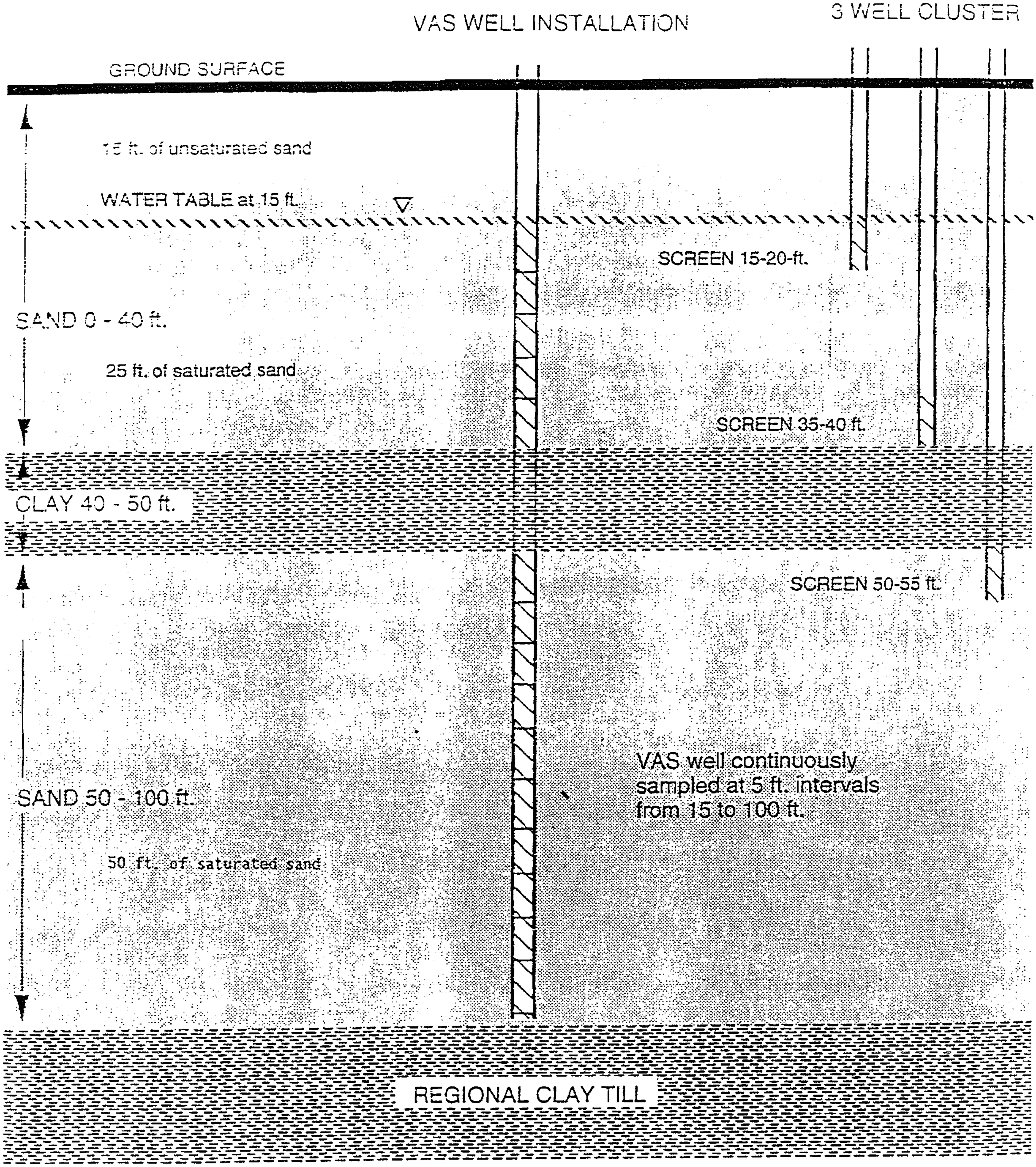
Sampling done to demonstrate biodegradation may require the analysis of additional parameters (BOD, COD, DO, and treatability study parameters), in addition to the standard Target Compound List/Target Analyte List (TCL/TAL) parameters. If laboratory analysis is required, QA/QC protocols for a DQO of level III should be followed.

VI. COST COMPARISON

Cost estimates outlined below were developed using a hypothetical hydrogeological setting to compare multiple well installations versus VAS. The intent of the hypothetical plume mapping investigation was to characterize the vertical extent of contamination (i.e. plume mapping as defined in Section III). However if the decision is made to install a permanent well at a VAS location during the course of the study the costs would increase. The cost for this permanent well must be justified on its own merit. It does not alter the base cost comparison between VAS and nested wells.

The cost comparison is based on a hydrogeological setting that is typical of many Michigan sites. Cost estimates for the tasks and materials were taken from MDNR Level of Effort (LOE) contract prices.

FIGURE 1. HYDROGEOLOGICAL CROSS SECTION



2. The design of the investigation should not rely solely on simple theoretical conceptual models of chemical transport mechanisms to completely define groundwater contaminant dispersion, nor assume a contaminant plume to have a simple, predictable geometry.

3. VAS is a cost-effective way of providing information on the nature and extent of contamination throughout the aquifer, and may prove to be more efficient by reducing the number of field investigative phases.

4. Unless there are compelling reasons to the contrary, VAS should be used at all new Superfund sites and at existing sites where it has been determined to be appropriate.

Figure 1 - Vertical Profile Boring Locations and mapped West Edge of Evergreen Plume in 2009

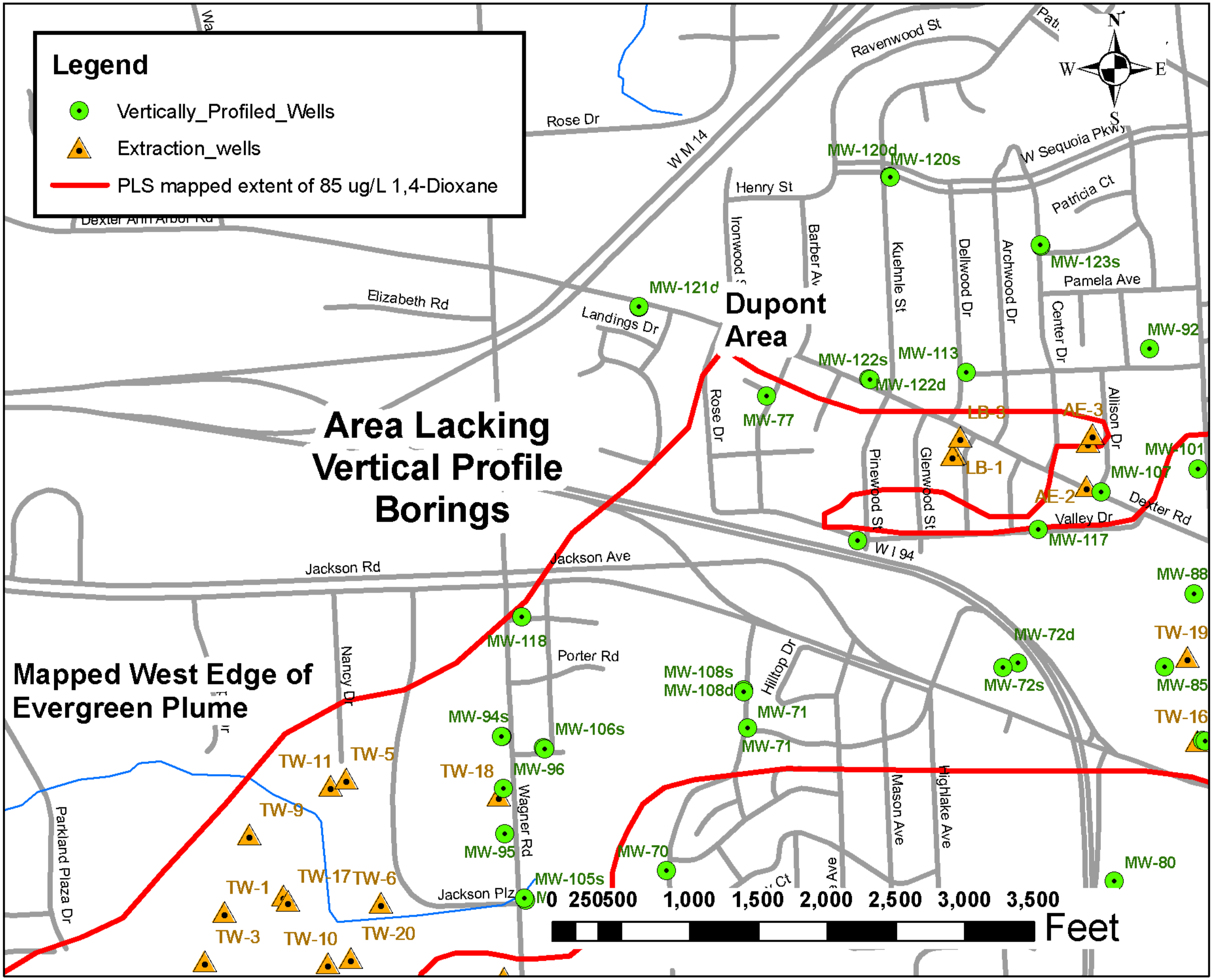


Figure 2 - Vertical Profile Boring Locations and mapped extent of Evergreen Plume in 2009

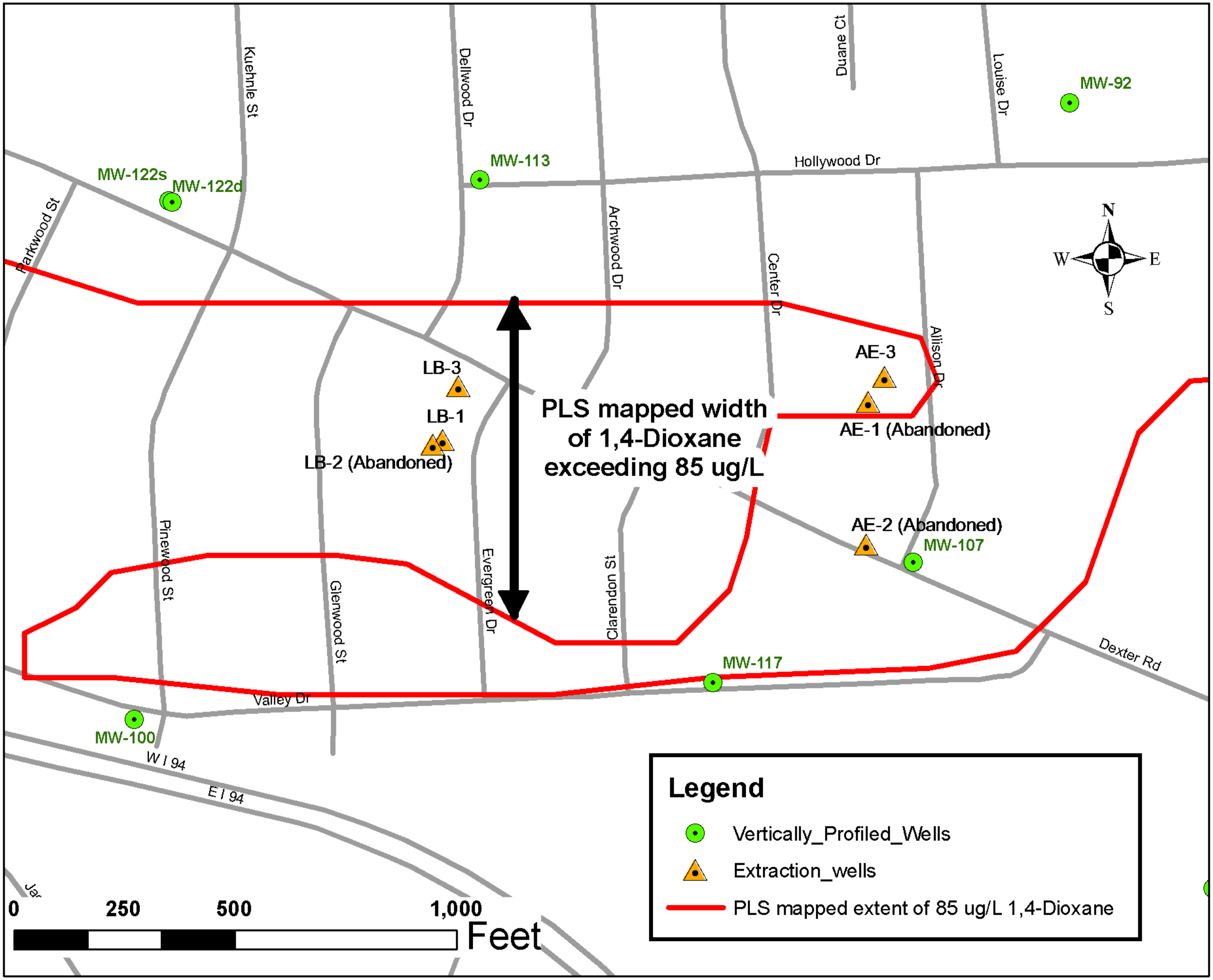


Figure 3 - Wells between Evergreen and Allison Drives sampled in 2009

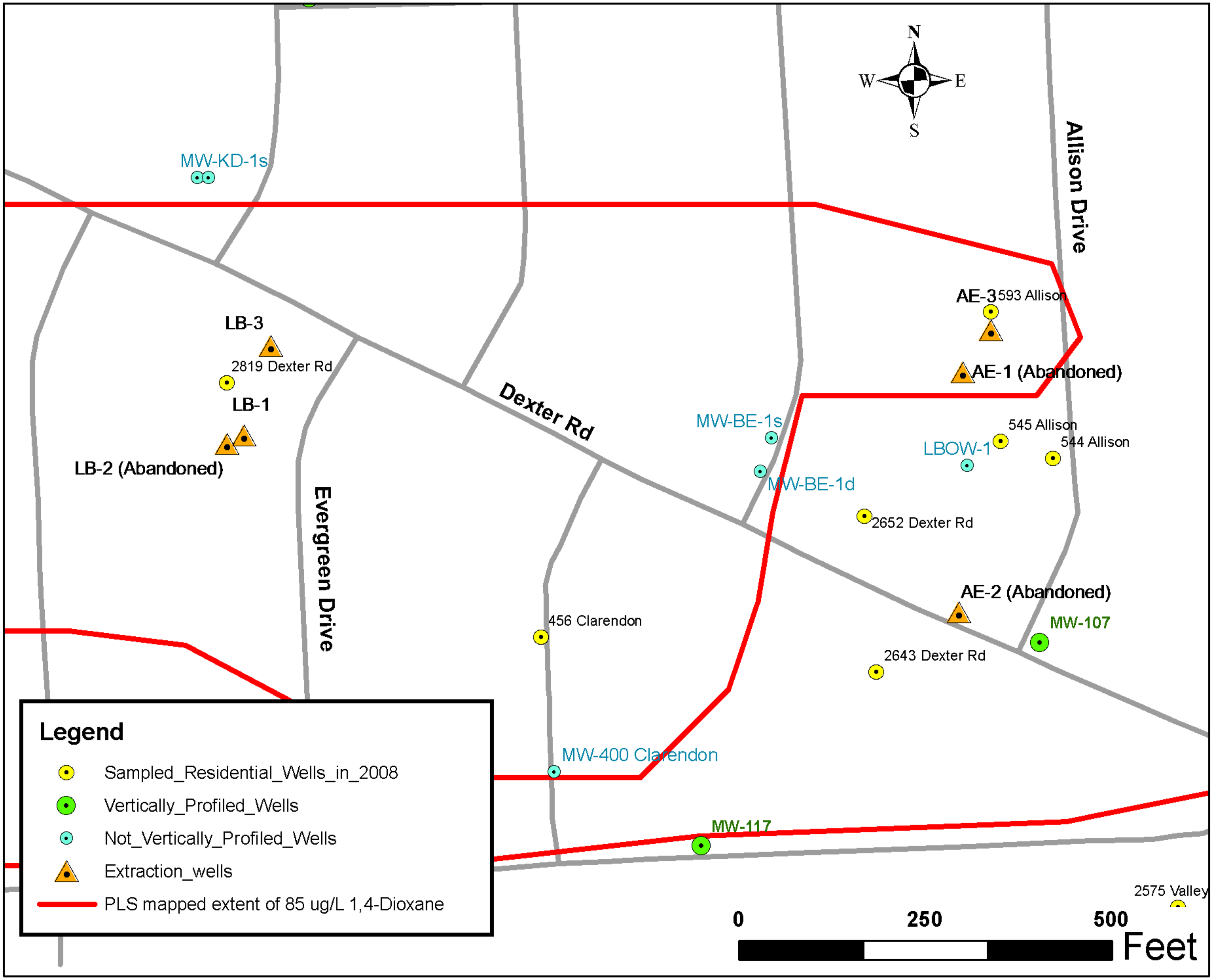


Figure 4. 1,4-Dioxane concentrations in wells downgradient of Evergreen Drive.

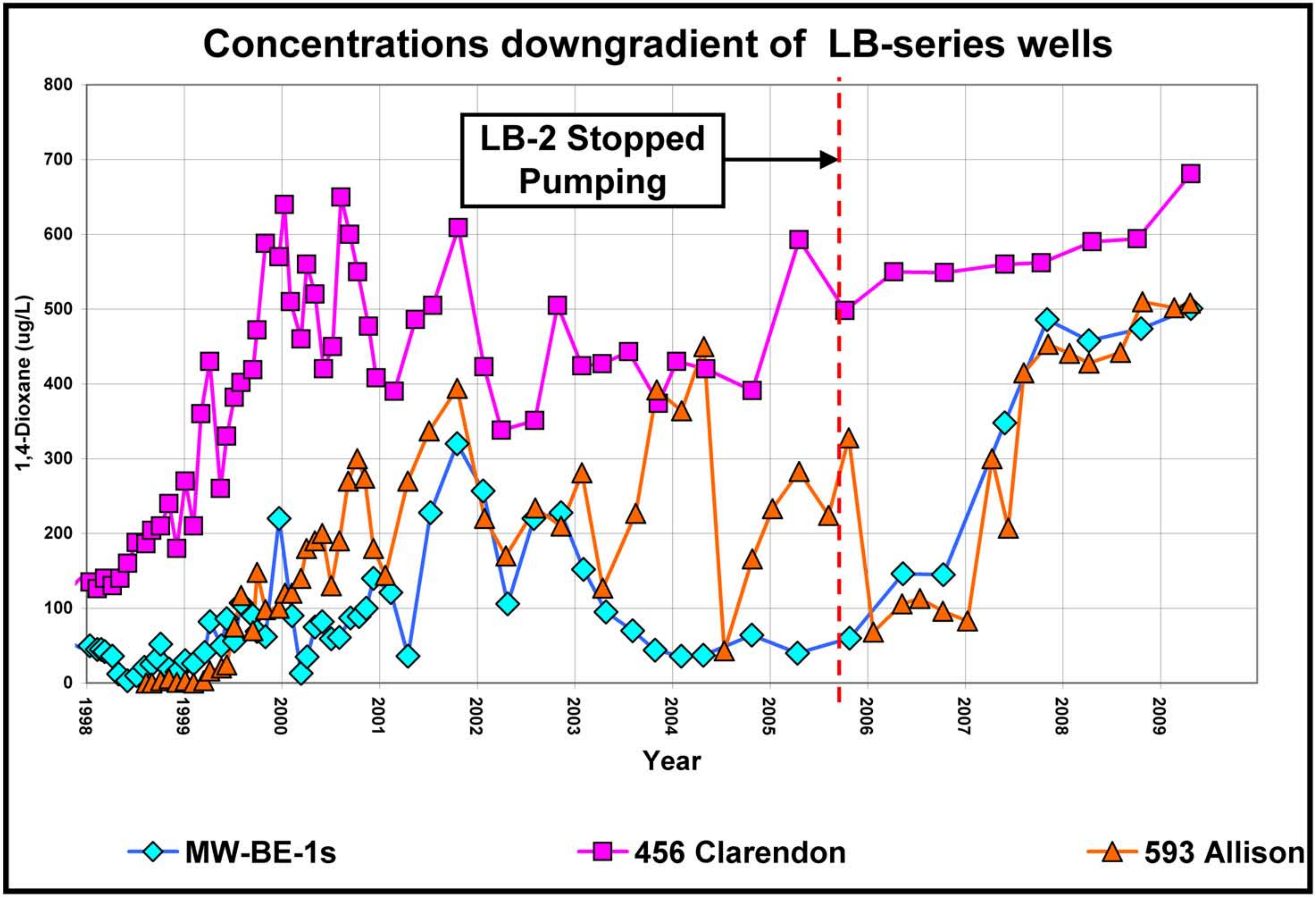


Figure 5 - Vertical Profile Borings and Monitoring Wells near Allison Drive

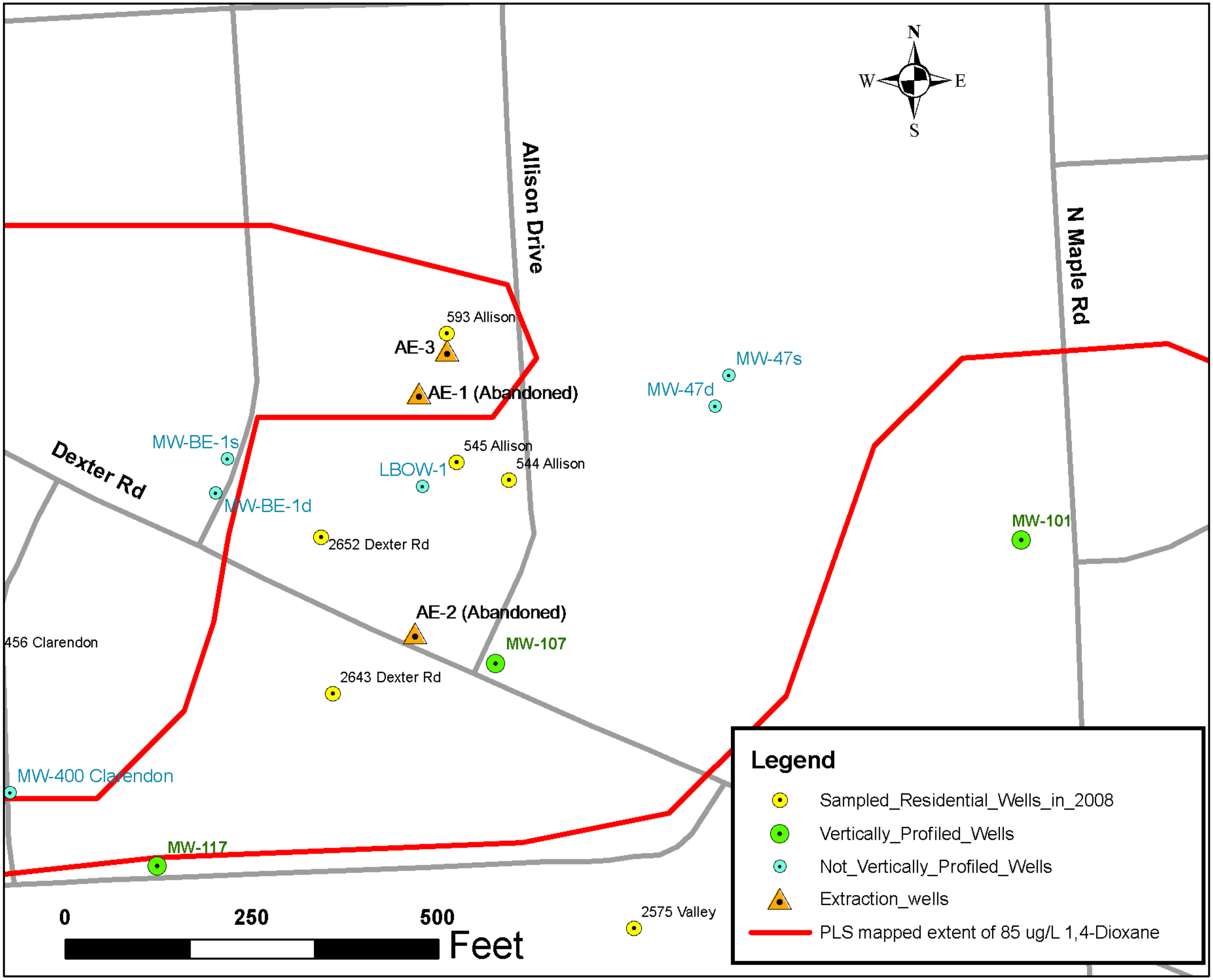


Figure 6 - Apparent break in contamination between Evergreen and MW-101,

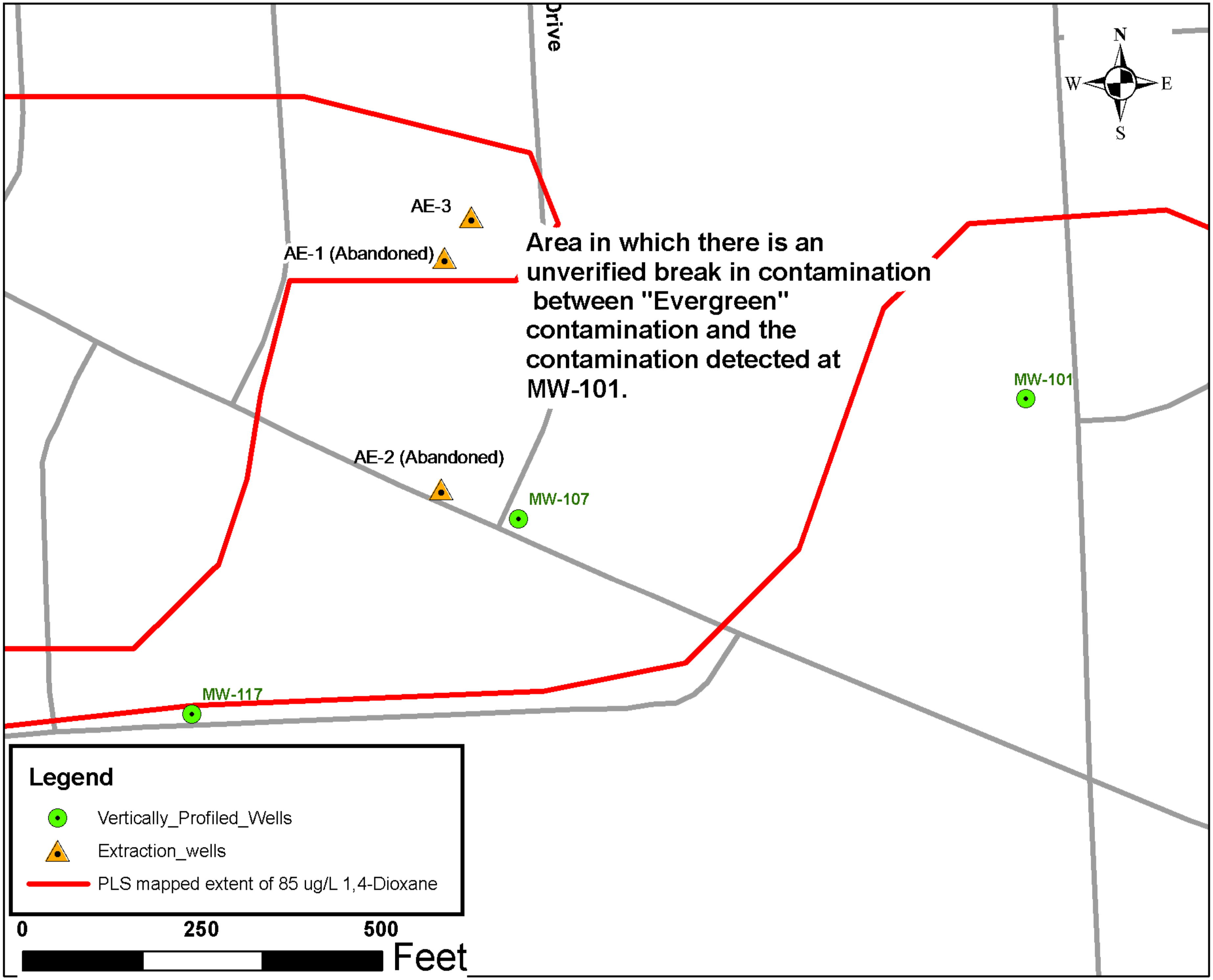


Figure 7. Cross section showing LB and AE-series wells and MW-101.

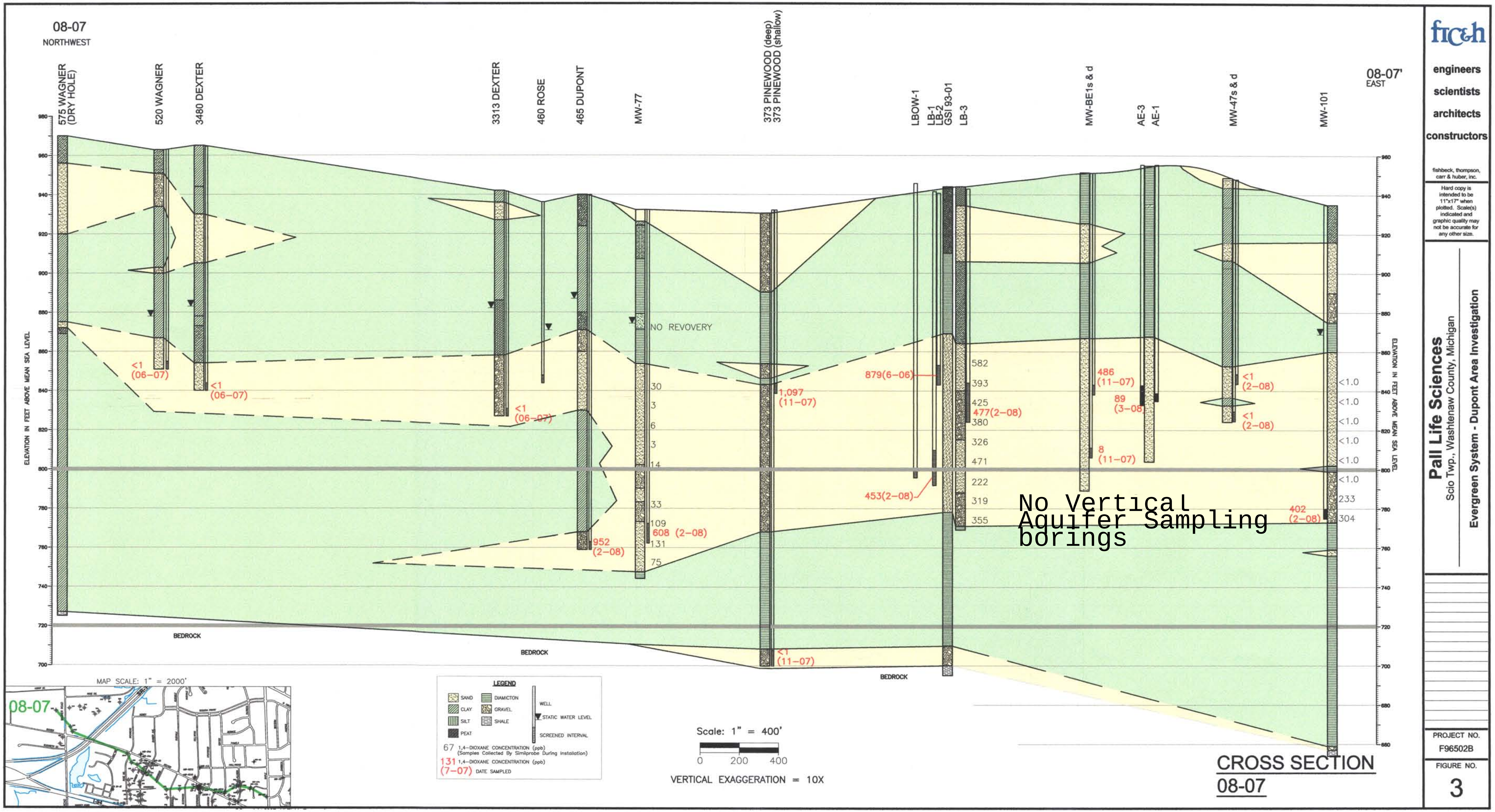


Figure 8 - Possible VAS Boring Locations,