King County

Department of Natural Resources and Parks
Solid Waste Division

VASHON ISLAND CLOSED LANDFILL 2010 ANNUAL GROUNDWATER DATA EVALUATION REPORT

April 2011

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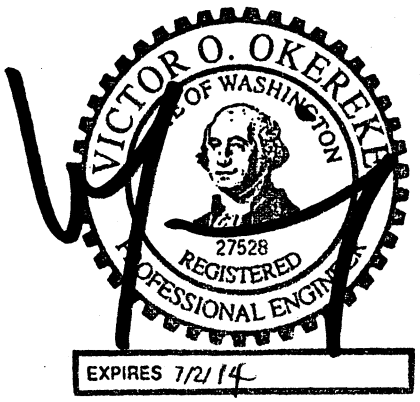
Vashon Island Closed Landfill 2010 Annual Groundwater Data Evaluation Report Certification

I certify in accordance with the requirements of Chapter 18.220 RCW, that the contents of this Groundwater Data Evaluation Report were prepared under my direction under a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Where applicable, some specific and related hydrogeologic portions have been duly certified by the responsible geologist or engineering geologists in accordance with Chapter 18.220.010 (12) RCW. Based on my inquiry of the person(s) directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.



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VASHON ISLAND CLOSED LANDFILL

2010 ANNUAL GROUNDWATER DATA EVALUATION REPORT

Prepared By:

King County Department of Natural Resources & Parks
Solid Waste Division, Engineering Services Section

April 2011

TABLE OF CONTENTS

1. INTRODUCTION 1-1

1.1. REGIONAL SETTING 1-1
1.2. BACKGROUND AND PREVIOUS INVESTIGATIONS 1-2
1.3. LANDFILL HISTORY AND SITE IMPROVEMENTS 1-3
1.4. SITE GEOLOGY AND HYDROGEOLOGY 1-5

2. EVALUATION METHODS 2-1

2.1. DATA QUALITY 2-1

3. RESULTS 3-1

3.1. GROUND WATER ELEVATIONS AND FLOW DIRECTION 3-1
3.1.1. Groundwater in Channel Cc1 3-1
3.1.2. Groundwater in Channel Cc2 3-2
3.1.3. Groundwater in Regional Aquifer & Channel Cc3 3-3
3.2. GROUND WATER QUALITY 3-3
3.2.1. Groundwater Within or Adjacent to Channel Cc1 3-4
3.2.2. Groundwater in Channel Cc2 3-7
3.2.3. Groundwater in Regional Aquifer & Channel Cc3 3-13
3.3. WEIR WATER QUALITY 3-17
3.4. OFFSITE DOMESTIC WELL MONITORING 3-18

4. LANDFILL GAS 4-19

5. CONCLUSIONS AND RECOMMENDATIONS 5-19

5.1. CONCLUSIONS 5-19
5.2. RECOMMENDATIONS/PROPOSED ACTIONS 5-20

6. REFERENCES 6-1

LIST OF FIGURES

Figure 1	Landfill Location Map
Figure 2	Vashon Island Water Table
Figure 3	Landfill Monitoring Stations Map
Figure 4	Site Stratographic Cross Section Locations
Figure 5	Site Stratographic Cross Section A-A'
Figure 6	Site Stratographic Cross Section B-B'
Figure 7	Site Stratographic Cross Section C-C'
Figure 8	Site Stratographic Cross Section D-D'
Figure 9	Site Stratographic Cross Section E-E'
Figure 10	Water Level Elevations for Groundwater in or Adjacent to Channel Cc1
Figure 11	Water Level Elevations for in Channel Cc2
Figure 12	Water Level Elevations for Beneath Channels Cc2
Figure 13	Water Level Elevations for Regional Aquifer & Cc3

LIST OF TABLES

Table 1-1	Regional and Vashon Island Landfill Hydrostratigraphy
Table 1-2	Vashon Island Landfill Groundwater Monitoring Well Completion Details
Table 1-3	2010 Site Maintenance Activities
Table 3-1	Statistical Summary for Groundwater
Table 3-2	Groundwater Trends in Individual Wells
Table 3-3	Statistical Summary for Hillside Weirs

LIST OF APPENDICES

Appendix A	Groundwater Quality Standards
Appendix B	Exceedance Reports Regulatory Standards Exceedance Reports & Prediction Limit Exceedance Reports 2007 Calculated Prediction Limits Seeps Exceedance Reports for Surface Water Criteria Seeps Exceedance Reports for Groundwater Criteria
Appendix C	Time Concentration Plots for groundwater within or adjacent to Channel Cc1
Appendix D	Time Concentration Plots for groundwater in Channel Cc2
Appendix E	Time Concentration Plots for groundwater beneath Channel Cc2/ Cc3
Appendix F	Time Concentration Plots for Regional Aquifer & Channel Cc3
Appendix G	Groundwater Velocity Calculations and Potentiometric Maps
Appendix H	Monitoring Well Keys
Appendix I	Groundwater Chemistry Data
Appendix J	Ion Balance Calculations & Trilinear Diagrams
Appendix K	Gas Monitoring Data
Appendix L	Inspection Survey Reports

1. INTRODUCTION

This is the 2010 Annual Groundwater Data Evaluation Report that presents the results of statistical analyses on the ground water monitoring data collected at the Vashon Island Closed Landfill from 1986 through December 2010. This annual report describes the hydrogeologic conditions at the landfill and presents the evaluations on the groundwater quality data collected from upgradient and downgradient monitoring wells and on the water quality from seeps on the hillside to the west of the landfill. The data are presented in compliance with Washington Department of Ecology "Criteria for Municipal Solid Waste Landfills" (WAC 173-351-415), and the Code of the King County Board of Health "King County Solid Waste Regulations" (Title 10, Rules and Regulations No. 8).

To meet the annual reporting requirement of WAC 173-351, this annual report includes a discussion of maintenance activities at the site in 2010, surface water data, landfill gas data and leachate data.

This report also provides a brief description of the partial closure and site improvements that were completed in 1989 and mentions the site investigations conducted at the landfill in 1995 and 1999 and the final closure construction completed in 2002. Groundwater quality trends are discussed in context of these site improvements. This report also includes: a summary of previous site investigations; a description of the location, topography, and regional geology and groundwater hydrology of the landfill; a history of the landfill; evaluation methods; data quality; site hydrogeology; and results and discussion of groundwater flow and chemistry at the landfill. Planned future activities at the site are presented in Section 4.

1.1. REGIONAL SETTING

The Vashon Landfill includes a 24-acre mixed municipal refuse fill area, located on a 145-acre parcel in the west central portion of Vashon Island (Figure 1). Groundwater monitoring at the landfill has occurred at various sampling locations (Figure 3) since 1986. Most of the property exists in sparsely to unwooded, gently rolling terrain at elevations of 300 to 400 feet. The western portion of the property (west of 130th Avenue SW) is undeveloped, forested land that slopes steeply towards Colvos Passage.

The Vashon Landfill site is within the Judd Creek drainage area with surface water draining towards the south. The undeveloped portion of the property west of 130th Avenue SW drains westward. Judd Creek discharges approximately three miles to the south east to Quartermaster Harbor. Judd Creek is one of Vashon Island's largest creeks. It flows through a drainage area of 3,149 acres with midsummer low flows of about 224 gpm (Carr, 1983).

Vashon Island hydrogeology has previously been characterized based on island well logs (Carr, 1983). The island is composed of glacially derived sediments that layered in three units. The most recent unit is glacial till which mantles the island with a thickness of 1 to greater than 50 feet. Beneath the till is a sand, and sand and gravel zone, which is 50 to 400 feet thick. In the landfill vicinity, this unit is estimated to be up to 300 feet thick. The deepest unit identified consists of silt and clay with sandy zones that extend to depths of about 600 feet below sea level.

The surface till has poor water-bearing characteristics and does not contain an aquifer. However, the till is important to island hydrology because groundwater recharge through the till is variable from location to location. The sand and gravel stratum contains the "Principal Aquifer" of the island, which services about 95 percent of island wells (Carr, 1983). In the landfill vicinity, the direction of regional groundwater flow within the Principal Aquifer is generally westward (Figure 2). Recharge of this Principal Aquifer occurs from infiltration of rainwater through the till. Island wide, the aquifer has generally good water quality, with local areas of elevated nitrate and iron levels. A "Deep Aquifer" exists about 100 to 300 feet below sea level, but is not penetrated by many wells, and none at the landfill site. See Table 1-1.

1.2. BACKGROUND AND PREVIOUS INVESTIGATIONS

Hydrogeology and water quality studies of the Vashon Landfill vicinity have been performed on behalf of the King County Solid Waste Division by R. W. Beck (1984), Harper-Owes (1986 and 1988), CH2M Hill (1995 and 1996), and Berryman & Henigar (2000). Central conclusions of the earlier reports were that groundwater beneath the landfill exists in two separate zones. The CH2M Hill report defined a third zone of groundwater. The 2000 report describes groundwater as occurring as both perched saturated zones and within a deeper, extensive saturated zone. This deeper zone is identified as the regional aquifer. The latest investigation included 3 additional groundwater wells in the regional aquifer, completed in 2003. The *Vashon Island Hydrogeologic Report Update* (Berryman & Henigar with UES) was finalized in December 2004. The 2004 Update identified geologic units beneath the landfill; identified as Units A through G. Table 1-1 in this report (Table 2-4 in the 2004 Update) describes the identified units. Unit C is a lacustrine silt incised by channel deposits. Three distinct channel deposits were identified and loosely correspond to zones identified in previous reports. Wells screened in channel Cc1, the uppermost channel, are described in previous reports as "screened above the lacustrine silt". Wells screened in channel Cc2, the middle channel, are described as "screened within the lacustrine silt." Wells in the lower channel, Cc3, are described as "screened below the lacustrine silt". The regional aquifer is identified within the Unit D formation. The detailed description of the hydrogeology is found in the 2004 Hydrogeologic Update.

Channel Cc2 and the regional aquifer are the only water bearing units with sufficient information to produce potentiometric maps. Direction of groundwater flow within channel Cc2 was determined in the 2004 Update and subsequent quarterly

potentiometric reports to be primarily westward. The direction of groundwater flow within the regional aquifer is indeterminate, with flow components potentially northward, westward and southward.

A steep slope drops down to the west of the landfill and cuts across a water-bearing silt/sand contact. As a result, some 400 to 500 feet to the west of the landfill, groundwater emerges and enters an unnamed creek before entering Puget Sound at Colvos Passage approximately 2/3 of a mile to the west. A hydrogeologic investigation of the hillslope was completed in 2011 that attempted to locate the outcroppings of the identified Unit C channels and provide water quality monitoring locations for the channels. The Vashon Landfill Western Hillslope Investigation Report presents the findings of this project.

The R. W. Beck (1984) and Harper-Owes (1986) reports indicated some evidence of leachate in the sand and gravel units beneath the till. Water quality conditions were re-evaluated in 1988 (letter report by Harper-Owes to Kevin Kiernan, King County Solid Waste Division) just prior to construction of the landfill closure and upgraded disposal area. Conclusions at that time were that the leachate was more dilute than typical of municipal landfills in the Pacific Northwest with no indication of elevated concentrations of organic compounds. Perimeter monitoring wells had some exceedances of primary and secondary drinking water criteria. The hillside weeps had only exceedances of secondary drinking water criteria.

1.3. LANDFILL HISTORY AND SITE IMPROVEMENTS

Solid waste disposal operations have been ongoing at the landfill since the early 1900s. Operation of the landfill was taken over by the Solid Waste Division by the late 1950's (R.W. Beck and Associates, 1983) and daily cover, record keeping, and other updated solid waste management practices were initiated. In 1983, the first four groundwater monitoring wells were installed at the landfill. Piezometers P-1 and P-2, previously located in the fill area on the eastside, were abandoned in 1988 by overdrilling and then filling the borehole with bentonite in accordance with the Washington Administrative Code 173-160 as required at that time. An analysis of various leachate collection system alternatives was performed in order to meet King County Solid Waste Regulations (KCSWR - Regulation No. 8). The selected design consisted of installing an impermeable cap over the existing refuse area, a passive gas collection system under this cap, a leachate collection and conveyance system, an aerated pretreatment lagoon, storm water control facilities (ditches, culverts, and siltation and detention ponds), and a venting and treatment system of flares. A liner for the future refuse area was installed. These improvements were completed in 1989. The northwest 2.3 acres of the landfill received final cover in 1988-1990. Two piezometers, MW-13 and MW-24 were installed in 1992. MW-13 is now being used as monitoring well. MW-24 is monitored for groundwater levels.

The existing groundwater monitoring network was supplemented by the installation of eight groundwater monitoring wells during the summer of 1995. Figure 3 shows the location of new monitoring wells 7, 8, 9, 10, 11, 12, 14, and 19. Eight gas probes were installed around the perimeter of the refuse area to determine if gas migration was occurring at the landfill in 1995. Other improvements to the gas collection system included converting the system from passive to active and the conveyance and treatment system change from flares to activated carbon in 1996.

A detailed discussion of the depths and locations of the monitoring wells and gas probes installed in 1995 is provided in the Groundwater Monitoring Well Construction Work Plan (CH2M Hill, 1995).

During fall 1998, two more wells MW-20 and MW-21 were installed to provide supplementary monitoring of an extensive sand bed in the lacustrine silt. The most recent interpretation of the site hydrogeology is presented in the Vashon Island Landfill Hydrogeologic Report (Berryman & Henigar et. al., 2000). This report addresses the requirements in Chapter 173-351-490 of the Washington Administrative Code.

In August 1999, landfilling was discontinued at the Vashon Landfill and a temporary plastic cover was placed over the refuse mound. A transfer/recycling station was completed in the summer of 1999 to receive the waste generated on the island.

Storm water facility improvements were constructed during the summer and fall of 1999, including a detention pond in the southeast corner and an underground drain system around the perimeter of the landfill.

The final cover placement occurred in fall 2001. The landfill closure area is approximately 34 acres. The basic components of the cover system, from the top down, include: vegetative layer, upper drainage layer, impervious layer (HDPE), and lower gravel drainage layer (Berryman & Henigar et. al, 1999).

MW-11 was damaged in February 2001 during the Nisqually earthquake. No more samples have been collected from this well since then. MW-11 was decommissioned and the replacement well, MW-29, was installed in the summer of 2003. Additionally, MW-6S & D were damaged in the earthquake and were decommissioned as part of the drilling operations in 2003.

Drilling operations in 2003 also included installing 3 additional monitoring wells (MW-26, MW-27 and MW-28) and one piezometer (MW-25) to expand the monitoring network for the regional aquifer. MW-28 has been dry since completion. The 2004 revision to the 2000 Hydrogeologic Report was finalized in December 2004, incorporating these new wells into the hydrogeologic interpretation of the site. Table 1-2 describes well details for all of the wells on the site.

Maintenance activities for the environmental control facilities are performed throughout the year. The Operations and Maintenance Plan was finalized at the end of 2005, which

provides tables listing the specific O&M activities for each system. The new listings were incorporated into the SWD Operations tracking database in 2006. A summary of the maintenance activities completed in 2009 is included as Table 1-3.

In March 2006, three documents representing the environmental evaluation of the landfill site were submitted. The first report, "Environmental Evaluation", provides evaluation of the landfill environmental control systems and their interaction with the hydrogeologic environment. The second document, "Potential Effects of Landfill Gas and Leachate on Vashon Landfill Groundwater and Springs", addresses a chemistry based evaluation of the source of volatile organics seen in some of the wells. The third document, "VOC Sampling and Test Results", reports the findings of the soil gas sampling performed at the site. In combination these documents address the requirements of Compliance Task 4 in the Vashon Closed Landfill Permit.

These reports provided recommendations for further actions. Some of these recommendations were completed in 2006. The last task of the leachate lagoon liner testing was completed in 2007. The results were reported and concluded that the liner did not have any leaks.

Other recommendations in the reports require the procurement of consultant services. Some of these services are being performed by King County Water and Land Division (KCWLD). Aspect Consulting Inc. was hired to review all environmental investigations, monitoring and remediation performed at the landfill and to identify data gaps and identify enhancements to the existing engineering control systems.

As part of an ongoing investigation on the West Hillslope of the landfill, three shallow monitoring wells (MW-30, MW-31 and MW-32) were hand augured in December 2009. These three monitoring wells were sampled for one year and findings from this investigation will be summarized in the Vashon Landfill Western Hillslope Report.

1.4. SITE GEOLOGY AND HYDROGEOLOGY

Surficial till, which corresponds to Vashon till, mantles the site. The weathered till has a thickness of 15-50 feet throughout most of the landfill site. No wells monitor the Vashon Till. The till is absent in southern portions of the site.

The outwash is underlain by a lacustrine silt layer that is interpreted to be laterally continuous beneath the site. This lacustrine silt is incised by fluvial sands and gravels. These sands and gravels are interpreted as channel deposits. Perched saturated zones identified beneath the Vashon Island Landfill site occur in channel deposits (Cc1 & Cc2) within the uppermost lacustrine silt (Unit C). Groundwater in the deeper saturated zone occurs in sands and gravels within the lowermost Unit C channel deposits (Cc3) and within Units D and F. This deeper saturated zone is apparently hydraulically continuous with the regional aquifer. Units D and F are generally separated by an aquitard (Unit E). However, this aquitard has likely been removed by erosion beneath at least some

portions of the site (specifically, at MW-25 and MW-26, see Figure 7). A deeper aquitard, Unit G, was encountered in only one boring (MW-7, see Figures 6, 8, and 9). Due to its limited distribution, the hydrogeologic effect of the Unit G aquitard beneath the Vashon Island Landfill site is limited.

Groundwater perched in or adjacent to the upper Unit C channel deposits (Cc1) is evaluated using wells MW-1, MW-3, MW-4, MW-5S, MW-6S, MW-10, MW-13, and MW-24 (see Figures 6 through 9). All wells measure water levels within the Cc1 deposits, but not all wells produce sufficient water for sampling. Wells typically producing sufficient water include MW-10, MW-13, and periodically MW-1 and MW-3. Well MW-6S was also installed in these deposits; however, it was decommissioned after being damaged during the February 2001 Nisqually earthquake.

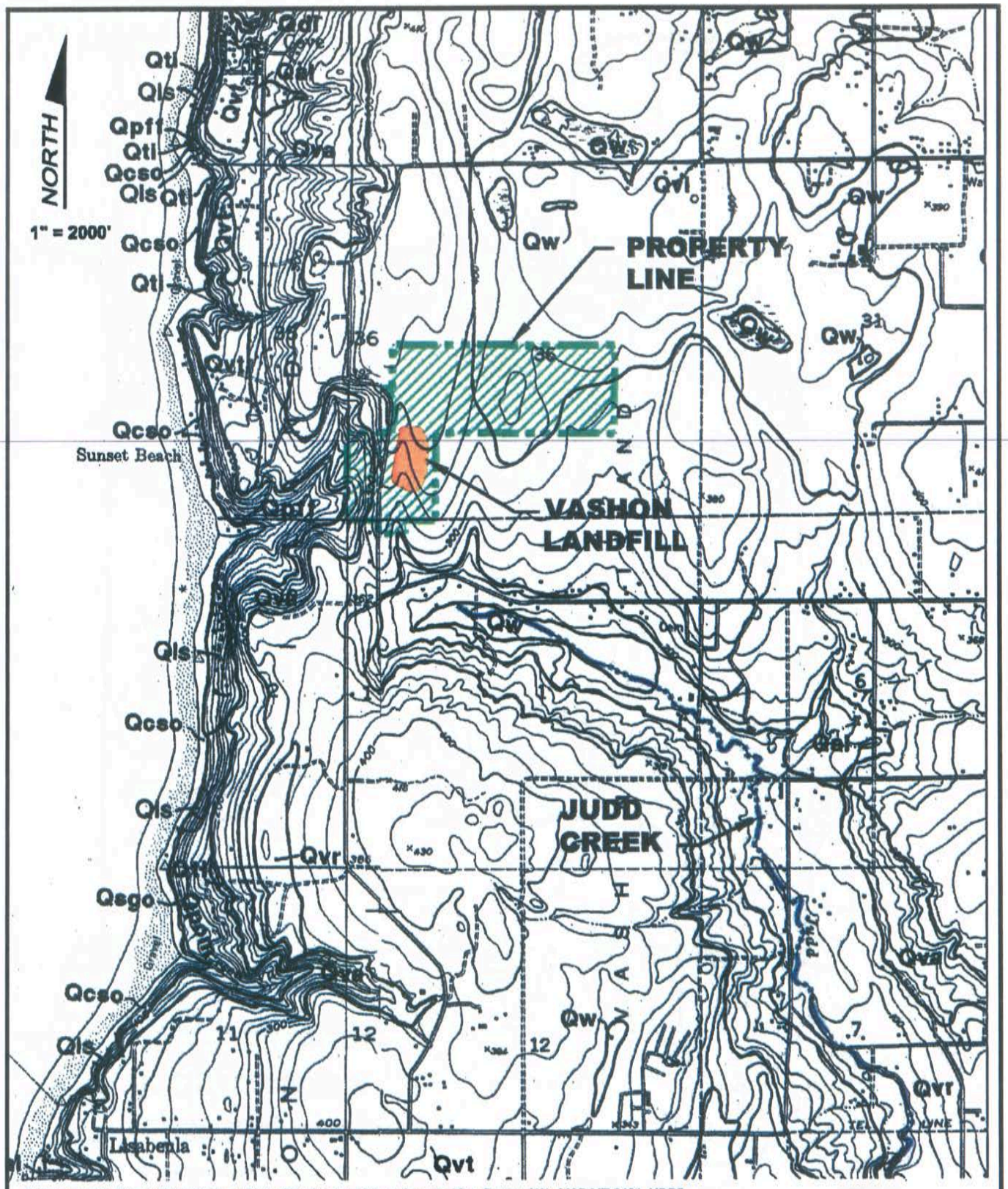
Wells MW-2, MW-5D, MW-9, MW-20, and MW-21 are completed within the middle channel deposits (Cc2) (see Figures 5 and 9). Well MW-6D was also installed in these deposits; however, it was decommissioned after being damaged during the February 2001 Nisqually earthquake. Wells MW-8 and MW-14 are installed in silty sands that are beneath the middle channel deposits and are laterally equivalent with and adjacent to the lower channel deposits (Cc3) (see Figures 5 and 9). Hydrographs for wells MW-8, MW-14, and wells completed within perched saturated zones within the middle channel deposits are shown in Figure 3-9. Groundwater in wells MW-8 and MW-14 does not appear hydraulically connected with groundwater within either the middle channel deposits (Cc2) or the lower channel deposits (Cc3).

Four borings (MW-7, MW-11, MW-12, and MW-19) were advanced to elevations between 8 and 40 feet to evaluate site stratigraphy at depth (CH2M HILL, 1996). These borings were completed as wells screened to intercept groundwater in Unit D (see Figures 5 through 9). Well MW-11 was decommissioned after being damaged during the February 2001 Nisqually earthquake.

Five additional borings were advanced into Unit D and completed as monitoring wells during 2003 (B&H and UES, 2003a and 2003b). Of these, wells MW-25, MW-26, MW-29 were installed to screen groundwater in Unit D. Well MW-27 is constructed to screen the lower Unit C channel deposits (Cc3); the base of the well screen also penetrates the upper few feet of underlying Unit D deposits. As is discussed in Section 3.2.3, groundwater in MW-27 is interpreted as being equivalent with groundwater in saturated Unit D soils and therefore with the regional aquifer. Well MW-28 was installed to screen the contact between Unit D and Unit E; the elevation of this contact exceeds the water table elevation in Unit D at this location (see Figure 6).

Geologic cross-sections of the landfill (Figures 4 to 9) show the relationship of the geologic units beneath the site and the identified water-bearing zones. Channel Cc2 and the regional aquifer are the only water bearing units with sufficient information to produce potentiometric maps. Direction of groundwater flow within channel Cc2 was determined in the 2004 Update and subsequent quarterly potentiometric reports to be

primarily westward. The direction of groundwater flow within the regional aquifer is indeterminate, with flow components potentially northward, westward and southward.



Source: Booth, Derek, 1991, Geologic Map of Vashon and Maury Islands, King County, WA, MAP MF-2161, USGS

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Regional Surficial Geologic Map

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update

Figure 1

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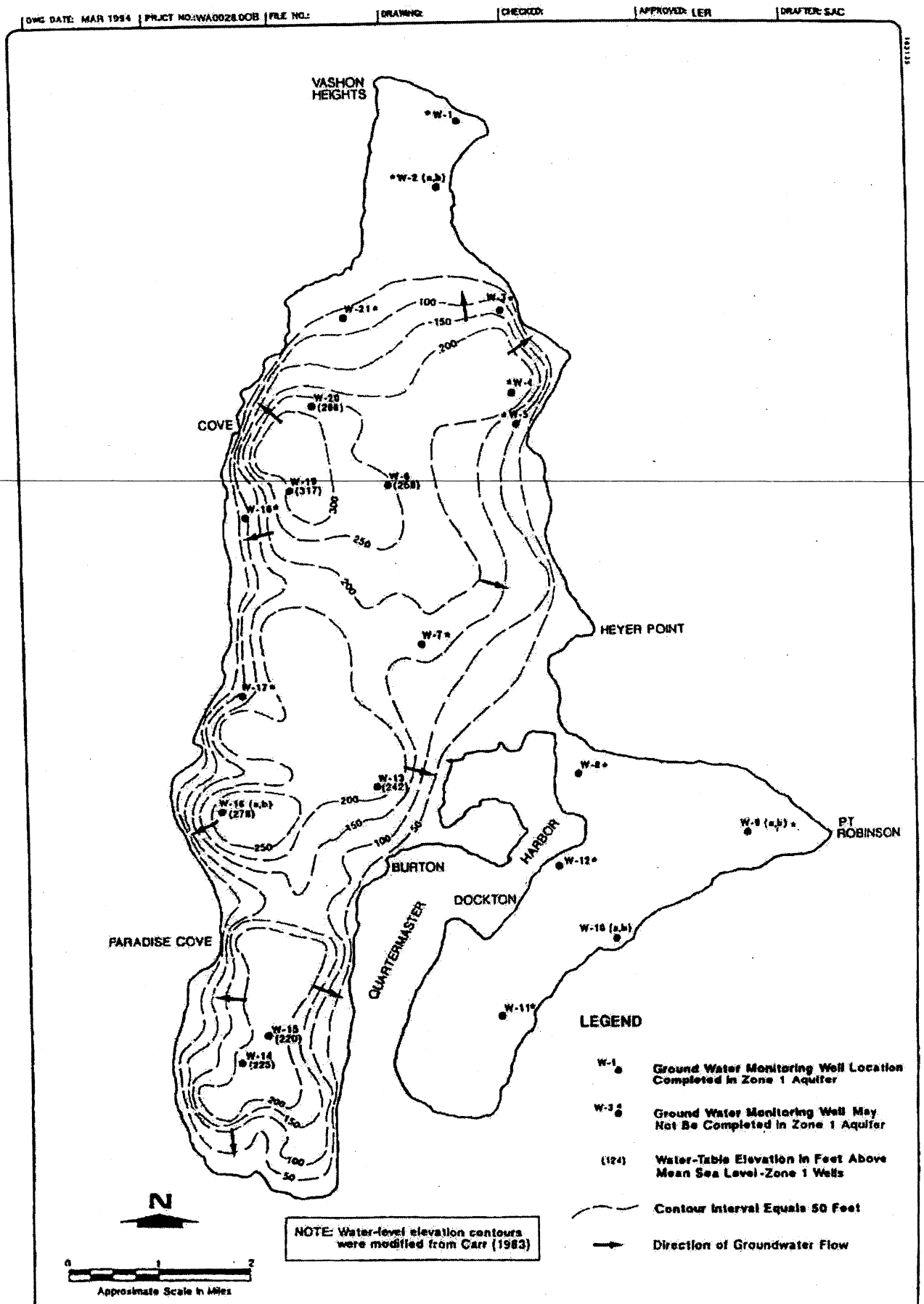

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GENERALIZED WATER-TABLE ELEVATIONS FOR ZONE 1 AQUIFER
Source April 1991,
Vashon Groundwater Management Plan

FIGURE 2

Table 1-1
Summary of Vashon Island Landfill Site Stratigraphic Units

Formation[a]	Depositional Facies	Sediment Type	Approximate Elevations and Locations Beneath Vashon Island Landfill Site
Unit A: Vashon till (Qvt)	Beneath continental glacier	Dense to very dense yellow-gray to gra y fine sandy silt or silty gravel with trace cobbles and boulders.	Occurs as surficial deposit in all portions of the site except where absent by erosion. The base of the till varies from elevations of about 362 feet in the northwest to about 330 feet in the south. In general, till is absent below about 330 feet.
Unconformity			
Unit B: pre-Vashon proglacial sand (Qva)	Fluvial, possibly glaciolacustrine	Approximately 40- to 60-foot-thick deposit of clean fine sands with minor well-graded gravelly sand. Includes laterally equivalent slightly silty fine sands and minor fine sandy silt. Typically yellow brown to brown, loose, gravels (where present) typically fine and subangular to subrounded.	Occurs beneath entire site directly beneath till or as surficial unit in areas where till is absent by erosion. Basal contact elevation ranges from 304 to 289 feet.
Unconformity			
Unit C: pre-Vashon glaciolacustrine deposits (Qpff and Qpfc?)	Glaciolacustrine incised by sand- and gravel-filled channels; the channels may reflect periodic rapid draining of the lake.	Approximately 100- to 120-foot-thick sequence, predominantly laminated floodplain or lacustrine silts, includes laterally equivalent sand, gravelly sand, and sandy gravel channel deposits incised into the lacustrine silts. At least three significant and laterally extensive channel deposits are present within this unit.	Occurs beneath entire site at elevations of about 304 to about 181 feet. Where fully penetrated, the basal contact elevation ranges from 181 to 191 feet.
Unconformity			
Unit D: pre-Vashon fluvial deposits (Qpfc?)	Meandering river channel and flood plain.	Fluvial channel and silt or clay overbank deposits. The channel deposits are typically coarser-grained than those of Unit C.	Occurs beneath the entire site at elevations of about 125 to 191 feet. Gravelly sand channel deposits extend beneath the northern, central, and western portions of the site; soils east of this are significantly finer-grained. Where fully penetrated, the basal contact elevation ranges from 125 to 134 feet.

Table 1-1
2010 Vashon Island Landfill Annual Groundwater Evaluation Report

Table 1-1 Summary of Vashon Island Landfill Site Stratigraphic Units			
Formation[a]	**Depositional Facies**	**Sediment Type**	**Approximate Elevations and Locations Beneath Vashon Island Landfill Site**
Disconformity with least 40 feet of erosional relief.			
Unit E: pre-Vashon glacial till/ glaciolacustrine deposits (Qpff and/or Qpfc?)	Glaciolacustrine overlying basal till	Silty gravel and laterally equivalent silt, clay, and slightly silty fine sand.	Occurs at elevations of 96 to 134 feet, apparently beneath most of the site (only six borings penetrate this deposit). Apparently absent due to erosion at MW-25. The silty gravel facies is the basal unit at MW-7, MW-11, and MW-28 and generally occurs at elevations between 106 and 134 feet.
Possible Unconformity			
Unit F: pre-Vashon fluvial deposits (Qpfc?)	Meandering river channel and flood plain	Sequence of aggrading channel and overbank deposits. Predominantly fine sands and silty sands with laterally equivalent fine to medium sand channel deposits. Sediments contain white pumice and woody debris.	Occurs at elevations below about 100 to 111 feet beneath all portions of the site.
Disconformity with at least 68 feet of erosional relief			
Unit G: pre-Vashon lacustrine deposits (Qcso?)	Lacustrine	More than 50-foot-thick deposit of firm, dark gray clay and clayey silt with trace of fine sand and trace fine gravel.	Identified in MW-7 at elevations of 19.6 to 76 feet, not fully penetrated.
[a] Assignments to classifications derived from Booth (1991) are queried where tentative.			

Table 1-2
Vashon Island Landfill Groundwater Monitoring Well Completion Details

Well Number	Date Completed	Installed By	Top of PVC Casing Elevation (feet)[a]	Well Casing and Screen	Well Dia. (inches)	Screen slot (inches)	Top of Screen Elevation[b]	Bottom of Screen Elevation[b]	Top of Seal Elevation[b]	Bottom of Seal Elevation[b]	Seal Type	Top of Sand Pack (feet elev.)[b]	Bottom of Sand Pack (feet elev.)[b]	Sand Type	Reference[c]
MW-1	9/8/1983	Sweet-Edwards	403.60	Sch 80 PVC	3	0.010	284.48	274.48	402.48	289.48	Bentonite	289.48	272.48	3/8 minus pea gravel	A
MW-2	9/9/1983	Sweet-Edwards	314.28	Sch 80 PVC	3	0.010	233.58	228.58	312.58	246.58	Bentonite	244.58	227.58	3/8 minus pea gravel	A
MW-3	9/12/1983	Sweet-Edwards	314.87	Sch 80 PVC	3	0.010	277.90	272.90	312.90	280.90	Bentonite	280.90	272.90	3/8 minus pea gravel	A
MW-4	9/14/1983	Sweet-Edwards	374.21	Sch 80 PVC	3	0.010	273.08	263.08	373.08	278.08	Bentonite	278.08	263.08	3/8 minus pea gravel	A
MW-5S	3/6/1986	Golder	356.63	Sch 40 PVC[b]	2	0.020	281.86	271.86	355.86	352.86	Bentonite	352.86	271.36	#8 Monteray & Gravel	B
MW-5D	3/6/1986	Golder	357.20	Sch 40 PVC[b]	2	0.020	240.86	229.86	255.36	249.86	Bentonite	253.86	229.86	#8 Monteray & Gravel	B
MW-6S[d]	3/19/1986	Golder	394.2	Sch 40 PVC[b]	2	0.020	287.42	277.42	392.42	389.42	Bentonite	389.42	276.42	#8 Aqua and Gravel	B
MW-6D[d]	3/19/1986	Golder	394.1	Sch 40 PVC[b]	2	0.020	241.92	231.92	256.42	250.42	Bentonite	244.42	231.42	#8 Aqua	B
MW-7	4/28/1995	CH2M HILL	373.25	Sch 40 PVC	2	0.010	151.09	141.09	371.09	154.09	Bentonite	154.09	139.09	#20 x 40	C
MW-8	6/30/1995	CH2M HILL	383.42	Sch 40 PVC	2	0.010	213.24	203.24	381.24	214.24	Bentonite	214.24	201.24	#20 x 40	C
MW-9	6/12/1995	CH2M HILL	402.57	Sch 40 PVC	2	0.010	233.64	223.64	400.64	236.64	Bentonite	236.64	220.64	#20 x 40	C
MW-10	7/1/1995	CH2M HILL	407.51	Sch 40 PVC	2	0.010	262.34	252.34	405.34	265.34	Bentonite	265.34	250.34	#20 x 40	C
MW-11[d]	5/15/1995	CH2M HILL	406.39	Sch 40 PVC	2	0.010	162.28	152.28	404.28	164.28	Bentonite	164.28	144.28	#20 x 40	C
MW-12	5/26/1995	CH2M HILL	312.39	Sch 40 PVC	2	0.010	139.62	129.62	310.12	143.12	Bentonite	143.12	124.12	#20 x 40	C
MW-13	4/22/1992	Terra	374.07	Sch 40 PVC	2	0.020	264.00	259.00	372.00	266.00	Bentonite	266.00	256.50	#8	D
MW-14	6/21/1995	CH2M HILL	375.68	Sch 40 PVC	2	0.020	212.62	202.62	373.62	219.62	Bentonite	219.62	201.62	#20 x 40	C
MW-19	6/12/1995	CH2M HILL	403.83	Sch 40 PVC	2	0.020	141.10	131.10	400.60	140.60	Bentonite	140.60	124.60	#20 x 40	C
MW-20	10/21/1998	UES	367.21	Sch 40 PVC	2	0.020	237.57	233.27	365.27	240.87	Bentonite	240.87	231.27	#20 x 40	E
MW-21	10/21/1998	UES	345.66	Sch 40 PVC	2	0.020	243.17	233.77	343.77	248.77	Bentonite	248.77	232.77	#20 x 40	E
MW-24	4/27/1992	Terra	373.93	Sch 40 PVC	2	0.020	291.50	281.50	372.00	295.00	Bentonite	295.00	282.00	#8	D
MW-25	8/11/2003	UES	399.22	Sch 40 PVC	2	0.020	148.78	134.68	397.28	152.28	Bentonite	152.28	130.28	#16 x 30	F
MW-26	8/6/2003	UES	403.40	Sch 40 PVC	2	0.020	155.12	141.02	401.22	158.92	Bentonite	158.92	137.52	#16 x 30	F
MW-27	8/15/2003	UES	383.06	Sch 40 PVC	2	0.020	194.27	180.07	380.77	197.27	Bentonite	197.27	177.27	#16 x 30	F
MW-28	8/29/2003	UES	395.59	Sch 40 PVC	2	0.020	173.91	159.51	393.51	177.01	Bentonite	177.01	157.71	#16 x 30	F
MW-29	8/29/2003	UES	410.57	Sch 40 PVC	2	0.020	169.80	155.00	408.00	172.00	Bentonite	172.00	147.00	#16 x 30	G
P-1S[d]	3/12/1986	Golder	No data	Sch 40 PVC	2	0.020	304.00	294.00	393.00	390.00	Bentonite	390.00	288.00	#8 Aqua and Gravel	B
P-1D[d]	3/12/1986	Golder	No data	Sch 40 PVC	2	0.020	278.50	268.50	288.00	283.00	Bentonite	283.00	268.00	#8 Aqua	B
P-1A[d]	3/25/1986	Golder	No data	Sch 40 PVC	2	0.020	280.02	270.02	354.02	286.02	Bentonite	286.02	269.02	#8 Monteray	B
P-1B[d]	3/29/1986	Golder	No data	Sch 40 PVC	2	0.020	299.08	289.08	380.08	304.08	Bentonite	304.08	289.08	10 x 20 silica	B
P-2[d]	3/19/1986	Golder	No data	Sch 40 PVC	2	0.020	273.73	258.73	283.73	278.73	Bentonite	278.73	256.73	#8 Aqua	B
P-2A[d]	3/24/1986	Golder	No data	Sch 40 PVC	2	0.020	293.60	281.60	348.60	306.60	Bentonite	306.60	280.10	#8 Aqua	B
P-4	2/29/1988	Golder	No data	Sch 80 PVC	1	0.020	374.90	372.90	407.40	376.90	Bentonite	376.90	371.90	#16 Monteray	H

[a] All survey data in feet are relative to site datum.
[b] Well installed as a dual-completion.
[c] A = R.W. Beck, 1984; B = Golder Associates, 1986; C = CH2M HILL, 1996; D = Terra Associates., 1992; E = B&H and UES, 1999b; F = B&H and UES, 2003b; G = B&H and UES, 2003a; H = Golder Associates, 1986.
[d] Well has been decommissioned.

Table 1-3 Vashon Landfill Signifigant Maintenance Activities Summary 2010

Maintenance Activity	Resolution
Pump 1 Removed at the PS-2 Wet Well	Pump has been repaired but waiting for liner repairs before re-installing
Grout Peeling at corregated pipe - vault connection in several vaults	Repairs expected in 2011
PS-2 Wet Well Liner has peeled away from wall and impeeded Pump 2	In bid process to remove old liner, seal any leaks and re-install new liner, estimated completion, Summer 2011
Condensate Knockout Broke	Fixed Winter 2010
West Hillslope Trail Maintenance	Major trail repairs made throughout 2010

2. Evaluation Methods

The site environmental evaluation is in accordance with the Draft Data Evaluation Supplement to the Vashon Landfill Sampling and Analysis Plan. The evaluation tools include:

- Interwell Prediction Limits
- Mann Kendall Trend Test
- Time Concentration Plots
- Descriptive Statistics
- Exceedance Tables
- Trilinear Plots

The prediction limit exceedances, regulatory standard exceedances (Appendix B), ion balances and trilinear diagrams (Appendix J) are prepared for each quarterly report and compiled in this report. The data evaluated from wells screened within Cc3-Regional aquifer, will be calculated and compared to intrawell prediction limits and wells screened within channel Cc2 will be calculated and compared to interwell prediction limits.

The Mann Kendall trend test is recalculated based on the new data obtained in 2010. The trend test is evaluated for long term trends, including historical data up to the last eight samples, and for short term trends using the last eight samples. For wells with historical data beyond 50 samples, the most recent 50 samples are used in the long term trend test (Table 3-2). Wells with fewer than 20 samples and wells that have not produced sufficient water for eight samples in the last two years are compiled as a long term trend only.

Groundwater levels in individual wells have been plotted as a function of time. Changes in water levels before and after the 1989 closure are noted. Groundwater flow directions were estimated based on water elevations in monitoring wells screened in similar water-bearing zones. Upgradient and downgradient wells are determined by flow direction.

2.1. DATA QUALITY

Five analytical labs have performed laboratory services for water samples collected at the Vashon Landfill including Laucks from 1986 to March 1990, AmTest from March 1990 to April 1992, and Analytical Resources (ARI) from April 1992 to May 1995, Laucks again from May 1995 to April 2008 and Pace from April 2008 to March 2009 and the King County Environmental Laboratory from April 2009 to current. The State Manchester Laboratory accredited all five laboratories for the methods used at the time the samples were analyzed.

Contamination of blanks has important ramifications for data quality. However, some compounds have high blank contamination rates for compounds, such as methylene chloride. Although improvements have been made in reducing the rate of blank contamination in the lab, blank samples that have a longer residence time in the lab, such as volatile trip blanks and full set trip blanks, still show elevated rates. Since the common lab contaminants do not provide the only evidence of landfill impacts, other volatile compounds are used for this evaluation. Other compounds, such as, sulfate, zinc and iron have also been detected in blanks. These detections will be noted for the individual samples in which they have occured. Some data, particularly concerning solvents, must be qualified based on blank contamination events and measures of precision and accuracy. All sample results qualified with a "B" have blank contamination associated with the analysis.

There are several instances, particularly in the case of certain organic parameters and arsenic where the limit of detection is above State or Federal water quality levels. Because these concentrations are not measurable, they cannot be reported. Another issue involving these limits arises when the limits of detection change. Especially noticeable for metal parameters, these changes may be due to dilution, or due to technical or contractual specifications. These changes must be kept in mind while reviewing data evaluation and conclusions.

3. RESULTS

3.1. GROUND WATER ELEVATIONS AND FLOW DIRECTION

The Vashon Island Landfill Hydrogeologic Report Update (Berryman & Henigar with UES) presents the latest interpretation completed in December 2004. Starting in the fourth quarter of 2004, this 2004 interpretation has been used in the preparation of potentiometric surface maps and calculations of groundwater velocities.

Monitoring well locations are shown on Figure 3. These monitoring wells penetrate three water-bearing zones. Cross-sections illustrating site statigraphy are presented in Figures 4 through 9.

The upper most unit over most of the property is till. This till unit is absent at the south end of the site. The upper most unit at the south end of the site consists of sands interbedded with silts. These sands interbedded with silt are directly beneath the till at the north end of the site. The silts act as partial aquitards as evidenced by different water levels in wells screened at different depths. Because of the presence of these silt barriers, groundwater has been subdivided for discussion purposes into 3 channels incised into the lacustrine silt and an extensive saturated zone. Groundwater in or adjacent to channel Cc1 is the perched saturated zone between the lacustrine silt (transitional beds) and the overlying advance outwash. Groundwater in channel Cc2 is the middle channel in Unit C and groundwater in channel Cc3 is the lowest channel. The regional aquifer is a saturated zone beneath the lacustrine silt.

The stratigraphy of the site identifies 7 geologic units, A through G. Unit A is the overlying Vashon till, B is outwash, C is lacustrine silt incised with channels of more permeable material and the regional aquifer is defined in Unit D. No wells are installed in the deeper units E through F; however some wells were overdrilled and provide information about these units. A thorough discussion of the site is in the Hydrogeologic Report Update. Wells are installed in 3 channels incised in Unit C and are identified as Channels Cc1, Cc2 and Cc3 in vertical descending order. Wells in Cc1 have previously been identified as "perched above the lacustrine silt" and well in Cc2 as within the lacustrine silt (MW-27). The well in Cc3 was not previously installed.

3.1.1. Groundwater in Channel Cc1

There are currently seven wells screened in or adjacent to Cc1 deposits: MW-1, MW-3, MW-4, MW-5S, MW-10, MW-13, and MW-24. Groundwater, when encountered in this zone, is encountered at elevations of 260 to 287 feet above mean sea level (MSL).

The saturated thickness of the channel Cc1 is generally less than 11 feet. The water levels in most of the wells (with the exception of MW-10 and MW-13) have declined to the extent to make sample collection impracticable. There is an insufficient volume of

water present to collect samples due to minimal recharge rates. The wells that have yielded sufficient groundwater for continuing analysis since 1993 are MW-10 and MW-13. In 1997, MW-4 started yielding sufficient groundwater for analysis again and stopped again in late 2000. In 2007, MW-4 again yielded sufficient groundwater for two samples. MW-3 yielded sufficient water for two samples in 2007 and MW-1 has not yielded sufficient water for sampling since 2002.

Water levels for most of the wells have fallen in elevation since 1991. The initial contributing factor was the periodic placement of temporary HDPE cover over the completed refuse fill area. This practice began in 1991. The final closure of the landfill in 2002 appears to have further reduced surface recharge to this sand zone.

Historically, water levels in the wells in the groundwater in and adjacent to channel Cc1 show a variation from less than one foot to almost five feet with no marked seasonality, with the exception of MW-4 (see Figure 10). MW-4 is screened across a silt contact and the well can act as a sump. The 2004 Update recommends not sampling the well unless the water levels rise above the silt contact. There was sufficient groundwater for two samples in 2007, but previously the water levels were not above the silt contact since November 2000. Water levels are measured and reported quarterly to confirm this.

Field permeability tests performed by Harper-Owes (1986) indicated that the average permeability of sand in channel Cc1 was approximately 4.3 feet per day (ft/day).

3.1.2. Groundwater in Channel Cc2

Monitoring wells MW-2, MW-20, MW-21, MW-5D, MW-6D, MW-14, MW-8, and MW-9 are screened at elevations between 200 and 234 feet MSL. MW-6D has been decommissioned.

Wells MW-9, MW-2, MW-20, MW-21, and MW-5D are completed in channel Cc2. Wells MW-14 and MW-8 are screened in silty sands beneath the Cc2 deposits and laterally equivalent with the Cc3 deposits. Groundwater levels in MW-8 and MW-14 do not appear to be hydraulically equivalent with groundwater within either Cc2 or Cc3. The water levels recorded for wells MW-14 and MW-8 suggest these wells are along flowpaths from Cc2 to Cc3.

Annual water level fluctuations in the wells MW-8 and MW-14 tended to be minor, with an annual range of about 1 foot. Water level fluctuations in MW-9 were about 1 foot. Annual water level fluctuations in MW-2, MW-20, MW-21, and MW-5D were less than 1 foot. See Figures 11 and 12. This low or lack of response to the annual cycle of wet and dry seasons can be explained by the landfill not being located in an area where significant recharge to the aquifer occurs (Carr, 1983). Relatively low permeability surficial deposits (till) and partial closures in 1989 and 1999 contribute to the lack of significant recharge.

The general flow direction in the continuous thin sand, where MW-20, MW-21, MW-2, and MW-5D are located, is to the west or southwest. The potentiometric maps submitted quarterly and included in Appendix G generally agree with the flow directions reported by Carr (1983, see Figure 2).

The perched zone monitored by MW-2, MW-20, MW-21, and MW-5D has a hydraulic gradient between 0.008 and 0.009 ft/ft. The hydraulic conductivity for this perched zone is estimated between 0.01 and 0.45 ft/day. The effective porosity ranges from 0.2 and 0.3. The estimated horizontal groundwater velocity for this zone in 2010 ranged from 0.0001 to 0.02 ft/day (see Appendix G). The calculated velocities are expected to be accurate only within one order of magnitude due to variability in permeability rates. Quarterly velocity calculations and potentiometric maps are attached in Appendix G.

3.1.3. Groundwater in Regional Aquifer & Channel Cc3

There are six wells screened within the regional aquifer (MW-12, MW-7, MW-19, MW-25, MW-26 and MW-29). MW-27, screened both in channel Cc3 and the regional, is included with the regional wells for the potentiometric mapping. Groundwater is encountered at elevations of 154 to 195 feet MSL (see Figure 13).

The general flow direction in the regional aquifer is radially away from MW-27. The water fluctuations for the regional wells are less than two feet and also without considerable seasonal trends, see Figure 13. This lack of response to the annual cycle of wet and dry seasons can be explained by the landfill not being located in an area where significant recharge to the aquifer occurs (Carr, 1983). Relatively low permeability surficial deposits (till) and site closures attributes to the lack of significant recharge. The potentiometric maps shown in Appendix G generally agree with the flow directions reported by Carr (1983, see Figure 2).

The groundwater velocity occurring in the regional aquifer in 2010 is between 0.4 and 6.8 ft/day, with a hydraulic gradient of 0.05 ft/ft and hydraulic conductivity estimated between 3.0 and 9.0 ft/day. The estimated velocities are expected to be accurate only within one order of magnitude due to variability in permeability rates (see Appendix G).

3.2. GROUND WATER QUALITY

Results for the groundwater quality beneath the Vashon Landfill are presented according to two channels, Cc1 and Cc2; and the regional aquifer. MW-8 and MW-14 are discussed with the Channel Cc2 wells. MW-27, which is screened in both channel Cc3 and the regional aquifer, is discussed with the regional aquifer wells. Statistical summaries present data from two time periods, long and short. Emphasis is on the short term results, obtained from January 2009 to December 2010. All statistics and trend information discussed in the text is for this period unless otherwise identified. The

tables provide trends and statistics for both this recent period and the previous samples. During this recent sampling period, the number of samples varies between seven and nine for most wells. The quantity of data available for certain wells is limited. These wells have limited data due to a short monitoring history, are seasonally dry, have low production or are slow to recover and did not yield adequate data for comprehensive analyses. Therefore only long term trend tests are available for these wells. Apparent trends in individual wells, long and short-term, are discussed where applicable. Hydraulically upgradient wells are presented first.

Due to the presence of volatile organic compounds in the downgradient wells within channel Cc2, MW-2, MW-21 and MW-5D were put into assessment monitoring. As the first step in assessment monitoring, these wells were tested with an expanded parameter list as defined by WAC 173-351 Appendix III. Results indicated that the single parameter detected in the downgradient wells not included in the lists defined by Appendix I and II was dichlorodifluoromethane. These test results led to an agreement that wells in assessment monitoring at the site should be tested for dichlorodifluoromethane in addition to the Appendix I and II lists. This addition was specifically required for MW-20, MW-2, MW-21, MW-5D, MW-4, MW-8 and MW-27. For site wide consistency, all wells on site are tested for Appendix I and II parameters and dichlorodifluoromethane,

It is also important to note that several compounds, in particular acetone and methylene chloride, have been frequently detected in blanks and field samples at similar concentrations. The likely source of these compounds is laboratory contamination.

The pH field data for the period between late 1993 and early 1996 may not be reliable because of inconsistent field instrumentation.

The summary statistics are presented in Table 3-1. A summary of long and short-term trend evaluations for individual wells is presented in Table 3-2. Exceedances of water quality standards, prediction limit exceedances, time-concentration plots, potentiometric maps, groundwater velocities, and raw analytical data are presented as appendices.

3.2.1. Groundwater Within or Adjacent to Channel Cc1

As described in Section 3.1.1, MW-10, MW-3, MW-4 and MW-13 are the only monitoring wells in the groundwater within or adjacent to channel Cc1 silt for which water quality samples were taken in the most recent period (January 2009 to December 20010). There was insufficient water to collect samples from MW-3 and MW-4 during this period.

MW-10

MW-10 was installed with eight additional groundwater monitoring wells during the summer of 1995. MW-10 is located in the northwest corner of the site. It is screened between 252.34 and 262.34 feet MSL. MW-10 is northwest to the placement of the refuse. MW-10 monitors a perched system distinct from other wells above the lacustrine silt. Water quality in MW-10 is discussed below.

The pH (field) is neutral (median 7.3). Specific conductance (field, median 130.0 μmhos/cm) and total dissolved solids (median 99.0 mg/L) levels are low and stable. Sulfate (median 9.6 mg/L), chloride (median 3.3 mg/L) and nitrate (median 0.39 mg/L) are low and stable. See time concentration plots and statistical summaries. During the recent period, no conventional parameters exceed the water quality standards.

Iron (median 0.03 mg/L) is low and stable. Concentrations of common metals sodium, calcium, and magnesium are low and stable. Specific conductance shows a decreasing short term trend. There were no other short term trends for this well. Arsenic exceeds the State Groundwater Quality Criteria in all eight samples. Arsenic is to some extent common, a naturally occurring element in groundwater throughout western Washington as identified by USGS and Washington State Department of Health.

No volatile organic compounds (VOC) have been detected in MW-10 since 2001.

In general, the water quality in this well is good with no indications of landfill impact.

MW-13

MW-13 is screened above the lacustrine silt in sandy soils. It was installed in 1992. It was placed on the quarterly monitoring schedule in June of 1994. MW-13 is located in the southeast portion of the site. It is screened between 261.07 and 266.07 feet. MSL.

The pH is neutral (median 7.2). Specific conductance (median 168 μmhos/cm), total dissolved solids (median 128 mg/L), nitrate (median 0.08 mg/L), and sulfate (median 18.1 mg/L) are low and stable. See time concentration plots, and statistical summaries.

Manganese (1 detection in the last two years) is low and stable. Concentrations of common metals sodium, potassium and magnesium are low and stable. There are no short term trends in this well. Thallium and zinc are sporadically detected. Vanadium is detected regularly at low levels. Mercury has been

detected twice and copper has been detected once in the entire monitoring history. Their use as indicators of landfill impacts is limited.

Arsenic exceeds the State Groundwater Quality Criteria of 0.05 μg/L in all eight recent samples. No other samples exceed State or Federal standards. Arsenic is to some extent common, a naturally occurring element in groundwater throughout western Washington.

No volatile organic compounds have been detected in this well since 1999.

In general, water in this well is of good quality with no indications of potential landfill impact.

MW-1, MW-3, MW-4

MW-1, MW-3 and MW-4 did not produce sufficient water to provide a sample in 2009. They are monitored quarterly for water levels and will be sampled if possible. MW-3 shows similar or decreased values compared to previous years when samples were collected. Available chemical data is shown on time concentration plots and in the descriptive statistics table. MW-4 was placed in assessment monitoring in 2003, but did not have sufficient water for sampling until 2007. There was insufficient water for sampling in 2010.

MW-24

MW-24 also monitors water in channel Cc1. Per Chapter 4 of the 2004 Hydrogeologic Update, MW-24 is screened within a silt and will not be monitored unless water levels rise above the silt sand contact, at 291.0 feet MSL. Water levels are measured quarterly at MW-24 and the elevation has remained below the specified elevation.

Groundwater Perched In and Adjacent to Channel Cc1 Summary

Water Quality in MW-10 is good and is not considered impacted by landfilling activities. The absence of manganese in this well is notable. The conditions in this well in combination with low iron suggest a predominantly oxidizing environment.

MW-13 water quality is good and is not considered impacted by landfilling activities as well.

Reduced water volumes in the other shallow wells following installation of the cover at the site suggest the cover is adequately preventing recharge through the waste and is protecting the groundwater.

3.2.2. Groundwater in Channel Cc2

Wells MW-9, MW-2, MW-20, MW-21, and MW-5D monitor the groundwater perched within channel Cc2. MW-8 and MW-14 monitor water beneath channel Cc2 and laterally equivalent with channel Cc3.

Wells MW-2, MW-20, MW-21, and MW-5D are completed in continuous thin sand that correlates with the elevation and location of one of the seeps (seep 2 or SW-W2) on the west side of the landfill.

MW-20

MW-20 is located in the southeast portion of the site. It was installed in October 1998. It is screened between 233.2 and 237.5 feet MSL in a continuous sand bed within the lacustrine silt. It is upgradient of the landfilled area and used to calculate prediction limits and for upgradient comparison to wells MW-2, MW-21 and MW-5D.

The field pH results show a higher pH (median 8.1). Measurements of specific conductance (median 165 μmhos/cm), chloride (median 4.0 mg/L) and sulfate (median 15.0 mg/L) are stable. Total dissolved solids (median 120 mg/L) are increasing. Nitrate was only detected twice in the last eight samples.

Iron (median 0.07 mg/L) has a short term decreasing trend. Calcium (median 12.0 mg/L) and magnesium (median 9.3 mg/L) both exhibit short term stability. During the 2010 reporting period, arsenic levels exceed the State Groundwater Quality Criteria in all four samples.

In 2010, there was one chloromethane detection in MW-20. Chloromethane is a common lab contaminant. None of the additional parameters from the assessment monitoring program were detected.

Groundwater from this well is believed to represent natural conditions. This well is not impacted by landfilling activities.

MW-9

MW-9 is located in the northwest portion of the site. It was also installed as part of the addition of eight groundwater monitoring wells during the summer of 1995. It is screened between 223.64 and 233.64 ft. MSL in sand and gravel.

The pH conditions in this well are fairly neutral with a median of 7.4. The specific conductance (median 150 μmhos/cm) is stable. The measurement of total dissolved solids (median 100 mg/L) fluctuates in a narrow range and exhibits no

evident trend. Nitrate (median 0.15 mg/L), chloride (median 4.0 mg/L), and sulfate (median 13.0 mg/L) appear to be stable in recent samples.

Iron (median 0.04 mg/L) levels are low and stable. Sodium (median 5.1 mg/L) levels are stable. Arsenic exceeds the State Groundwater Quality Criteria of 0.05 μg/L in all eight recent samples. Arsenic is to some extent common, a naturally occurring element in groundwater throughout western Washington.

In 2010, there was one acetone detection in MW-9. Acetone is a common lab contaminant. None of the additional parameters from the assessment monitoring program were detected.

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The general water characteristics in this well represent good quality with no indications of landfill impact.

MW-2, MW-21, and MW-5D

These three wells are located downgradient and in the southwest portion of the site. MW-2 is located easterly from the other two. Wells MW-2 and MW-5D have been monitored quarterly since September 1986. MW-21 was installed in fall 1998 and has been monitored continuously since then.

The screen elevations for these wells are: 227.58 ft. to 244.58 ft. MSL for MW-2; 228.86 ft. and 239.86 ft. MSL for MW-5D; and 233.7 ft. to 243.1 ft. MSL for MW-21.

The pH measurements from these wells show conditions close to neutrality. Median values for the three wells range from 6.6 to 6.9, are stable in all three wells. Several indicator parameters and metals in recent sampling events from wells MW-21, MW-2, and MW-5D are elevated relative to MW-20. Samples from MW-5D have the highest levels in the unit for iron (median 13.8 mg/L), manganese (1.77 mg/L), and sodium (14.8 mg/L). MW-2 has the highest levels for total dissolved solids (median 288 mg/L), and magnesium (39.8 mg/L. MW-21 has the highest levels for specific conductance (median 455 μmhos/cm), and calcium (33.8 mg/L). MW-2 and MW-21 have iron and manganese levels that are lower by an order of magnitude or more, than MW-5D. Chloride levels in all three wells are at or near the level in the upgradient well MW-20.

The State and Federal groundwater quality criteria are exceeded consistently for iron and manganese in MW-5D and MW-21. All four samples last year exceeded the criteria for manganese in MW-2. All recent samples from MW-5D, and MW-21, and 3 samples from MW-2 exceeded the State Ground Water Criterion for arsenic in 2008.

Iron continues to have a statistically significant short term trend for MW-5D and only one long term increasing trend for sulfate. and MW-2 and MW-21, show decreasing short term trends for total dissolved solids , alkalinity, vinyl chloride and trichlorofluoromethane and and shows an increasing short term trends for sulfate. Again the values are in historical ranges and may be the result of seasonal fluctuations.

Recent samples from MW-2, MW-21, and MW-5D consistently exceed the prediction limit (PL), calculated from upgradient MW-20 data, for specific conductance, total solids, total dissolved solids, alkalinity, nitrate, calcium, barium, magnesium and sodium. Samples from MW-21 and MW-5D consistently exceed the PL for chloride, iron and manganese. Samples from MW-2 exceeded the PL for vanadium. MW-5D consistently exceeded the PL for arsenic. Prediction limit exceedances are included in the Appendix B.

Groundwater sampling results from MW-2, MW-21, and MW-5D continue to show detections of volatile organic compounds (VOCs). The detections for the past eight samples indicate decreasing or stable levels for VOCs with the exception of cis-1,2-dichloroethene that has a short term increasing trend. Cis-1,2-dichloroethene does has a long term decreasing trend and graphically the short term trend is minor compared to the overall trend on the graph. All of these compounds are present in landfill gas as well as leachate and their distribution between phases (partitioning) is regulated by physical properties (Henry's constant, solubility, vapor pressure) where these phases are in contact.

Most of these detected compounds are likely components of the waste stream; however others are almost certainly degradation products of tetrachloroethene and/or trichloroethene by the process of reductive dechlorination. The detected VOCs, wells, median values or recent detection frequency for the last eight samples are:

- Benzene in MW-5D (median 0.74 μg/L) in all samples;
- 1,1 dichloroethane in MW-5D (6 out of 8 samples, median 0.27 μg/L)
- *Cis*-1,2 dichloroethene in MW-21 (8 out of 8 samples, median .606 μg/L) and MW-5D (8 out of 8 samples, median 8.49 μg/L);
- *Trans*- 1,2 dichloroethene in MW-5D (6 out of 8 samples, median 0.220 μg/L);
- Vinyl chloride in MW-21 (median 0.434 μg/L), MW-5D (median 5.9 μg/L) and MW-2 (median 0.294 μg/L) in the last eight samples;
- Trichlorofluoromethane in MW-21 (8 out of 8 samples, median 6.02 μg/L), MW-2 (8 out of 8 samples, median 4.68 μg/L) and MW-5D (0 out of 8 samples, median 0.100 μg/L) in all samples;
- Dichlorodifluoromethane in MW-21 (8 out of 8 samples, median 7.2 μg/L), MW-2 (8 out of 8 samples, median 7.9 μg/L) and MW-5D (8 out of 8 samples, median 1.3 μg/L).

VOCs exceeding State Groundwater Quality Criteria in 2010 samples are:

- Vinyl chloride, all recent samples from MW-2, MW-5D, and MW-21.

Historically, MW-5D has displayed elevated concentrations of some indicator constituents, along with some exceedances. However, evaluation of recent data indicates in most cases short-term stability at considerably lower concentrations than historical data in this well. In 1992-1995, total dissolved solids, chloride, manganese, calcium, and magnesium levels went up while iron levels went down. In early 2002, manganese, total dissolved solids and chloride levels were slightly higher than previous quarters while iron levels were unusually low. Levels for total dissolved solids, chloride, manganese, calcium, and magnesium returned to previous levels and iron came back up. During 2001 – 2002 an event similar to the one observed between 1992 and 1995, might have occurred but to a much lesser extent.

The assessment monitoring program for Appendix III parameters detected dichlorodifluoromethane as the single Appendix III parameter not included on the Appendix I and II lists. This parameter is included in the current monitoring program for this site.

There is an impact from landfill activities in wells MW-2, MW-5D, and MW-21. Closure activities have contributed to improvement of the water in MW-2, and MW-5D. MW-21 was installed following closure and exhibits similar characteristics to MW-2 and MW-5D. Improvement in water quality is characterized by decreases in specific conductance, chloride, nitrate and a reduction in the frequency and level of several VOCs.

The declines in concentration of general water quality indicators (specific conductance, dissolved solids, chlorides, metals, etc.) suggest that leachate impacts have been controlled as a result of closure activities. A different response for several volatile compounds strongly suggests that the source of these compounds has not been completely addressed by leachate control and most likely results from a landfill gas transport mechanism (although several show decreasing levels). The volatile compounds detected in groundwater are all present in significant amounts in landfill gas. Characterization of leachate indicates that the observed groundwater quality in impacted wells could not be achieved by leachate alone. Using the best available data, Vashon leachate does not contain adequate concentrations of VOCs or alkalinity to result in groundwater quality observed at MW-5D. Alkalinity and VOCs are two of the most likely contributions to groundwater by interaction with landfill gas.

Groundwater perched in Channel Cc2 Summary

The recent data reflects the natural variability in water quality present in MW-20. The relatively low and stable concentrations detected in MW-20 indicate that groundwater quality in this well is not impacted by the landfill. Chemical data from MW-20 represents natural aquifer conditions in the vicinity of the landfill.

Wells in the groundwater perched in channel Cc2 displaying impacts from landfill activities include MW-2, MW-21, MW-5D. Stronger reducing conditions are identified in wells MW-5D and MW-21 than in MW-2, consistent with historical conditions. Most volatile compounds indicate decreasing or stable levels.

Patterns observed for VOCs in wells MW-2 and MW-5D, and the fact that the wells were constructed with screened intervals extending above the saturated zone, indicate the possibility of a different mechanism of transport than for other water quality parameters. As discussed in the 1992 Annual Report, the observations indicate landfill gas as the most probable source of these groundwater impacts.

Further investigations were conducted in 2003. Gas samples were taken from the airspace above the water table. Samples of landfill gas from probes and the active gas collection system were also taken to provide a comparison to typical landfill gas generated at the Vashon Landfill. The results from this sampling event were submitted to agency in 2006.

Further evaluation of the site continued in 2004. An environmental evaluation technical memorandum was submitted to agency in 2006. The technical memorandum made recommendations for further investigation and actions on the site. These recommendations are discussed in Section 1.3. These wells will continue to be monitored for response to any activities undertaken at the site.

Wells MW-8 and MW-14 monitor the groundwater perched beneath channel Cc2.

Wells MW-8 and MW-14 are screened lower than MW-9. Water levels in these wells likely indicate vertical recharge to the underlying sand and gravel unit.

MW-14

MW-14 is located in the west portion of the site. MW-14 was installed as part of an addition of eight groundwater monitoring wells during the summer of 1995. It is screened below the lacustrine silt, between 202.62 and 212.62 ft. MSL.

Water in MW-14 exhibits slightly alkaline conditions (pH median 7.8) fluctuating in a moderate range. Specific conductance (median 160 μmhos/cm), total dissolved solids (median 125 mg/L), sulfate (median 12.4 mg/L), and chloride (median 3.3 mg/L) exhibit small fluctuations and no trends.

Iron (median 0.01 mg/L), calcium (median 12.0 mg/L), magnesium (median 9.4 mg/L), Manganese (median 0.049 mg/L), potassium (median 2.46 mg/L), and sodium (median 5.97 mg/L) show no trend with the exception of sodium, which shows an increasing short term trend with a decreasing long term trend. Zinc is detected occasionally. These detections are near or at the limit of detection.

Sampling results in 2010 exceed the Secondary State and Federal Drinking Water Standards for arsenic in three sampling events and two sampling events exceeded the criteria for manganese. These metal concentrations are considered to represent natural conditions.

General characteristics show this well to be of good quality with no indications of landfill impact.

MW-8

MW-8 is located in the west portion of the site. It was also installed as part of the addition of eight groundwater monitoring wells during the summer of 1995. MW-8 is screened between 203.24 and 213.24 ft. MSL and is beneath the lacustrine silt. The screened interval in MW-8 has intersected the potentiometric surface in all depth to water measurements.

MW-8 has nearly neutral pH values (median 6.7) with little variability and no apparent trends. Specific conductance (median 160 μmhos/cm), total dissolved solids (median 131 mg/L), nitrate (median 3.44 mg/L), and sulfate (median 9.1 mg/L)levels exhibit minor variability and no discernible trend. Chloride (median 4.7 mg/L), exhibits an increasing trend in both the short and long term trends.

Iron levels (median 0.040 mg/L) are low and stable. Other metals detected are barium, copper, manganese, vanadium and zinc. These detections are near or at the laboratory minimum detectable level. Magnesium (median 10.0 mg/L), sodium (median 6.1 mg/L), and potassium (median 1.1 mg/L) exhibit no trend in recent samples. Unlike other monitoring wells, there are no exceedances for arsenic State Groundwater Quality Criteria.

No volatile organics were detected at MW-8 in 2010.

General characteristics show this well to be of good quality except for nitrate. The source of the nitrate is uncertain due to the lack of any other impact indicators. Water in MW-8 is of good quality with low level of impact related to nitrate.

Groundwater Perched Beneath Channel Cc2 Summary

MW-8 is constructed with the screened interval extending above the saturated zone. Except for sulfate, samples from this well show stable and decreasing trends.

Evaluations for MW-14 exhibit stable concentrations for constituents that are considered to represent naturally occurring spatial variation and show no indications of impacts from the landfill. Quarterly monitoring will continue for both wells.

3.2.3. Groundwater in Regional Aquifer & Channel Cc3

Wells MW-7, MW-11, MW-12, MW-19, MW-26 and MW-29 monitor the groundwater in the regional aquifer. MW-27 is screened both in Channel Cc3 and the regional aquifer.

Construction differences make determination of groundwater gradients and flow direction difficult in the area monitored by these wells. Average screened depth below the water table in the wells ranges from near zero in MW-11, MW-26 and MW-29 to more than 30 ft in MW-12 and MW-7. Since MW-27 is screened in channel Cc3 and the regional aquifer, this represents a piezometric high. These differences along with spatial variation over the site may well account for prediction limit exceedances using MW-7 as background data.

MW-7

MW-7 is located in the southeast portion of the site. Historically, MW-7 has been interpreted to represent upgradient conditions. The interpretation provided in the 2004 Hydrogeologic Update, redefines MW-7 as downgradient of the site. This well was installed as part of the addition of eight groundwater monitoring wells during the summer of 1995. The screened elevations for this well are between 141.09 and 151.09 ft. MSL.

The pH conditions in MW-7 are slightly alkaline with a median of 7.9. Specific conductance levels vary from 150 to 165 μmhos/cm (median 155 μmhos/cm). Ammonia (median 0.21 mg/L) is consistently detected in this well. Nitrate detection is infrequent occuring six times (0.016 mg/L), in the last two years. Alkalinity (median 73 mg/L), total dissolved solids (median 122 mg/L), and chloride (median 3.4 mg/L), are stable. Sulfate (median 10.6 mg/L), has an increasing trend in recent samples, but historically has a decreasing trend.

Iron (median 0.01 mg/L) and manganese (median 0.133 mg/L) display no significant trends. Manganese exceeds water quality standards in all four of the most recent samples. All samples exceed State Groundwater Quality Criteria for

arsenic. Other metals detected occasionally in this period include selenium and zinc.

No volatile organic compounds were detected in 2010 at MW-7.

The results from MW-7 are considered to represent natural conditions and are not related to landfilling activities.

MW-11, MW-25 and MW-29

MW-11 was installed as part of the addition of eight groundwater monitoring wells during the summer of 1995. The screened elevations for these wells are between 152.28 and 162.28 ft. MSL. MW-11 was damaged during the Nisqually earthquake in February 2001. No more samples have been collected since then. The 2001 report contains the last assessment on well MW-11. The 2001 assessment indicated no impacts in this well from the landfill. MW-11 was decommissioned in 2003. MW-25 was installed to replace MW-11. However the screen failed during installation and the well cannot be developed. The well has been left in place for use as a piezometer. MW-29 was subsequently installed in 2003 as the replacement well for MW-11. The screened elevations for MW-29 are between 155.00 and 169.80 ft. MSL.

The water pH for MW-29 is slightly alkaline (median 7.5). Specific conductance is low (median 210), total dissolved solids (median 149 mg/L), alkalinity (median 101 mg/L), and chloride (median 4.0 mg/L), are stable. Sulfate (median 17.4 mg/L), has an increasing trend in recent and historical samples.

Iron (median 0.72 mg/L) and manganese (median 0.092 mg/L) are stable. Arsenic, Iron and manganese exceed water quality standards in all 2010 samples. All samples exceed State Groundwater Quality Criteria for arsenic. Other metals detected occasionally in this period include selenium and zinc.

Chloromethane was detected in two samples in 2010 at MW-29. Chloromethane is a common lab contaminant.

The results from MW-29 resemble the historic MW-11 data and are considered to represent natural conditions and are not related to landfilling activities.

MW-12, MW-19, MW-26, MW-27 and MW-28

MW-12 and MW-19 were both installed in the summer of 1995. MW-12 is located to the south of the site. The screened elevations for MW-25 are between 129.62 and 139.62 ft. MSL. MW-19 is located to the northwest of the site. The screened elevations for MW-19 are between 131.10 and 141.10 ft. MSL.

MW-26 and MW-27 were both installed in 2003. MW-26 is located in the northwest corner of the site and the screened elevations are between 141.02 and 155.12 ft. MSL. MW-27 is screened both in channel Cc3 and the regional aquifer. Water quality discussions for this well are included with the other regional wells. The screened elevations for MW-27 are between 180.07 and 194.27 ft. MSL.

MW-28 has been dry since installation. The screened elevations for MW-28 are between 159.51 and 173.91 ft. MSL.

The pH for the regional aquifer for monitoring wells MW-12 and MW-19 is slightly alkaline (medians 7.6 and 7.6). The pH for MW-27 is neutral (median 6.8) and for MW-26, more alkaline (median 8.1).

Some parameter levels for MW-19 are higher than in MW-7 indicated by prediction limit (PL) exceedances. Some frequent PL exceedances are for specific conductance, sulfate, chloride, magnesium, and manganese. Even though PL exceedances are noted, the highest concentrations of these parameters are low for groundwater in general and area groundwater specifically (see table on the next page). All parameters are currently stable.

Manganese and arsenic concentrations in MW-19 exceed the water quality standard criteria in all four samples last year.

MW-12 and MW-27 historically are the only wells in this unit with infrequent detections of manganese, except for one detection in the entire monitoring history of MW-27 and two detections in MW-12 for the history of the well. MW-12 exceeded the prediction limit for nitrate twice in 2010. The only significant trend evident in this well is a decreasing short term trend in total dissolved solids. MW-27 exhibits no short term trends.

Trends for MW-26 are stable for the past 8 samples with no short term trends. Manganese concentrations in MW-29 and MW-26 exceed the water quality standard criteria in all samples in 2010. Arsenic concentrations in MW-7, MW-19, MW-26 and MW-29 exceed the water quality standard criteria in all samples in 2010.

Chloromethane was detected in MW-19, and MW-27. and Chloromethane is a common lab contaminant. MW-19 had a toluene detection. This is the only detection of toluene for MW-19, including the sample taken in the first quarter of 2011, and we believe it is an anomaly most likely caused by exhaust fumes.

In general, conditions in MW-12 appear to be at a higher redox potential than other wells in the regional aquifer. This environment is characterized by lower levels of iron and ammonia, absence of manganese, and higher levels of nitrate.

The redox conditions in the north portion of the site are more reducing, determined by lower levels of nitrate, and higher levels of iron, manganese and ammonia.

The following table presents a water quality comparison of background conditions and the regional aquifer characterized beneath the Vashon Landfill. VOCs are not summarized due to the absence of detections in these wells.

CONSTITUENT	Area Background Range*	Vashon Landfill Regional Aquifer Jan 2009- Dec 2010
General Indicators		
pH	6.5 to 8.3	6.5 to 8.3
Conductivity (micromhos/cm)	80 to 545	125 to 230
Chloride	1.6 to 14	2.7 to 6.7
Sulfate	<0.50 to 41	8.5 to 18.4
Nitrate	<0.2 to 5.8	<0.01 to 3.4
Metals[a]		
Arsenic	<0.001 to 0.017	<0.001 to 0.0064
Iron	0.04 to 10	<0.005 to 0.88
Manganese	0.005 to 0.960	<0.001 to 1.35
Sodium	5.0 to 62	4.7 to 9.0

Notes: All values except pH and specific conductivity are reported in milligrams per liter (mg/L).
[a] = Total metals concentrations are reported for area background values.
*Background values are based on Carr (1983) and Vashon-Maury Island Groundwater Management Plan (1998)

Regional Aquifer Summary

Trend analyses for most wells in this unit show stable concentrations for many of the constituents in the short-term period. Exceptions include an increasing trend in alkalinity, ammonia, for MW-19, in sulfate for MW-7 and MW-29, in magnesium in MW-19, and a decreasing trend in total dissolved solids for MW-12. Conditions present in wells in the regional aquifer show no indication of impacts attributable to landfill activities at the Vashon Island site. The water quality in this unit is good and is believed to represent natural conditions.

Groundwater flow is not well defined in the regional aquifer in the area monitored by these wells. The additional wells installed in 2003 included MW-27, screened across the channel Cc3 – regional aquifer contact. This creates a potentiometric high. The extent of the influence of this radial flow is undetermined.

3.3. WEIR WATER QUALITY

The weirs are located in the western ravine adjacent to the landfill. The elevations for the weirs are 239.33 ft for Weir 1; 224.78 ft for Weir 2; and 195.38 for Weir 3. The weir sampling locations SW-W1, SW-W2 and SW-W3 are located downstream of each weir. The elevations for the sampling locations are 230.59 ft for SW-W1; 189.89 ft for SW-W2; and 187.23 ft for SW-W3 (See Figure 3). The sampling stations consist of a v-notch weir.

Historically, the naming for these locations has on occasion been inadvertently switched. After a thorough review of the data, corrections have been made and the probable results from switching location names have been associated with the correct location name. However, single unusual results may be the result of the naming issues rather than true fluctuations in the data. As a result of this data issue, results reported previously may differ from the current conditions.

The weirs have been monitored since March 1991. Results for water from the weirs are presented in two periods similar to groundwater. Emphasis is on results obtained from the last eight samples, predominantly between 2009 and 2010. The flow at SW-W1 was insufficient to collect any samples during dry periods so data is considered as a whole, rather than focusing on the last eight samples. Four samples were collected from all three wiers in 2010.
The specific conductance ranges between 70 and 860 μmhos/cm for SW-W1; 570 to 889 μmhos/cm for SW-W2; and 228 to 484 μmhos/cm for SW-W3. Chloride levels range from 3 to 15 mg/L for SW-W1; 25 to 34 mg/L for SW-W2; and 7 to 9 mg/L for SW-W3. In general for specific conductance and chloride, SW-W1 has the lowest levels while SW-W2 displays the highest levels, and SW-W3 is midrange but tends closer to SW-W1. The maximum levels for both constituents have decreased compared to historical values for all three locations and in general the variability has decreased, as shown by decreases in standard deviation for short and long term periods at SW-W2 and SW-W3.

The medians for calcium concentrations are 37 mg/L for SW-W1, 68 mg/L for SW-W2, and 29 mg/L for SW-W3. The medians for magnesium concentrations are 20 mg/L for SW-W1, 57 mg/L for SW-W2, and 24 for SW-W3. The medians for potassium concentrations are 1.4 mg/L for SW-W1, 3.6 mg/L for SW-W2, and 2.5 mg/L for SW-W3. The medians for sodium concentrations are 9 mg/L for SW-W1, 17 mg/L for SW-W2, and 10 mg/L for SW-W3. As with specific conductance and chloride, SW-W1 and SW-W3 have lower levels for calcium, magnesium, potassium, and sodium, while SW-W2 has the higher levels. The levels of these metals are stable relative to long term

values at all three locations. All medians above are equal to or lower than last years values.

The only volatile organic compound (VOC) detected with any frequency in the weirs is vinyl chloride. Vinyl chloride is rarely detected in SW-W1 and SW-W2, but is routinely detected in SW-W3. The median in the recent samples is 0.041 μg/L at SW-W3.

Most of the exceedances of the Federal and State Surface Water Quality Standards are for metals. Historically the value of these exceedances in evaluating water impacts associated with municipal solid waste landfills is limited since the standards are based on dissolved metals and the weir results are based on total metals. In 2007, field procedures changed allowing samples collected to be field filtered and metals to be analyzed for both total and dissolved constituents. Dissolved metals were then compared to groundwater criteria and total metals were compared to surface water criteria. Because water collected at the weirs is truly surface water, having been exposed to atmospheric conditions, it will no longer be compared to groundwater standards starting in 2011. Iron is the only parameter to periodically exceed the surface water quality standard. All other exceedances are very inconsistent.

Weir Summary

Conditions in SW-W1 represent the lowest levels of impact while SW-W2 displays somewhat higher low levels. SW-W3 exhibits a midrange impact on the basis of conventional parameters and metals, but has frequent detections of vinyl chloride. Water quality monitoring will continue at the weirs to provide water quality data for surface water flow leaving the site. The water quality is compared both to groundwater and surface water standards but starting in 2011 will only be compared to surface water standards.

The hillslope is part of an ongoing investigation. Three shallow monitoring wells (MW-30, MW-31 and MW-32) were hand augured in December 2009. These three monitoring wells were sampled for one year. Findings from this investigation will be part of a report scheduled for completion in spring of 2011.

3.4. OFFSITE DOMESTIC WELL MONITORING

In 2002, DNRP conducted sampling on Vashon-Maury Island in 11 domestic wells located around the landfill. No evidence of contamination originating from the landfill was found. The data was presented in the 2002 Annual Report. Data are included with the onsite well data, in the pdf files.

In 2005 SWD agreed to monitor 3 of these 11 wells. The first round of these samples was collected in October 2005. One of the three wells is no longer sampled as access is no longer available. Starting in 2010, samples will be collected from both of the offsite wells bi-annually. There were three samples collected in 2010 from the two off site wells. No evidence of contamination originating from the landfill was found. The results are included in the .pdf files, in Appendix I.

4. Landfill Gas

Landfill gas migration is monitored by a network of compliance probes installed around the perimeter of the landfill and ambient air stations around the property boundary. The monitoring network comprises of nine ambient air stations, three monitoring wells and twenty-six gas probes. Probes were monitored monthly until September 2009, when sampling moved to a quarterly cycle. The results can be found in the Vashon Island Closed Landfill Quarterly Reports. Methane was detected at a low level of 0.01 % methane for only three times out of 456 samples in 2008. There were no detections in 2007,2009, and 2010. The effects of landfill gas on current groundwater conditions are being reviewed by the consultant to determine whether data gaps exist in the current analysis. Conclusions from the landfill gas review will not be available until 2012.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Conditions at the Vashon Landfill have continued the historic trend with some volatiles showing decreasing trends. Therefore most of the conclusions drawn from the previous Annual Reports hold true for this report as well. The following conclusions reiterate some from the previous Annual Reports.

1. The groundwater generally moves westward in the middle channel of the lacustrine silt, now designated channel Cc2, within Unit C.
2. The flow direction within the regional aquifer is not well defined and potentiometric maps show the influence of well MW-27 being screened in both the lower channel of Unit C (Cc3) and in the regional aquifer (Unit D).
3. The wells in the regional aquifer showed low sensitivity to hydrologic activity, based on the observation of very small seasonal water level fluctuations, indicating limited groundwater recharge in the area of the landfill.
4. Landfilling impacts have been recognized in channel Cc2 at wells MW-5D, MW-21, and MW-2. Low levels of VOCs have been detected frequently in wells MW-2, MW-21, and MW-5D. Detections for most volatile compounds have declined

significantly or are stable except for cis-1,2 dichloroethene (short term increase in MW-21), dichloflouromethane (long term increase in MW-21 and long term decrease in MW-2 & MW-5D) and trichlorodifluoromethane (long term increase in MW-21 & MW-5D, and a short term decrease in MW-21 & MW-2). Leachate is believed to have contributed impacts in the past. Recent data, specifically levels of VOCs in MW-21, MW-2, and MW-5D, suggest contaminant transport from landfill gas.

5. The landfill closure has been effective in improving the water quality condition of impacted wells, based on reductions in specific conductance, total dissolved solids, chloride and several VOCs.
6. Results obtained from wells in the regional aquifer do not show impacts attributable to landfill activities. The data reflects the natural variations in water quality that exist around the site.

5.2. Recommendations/Proposed Actions

1. The existing monitoring network shall continue to be monitored as described in the 2004 Vashon Island Landfill Hydrogeologic Report Update and following protocols from the Draft Vashon Island Landfill Sampling and Analysis Plan.
2. Evaluation of the operating efficiency of the landfill gas collection system and probe network will begin in 2011.
3. The need for additional groundwater monitoring wells will be evaluated and locations for any necessary well(s) will be identified in 2012.
4. Monitoring of the wells will continue for Appendix I and II parameters, with the addition of dichlorodifluoromethane.
5. The water bearing zone in channel Cc2 shall continue in assessment monitoring in accordance with WAC 173-351-430.

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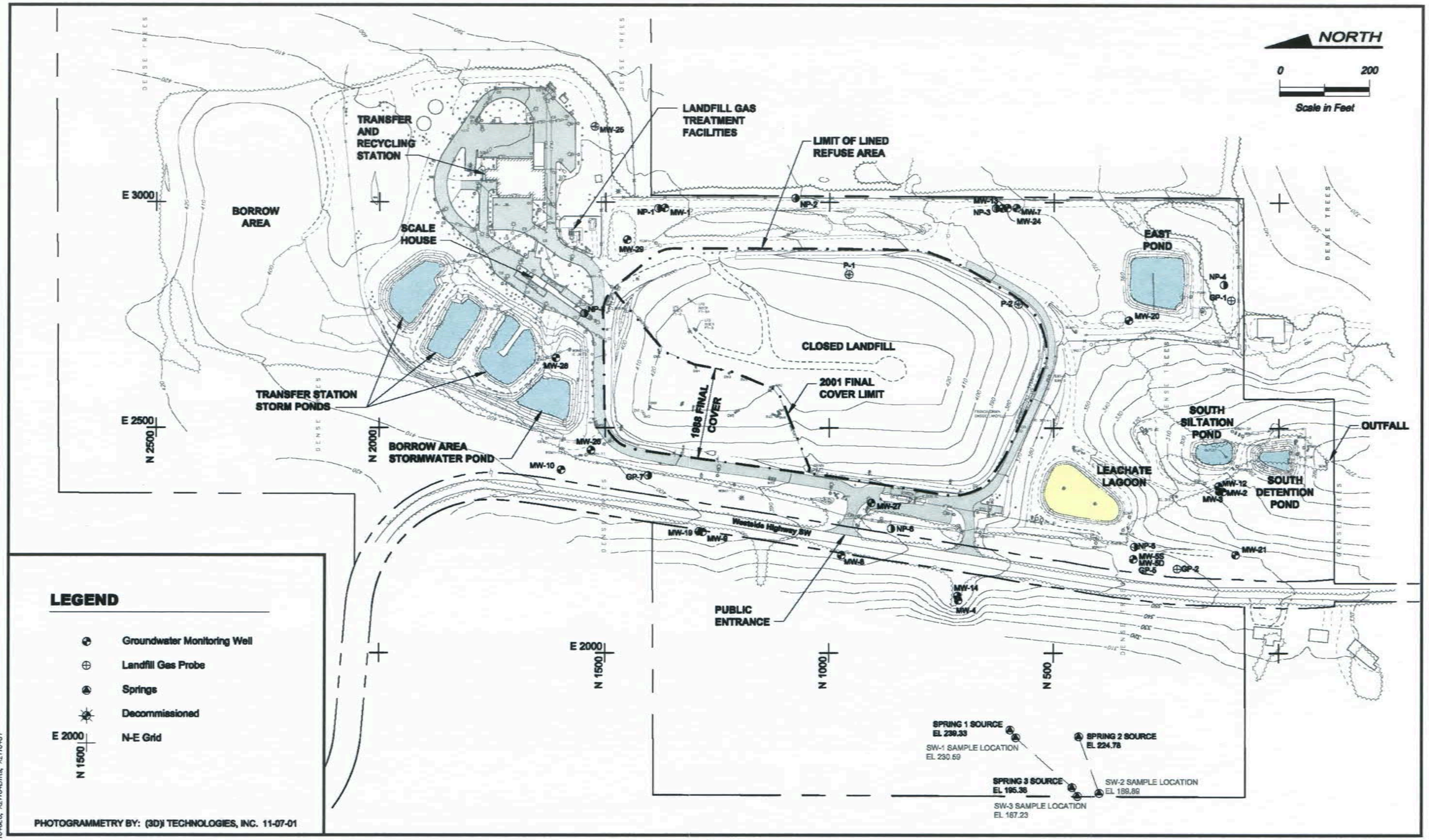

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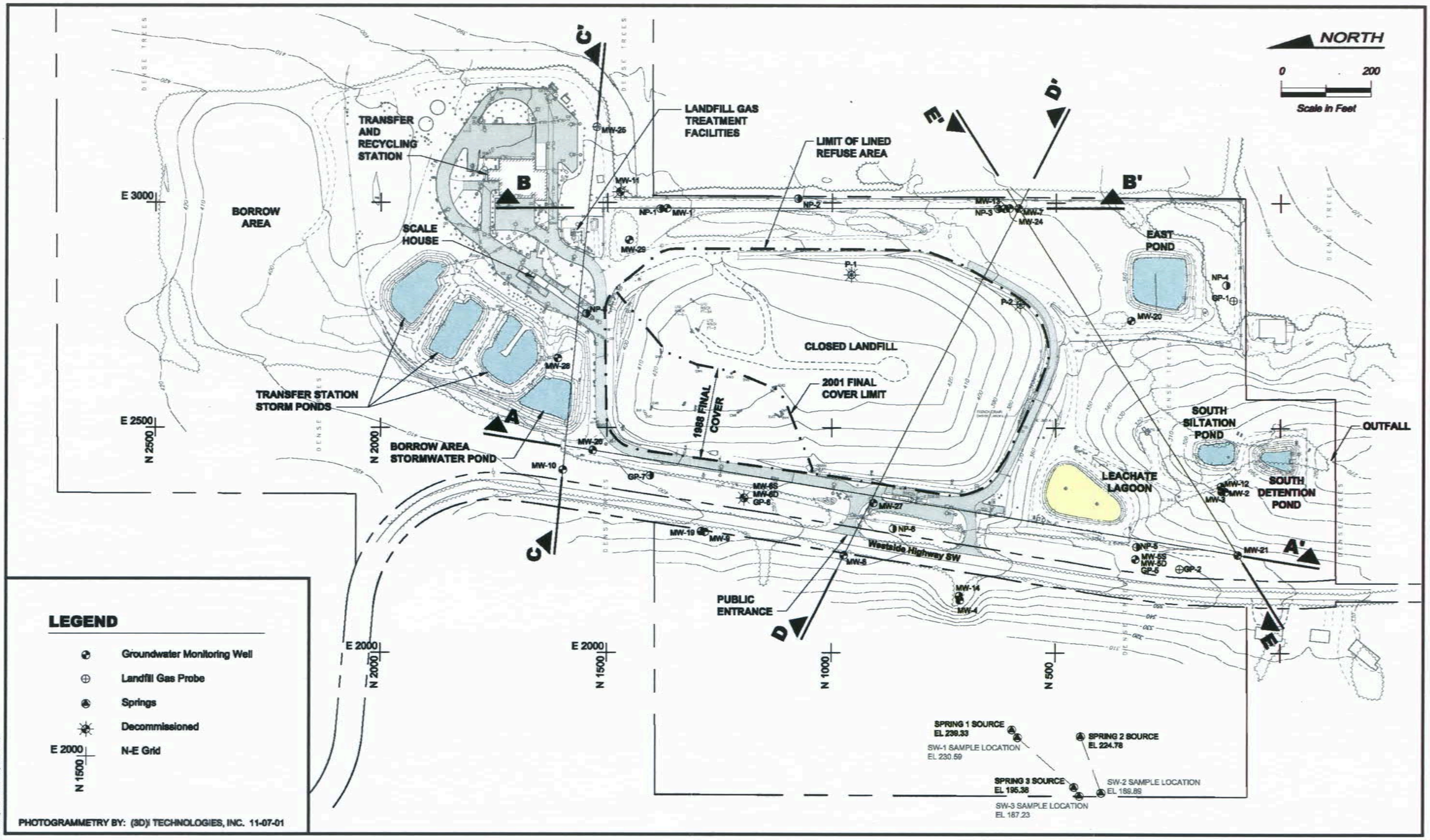
King County
Department of Natural Resources and Parks
Solid Waste Division

Site Map

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update
Prepared by Berryman & Henigar with UES

Figure
3



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Hydrogeologic Cross Section Location Map
Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update
Prepared by Berryman & Henigar with UES

Figure 4

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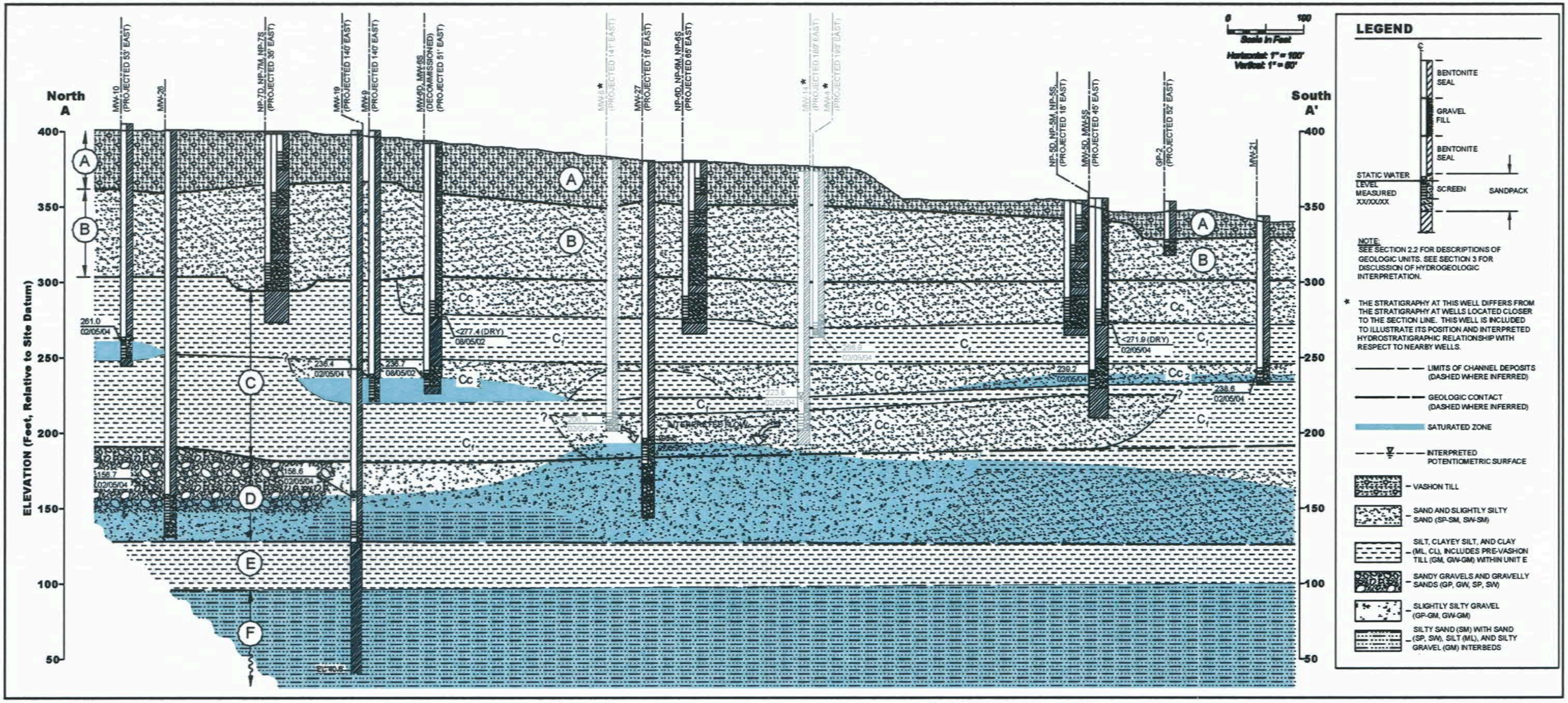

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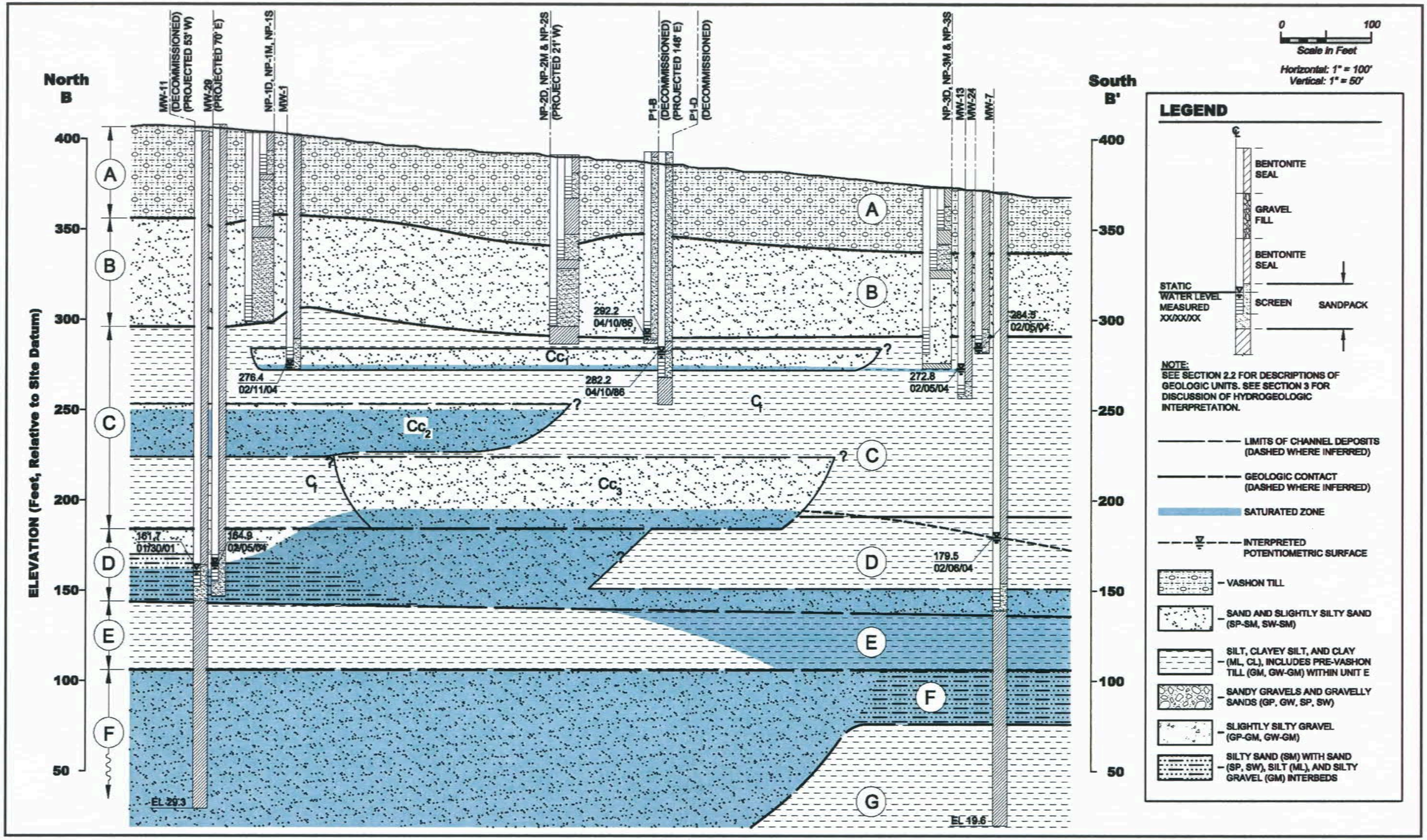
Hydrogeologic Cross Section A-A'

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update

Prepared by Berryman & Henigar with UES

Figure 5



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Solid Waste Division

Hydrogeologic Cross Section B-B' *Figure*

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update

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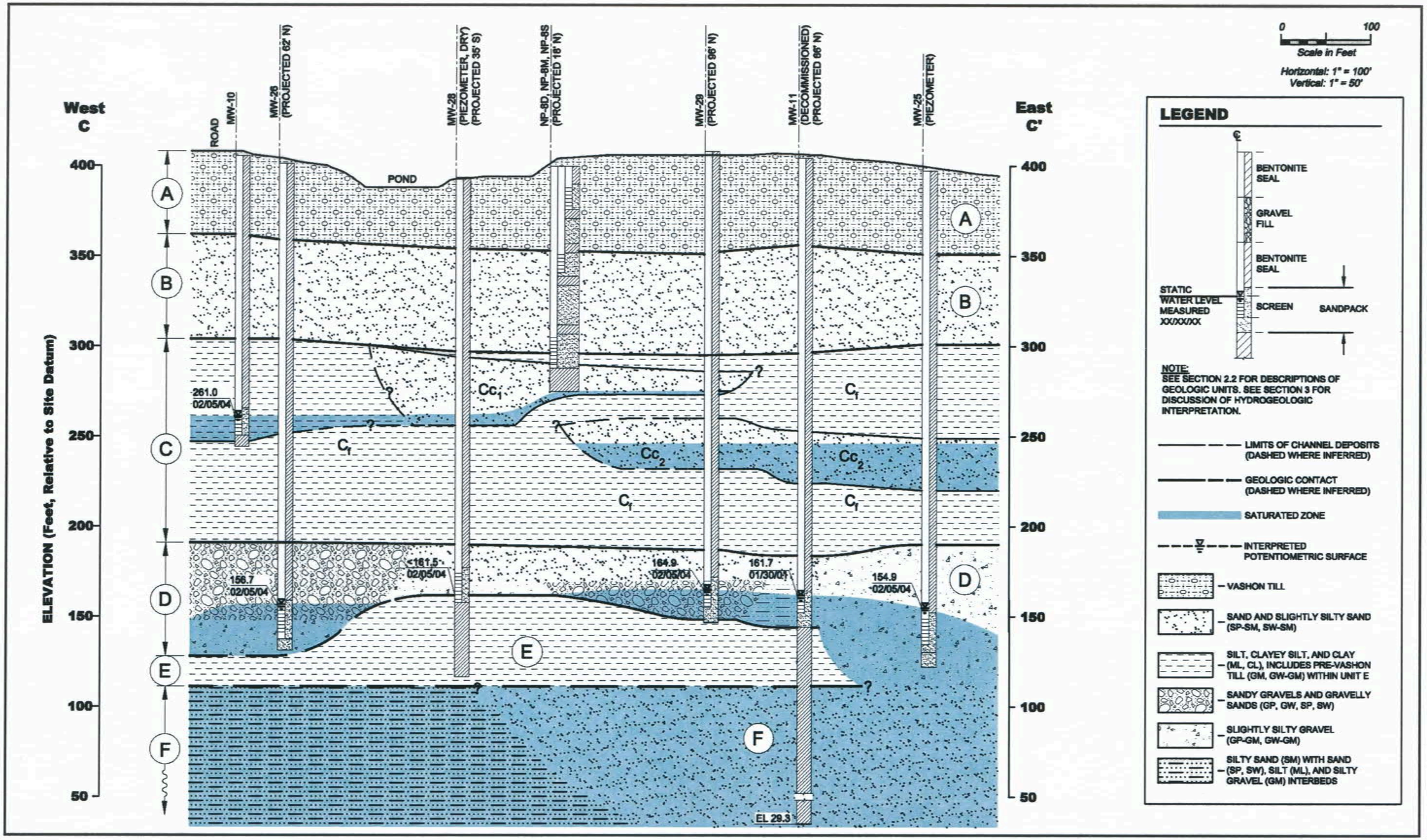
6



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King County
Department of Natural Resources and Parks
Solid Waste Division

Hydrogeologic Cross Section C-C'

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update

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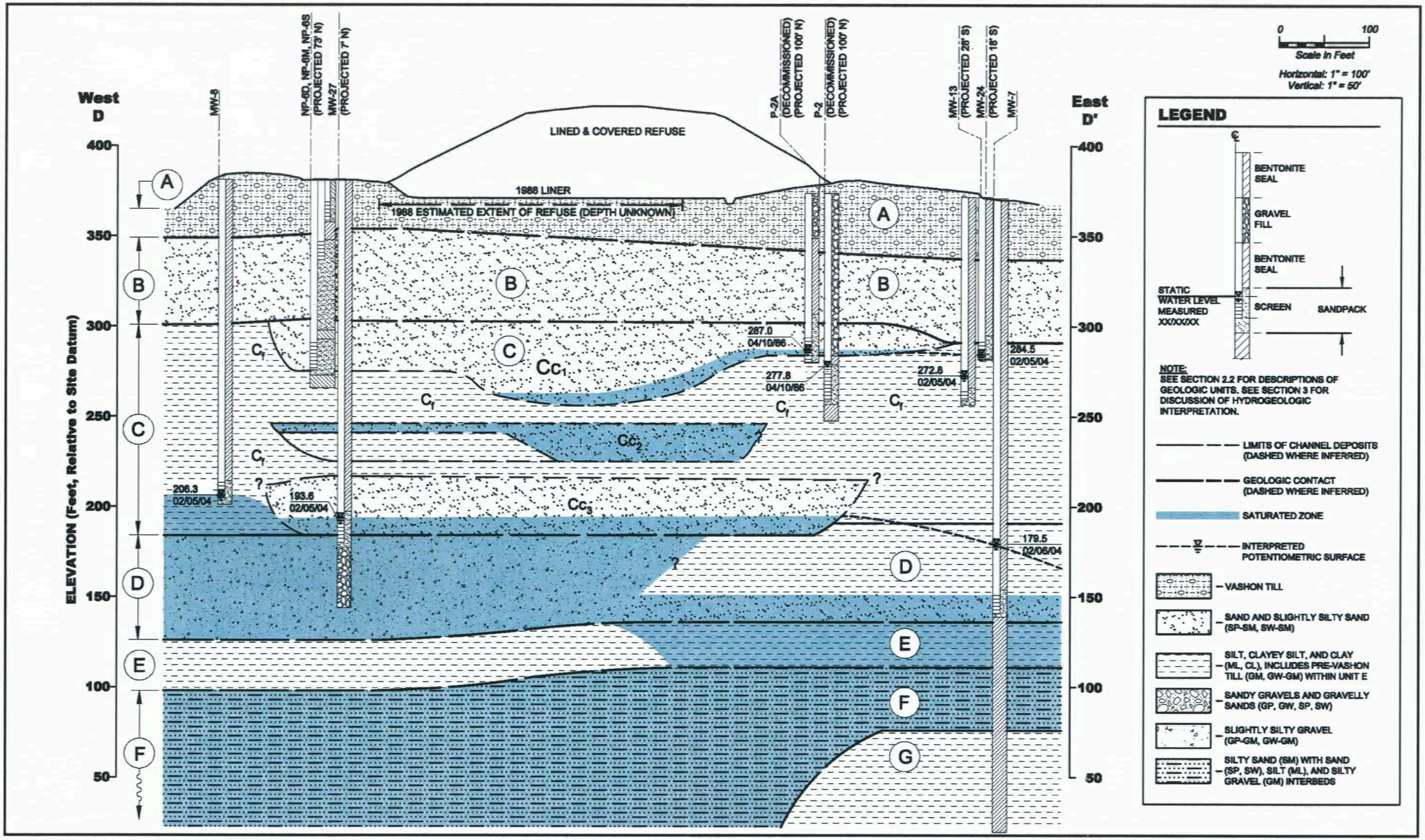
Figure 7



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XREFS: NONE

King County
Department of Natural Resources and Parks
Solid Waste Division

Hydrogeologic Cross Section D-D'

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update

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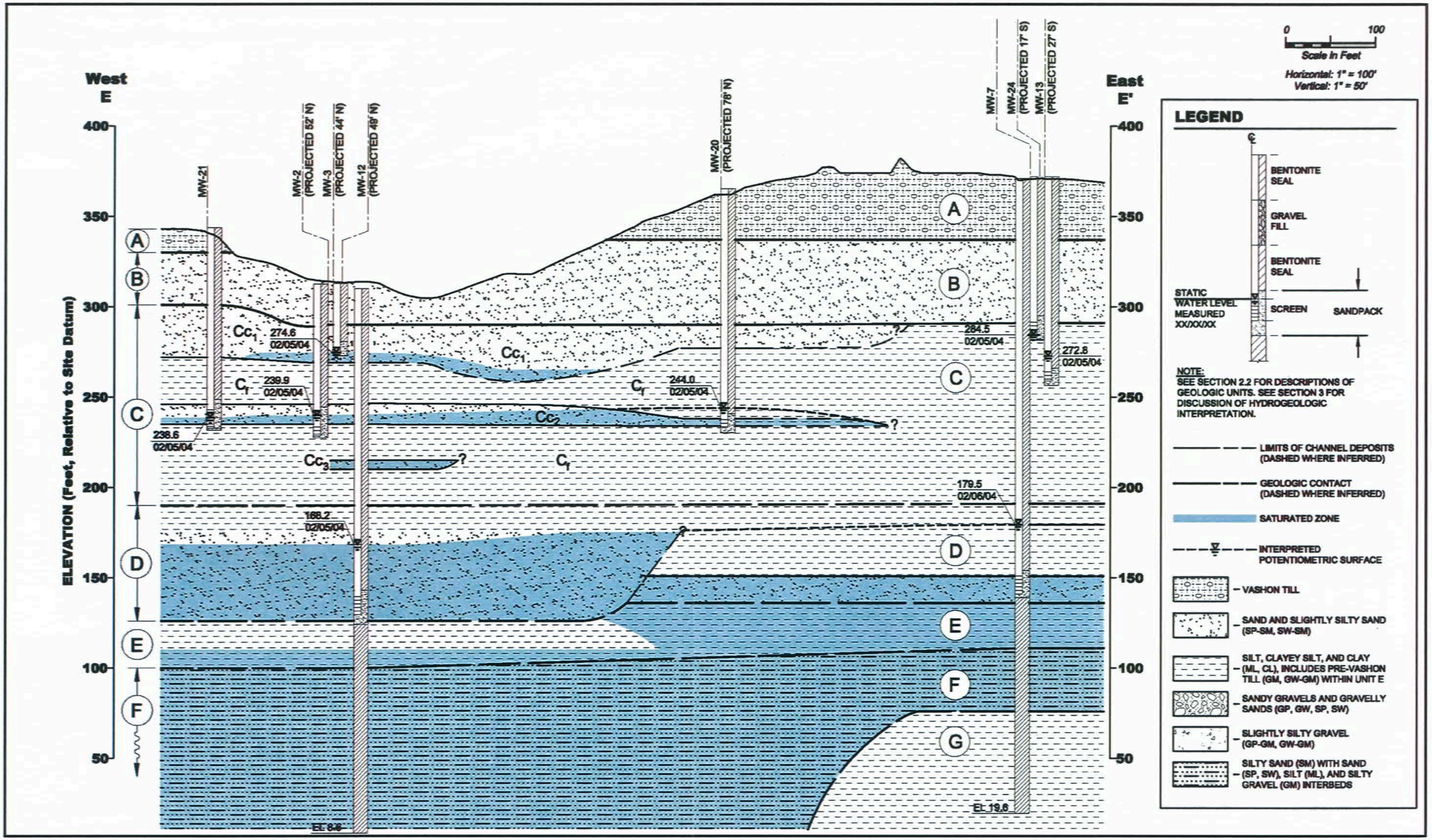
Figure 8



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King County
Department of Natural Resources and Parks
Solid Waste Division

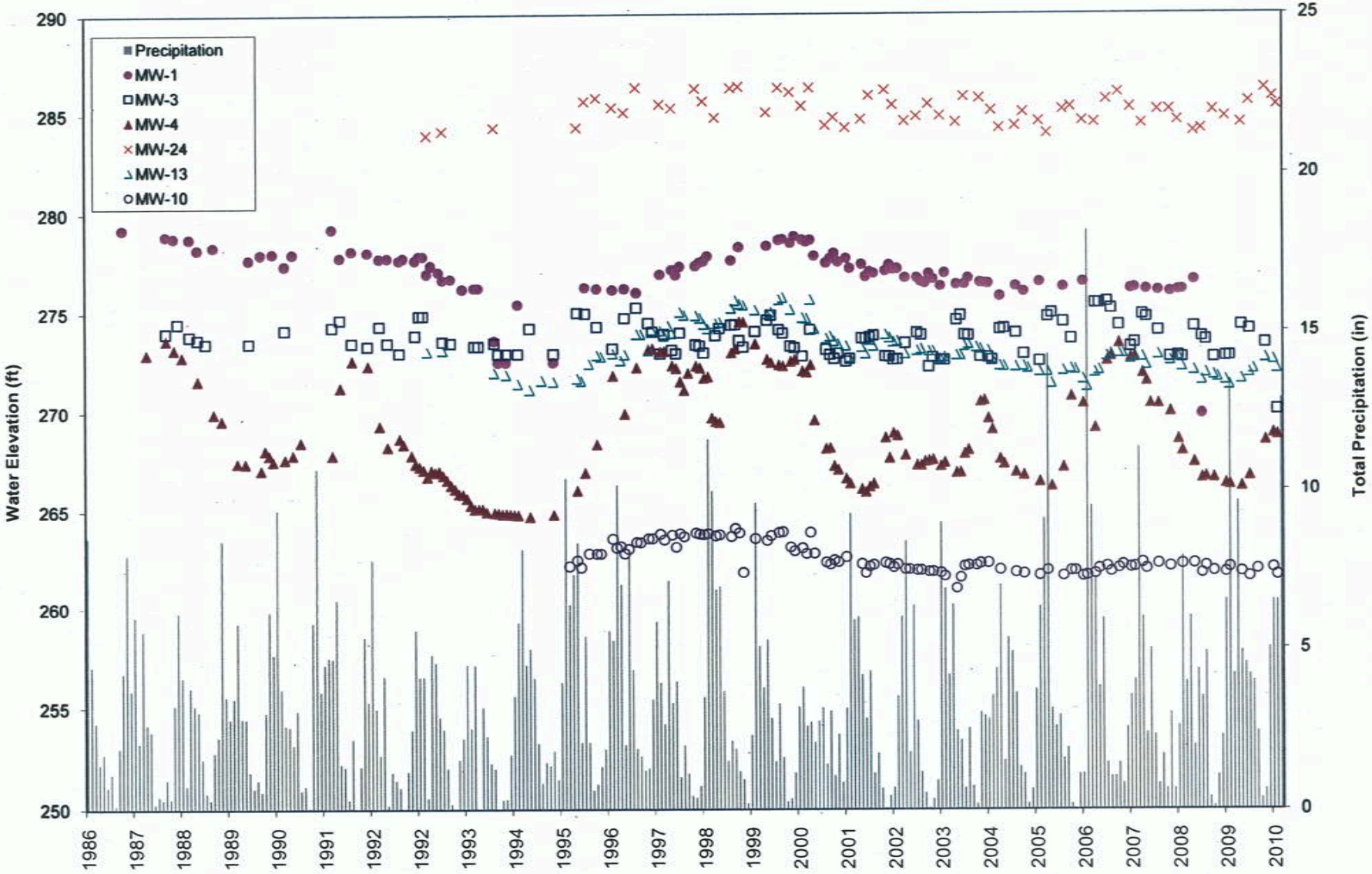
Hydrogeologic Cross Section E-E'

Source December 2004,
Vashon Island Landfill Hydrogeologic Report Update

Prepared by Berryman & Henigar with UES

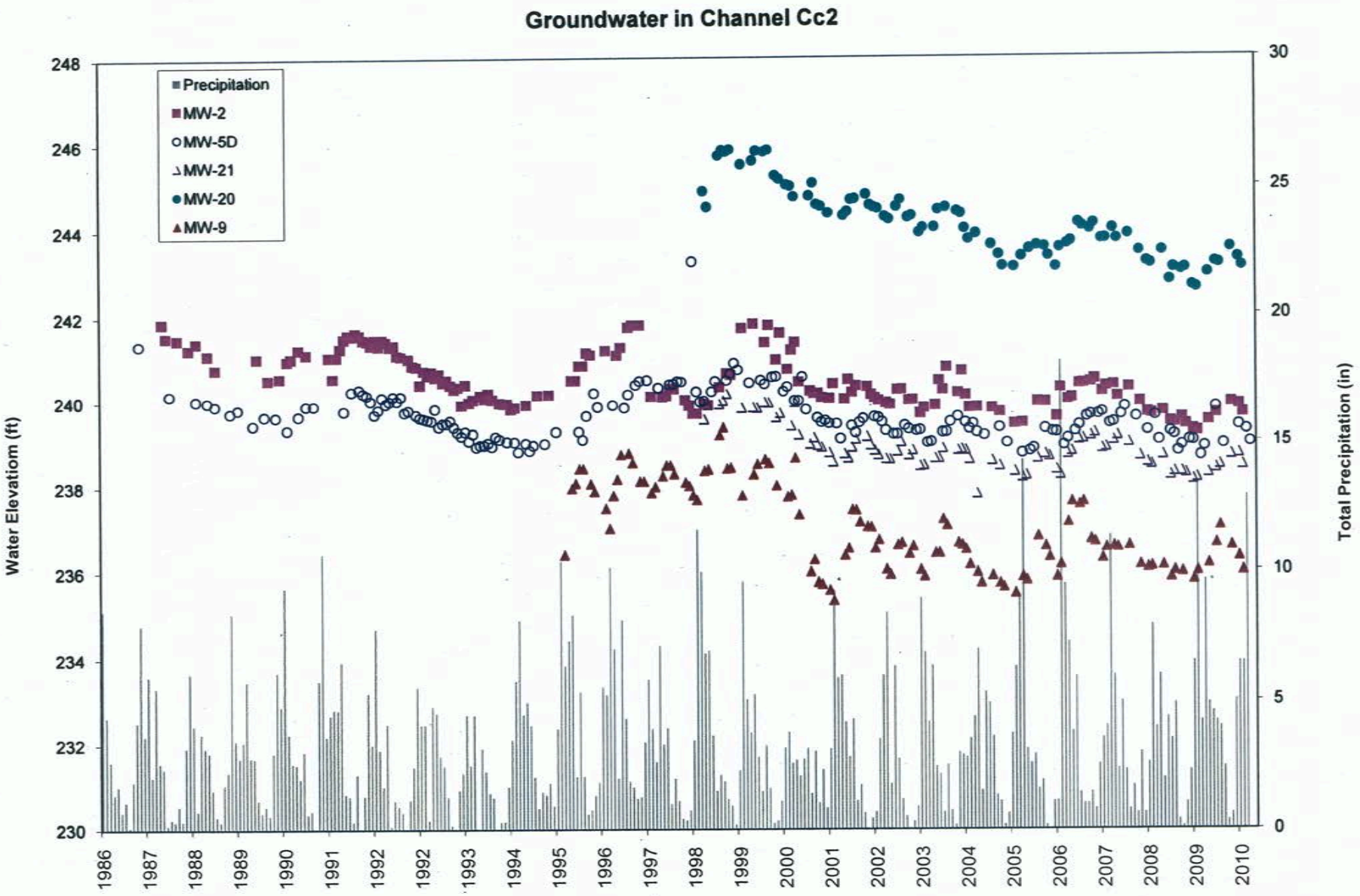
Figure 9

Groundwater in or Adjacent to Channel Cc1



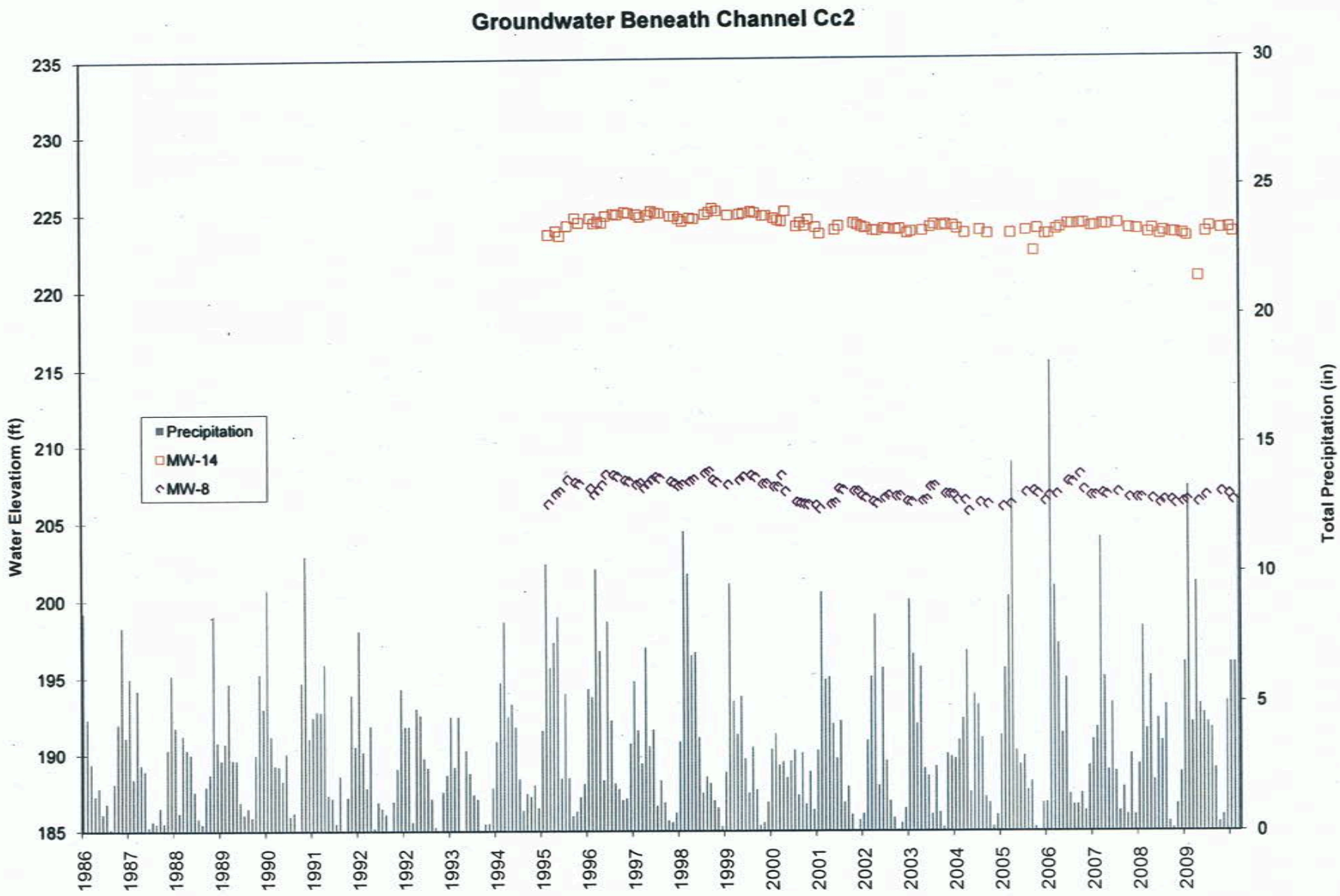
Precipitation Data Source:
Pre 2005: NOAA
Sea-Tac AP Station. Monthly Total Precipitation
2005: KC DNRP. WLRD, Rain Gage, Vashon Landfill

Figure 10



Precipitation Data Source:
Pre 2005: NOAA
Sea-Tac AP Station. Monthly Total Precipitation
2005: KC DNRP. WLRD, Rain Gage, Vashon Landfill

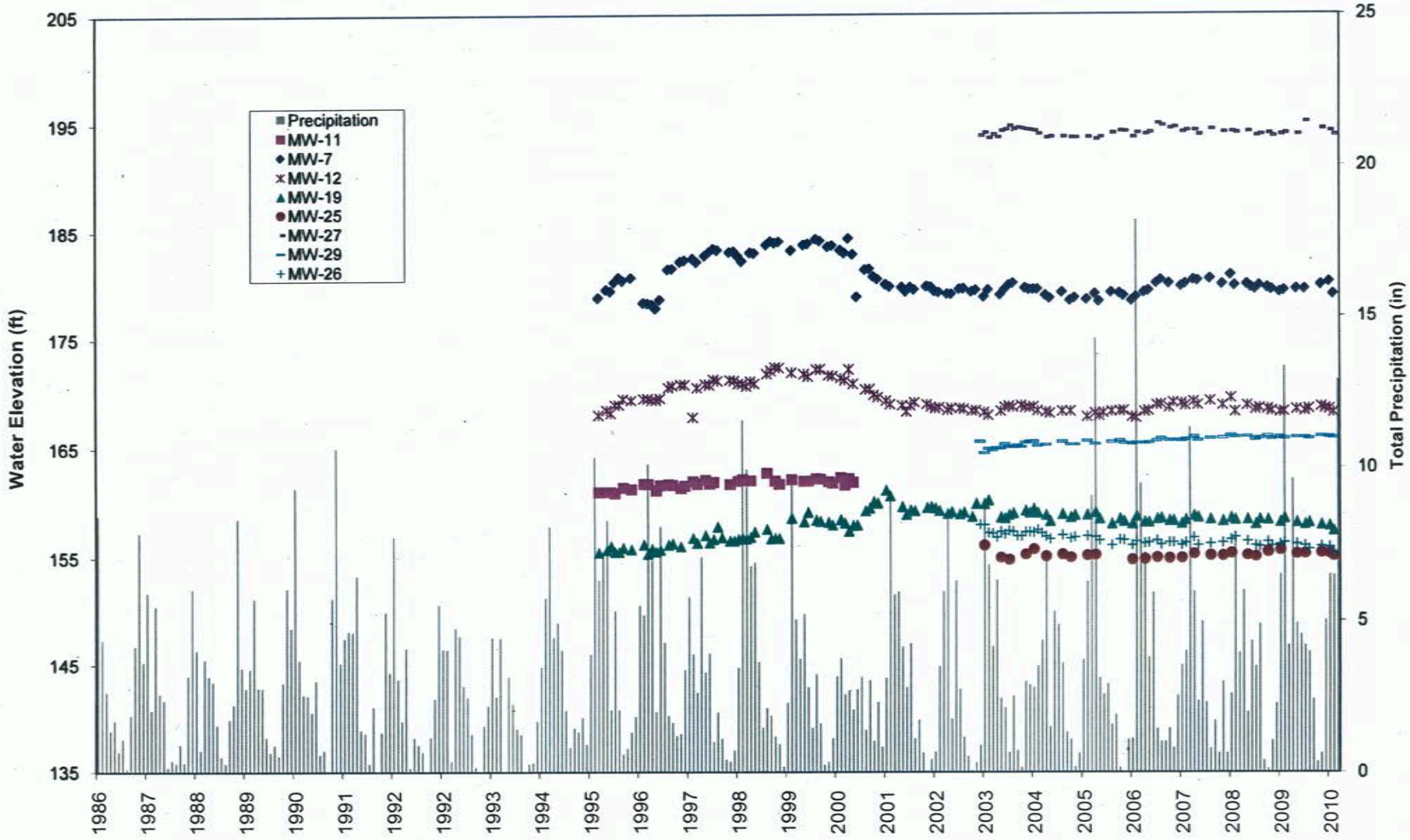
Figure 11



Precipitation Data Source:
Pre 2005: NOAA
Sea-Tac AP Station. Monthly Total Precipitation
2005: KC DNRP. WLRD, Rain Gage, Vashon Landfill

Figure 12

Groundwater Regional Aquifer & Channel Cc3



Precipitation Data Source:
Pre 2005: NOAA
Sea-Tac AP Station. Monthly Total Precipitation
2005: KC DNRP. WLRD, Rain Gage, Vashon Landfill

Figure 13

Tab[illegible]
Vashon I[illegible] andfill
Summary of Statistical Analyses [illegible] Groundwater Well Samples
May 1987 through December 2009

Groundwater in or adjacent to Cc1							
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient							
Time Interval	Long	Long	Long	Short	Long	Short	Long
pH field, Standard Units							
No. of Analyses	17	21	56	8	61	8	36
No. of Detections	17	21	56	8	61	8	36
Minimum	6.4	5.6	6.8	7.1	6.7	7.0	6.1
Maximum	8.2	6.8	8.4	7.5	8.0	7.4	8.0
Mean	7.21	6.17	7.43	7.33	7.25	7.12	6.54
Standard Deviation	0.43	0.35	0.31	0.14	0.26	0.16	0.35
Median	7.2	6.2	7.4	7.3	7.2	7.1	6.4
Specific Conductance field, micromhos/cm							
No. of Analyses	18	21	56	8	60	8	36
No. of Detections	18	21	56	8	60	8	36
Minimum	155	86	100	120	130	155	190
Maximum	250	200	150	135	180	180	860
Mean	190.0	116.5	126.6	128.1	155.4	166.9	573.3
Standard Deviation	27.2	28.9	9.5	5.3	13.1	8.4	145.3
Median	185	100	130	130	155	168	553
Total Dissolved Solids							
No. of Analyses	19	16	54	8	64	8	33
No. of Detections	19	16	54	8	64	8	33
Minimum	77	8	46	82	68	110	29
Maximum	170	90	130	114	150	134	500
Mean	125.6	66.3	93.5	98.8	111.8	125.4	358.7
Standard Deviation	26.5	19.7	14.6	10.5	15.0	8.0	103.6
Median	123	71	94	99	110	128	360
Alkalinity, mg/L							
No. of Analyses	5	14	55	8	60	8	15
No. of Detections	5	14	55	8	60	8	15
Minimum	98	24	52	54	30	68	58
Maximum	120	41	70	60	80	75	320
Mean	109.60	31.36	56.16	57.33	60.72	71.56	225.80
Standard Deviation	10.53	4.36	3.10	1.72	7.50	2.41	81.91
Median	110.0	31.0	56.0	57.2	60.0	71.3	240.0
Ammonia-N, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	4	9	7	2	11	0	19
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	0.1	0.7	0.1	0.0	0.1	ND	0.3
Mean	0.02	0.15	0.01	0.01	0.01	0.01	0.06
Standard Deviation	0.02	0.22	0.01	ID	0.01	ID	0.08
Median	0.03	0.03	0.01	0.01	0.01	0.01	0.03

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

Groundwater in or adjacent to Cc1							
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Nitrate-N, mg/L							
No. of Analyses	29	21	55	8	65	8	48
No. of Detections	21	21	55	8	63	8	23
Minimum	ND	0.2	0.2	0.4	ND	0.1	ND
Maximum	0.3	4.3	0.8	0.4	0.3	0.1	6.3
Mean	0.16	1.46	0.37	0.39	0.11	0.09	1.12
Standard Deviation	0.09	0.99	0.11	0.01	0.06	0.01	1.90
Median	0.16	1.20	0.35	0.39	0.10	0.08	0.10
Sulfate, mg/L							
No. of Analyses	29	21	55	8	64	8	48
No. of Detections	29	21	55	8	64	8	48
Minimum	11.0	7.7	2.6	9.1	17.0	17.7	3.7
Maximum	21.0	19.0	11.0	9.8	26.8	18.7	46.0
Mean	16.91	11.80	9.64	9.52	19.92	18.10	17.74
Standard Deviation	2.08	3.36	1.11	0.21	1.65	0.37	9.69
Median	17.0	11.0	10.0	9.6	19.8	18.1	16.0
Chloride, mg/L							
No. of Analyses	29	21	55	8	65	8	48
No. of Detections	29	21	54	8	65	8	46
Minimum	1.3	1.1	ND	3.1	2.5	2.7	ND
Maximum	6.3	11.0	4.0	3.4	5.6	3.2	19.0
Mean	4.27	3.27	2.97	3.26	3.72	3.03	8.87
Standard Deviation	0.87	2.49	0.38	0.09	0.79	0.16	4.52
Median	4.2	2.2	3.0	3.3	3.9	3.1	7.0
Dissolved Arsenic, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	25	1	54	8	64	8	6
Minimum	ND	ND	ND	0.0015	ND	0.0016	ND
Maximum	0.0070	0.0070	0.0020	0.0020	0.0030	0.0019	0.0060
Mean	0.0050	0.0012	0.0016	0.0017	0.0018	0.0018	0.0013
Standard Deviation	0.0013	ID	0.0004	0.0001	0.0004	0.0001	0.0012
Median	0.0050	0.0005	0.0016	0.0017	0.0020	0.0018	0.0005
Dissolved Iron, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	14	18	53	1	53	2	40
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	0.32	8.60	0.30	0.02	0.49	0.12	0.50
Mean	0.03	1.35	0.05	0.01	0.05	0.02	0.09
Standard Deviation	0.06	2.68	0.06	ID	0.09	ID	0.11
Median	0.02	0.05	0.03	0.01	0.03	0.01	0.06

Tabl
Vashon Is ndfill
Summary of Statistical Analyses . Groundwater Well Samples
May 1987 through December 2009

Groundwater in or adjacent to Cc1							
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Dissolved Manganese, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	6	17	6	1	45	1	42
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	0.058	2.700	0.003	0.001	0.027	0.005	0.970
Mean	0.01	0.46	0.00	0.00	0.00	0.00	0.18
Standard Deviation	0.01	0.96	0.00	ID	0.00	ID	0.22
Median	0.001	0.004	0.001	0.001	0.002	0.001	0.089
Dissolved Calcium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Minimum	11.0	7.6	4.3	8.5	6.5	7.5	17.0
Maximum	14.0	11.0	13.0	9.2	11.0	11.2	73.6
Mean	12.24	9.44	8.85	8.89	9.14	9.68	53.43
Standard Deviation	1.16	0.96	1.22	0.32	0.88	1.06	16.72
Median	11.7	9.4	8.9	9.0	9.3	9.7	55.0
Dissolved Magnesium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Minimum	10.7	1.8	4.2	8.0	7.7	9.8	8.6
Maximum	16.0	3.1	12.0	9.5	13.0	12.7	56.8
Mean	12.46	2.36	7.99	8.52	10.11	11.42	40.70
Standard Deviation	1.74	0.31	0.98	0.53	0.88	0.96	12.78
Median	11.8	2.3	7.9	8.6	10.0	11.4	42.0
Dissolved Sodium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Minimum	7.3	3.7	2.3	4.2	4.9	5.3	5.4
Maximum	10.0	6.4	6.4	5.0	14.4	6.7	24.8
Mean	8.34	4.75	4.49	4.62	5.95	5.93	15.55
Standard Deviation	0.95	0.84	0.53	0.25	1.16	0.49	5.54
Median	8.0	4.6	4.5	4.7	5.8	5.9	14.0
Dissolved Potasium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Minimum	2.2	2.5	0.7	1.3	1.1	1.4	0.9
Maximum	3.0	4.1	2.0	1.5	2.2	1.9	2.7
Mean	2.51	3.41	1.32	1.39	1.64	1.71	1.92
Standard Deviation	0.25	0.44	0.17	0.07	0.16	0.16	0.40
Median	2.4	3.5	1.3	1.4	1.6	1.7	2.0

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

Groundwater in or adjacent to Cc1							
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Benzene, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	1	0	1	0	1	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	0.3	ND	0.3	ND	0.2	ND	ND
Mean	0.37	0.21	0.10	0.10	0.10	0.10	0.39
Standard Deviation	ID	ID	ID	ID	ID	ID	ID
Median	0.5	0.1	0.1	0.1	0.1	0.1	0.1
Chloroethane, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	0	0	0	0	6
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	1.3
Mean	1.23	0.45	0.10	0.10	0.10	0.10	1.12
Standard Deviation	ID	ID	ID	ID	ID	ID	1.08
Median	1.5	0.1	0.1	0.1	0.1	0.1	1.0
Toluene, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	2	0	1	0	1	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	0.5	ND	0.4	ND	0.8	ND	ND
Mean	0.99	0.31	0.10	0.10	0.11	0.10	0.72
Standard Deviation	ID	ID	ID	ID	ID	ID	ID
Median	0.5	0.1	0.1	0.1	0.1	0.1	0.1
Trichloroethene, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	1	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	1.0	ND	ND	ND	ND	ND	ND
Mean	0.38	0.21	0.10	0.10	0.10	0.10	0.39
Standard Deviation	ID	ID	ID	ID	ID	ID	ID
Median	0.5	0.1	0.1	0.1	0.1	0.1	0.1
Vinyl Chloride, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	1	0	2	0	23
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	0.0	ND	0.0	ND	19.0
Mean	0.55	0.18	0.01	0.01	0.02	0.01	3.74
Standard Deviation	ID	ID	ID	ID	ID	ID	5.22
Median	0.5	0.0	0.0	0.0	0.0	0.0	1.0

Tabl
Vashon Is andfill
Summary of Statistical Analyses Groundwater Well Samples
May 1987 through December 2009

Groundwater in or adjacent to Cc1							
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Total Xylenes, ug/L							
No. of Analyses	29	21	55	8	65	8	48
No. of Detections	0	0	0	0	1	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	0.5	ND	ND
Mean	0.40	0.29	0.20	0.15	0.20	0.15	0.54
Standard Deviation	ID	ID	ID	ID	ID	ID	ID
Median	0.5	0.2	0.2	0.2	0.2	0.2	0.2
cis-1,2-Dichloroethene, ug/L							
No. of Analyses	17	18	55	8	65	8	35
No. of Detections	0	0	0	0	1	0	14
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	0.8	ND	16.0
Mean	0.26	0.17	0.10	0.10	0.11	0.10	1.24
Standard Deviation	ID	ID	ID	ID	ID	ID	2.74
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.5
trans-1,2-Dichloroethene, ug/L							
No. of Analyses	21	20	55	8	65	8	40
No. of Detections	0	0	0	0	0	0	1
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	0.3
Mean	0.31	0.20	0.10	0.10	0.10	0.10	0.37
Standard Deviation	ID	ID	ID	ID	ID	ID	ID
Median	0.5	0.1	0.1	0.1	0.1	0.1	0.1
1,1 Dichloroethane, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	0	0	0	0	17
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	1.0
Mean	0.37	0.21	0.10	0.10	0.10	0.10	0.54
Standard Deviation	ID	ID	ID	ID	ID	ID	0.69
Median	0.5	0.1	0.1	0.1	0.1	0.1	0.5
1,2-Dichloropropane, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND
Mean	0.37	0.21	0.10	0.10	0.10	0.10	0.39
Standard Deviation	ID	ID	ID	ID	ID	ID	ID
Median	0.50	0.10	0.10	0.10	0.10	0.10	0.10

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

Groundwater in or adjacent to Cc1							
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Trichlorofluoromethane, ug/L							
No. of Analyses	10	15	55	8	65	8	26
No. of Detections	0	7	1	0	1	0	22
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	0.7	0.2	ND	1.0	ND	2.1
Mean	0.10	0.24	0.10	0.10	0.11	0.10	1.24
Standard Deviation	ID	0.20	ID	ID	ID	ID	0.95
Median	0.1	0.1	0.1	0.1	0.1	0.1	1.2
Dichlorodifluoromethane, ug/L							
No. of Analyses	5	14	55	8	60	8	16
No. of Detections	0	0	0	0	1	0	12
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	1.5	ND	4.2
Mean	0.10	0.10	0.10	0.10	0.13	0.10	1.79
Standard Deviation	ID	ID	ID	ID	ID	ID	1.44
Median	0.1	0.1	0.1	0.1	0.1	0.1	1.6

NOTES:

ID	Insufficient Data. The number of detections is less than 3.
ND	Not Detected (at laboratory MDL).
mg/L	Milligram per liter.
ug/L	Microgram per liter.
Current	Reflects the most recent analysis data, up to eight analyses maximum.

Tab'
Vashon Is[illegible] andfill
Summary of Statistical Analyses[illegible] Groundwater Well Samples
May 1987 through December 2009

	Groundwater in Channel Cc2													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH field, Standard Units														
No. of Analyses	40	8	41	8	111	8	104	8	56	7	55	8	56	8
No. of Detections	40	8	41	8	111	8	104	8	56	7	55	8	56	8
Minimum	7.0	7.8	6.6	6.6	6.1	6.5	6.0	6.5	6.7	7.5	6.2	6.5	6.8	7.1
Maximum	8.6	8.2	7.3	7.2	7.8	7.0	8.0	7.1	8.5	7.9	8.0	6.9	8.0	7.4
Mean	7.96	7.99	6.85	6.81	6.88	6.75	6.69	6.70	7.70	7.71	6.95	6.71	7.44	7.26
Standard Deviation	0.37	0.13	0.16	0.21	0.26	0.15	0.30	0.22	0.33	0.13	0.35	0.13	0.21	0.13
Median	8.1	8.0	6.9	6.8	6.9	6.8	6.7	6.6	7.8	7.8	6.9	6.7	7.4	7.3
Specific Conductance field, micr[illegible]														
No. of Analyses	41	8	41	8	110	8	103	8	56	7	55	8	56	8
No. of Detections	41	8	41	8	110	8	103	8	56	7	55	8	56	8
Minimum	150	160	285	350	230	360	110	235	140	150	130	145	110	140
Maximum	185	175	470	480	1024	460	1760	550	190	190	650	165	180	155
Mean	166.5	169.4	369.0	431.9	475.0	411.3	835.7	399.4	157.8	164.3	176.7	158.1	149.2	148.1
Standard Deviation	8.9	6.2	51.1	50.7	122.7	35.9	373.3	99.3	10.6	12.4	66.5	5.9	16.1	5.3
Median	165	170	370	455	470	418	735	403	160	160	170	160	150	150
Total Dissolved Solids														
No. of Analyses	40	8	40	8	103	8	102	8	55	7	55	8	55	8
No. of Detections	40	8	40	8	103	8	102	8	55	7	55	8	55	8
Minimum	50	110	200	237	170	34	250	229	71	110	54	99	58	104
Maximum	160	140	290	307	480	300	900	351	150	130	150	134	160	150
Mean	113.6	127.4	240.8	284.6	287.8	253.4	519.0	265.4	114.8	123.1	113.7	126.1	104.3	117.3
Standard Deviation	18.0	11.1	21.4	22.5	62.7	89.7	186.8	78.5	16.8	6.2	18.7	16.7	18.2	4.9
Median	120	130	240	287	280	288	475	282	120	125	120	131	100	117
Alkalinity, mg/L														
No. of Analyses	41	8	40	8	56	8	57	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	56	8	57	8	55	7	55	8	55	8
Minimum	68	59	160	208	110	238	80	199	66	54	54	54	56	63
Maximum	80	76	290	290	500	270	724	314	84	76	78	68	78	100
Mean	71.51	71.71	212.5	260.6	233.4	254.6	342.2	227.1	72.1	70.0	62.5	65.8	64.6	66.0
Standard Deviation	2.46	5.64	33.8	24.8	58.9	10.8	109.9	68.6	3.0	7.9	4.6	15.9	4.9	2.1
Median	71.0	73.3	210	265	240	254	320	231	72	74	62	61	64	66
Ammonia-N, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	55	8
No. of Detections	11	6	17	1	15	0	94	8	10	1	7	0	10	0
Minimum	ND	ND	ND	ND	ND	ND	ND	0.0	ND	ND	ND	ND	ND	ND
Maximum	0.1	0.0	0.1	0.0	0.0	ND	0.4	0.2	0.3	0.0	0.4	ND	0.1	ND
Mean	0.02	0.01	0.02	ID	0.01	0.01	0.07	0.08	0.02	0.01	0.02	0.01	0.01	0.01
Standard Deviation	0.02	0.00	0.03	ID	0.01	ID	0.07	0.10	0.04	ID	0.06	ID	0.01	ID
Median	0.02	0.01	0.02	ID	0.01	0.01	0.06	0.05	0.01	0.01	0.01	0.01	0.01	0.01

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Groundwater in Channel Cc2													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Nitrate-N, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	56	8
No. of Detections	4	2	7	8	40	8	17	2	9	1	54	8	56	7
Minimum	ND	ND	ND	0.1	ND	0.3	ND	ND	ND	ND	ND	3.0	0.0	ND
Maximum	0.1	0.0	0.1	0.3	0.4	0.5	0.3	0.0	0.1	0.0	8.1	4.2	1.6	0.2
Mean	0.02	0.01	0.03	0.17	0.06	0.39	0.05	0.01	0.02	0.01	3.99	3.07	0.25	0.17
Standard Deviation	0.02	ID	0.04	0.05	0.05	0.07	0.06	ID	0.01	ID	1.10	1.39	0.30	0.03
Median	0.03	0.01	0.03	0.16	0.05	0.36	0.05	0.01	0.02	0.01	3.80	3.44	0.15	0.17
Sulfate, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	114	8	86	8	55	7	55	8	55	8
Minimum	14.0	16.0	10.0	12.7	1.5	12.0	ND	8.5	9.0	11.9	7.2	8.2	9.0	12.2
Maximum	18.0	17.9	19.0	16.3	18.8	15.7	81.8	13.8	13.0	13.0	11.0	9.1	15.0	18.0
Mean	15.29	16.78	12.78	14.36	11.34	14.18	4.60	10.73	11.02	12.39	8.83	10.19	12.47	13.50
Standard Deviation	0.96	0.70	2.90	1.20	2.01	1.31	7.62	1.71	0.95	0.37	0.77	3.45	1.26	0.77
Median	15.0	16.8	12.0	14.3	11.4	14.1	4.6	10.7	11.0	12.4	9.0	9.1	13.0	13.5
Chloride, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	111	8	113	8	55	7	55	8	55	8
Minimum	3.0	3.5	2.8	3.9	ND	3.1	ND	3.0	2.8	3.0	3.0	4.4	3.0	3.9
Maximum	4.3	4.1	9.0	5.0	8.8	4.3	89.0	7.0	4.0	3.5	5.1	4.9	5.2	5.9
Mean	3.84	3.69	4.60	4.46	4.59	3.95	26.62	4.65	3.10	3.29	4.17	4.89	4.02	4.32
Standard Deviation	0.29	0.20	1.43	0.34	1.57	0.44	25.73	1.54	0.26	0.16	0.40	0.46	0.47	0.16
Median	4.0	3.6	4.0	4.5	4.2	4.1	22.4	4.4	3.0	3.3	4.0	4.7	4.0	4.4
Dissolved Arsenic, mg/L														
No. of Analyses	41	8	40	8	115	8	118	8	55	7	55	8	55	8
No. of Detections	40	8	40	6	69	6	117	8	55	7	1	0	54	8
Minimum	ND	0.0014	0.0016	ND	ND	ND	ND	0.0087	0.0020	0.0024	ND	ND	ND	0.0017
Maximum	0.0050	0.0018	0.0230	0.0016	0.0040	0.0012	0.3200	0.1240	0.0035	0.0029	0.0021	ND	0.0030	0.0025
Mean	0.0019	0.0016	0.0085	0.0011	0.0011	0.0009	0.1052	0.0645	0.0028	0.0028	0.0005	0.0007	0.0024	0.0024
Standard Deviation	0.0006	0.0001	0.0066	0.0004	0.0007	0.0003	0.0668	0.0541	0.0003	0.0002	ID	ID	0.0005	0.0001
Median	0.0020	0.0016	0.0055	0.0011	0.0010	0.0010	0.1100	0.0833	0.0030	0.0028	0.0005	0.0005	0.0024	0.0024
Dissolved Iron, mg/L														
No. of Analyses	41	8	40	8	115	8	117	8	55	7	55	8	55	8
No. of Detections	40	3	40	8	104	1	117	8	51	2	50	1	48	1
Minimum	ND	ND	0.9	0.7	ND	ND	1.5	2.5	ND	ND	ND	ND	ND	ND
Maximum	0.51	0.07	5.20	1.03	0.89	0.14	59.00	17.00	0.23	0.12	0.17	0.08	0.29	0.07
Mean	0.09	0.01	2.40	0.81	0.09	0.02	23.28	9.45	0.05	0.02	0.04	0.01	0.05	0.01
Standard Deviation	0.08	0.02	1.19	0.13	0.12	ID	11.97	6.85	0.05	ID	0.03	ID	0.06	ID
Median	0.07	0.01	2.10	0.80	0.06	0.01	21.00	13.80	0.04	0.01	0.04	0.01	0.04	0.01

Table 1
Vashon Island Landfill
Summary of Statistical Analyses Groundwater Well Samples
May 1987 through December 2009

	Groundwater in Channel Cc2													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Dissolved Manganese, mg/L														
No. of Analyses	41	8	39	8	115	8	117	8	55	7	55	8	55	8
No. of Detections	41	8	39	8	114	8	117	8	55	7	4	0	6	1
Minimum	0.073	0.053	0.300	0.292	ND	0.086	0.880	0.780	0.034	0.012	ND	ND	ND	ND
Maximum	0.280	0.128	1.600	0.523	0.590	0.120	11.500	2.140	0.061	0.056	0.003	ND	0.044	0.540
Mean	0.18	0.088	0.74	0.36	0.13	0.10	2.84	1.03	0.05	0.05	0.00	0.08	0.00	0.00
Standard Deviation	0.06	0.030	0.34	0.08	0.09	0.01	2.76	0.61	0.01	0.01	0.00	ID	0.01	ID
Median	0.190	0.084	0.640	0.322	0.115	0.110	1.770	0.953	0.051	0.049	0.001	0.001	0.001	0.001
Dissolved Calcium, mg/L														
No. of Analyses	41	8	40	8	89	8	89	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	89	8	55	7	55	8	55	8
Minimum	9.6	9.1	18.0	28.8	4.3	27.0	31.0	29.7	9.1	11.4	9.8	10.7	5.1	10.4
Maximum	18.0	15.0	40.0	36.9	47.9	35.8	149.0	48.1	18.0	14.2	15.9	12.4	14.0	15.0
Mean	12.14	11.93	28.02	33.13	34.90	31.86	75.53	34.24	12.37	12.40	12.45	12.10	11.31	11.38
Standard Deviation	1.84	1.72	5.69	2.74	9.52	3.08	33.35	10.21	1.56	0.94	1.23	1.39	1.63	0.78
Median	12.0	12.0	27.5	33.8	36.0	32.0	60.0	32.9	12.0	12.0	12.0	11.9	12.0	11.3
Dissolved Magnesium, mg/L														
No. of Analyses	41	8	40	8	89	8	89	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	89	8	55	7	55	8	55	8
Minimum	7.7	8.2	17.0	30.6	3.9	30.0	21.0	21.7	6.8	8.4	7.1	8.9	6.6	8.4
Maximum	13.0	12.2	43.0	43.2	53.9	40.3	102.0	35.5	12.0	10.3	11.9	10.6	11.0	13.0
Mean	9.60	10.17	27.32	38.53	38.69	37.91	56.38	24.77	8.48	9.29	9.41	10.13	8.75	9.44
Standard Deviation	1.14	1.32	6.92	3.95	10.92	3.70	26.51	9.11	0.86	0.73	0.83	1.39	0.91	0.78
Median	9.3	10.0	26.0	38.7	37.0	39.8	45.0	26.3	8.3	9.4	9.4	10.0	8.8	9.5
Dissolved Sodium, mg/L														
No. of Analyses	41	8	40	8	89	8	90	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	90	8	55	7	55	8	55	8
Minimum	4.2	6.0	8.9	10.0	2.2	8.5	12.0	13.4	5.0	5.2	4.5	5.7	4.5	4.8
Maximum	8.0	7.6	13.0	12.3	14.0	11.5	27.1	16.8	7.3	6.5	7.3	6.5	6.1	6.1
Mean	6.17	6.79	10.23	11.11	10.82	10.62	17.50	13.77	5.62	5.87	6.14	6.20	5.12	5.28
Standard Deviation	0.90	0.56	0.95	0.85	1.84	0.94	3.84	3.87	0.47	0.41	0.52	0.23	0.37	0.32
Median	6.1	6.8	10.0	11.3	11.0	10.9	17.0	14.8	5.6	5.97	6.2	6.1	5.1	5.4
Dissolved Potasium, mg/L														
No. of Analyses	41	8	40	8	89	8	90	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	90	8	55	7	55	8	55	8
Minimum	1.5	1.7	1.9	2.6	0.6	2.1	2.3	2.6	2.0	2.2	0.9	1.0	1.2	1.8
Maximum	2.9	2.4	3.3	3.2	3.7	2.7	5.3	3.2	3.4	2.6	1.5	1.2	2.3	2.3
Mean	2.02	2.07	2.40	2.92	2.60	2.55	3.74	2.80	2.42	2.45	1.09	1.28	1.84	1.96
Standard Deviation	0.25	0.21	0.35	0.17	0.43	0.19	0.86	0.32	0.24	0.13	0.13	0.45	0.18	0.08
Median	2.0	2.1	2.3	2.9	2.6	2.6	3.5	2.8	2.4	2.46	1.1	1.1	1.8	1.9

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Groundwater in Channel Cc2													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Benzene, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	3	0	0	0	89	8	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	0.3	ND	ND	ND	5.0	0.8	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.11	ND	0.22	0.10	1.27	0.49	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	0.03	ID	ID	ID	1.24	0.23	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	ND	0.1	0.1	0.74	0.45	0.1	0.1	0.1	0.1	0.1	0.1
Chloroethane, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	27	0	9	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	1.2	ND	0.9	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.83	0.10	0.58	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	0.93	ID	0.83	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Toluene, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	1	0	0	2	0	49	0	0	0	0	1	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	0.2	ND	ND	0.3	ND	2.9	ND	ND	ND	ND	0.3	ND	ND
Mean	0.10	0.12	0.10	0.10	0.60	0.10	0.93	0.10	0.10	0.10	0.10	0.13	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	0.92	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Trichloroethene, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	0	0	32	3	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	1.8	0.4	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.22	0.10	0.43	0.19	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	0.46	0.13	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vinyl Chloride, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	40	8	114	8	103	8	1	0	0	0	0	0
Minimum	ND	ND	0.3	0.3	ND	0.2	ND	3.8	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	1.0	0.5	40.0	0.4	38.0	9.7	0.0	ND	ND	ND	ND	ND
Mean	0.01	0.01	0.50	0.42	8.25	0.29	15.45	5.26	0.01	0.01	0.01	0.01	0.01	0.01
Standard Deviation	ID	ID	0.16	0.08	8.67	0.06	8.79	3.01	ID	ID	ID	ID	ID	ID
Median	0.0	0.0	0.51	0.434	6.4	0.294	15.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0

Tab

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Summary of Statistical Analyse Groundwater Well Samples

May 1987 through December 2009

	Groundwater in Channel Cc2													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Total Xylenes, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	0	0	19	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND	ND	ND
Mean	0.20	0.15	0.20	0.15	0.29	0.15	0.49	0.14	0.20	0.16	0.20	0.14	0.20	0.13
Standard Deviation	ID	ID	ID	ID	ID	ID	0.52	ID	ID	ID	ID	ID	ID	ID
Median	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.1
cis-1,2-Dichloroethene, ug/L														
No. of Analyses	41	8	40	8	99	8	102	8	55	7	55	8	56	8
No. of Detections	0	0	39	8	31	0	96	8	0	0	0	0	0	0
Minimum	ND	ND	ND	0.5	ND	ND	ND	4.5	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	8.7	0.8	0.6	ND	22.0	10.2	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	3.38	0.63	0.19	0.10	10.86	7.09	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	2.47	0.12	0.14	ID	4.08	3.67	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	2.3	0.606	0.1	0.1	11.0	8.490	0.1	0.1	0.1	0.1	0.1	0.1
trans-1,2-Dichloroethene, ug/L														
No. of Analyses	41	8	40	8	102	8	105	8	55	7	55	8	56	8
No. of Detections	0	0	9	0	0	0	79	6	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	0.4	ND	ND	ND	0.9	0.3	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.15	0.10	0.15	0.10	0.44	0.19	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	0.10	ID	ID	ID	0.19	0.08	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.220	0.1	0.1	0.1	0.1	0.1	0.1
1,1 Dichloroethane, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	8	0	72	6	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	0.3	ND	1.2	0.3	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.22	0.10	0.50	0.19	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	0.18	ID	0.32	0.09	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.100	0.5	0.210	0.1	0.1	0.1	0.1	0.1	0.1
1,2-Dichloropropane, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	0	0	64	6	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	2.8	0.9	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.22	0.10	0.60	0.37	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	0.58	0.32	ID	ID	ID	ID	ID	ID
Median	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.27	0.10	0.10	0.10	0.10	0.10	0.10

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Groundwater in Channel Cc2													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Trichlorofluoromethane, ug/L														
No. of Analyses	41	8	40	8	89	8	90	8	55	7	55	8	56	8
No. of Detections	0	0	37	8	85	8	21	0	0	0	20	0	0	0
Minimum	ND	ND	ND	4.2	ND	3.9	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	9.0	8.2	23.0	6.1	1.5	ND	ND	ND	0.6	ND	ND	ND
Mean	0.10	0.10	2.57	6.02	8.39	4.76	0.24	0.10	0.10	0.10	0.19	0.10	0.10	0.10
Standard Deviation	ID	ID	2.31	1.55	5.71	0.83	0.29	ID	ID	ID	0.13	ID	ID	ID
Median	0.1	0.1	2.0	6.02	6.2	4.68	0.1	0.100	0.1	0.1	0.1	0.1	0.1	0.1
Dichlorodifluoromethane, ug/L														
No. of Analyses	41	8	39	8	55	8	56	8	55	7	55	8	56	8
No. of Detections	1	0	38	8	53	8	56	8	0	0	11	0	0	0
Minimum	ND	ND	ND	5.5	ND	5.8	0.9	0.6	ND	ND	ND	ND	ND	ND
Maximum	0.2	ND	20.0	12.4	45.0	9.5	10.0	2.6	ND	ND	0.6	ND	ND	ND
Mean	0.10	0.10	6.47	8.30	14.35	7.72	4.49	1.35	0.10	0.10	0.16	0.10	0.10	0.10
Standard Deviation	ID	ID	4.10	2.65	7.90	1.58	1.88	0.91	ID	ID	0.13	ID	ID	ID
Median	0.1	0.1	5.8	7.2	14.0	7.9	4.4	1.3	0.1	0.1	0.1	0.1	0.1	0.1

NOTES:

ID	Insufficient Data. The number of detections is less than 3.
ND	Not Detected (at laboratory MDL).
mg/L	Milligram per liter.
ug/L	Microgram per liter.
Current	Reflects the most recent analysis data, up to eight analyses maximum.

Tab 1
Vashon Is andfill
Summary of Statistical Analyse Groundwater Well Samples
May 1987 through December 2009

	Regional Aquifer / Channel Cc3												
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient			a										
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH field, Standard Units													
No. of Analyses	55	8	25	55	8	56	8	26	8	26	8	26	8
No. of Detections	55	8	25	55	8	56	8	26	8	26	8	26	8
Minimum	6.8	7.7	6.9	6.8	7.3	6.8	7.5	7.9	7.9	6.6	6.5	7.4	7.3
Maximum	8.4	8.1	8.4	8.4	7.8	8.5	7.8	8.6	8.3	7.2	7.0	7.8	7.8
Mean	7.70	7.85	7.52	7.53	7.54	7.71	7.61	8.23	8.09	6.91	6.79	7.60	7.51
Standard Deviation	0.34	0.14	0.36	0.28	0.17	0.27	0.11	0.18	0.13	0.12	0.18	0.13	0.18
Median	7.8	7.9	7.6	7.5	7.6	7.7	7.6	8.2	8.1	6.9	6.8	7.6	7.5
Specific Conductance field, micr													
No. of Analyses	55	8	25	55	8	56	8	26	8	26	8	26	8
No. of Detections	55	8	25	55	8	56	8	26	8	26	8	26	8
Minimum	100	150	153	115	125	100	215	150	160	145	155	165	195
Maximum	190	165	220	185	145	220	230	180	180	190	180	225	225
Mean	157.1	155.6	179.4	136.8	138.1	183.7	220.0	167.7	166.9	174.4	167.5	205.8	210.0
Standard Deviation	12.7	5.6	13.9	10.7	7.0	20.7	5.3	6.5	7.5	10.7	7.1	15.7	10.7
Median	160	155	180	135	140	183	220	170	165	175	168	210	210
Total Dissolved Solids													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	63	104	36	53	90	80	95	90	128	57	110	90	140
Maximum	160	125	130	150	115	170	159	450	210	140	132	170	154
Mean	109.0	118.1	113.1	96.0	103.5	122.9	142.8	129.9	141.1	110.9	123.0	133.8	148.6
Standard Deviation	16.3	8.1	18.8	16.9	8.1	16.5	25.3	67.1	27.9	20.0	9.0	16.3	4.3
Median	110	122	120	98	104	120	155	120	132	115	125	135	149
Alkalinity, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	58	70	74	30	53	64	64	70	71	62	65	88	98
Maximum	100	100	100	66	63	110	109	86	80	78	76	110	140
Mean	72.7	71.1	81.9	56.5	57.6	77.2	97.9	73.4	75.0	68.6	69.6	94.0	105.2
Standard Deviation	4.7	5.2	5.2	5.0	3.1	9.1	14.9	3.6	3.1	3.3	3.5	5.0	14.1
Median	72	73	83	57	58	76	105	72	74	69	70	93	101
Ammonia-N, mg/L													
No. of Analyses	54	8	24	54	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	20	5	0	41	7	26	8	6	0	3	0
Minimum	0.1	0.2	ND	ND	ND	ND	ND	0.2	0.2	ND	ND	ND	ND
Maximum	0.3	0.3	0.1	0.1	ND	0.2	0.1	0.3	0.2	0.5	ND	0.0	ND
Mean	0.18	0.20	0.03	0.01	0.01	0.05	0.05	0.21	0.23	0.04	0.01	0.02	0.01
Standard Deviation	0.04	0.09	0.03	0.01	ID	0.04	0.02	0.04	0.01	0.09	ID	0.01	ID
Median	0.18	0.21	0.02	0.01	0.01	0.04	0.04	0.20	0.23	0.02	0.01	0.02	0.01

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Regional Aquifer / Channel Cc3												
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient			a										
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Nitrate-N, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	22	6	6	55	8	17	4	1	7	25	8	0	1
Minimum	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	ND	1.9	ND	ND
Maximum	0.3	0.018	0.0	1.9	0.8	0.8	0.1	0.1	0.0	6.5	3.4	ND	0.1
Mean	0.03	0.570	0.01	0.74	0.73	0.03	0.03	0.03	0.03	3.28	2.47	0.02	0.01
Standard Deviation	0.05	1.47	0.00	0.19	0.05	0.11	0.04	ID	0.01	1.60	0.54	ID	ID
Median	0.03	0.02	0.01	0.73	0.75	0.02	0.01	0.03	0.03	3.20	2.26	0.03	0.01
Sulfate, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	9.4	8.7	13.0	9.0	9.8	18.0	12.0	12.0	11.0	7.8	8.5	15.0	15.0
Maximum	14.0	10.8	17.0	12.0	10.4	24.0	18.4	14.0	13.4	11.0	10.8	18.0	17.8
Mean	10.40	10.29	14.58	10.03	10.16	20.04	17.04	12.92	12.79	9.47	9.87	16.31	17.05
Standard Deviation	0.71	0.93	0.93	0.53	0.26	1.73	2.10	0.63	0.83	0.96	0.88	0.97	0.95
Median	10.0	10.6	14.5	10.0	10.3	20.0	17.5	13.0	13.2	9.4	10.3	16.0	17.4
Chloride, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	2.7	2.9	3.0	2.6	2.7	4.0	3.7	3.0	3.6	4.0	4.5	3.6	3.7
Maximum	5.0	3.6	6.0	5.0	3.2	6.5	6.7	7.0	5.3	5.3	5.6	5.6	4.3
Mean	3.15	3.50	3.63	3.07	3.02	5.13	5.87	3.97	3.99	4.62	5.12	4.05	4.02
Standard Deviation	0.38	0.42	0.69	0.42	0.17	0.54	0.93	0.67	0.54	0.49	0.35	0.35	0.19
Median	3.0	3.4	3.8	3.0	3.1	5.0	6.2	4.0	3.9	4.7	5.1	4.0	4.0
Dissolved Arsenic, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	2	0	26	8
Minimum	0.0021	0.0047	0.0030	0.0017	0.0020	0.0017	0.0017	0.0020	0.0032	ND	ND	0.0039	0.0046
Maximum	0.0220	0.0064	0.0070	0.0056	0.0023	0.0270	0.0024	0.0032	0.0034	0.0013	ND	0.0080	0.0052
Mean	0.0080	0.0053	0.0050	0.0021	0.0022	0.0053	0.0020	0.0025	0.0033	0.0006	0.0005	0.0050	0.0048
Standard Deviation	0.0037	0.0021	0.0011	0.0005	0.0001	0.0043	0.0002	0.0004	0.0001	ID	ID	0.0009	0.0002
Median	0.0070	0.0061	0.0050	0.0020	0.0022	0.0040	0.0019	0.0027	0.0033	0.0005	0.0005	0.0050	0.0047
Dissolved Iron, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	1	24	50	1	54	8	26	8	25	1	26	8
Minimum	0.0	ND	0.1	ND	ND	ND	0.0	0.0	0.0	ND	ND	0.290	0.451
Maximum	0.22	0.04	4.00	0.42	0.05	0.19	0.19	0.23	0.12	0.30	0.04	0.81	0.88
Mean	0.06	0.02	0.35	0.05	0.01	0.06	0.07	0.12	0.06	0.06	0.01	0.61	0.69
Standard Deviation	0.04	ID	0.78	0.07	ID	0.04	0.05	0.04	0.03	0.05	ID	0.14	0.13
Median	0.05	0.01	0.20	0.03	0.01	0.06	0.05	0.12	0.05	0.05	0.01	0.66	0.72

Tab'
Vashon Is[illegible] andfill
Summary of Statistical Analyses [illegible] Groundwater Well Samples
May 1987 through December 2009

	Regional Aquifer / Channel Cc3												
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient			a										
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Dissolved Manganese, mg/L													
No. of Analyses	54	8	24	55	8	54	8	26	8	26	8	26	8
No. of Detections	52	8	24	2	0	54	7	26	8	1	0	26	8
Minimum	ND	0.120	0.077	ND	ND	0.160	ND	0.059	0.042	ND	ND	0.086	0.068
Maximum	0.190	0.141	0.130	0.140	ND	0.560	1.350	0.080	0.065	0.002	ND	0.100	0.110
Mean	0.13	0.11	0.10	0.00	0.00	0.35	0.69	0.07	0.06	0.00	0.00	0.093	0.092
Standard Deviation	0.04	0.05	0.01	ID	ID	0.13	0.44	0.01	0.01	ID	ID	0.004	0.012
Median	0.140	0.133	0.094	0.001	0.001	0.325	0.566	0.067	0.056	0.001	0.001	0.093	0.092
Dissolved Calcium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	9.2	11.9	12.0	7.7	9.0	9.2	10.0	14.0	11.2	11.0	11.7	16.0	13.6
Maximum	18.0	16.0	18.0	13.0	9.9	18.0	18.1	18.3	17.1	17.0	13.0	23.0	19.0
Mean	12.88	12.76	15.79	9.69	9.53	13.33	15.45	15.90	15.04	13.17	12.59	18.32	17.86
Standard Deviation	1.71	0.77	1.53	1.21	0.39	1.81	2.39	1.23	1.74	1.34	0.47	1.49	1.79
Median	13.0	12.4	16.0	9.4	9.7	13.0	16.0	16.0	15.5	13.0	12.8	18.0	18.6
Dissolved Magnesium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	6.3	7.3	8.4	6.2	7.5	8.8	8.4	5.4	5.6	8.8	10.0	10.0	10.8
Maximum	11.0	8.8	11.0	9.5	8.5	16.0	16.2	7.9	6.9	13.0	11.5	15.0	14.3
Mean	7.94	8.63	9.92	7.40	8.02	11.70	14.53	6.46	6.45	10.34	10.83	12.07	13.29
Standard Deviation	0.77	0.32	0.62	0.71	0.37	1.32	2.58	0.63	0.41	1.11	0.48	1.12	1.16
Median	8.0	8.7	9.9	7.3	8.1	11.0	15.1	6.4	6.5	10.0	11.0	12.0	13.5
Dissolved Sodium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	4.8	5.4	4.9	4.3	4.7	5.1	4.8	6.7	6.5	5.3	6.0	5.2	5.2
Maximum	7.5	6.3	7.0	10.0	5.4	7.5	7.3	9.2	9.0	7.4	6.7	7.3	6.7
Mean	5.95	5.99	5.90	5.49	5.12	6.12	6.68	7.72	8.35	6.10	6.38	5.92	6.15
Standard Deviation	0.62	0.23	0.52	1.15	0.22	0.50	0.80	0.68	0.78	0.61	0.25	0.52	0.47
Median	6.0	6.0	5.9	5.2	5.2	6.1	6.9	7.6	8.7	6.1	6.4	5.8	6.3
Dissolved Potasium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Minimum	1.6	2.2	1.7	1.4	1.5	1.9	1.7	2.3	2.1	1.0	1.2	1.7	1.6
Maximum	3.6	2.7	2.6	2.3	1.8	3.3	2.7	3.3	3.1	1.5	1.4	2.5	2.2
Mean	2.51	2.31	2.08	1.72	1.65	2.37	2.44	2.76	2.79	1.23	1.34	1.95	2.05
Standard Deviation	0.33	0.58	0.21	0.21	0.08	0.27	0.32	0.25	0.30	0.13	0.06	0.18	0.21
Median	2.5	2.5	2.1	1.7	1.7	2.3	2.6	2.8	2.9	1.2	1.4	1.9	2.1

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Regional Aquifer / Channel Cc3												
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient			a										
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Benzene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloroethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Toluene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	1	0	0	0	1	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	0.2	ND	ND	ND	0.9	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.21	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Trichloroethene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	1	0	1	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	0.4	ND	0.3	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vinyl Chloride, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tab
Vashon Is andfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Regional Aquifer / Channel Cc3												
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient			a										
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Total Xylenes, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.20	0.14	0.20	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
cis-1,2-Dichloroethene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
trans-1,2-Dichloroethene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1,1 Dichloroethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1,2-Dichloropropane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Table 3-1
Vashon Island Landfill
Summary of Statistical Analyses for Groundwater Well Samples
May 1987 through December 2009

	Regional Aquifer / Channel Cc3												
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient			a										
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Trichlorofluoromethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	1	0	0	0	0	0	0	1	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	0.7	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND
Mean	0.10	0.10	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Dichlorodifluoromethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	2	0	0	0
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	ND	ND
Mean	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.10	0.10	0.10
Standard Deviation	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Median	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

NOTES:

ID	Insufficient Data. The number of detections is less than 3.
ND	Not Detected (at laboratory MDL).
mg/L	Milligram per liter.
ug/L	Microgram per liter.
Current	Reflects the most recent analysis data, up to eight analyses maximum.
a	(Decommisioned 2003)

Tabl

Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in or Adjacent to Cc1						
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient Location							
Time Interval	Long	Long	Long	Short	Long	Short	Long
pH field, Standard Units							
No. of Analyses	17	21	56	8	61	8	36
No. of Detections	17	21	56	8	61	8	36
Trend	--	--	--	--	--	--	--
S - value	0.0	8.0	-47.0	-9.0		0.0	34.0
Probability	0.967	0.833	0.700	0.337	0.000	1.000	0.653
Significant	NO	NO	NO	NO	YES	NO	NO
Specific Conductance field, micromhos/cm							
No. of Analyses	18	21	56	8	60	8	36
No. of Detections	18	21	56	8	60	8	36
Trend	I	D	I	D	--	--	--
S - value	76.0	-74.0	381.0	-17.0		-4.0	-85.0
Probability	0.004	0.027	0.001	0.047	0.000	0.720	0.253
Significant	YES	YES	YES	YES	YES	NO	NO
Total Dissolved Solids							
No. of Analyses	19	16	54	8	64	8	33
No. of Detections	19	16	54	8	64	8	33
Trend	--	D	--	--	I	--	D
S - value	3.0	-45.0	-63.0	7.0	288.0	1.0	-269.0
Probability	0.944	0.048	0.604	0.473	0.016	1.000	0.000
Significant	NO	YES	NO	NO	YES	NO	YES
Alkalinity, mg/L							
No. of Analyses	5	14	55	8	60	8	15
No. of Detections	5	14	55	8	60	8	15
Trend	--	--	I	--	I	--	D
S - value	-1.0	-27.0	282.0	-7.0	863.0	8.0	-63.0
Probability	1.000	0.155	0.019	0.473	0.000	0.398	0.002
Significant	NO	NO	YES	NO	YES	NO	YES
Ammonia-N, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	4	9	7	2	11	0	19
Trend	--	D	I	--	I	--	--
S - value	-30.0	-71.0	461.0	6.0	265.0	-7.0	-133.0
Probability	0.605	0.035	0.000	--	0.027	--	0.241
Significant	NO	YES	YES	--	YES	--	NO
Nitrate-N, mg/L							
No. of Analyses	29	21	55	8	65	8	48
No. of Detections	21	21	55	8	63	8	23
Trend	--	--	--	--	--	--	I
S - value	-8.0	54.0	110.0	-8.0	-168.0	-6.0	376.0
Probability	0.896	0.110	0.362	0.398	0.162	0.548	0.001
Significant	NO	NO	NO	NO	NO	NO	YES
Sulfate, mg/L							
No. of Analyses	29	21	55	8	64	8	48
No. of Detections	29	21	55	8	64	8	48
Trend	--	D	--	--	D	--	I
S - value	-57.0	-78.0	-5.0	10.0	-340.0	2.0	416.0
Probability	0.294	0.020	0.973	0.276	0.005	0.904	0.000
Significant	NO	YES	NO	NO	YES	NO	YES

Table 3-2
Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in or Adjacent to Cc1						
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient Location							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Chloride, mg/L							
No. of Analyses	29	21	55	8	65	8	48
No. of Detections	29	21	54	8	65	8	46
Trend	--	D	--	--	D	--	--
S - value	95.0	-69.0	172.0	8.0	-511.0	6.0	102.0
Probability	0.078	0.040	0.153	0.398	0.000	0.548	0.369
Significant	NO	YES	NO	NO	YES	NO	NO
Dissolved Iron, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	14	18	53	1	53	2	40
Trend	--	--	I	--	I	--	--
S - value	-96.0	-62.0	403.0	-7.0	634.0	-11.0	176.0
Probability	0.090	0.065	0.001	--	0.000	--	0.120
Significant	NO	NO	YES	--	YES	--	NO
Dissolved Manganese, mg/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	6	17	6	1	45	1	42
Trend	D	D	--	--	D	--	I
S - value	-134.0	-104.0	195.0	5.0	-346.0	-5.0	306.0
Probability	0.018	0.002	0.105	--	0.004	--	0.007
Significant	YES	YES	NO	--	YES	--	YES
Dissolved Calcium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Trend	I	--	--	--	--	--	D
S - value	25.0	-13.0	-24.0	8.0	153.0	6.0	-191.0
Probability	0.032	0.553	0.847	0.398	0.204	0.548	0.000
Significant	YES	NO	NO	NO	NO	NO	YES
Dissolved Magnesium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Trend	I	--	--	--	I	--	D
S - value	28.0	-5.0	-15.0	4.0	325.0	2.0	-170.0
Probability	0.016	0.843	0.907	0.720	0.007	0.904	0.000
Significant	YES	NO	NO	NO	YES	NO	YES
Dissolved Sodium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Trend	--	--	D	--	--	--	D
S - value	18.0	-8.0	-370.0	12.0	-225.0	4.0	-181.0
Probability	0.128	0.729	0.002	0.178	0.061	0.720	0.000
Significant	NO	NO	YES	NO	NO	NO	YES
Dissolved Potassium, mg/L							
No. of Analyses	10	15	55	8	65	8	25
No. of Detections	10	15	55	8	65	8	25
Trend	--	D	D	--	D	--	D
S - value	20.0	-50.0	-239.0	13.0	-290.0	9.0	-194.0
Probability	0.089	0.015	0.046	0.143	0.016	0.337	0.000
Significant	NO	YES	YES	NO	YES	NO	YES

Tab

Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in or Adjacent to Cc1						
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient Location							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Benzene, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	1	0	1	0	1	0	0
Trend	--	--	--	--	--	--	--
S - value	-203.0	-72.0	-45.0	0.0	0.0	0.0	-533.0
Probability	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--
Vinyl chloride, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	1	0	2	0	23
Trend	--	--	--	--	--	--	D
S - value	-134.0	-78.0	-43.0	0.0	43.0	0.0	-386.0
Probability	--	--	--	--	--	--	0.001
Significant	--	--	--	--	--	--	YES
cis 1,2-Dichloroethene, ug/L							
No. of Analyses	17	18	55	8	65	8	35
No. of Detections	0	0	0	0	1	0	14
Trend	--	--	--	--	--	--	I
S - value	-62.0	-45.0	0.0	0.0	-35.0	0.0	167.0
Probability	--	--	--	--	--	--	0.018
Significant	--	--	--	--	--	--	YES
trans 1,2-Dichloroethene, ug/L							
No. of Analyses	21	20	55	8	65	8	40
No. of Detections	0	0	0	0	0	0	1
Trend	--	--	--	--	--	--	--
S - value	-110.0	-75.0	0.0	0.0	0.0	0.0	-303.0
Probability	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--
1,1-Dichloroethane, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	0	0	0	0	17
Trend	--	--	--	--	--	--	D
S - value	-200.0	-72.0	0.0	0.0	0.0	0.0	-270.0
Probability	--	--	--	--	--	--	0.017
Significant	--	--	--	--	--	--	YES
1,2-Dichloropropane, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--
S - value	-200.0	-72.0	0.0	0.0	0.0	0.0	-533.0
Probability	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--

Table 3-2
Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in or Adjacent to Cc1						
Well Location	MW-1	MW-3	MW-10		MW-13		MW-4
Gradient Location							
Time Interval	Long	Long	Long	Short	Long	Short	Long
Chloroethane, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	0	0	0	0	0	0	6
Trend	--	--	--	--	--	--	D
S - value	-77.0	-61.0	0.0	0.0	0.0	0.0	-461.0
Probability	--	--	--	--	--	--	0.000
Significant	--	--	--	--	--	--	YES
Toluene, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	2	0	1	0	1	0	0
Trend	--	--	--	--	--	--	--
S - value	-88.0	-67.0	-45.0	0.0	0.0	0.0	-421.0
Probability	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--
Trichloroethene, ug/L							
No. of Analyses	30	21	55	8	65	8	48
No. of Detections	1	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--
S - value	-215.0	-72.0	0.0	0.0	0.0	0.0	-533.0
Probability	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--
Total Xylenes, ug/L							
No. of Analyses	29	21	55	8	65	8	48
No. of Detections	0	0	0	0	1	0	0
Trend	--	--	--	--	--	--	--
S - value	-190.0	-72.0	0.0	-16.0	0.0	-16.0	-533.0
Probability	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--
Trichlorofluoromethane, ug/L							
No. of Analyses	10	15	55	8	65	8	26
No. of Detections	0	7	1	0	1	0	22
Trend	--	--	--	--	--	--	--
S - value	0.0	-1.0	-47.0	0.0	-35.0	0.0	-50.0
Probability	--	1.000	--	--	--	--	0.280
Significant	--	NO	--	--	--	--	NO
Dichlorodifluoromethane, ug/L							
No. of Analyses	5	14	55	8	60	8	16
No. of Detections	0	0	0	0	1	0	12
Trend	--	--	--	--	--	--	D
S - value	0.0	0.0	0.0	0.0	-35.0	0.0	-61.0
Probability	--	--	--	--	--	--	0.007
Significant	--	--	--	--	--	--	YES

NOTES

Long Period of record excluding the last 8 sampling quarters.
The maximum No. of Analyses considered for the statistics are 40.
Short Results fron the most recent sampling quarters

Tab 2

Vashon Island Landfill

Trends in Individual Wells

May 1987 through December 2010

	Groundwater in Cc2 and between Cc2 and Cc3													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient Location	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH field, Standard Units														
No. of Analyses	40	8	41	8	111	8	104	8	56	7	55	8	56	8
No. of Detections	40	8	41	8	111	8	104	8	56	7	55	8	56	8
Trend	I	--	--	--	D	--	--	--	--	--	D	--	--	--
S - value	302.0	8.0	-63.0	9.0	-476.0	4.0	-99.0	3.0	147.0	-16.0	-374.0	0.0	24.0	-1.0
Probability	0.000	0.398	0.486	0.337	0.000	0.720	0.412	0.812	0.222	0.062	0.002	1.000	0.847	1.000
Significant	YES	NO	NO	NO	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO
Specific Conductance field, micromhos/cm														
No. of Analyses	41	8	41	8	110	8	103	8	56	7	55	8	56	8
No. of Detections	41	8	41	8	110	8	103	8	56	7	55	8	56	8
Trend	--	--	--	--	I	--	D	--	--	--	--	--	I	--
S - value	128.0	-5.0	159.0	-11.0	485.0	-11.0	-318.0	-8.0	152.0	-4.0	6.0	4.0	377.0	9.0
Probability	0.154	0.634	0.076	2.E-01	0.000	2.E-01	0.008	0.398	0.207	0.720	0.967	0.720	0.002	0.337
Significant	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	YES	NO
Total Dissolved Solids														
No. of Analyses	40	8	40	8	103	8	102	8	55	7	55	8	55	8
No. of Detections	40	8	40	8	103	8	102	8	55	7	55	8	55	8
Trend	--	--	--	D	I	D	D	--	--	--	--	--	--	--
S - value	-76.0	-2.0	145.0	-21.0	557.0	-21.0	-555.0	-8.0	61.0	6.0	-144.0	1.0	-218.0	12.0
Probability	0.382	0.904	0.093	0.010	0.000	0.010	0.000	0.398	0.616	0.472	0.232	1.000	0.069	0.178
Significant	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO
Alkalinity, mg/L														
No. of Analyses	41	8	40	8	56	8	57	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	56	8	57	8	55	7	55	8	55	8
Trend	--	--	I	D	I	D	D	--	--	--	D	--	I	--
S - value	-139.0	-10.0	395.0	-18.0	652.0	-18.0	-525.0	-13.0	27.0	3.0	-289.0	-10.0	299.0	1.0
Probability	0.121	0.276	0.000	0.032	0.000	0.032	0.000	0.143	0.828	0.772	0.016	0.276	0.013	1.000
Significant	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO	YES	NO	YES	NO
Ammonia-N, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	55	8
No. of Detections	11	6	17	1	15	0	94	8	10	1	7	0	10	0
Trend	--	--	--	--	I	--	--	--	I	--	I	--	I	--
S - value	1.0	6.0	-109.0	-1.0	353.0	-1.0	38.0	4.0	334.0	-9.0	409.0	-7.0	285.0	-7.0
Probability	1.000	0.548	0.208	--	0.003	--	0.757	0.720	0.005	--	0.001	--	0.018	--
Significant	NO	NO	NO	--	YES	--	NO	NO	YES	--	YES	--	YES	--
Nitrate-N, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	56	8
No. of Detections	4	2	7	8	40	8	17	2	9	1	54	8	56	7
Trend	I	--	I	--	I	--	--	--	I	--	--	--	I	--
S - value	365.0	-3.0	231.0	1.0	516.0	1.0	140.0	-4.0	576.0	-11.0	144.0	-6.0	243.0	16.0
Probability	0.000	--	0.007	1.000	0.000	1.000	0.245	--	0.000	--	0.232	0.548	0.043	0.062
Significant	YES	--	YES	NO	YES	NO	NO	--	YES	--	NO	NO	YES	NO
Sulfate, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	114	8	86	8	55	7	55	8	55	8
Trend	I	I	D	I	D	I	I	--	I	--	--	--	I	--
S - value	414.0	23.0	-284.0	20.0	-282.0	20.0	607.0	2.0	652.0	11.0	57.0	-2.0	455.0	10.0
Probability	0.000	0.004	0.001	0.014	0.019	0.014	0.000	0.904	0.000	0.136	0.639	0.904	0.000	0.276
Significant	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	YES	NO

Table 3-2
Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in Cc2 and between Cc2 and Cc3													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient Location	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Chloride, mg/L														
No. of Analyses	41	8	40	8	114	8	118	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	111	8	113	8	55	7	55	8	55	8
Trend	D	--	D	--	D	--	D	--	--	--	I	I	--	--
S - value	-332.0	6.0	-451.0	0.0	-432.0	0.0	-691.0	-4.0	67.0	-4.0	359.0	21.0	199.0	10.0
Probability	0.000	0.548	0.000	1.000	0.000	1.000	0.000	0.720	0.581	0.667	0.003	0.010	0.098	0.276
Significant	YES	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	YES	NO	NO
Dissolved Iron, mg/L														
No. of Analyses	41	8	40	8	115	8	117	8	55	7	55	8	55	8
No. of Detections	40	3	40	8	104	1	117	8	51	2	50	1	48	1
Trend	I	--	D	--	I	--	--	D	I	--	I	--	I	--
S - value	218.0	-2.0	-270.0	-4.0	587.0	-4.0	-10.0	-2.0	619.0	-11.0	539.0	-7.0	497.0	-7.0
Probability	0.015	--	0.002	0.720	0.000	--	0.940	0.000	0.000	--	0.000	--	0.000	--
Significant	YES	NO	YES	NO	YES	--	NO	YES	YES	--	YES	--	YES	--
Dissolved Manganese, mg/L														
No. of Analyses	41	8	39	8	115	8	117	8	55	7	55	8	55	8
No. of Detections	41	8	39	8	114	8	117	8	55	7	4	0	6	1
Trend	D	--	D	--	I	--	D	--	I	--	--	--	--	--
S - value	-309.0	4.0	-340.0	-2.0	296.0	-2.0	-265.0	-10.0	447.0	5.0	11.0	0.0	124.0	-7.0
Probability	0.000	0.720	0.000	0.904	0.014	0.904	0.027	0.276	0.000	0.562	0.933	--	0.304	--
Significant	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO	--	NO	--
Dissolved Calcium, mg/L														
No. of Analyses	41	8	40	8	89	8	89	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	89	8	55	7	55	8	55	8
Trend	--	--	--	--	I	--	D	--	--	--	--	--	--	--
S - value	65.0	7.0	80.0	-4.0	248.0	-4.0	-656.0	-12.0	54.0	8.0	-139.0	-7.0	205.0	3.0
Probability	0.472	0.473	0.357	0.720	0.039	0.720	0.000	0.178	0.658	0.310	0.248	0.473	0.088	0.812
Significant	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	NO
Dissolved Magnesium, mg/L														
No. of Analyses	41	8	40	8	89	8	89	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	89	8	55	7	55	8	55	8
Trend	--	--	I	--	I	--	D	--	--	--	D	--	--	--
S - value	-41.0	6.0	262.0	-7.0	313.0	-7.0	-676.0	-10.0	-7.0	11.0	-322.0	6.0	199.0	8.0
Probability	0.653	0.548	0.002	0.473	0.009	0.473	0.000	0.276	0.960	0.136	0.007	0.548	0.098	0.812
Significant	NO	NO	YES	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO	NO
Dissolved Sodium, mg/L														
No. of Analyses	41	8	40	8	89	8	90	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	90	8	55	7	55	8	55	8
Trend	--	--	--	--	--	--	--	--	D	I	D	--	--	--
S - value	85.0	10.0	35.0	7.0	16.0	7.0	-173.0	-4.0	-294.0	15.0	-411.0	8.0	-11.0	8.0
Probability	0.345	0.276	0.692	0.473	0.900	0.473	0.150	0.720	0.014	0.030	0.001	0.398	0.933	0.398
Significant	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO
Dissolved Potassium, mg/L														
No. of Analyses	41	8	40	8	89	8	90	8	55	7	55	8	55	8
No. of Detections	41	8	40	8	89	8	90	8	55	7	55	8	55	8
Trend	--	--	I	--	--	--	D	--	D	--	D	--	--	--
S - value	-27.0	0.0	187.0	-8.0	198.0	-8.0	-408.0	6.0	-298.0	8.0	-248.0	11.0	89.0	-3.0
Probability	0.770	1.000	0.030	0.398	0.099	0.398	0.001	0.548	0.013	0.310	0.039	0.227	0.462	0.812
Significant	NO	NO	YES	NO	NO	NO	YES	NO	YES	NO	YES	NO	NO	NO

Tab.

Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in Cc2 and between Cc2 and Cc3													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient Location	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Benzene, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	3	0	0	0	89	8	0	0	0	0	0	0
Trend	--	--	--	--	--	--	D	--	--	--	--	--	--	--
S - value	0.0	0.0	-83.0	0.0	0.0	0.0	-524.0	-10.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	0.000	0.276	--	--	--	--	--	--
Significant	--	--	NO	--	--	--	YES	NO	--	--	--	--	--	--
Vinyl chloride, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	40	8	114	8	103	8	1	0	0	0	0	0
Trend	--	--	D	D	D	D	D	--	--	--	--	--	--	--
S - value	0.0	0.0	-187.0	-20.0	-729.0	-20.0	-785.0	-4.0	48.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	0.030	0.014	0.000	0.014	0.000	0.720	--	--	--	--	--	--
Significant	--	--	YES	YES	YES	YES	YES	NO	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L														
No. of Analyses	41	8	40	8	99	8	102	8	55	7	55	8	56	8
No. of Detections	0	0	39	8	31	0	96	8	0	0	0	0	0	0
Trend	--	--	D	I	D	--	D	--	--	--	--	--	--	--
S - value	0.0	0.0	-491.0	18.0	-379.0	18.0	-330.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	0.000	0.032	0.002	--	0.006	0.812	--	--	--	--	--	--
Significant	--	--	YES	YES	YES	--	YES	NO	--	--	--	--	--	--
trans 1,2-Dichloroethene, ug/L														
No. of Analyses	41	8	40	8	102	8	105	8	55	7	55	8	56	8
No. of Detections	0	0	9	0	0	0	79	6	0	0	0	0	0	0
Trend	--	--	D	--	--	--	D	--	--	--	--	--	--	--
S - value	0.0	0.0	-256.0	0.0	0.0	0.0	-240.0	-6.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	0.003	--	--	--	0.046	0.548	--	--	--	--	--	--
Significant	--	--	YES	--	--	--	YES	NO	--	--	--	--	--	--
1,1-Dichloroethane, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	8	0	72	6	0	0	0	0	0	0
Trend	--	--	--	--	--	--	D	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	19.0	0.0	-561.0	-9.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	0.880	--	0.000	0.337	--	--	--	--	--	--
Significant	--	--	--	--	NO	--	YES	NO	--	--	--	--	--	--
1,2-Dichloropropane, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	0	0	64	6	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	-217.0	-11.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	0.071	0.227	--	--	--	--	--	--
Significant	--	--	--	--	--	--	NO	NO	--	--	--	--	--	--

Table 3-2
Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

	Groundwater in Cc2 and between Cc2 and Cc3													
Well Location	MW-20		MW-21		MW-2		MW-5D		MW-14		MW-8		MW-9	
Gradient Location	Up		Down		Down		Down							
Time Interval	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Chloroethane, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	27	0	9	0	0	0	0	0	0	0
Trend	--	--	--	--	D	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	-516.0	0.0	-45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	0.000	--	0.713	--	--	--	--	--	--	--
Significant	--	--	--	--	YES	--	NO	--	--	--	--	--	--	--
Toluene, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	1	0	0	2	0	49	0	0	0	0	1	0	0
Trend	--	--	--	--	--	--	D	--	--	--	--	--	--	--
S - value	0.0	-3.0	0.0	0.0	0.0	0.0	-375.0	0.0	0.0	0.0	0.0	-3.0	0.0	0.0
Probability	--	--	--	--	--	--	0.002	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	YES	--	--	--	--	--	--	--
Trichloroethene, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	0	0	32	3	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	-46.0	-3.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	0.707	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	NO	NO	--	--	--	--	--	--
Total Xylenes, ug/L														
No. of Analyses	41	8	40	8	126	8	119	8	55	7	55	8	56	8
No. of Detections	0	0	0	0	0	0	19	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	-16.0	0.0	-16.0	0.0	-16.0	0.0	-16.0	0.0	-12.0	0.0	-16.0	0.0	-16.0
Probability	--	--	--	--	--	--	0.993	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	NO	--	--	--	--	--	--	--
Trichlorofluoromethane, ug/L														
No. of Analyses	41	8	40	8	89	8	90	8	55	7	55	8	56	8
No. of Detections	0	0	37	8	85	8	21	0	0	0	20	0	0	0
Trend	--	--	I	D	--	D	I	--	--	--	D	--	--	--
S - value	0.0	0.0	325.0	-18.0	188.0	-18.0	241.0	0.0	0.0	0.0	-425.0	0.0	0.0	0.0
Probability	--	--	0.000	0.032	0.118	0.032	0.045	--	--	--	0.000	--	--	--
Significant	--	--	YES	YES	NO	YES	YES	--	--	--	YES	--	--	--
Dichlorodifluoromethane, ug/L														
No. of Analyses	41	8	39	8	55	8	56	8	55	7	55	8	56	8
No. of Detections	1	0	38	8	53	8	56	8	0	0	11	0	0	0
Trend	--	--	I	--	D	--	D	--	--	--	--	--	--	--
S - value	-34.0	0.0	237.0	-12.0	-236	-12.0	-558.0	4.0	0.0	0.0	-233.0	0.0	0.0	0.0
Probability	--	--	0.004	0.178	0.049	0.178	0.000	0.720	--	--	0.052	--	--	--
Significant	--	--	YES	NO	YES	NO	YES	NO	--	--	NO	--	--	--

NOTES

Gradient indicates location of monitoring AYell relative to the hydraulic gradient and the placement of soild AYaste

Tab E

Vashon Island Landfill

Trends in Individual Wells

May 1987 through December 2010

Groundwater in Cc3 and the Regional Aquifer													
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient Location	Up		Side	Side		Down		(Installed 2003)		(Installed 2003)		(Installed 2003)	
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
pH field, Standard Units													
No. of Analyses	55	8	25	55	8	56	8	26	8	26	8	26	8
No. of Detections	55	8	25	55	8	56	8	26	8	26	8	26	8
Trend	I	--	--	--	--	--	--	D	--	--	--	--	--
S - value	312.0	7.0	-17.0	-63.0	2.0	37.0	-2.0	-93.0	-4.0	-51.0	-12.0	-10.0	-6.0
Probability	0.009	0.473	0.709	0.604	0.904	0.763	0.904	0.043	0.720	0.270	0.178	0.843	0.548
Significant	YES	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO
Specific Conductance field, micromhos/cm													
No. of Analyses	55	8	25	55	8	56	8	26	8	26	8	26	8
No. of Detections	55	8	25	55	8	56	8	26	8	26	8	26	8
Trend	--	--	--	--	--	I	--	--	--	--	--	I	--
S - value	218.0	-5.0	-16.0	128.0	5.0	403.0	0.0	76.0	-4.0	-7.0	-12.0	132.0	0.0
Probability	0.069	0.634	0.726	0.288	0.634	0.001	1.000	0.098	0.720	0.895	0.178	0.004	1.000
Significant	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	YES	NO
Total Dissolved Solids													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	--	--	I	--	D	--	--	--	--	--	--	--	--
S - value	-113.0	-6.0	99.0	-192.0	-18.0	171.0	15.0	5.0	-1.0	12.0	9.0	59.0	9.0
Probability	0.349	0.548	0.015	0.110	0.032	0.155	0.085	0.930	1.000	0.808	0.337	0.102	0.337
Significant	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO
Alkalinity, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	--	--	--	D	--	I	I	--	--	--	--	I	--
S - value	-24.0	-6.0	8.0	-325.0	-6.0	961.0	17.0	56.0	-3.0	-5.0	-10.0	103.0	-5.0
Probability	0.847	0.548	0.862	0.007	0.548	0.000	0.047	0.225	0.812	0.930	0.276	0.004	0.634
Significant	NO	NO	NO	YES	NO	YES	YES	NO	NO	NO	NO	YES	NO
Ammonia-N, mg/L													
No. of Analyses	54	8	24	54	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	20	5	0	41	7	26	8	6	0	6	0
Trend	--	--	D	I	--	D	I	--	--	--	--	--	--
S - value	-64.0	-10.0	-152.0	410.0	-7.0	-453.0	22.0	-74.0	-11.0	-16.0	-7.0	-15.0	-5.0
Probability	0.598	0.276	0.000	0.001	--	0.000	0.006	0.108	0.227	0.741	--	0.693	--
Significant	NO	NO	YES	YES	--	YES	YES	NO	NO	NO	--	NO	--
Nitrate-N, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	22	6	6	55	8	17	4	1	7	25	8	25	1
Trend	I	--	--	I	--	I	--	--	--	--	--	--	--
S - value	435.0	-5.0	-49.0	635.0	-6.0	484.0	2.0	31.0	0.0	21.0	12.0	19.0	12.0
Probability	0.000	0.634	0.234	0.000	0.548	0.000	0.904	--	1.000	0.659	0.178	0.612	--
Significant	YES	NO	NO	YES	NO	YES	NO	--	NO	NO	NO	NO	--
Sulfate, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	D	I	--	--	--	D	--	I	--	D	--	I	I
S - value	-341.0	23.0	-65.0	-97.0	9.0	-710.0	5.0	92.0	14.0	-123.0	-1.0	137.0	17.0
Probability	0.004	0.004	0.112	0.422	0.337	0.000	0.634	0.045	0.108	0.007	1.000	0.000	0.047
Significant	YES	YES	NO	NO	NO	YES	NO	YES	NO	YES	NO	YES	YES

Table 3-2
Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

Groundwater in Cc3 and the Regional Aquifer													
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient Location	Up		Side	Side		Down		(Installed 2003)		(Installed 2003)		(Installed 2003)	
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Chloride, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	--	--	--	--	--	I	--	D	--	I	--	--	--
S - value	106.0	4.0	35.0	-101.0	12.0	299.0	8.0	-97.0	8.0	99.0	2.0	-32.0	-4.0
Probability	0.380	0.720	0.399	0.403	0.178	0.013	0.398	0.034	0.398	0.031	0.904	0.382	0.720
Significant	NO	NO	NO	NO	NO	YES	NO	YES	NO	YES	NO	NO	NO
Dissolved Iron, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	1	24	50	1	54	8	26	8	25	1	25	8
Trend	I	--	--	I	--	I	--	--	--	--	--	I	--
S - value	290.0	-7.0	13.0	410.0	-7.0	631.0	15.0	27.0	-1.0	18.0	-7.0	176.0	-8.0
Probability	0.016	--	0.766	0.001	--	0.000	0.085	0.567	1.000	0.708	--	0.000	0.398
Significant	YES	--	NO	YES	--	YES	NO	NO	NO	NO	--	YES	NO
Dissolved Manganese, mg/L													
No. of Analyses	54	8	24	55	8	54	8	26	8	26	8	26	8
No. of Detections	52	8	24	2	0	54	7	26	8	1	0	1	8
Trend	--	--	D	--	--	I	--	D	--	--	--	--	--
S - value	231.0	7.0	-98.0	12.0	0.0	747.0	12.0	-188.0	0.0	0.0	0.0	-10.0	-6.0
Probability	0.054	0.473	0.016	--	--	0.000	0.178	0.000	1.000	--	--	--	0.548
Significant	NO	NO	YES	--	--	YES	NO	YES	NO	--	--	--	NO
Dissolved Calcium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	--	--	--	--	--	I	--	D	--	D	--	--	--
S - value	-47.0	2.0	-41.0	34.0	-9.0	356.0	6.0	-103.0	14.0	-94.0	-16.0	-20.0	9.0
Probability	0.700	0.904	0.321	0.783	0.337	0.003	0.548	0.025	0.108	0.040	0.062	0.592	0.337
Significant	NO	NO	NO	NO	NO	YES	NO	YES	NO	YES	NO	NO	NO
Dissolved Magnesium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	D	--	--	--	--	I	I	D	--	--	--	--	--
S - value	-246.0	14.0	23.0	-58.0	10.0	357.0	18.0	-96.0	2.0	-83.0	9.0	-1.0	5.0
Probability	0.040	0.108	0.585	0.634	0.276	0.003	0.032	0.036	0.904	0.071	0.337	1.000	0.634
Significant	YES	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO
Dissolved Sodium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	D	--	--	D	--	--	--	--	--	D	--	--	--
S - value	-267.0	16.0	-78.0	-554.0	6.0	-68.0	12.0	-20.0	-10.0	-101.0	14.0	-25.0	4.0
Probability	0.026	0.062	0.056	0.000	0.548	0.575	0.178	0.675	0.276	0.028	0.108	0.499	0.720
Significant	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO
Dissolved Potassium, mg/L													
No. of Analyses	54	8	24	55	8	55	8	26	8	26	8	26	8
No. of Detections	54	8	24	55	8	55	8	26	8	26	8	26	8
Trend	--	--	D	D	--	D	--	D	--	--	--	--	--
S - value	-164.0	9.0	-134.0	-515.0	10.0	-412.0	1.0	-93.0	8.0	-49.0	-1.0	-27.0	6.0
Probability	0.173	0.337	0.001	0.000	0.276	0.001	1.000	0.043	0.398	0.290	1.000	0.463	0.548
Significant	NO	NO	YES	YES	NO	YES	NO	YES	NO	NO	NO	NO	NO

Tab

Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

Groundwater in Cc3 and the Regional Aquifer													
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient Location	Up		Side	Side		Down		(Installed 2003)		(Installed 2003)		(Installed 2003)	
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Benzene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl chloride, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
cis 1,2-Dichloroethene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
trans 1,2-Dichloroethene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 3-2
Vashon Island Landfill
Trends in Individual Wells
May 1987 through December 2010

Groundwater in Cc3 and the Regional Aquifer													
Well Location	MW-7		MW-11	MW-12		MW-19		MW-26		MW-27		MW-29	
Gradient Location	Up		Side	Side		Down		(Installed 2003)		(Installed 2003)		(Installed 2003)	
Time Interval	Long	Short	Long	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short
Chloroethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	1	0	0	0	1	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	-9.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	1	0	1	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	11.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	0	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	-16.0	0.0	0.0	-16.0	0.0	-16.0	0.0	-16.0	0.0	-16.0	0.0	-16.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	1	0	0	0	0	0	0	1	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	-19.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane, ug/L													
No. of Analyses	54	8	24	56	8	55	8	26	8	26	8	26	8
No. of Detections	0	0	0	0	0	0	0	0	0	2	0	0	0
Trend	--	--	--	--	--	--	--	--	--	--	--	--	--
S - value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-29.0	0.0	0.0	0.0
Probability	--	--	--	--	--	--	--	--	--	--	--	--	--
Significant	--	--	--	--	--	--	--	--	--	--	--	--	--

NOTES

Table 3-3
Vashon Island Landfill
Summary of Statistical Analyses for Seeps
1991 through 2009

	West Hillside Seeps				
Monitoring Location	SW-W1	SW-W2		SW-W3	
Time Interval	Long	Long	Short	Long	Short
pH field, Standard Units					
No. of Analyses	47	69	8	70	8
No. of Detections	47	69	8	69	8
Minimum	6.5	6.9	7.4	ND	6.8
Maximum	8.4	8.5	8.3	8.6	10.7
Mean	7.5	8.0	7.9	7.8	7.8
Standard Deviation	0.5	0.4	0.3	0.5	1.3
Median	7.7	8.1	7.9	7.9	7.5
Specific Conductance field, micromhos/cm					
No. of Analyses	47	69	8	70	8
No. of Detections	47	69	8	70	8
Minimum	70	410	570	250	228
Maximum	860	1200	889	1034	484
Mean	383.5	807.9	718.5	523.5	365.0
Standard Deviation	177.8	182.5	110.8	163.2	79.7
Median	362	770	711	473	383
Chemical Oxygen Demand, mg/L					
No. of Analyses	47	70	8	70	8
No. of Detections	40	69	8	59	8
Minimum	ND	ND	8.9	ND	2.5
Maximum	100.0	130.0	47.7	160.0	95.5
Mean	18.88	21.84	19.28	17.53	22.70
Standard Deviation	20.82	20.47	12.16	21.91	29.78
Median	12.0	14.0	17.6	10.0	14.2
Alkalinity, mg/L					
No. of Analyses	19	29	8	28	8
No. of Detections	19	29	8	28	8
Minimum	90	400	323	170	138
Maximum	150	530	428	290	182
Mean	110.0	457.6	394.6	223.9	165.9
Standard Deviation	17.8	34.1	32.5	35.2	15.0
Median	107	460	396	230	168
Ammonia-N, mg/L					
No. of Analyses	47	71	8	71	8
No. of Detections	26	30	8	22	8
Minimum	ND	ND	0.005	ND	0.005
Maximum	0.14	45.00	0.03	0.20	0.03
Mean	0.029	0.652	0.015	0.020	0.013
Standard Deviation	0.030	5.338	0.010	0.029	0.011
Median	0.02	0.02	0.01	0.02	0.01
Nitrate-N, mg/L					
No. of Analyses	47	71	8	71	8
No. of Detections	39	42	8	62	8
Minimum	ND	ND	0.0613	ND	0.29
Maximum	3.10	9.00	0.27	1.40	0.78
Mean	0.999	0.232	0.145	0.264	0.440
Standard Deviation	0.927	1.063	0.077	0.260	0.161
Median	0.75	0.05	0.13	0.18	0.39
Sulfate, mg/L					
No. of Analyses	47	71	8	71	8
No. of Detections	46	71	8	71	8
Minimum	ND	5	7	6	9
Maximum	36	30	10	109	13
Mean	12.8	7.9	8.6	12.5	11.3
Standard Deviation	6.1	3.7	1.0	11.8	1.3
Median	13	7	9	11	12

Table 3-3
Vashon Island Landfill
Summary of Statistical Analyses for Seeps
1991 through 2009

	West Hillside Seeps				
Monitoring Location	SW-W1	SW-W2		SW-W3	
Time Interval	Long	Long	Short	Long	Short
Chloride, mg/L					
No. of Analyses	47	69	8	70	8
No. of Detections	47	67	8	68	8
Minimum	3	ND	25	ND	7
Maximum	15	79	34	48	9
Mean	6.3	35.6	30.2	14.1	8.3
Standard Deviation	2.2	11.5	3.5	6.6	0.7
Median	6	34	31	13	9
Dissolved Arsenic, mg/L					
No. of Analyses	47	70	8	70	8
No. of Detections	47	70	8	69	8
Minimum	0.003	0.002	0.002	ND	0.002
Maximum	0.083	0.017	0.006	0.052	0.034
Mean	0.0133	0.0051	0.0029	0.0059	0.0070
Standard Deviation	0.0137	0.0027	0.0015	0.0063	0.0107
Median	0.009	0.004	0.002	0.005	0.003
Dissolved Iron, mg/L					
No. of Analyses	47	70	8	70	8
No. of Detections	47	70	8	70	8
Minimum	1.1	0.4	1.5	0.5	0.6
Maximum	76.0	21.0	8.0	37.5	22.4
Mean	9.99	4.48	2.73	3.86	3.64
Standard Deviation	12.47	4.43	2.16	5.64	7.58
Median	6.5	3.0	2.1	2.3	1.0
Dissolved Manganese, mg/L					
No. of Analyses	47	69	8	69	8
No. of Detections	47	69	8	69	8
Minimum	0.55	0.49	0.34	0.25	0.41
Maximum	18.00	10.00	2.41	8.56	6.92
Mean	2.797	2.320	0.744	1.209	1.306
Standard Deviation	2.927	2.106	0.694	1.346	2.270
Median	2.00	1.40	0.47	0.83	0.50
Dissolved Calcium, mg/L					
No. of Analyses	42	64	8	64	8
No. of Detections	42	64	8	64	8
Minimum	16	27	55	27	24
Maximum	85	127	77	93	35
Mean	40.6	82.8	67.8	52.0	29.1
Standard Deviation	21.3	19.0	6.4	17.5	3.3
Median	37	81	68	47	29
Dissolved Magnesium, mg/L					
No. of Analyses	42	64	8	65	8
No. of Detections	42	64	8	65	8
Minimum	11	20	46	20	18
Maximum	55	104	67	89	27
Mean	24.3	71.6	56.1	40.1	22.6
Standard Deviation	11.3	17.7	7.2	14.0	3.2
Median	20	67	57	35	24
Dissolved Sodium, mg/L					
No. of Analyses	42	65	8	64	8
No. of Detections	42	65	8	64	8
Minimum	6	8	13	8	8
Maximum	17	25	20	19	11
Mean	10.3	16.4	16.9	12.6	9.7
Standard Deviation	3.2	2.6	2.1	2.9	1.0
Median	9	16	17	12	10

Table 3-3
Vashon Island Landfill
Summary of Statistical Analyses for Seeps
1991 through 2009

	West Hillside Seeps				
Monitoring Location	SW-W1	SW-W2		SW-W3	
Time Interval	Long	Long	Short	Long	Short
Dissolved Potasium, mg/L					
No. of Analyses	42	65	8	65	8
No. of Detections	42	65	8	65	8
Minimum	0.8	1.8	2.7	1.8	1.8
Maximum	2.8	5.6	4.0	17.0	3.1
Mean	1.54	3.57	3.41	2.90	2.42
Standard Deviation	0.46	0.59	0.48	1.86	0.41
Median	1.4	3.5	3.6	2.5	2.5
Vinyl Chloride, ug/L					
No. of Analyses	44	66	8	68	8
No. of Detections	7	1	4	41	8
Minimum	ND	ND	ND	ND	0.0394
Maximum	1.00	1.00	0.01	1.00	0.06
Mean	0.10	ID	0.01	0.09	0.05
Standard Deviation	0.26	ID	0.00	0.20	0.01
Median	0.01	ID	0.01	0.05	0.0409

NOTES:

ID	Insufficient Data. The number of detections is less than 3.
ND	Not Detected (at laboratory MDL).
mg/L	Milligram per liter.
ug/L	Microgram per liter.
Short	Reflects the most recent analysis data, up to eight analyses maximum.

Appendix A

Groundwater Quality Standards

Water Quality Standards

Analyte	CAS No.	Eff. Date	Federal Drinking Water Standards MCL		Ref.	Ground Water Quality Criteria Criterion*		Eff. Date	Ref.
Primary Standards									
A. Inorganics									
Antimony	7440-36-0	17-Jan-94	0.006	mg/L	FR v. 57 No.138	0.006	mg/L	17-Jan-94	WAC 173-200
Arsenic c	7440-38-2	23-Jan-06	0.01	mg/L	66 FR 28342	0.00005	mg/L	01-Dec-90	WAC 173-200
Asbestos	132207-33-1	30-Jul-92	7	mf/L	FR v. 56 No. 20	7	mf/L	30-Jul-92	WAC 173-200
Barium	7440-39-3	1-Jan-93	2.0	mg/L	FR v. 56 No. 126	1.0	mg/L	01-Dec-90	WAC 173-200
Beryllium	7440-41-7	17-Jan-94	0.004	mg/L	FR v. 57 No.138	0.004	mg/L	17-Jan-94	WAC 173-200
Cadmium	7440-43-9	30-Jul-92	0.005	mg/L	FR v. 56 No. 20	0.005	mg/L	01-Dec-90	WAC 173-200
Chromium	7440-47-3	30-Jul-92	0.1	mg/L	FR v. 56 No. 20	0.05	mg/L	01-Dec-90	WAC 173-200
Copper	7440-50-8	7-Dec-92	1.3**	mg/L	FR v. 57 No. 125	1.0	mg/L	01-Dec-90	WAC 173-200
Cyanide	57-12-5	17-Jan-94	0.2	mg/L	FR v. 57 No.138	0.2	mg/L	17-Jan-94	WAC 173-200
Fluoride	16984-48-8	2-Oct-87	4.0	mg/L	40 CFR 141	4.0	mg/L	01-Dec-90	WAC 173-200
Lead	7439-92-1	7-Dec-92	0.015**	mg/L	FR v. 57 No. 125	0.015	mg/L	01-Dec-90	WAC 173-200
Mercury	7439-97-6	2-Apr-86	0.002	mg/L	40 CFR 141	0.002	mg/L	01-Dec-90	WAC 173-200
Nickel	7440-02-0	17-Jan-94	0.1	mg/L	FR v. 57 No.138	0.1	mg/L	17-Jan-94	WAC 173-200
Nitrate	14797-55-8	2-Apr-86	10.0	mg/L	FR v. 56 No. 20	10.0	mg/L	01-Dec-90	WAC 173-200
Nitrate and Nitrite	14797-55-8+147	30-Jul-92	10.0	mg/L	FR v. 56 No. 20	10.0	mg/L	30-Jul-92	WAC 173-200
Nitrite	14797-65-0	30-Jul-92	1	mg/L	FR v. 56 No. 20	1.0	mg/L	30-Jul-92	WAC 173-200
Selenium	7782-49-2	30-Jul-92	0.05	mg/L	FR v. 56 No. 20	0.01	mg/L	01-Dec-90	WAC 173-200
Silver	7440-22-4		--			0.05	mg/L	01-Dec-90	WAC 173-200
Sodium	7440-23-5	20-Sep-04	20***	mg/L		20***	mg/L	03-Jul-04	WAC 246-290
Thallium	7440-28-0	17-Jan-94	0.002	mg/L	FR v. 57 No.138	0.002	mg/L	17-Jan-94	WAC 173-200
Total Coliforms		24-Dec-75	1/100	mL	40 CFR 141	1/100	mL	01-Dec-90	WAC 173-200
Turbidity		24-Dec-75	1	NTU	40 CFR 141	--	--	--	--
B. Organic Chemicals									
Alachlor	15972-60-8	30-Jul-92	2	ug/L	FR v. 56 No. 20	2	ug/L	30-Jul-92	WAC 173-200
Atrazine	1912-24-9	30-Jul-92	3	ug/L	FR v. 56 No. 20	3	ug/L	30-Jul-92	WAC 173-200
Benzene c	71-43-2	9-Jan-89	5	ug/L	40 CFR 141	1	ug/L	01-Dec-90	WAC 173-200
Bis(2-ethylhexyl)phthalate	117-81-7	17-Jan-94	6	ug/L	FR v. 57 No.138	6	ug/L	01-Dec-90	WAC 173-200
Bromodichloromethane c	75-27-4		--			0.3	ug/L	01-Dec-90	WAC 173-200
Bromoform c	75-25-2		--			5	ug/L	01-Dec-90	WAC 173-200
Carbofuran	1563-66-2	30-Jul-92	40	ug/L	FR v. 56 No. 20	40	ug/L	30-Jul-92	WAC 173-200
Carbon Tetrachloride c	56-23-5	9-Jan-89	5	ug/L	40 CFR 141	0.3	ug/L	01-Dec-90	WAC 173-200
Chlordane c	5103-71-9	30-Jul-92	2	ug/L	FR v. 56 No. 20	0.06	ug/L	01-Dec-90	WAC 173-200
Chlorobenzene	108-90-7	30-Jul-92	100	ug/L	FR v. 56 No. 20	100	ug/L	30-Jul-92	WAC 173-200
Chlorodibromomethane c	124-48-1		--			0.5	ug/L	01-Dec-90	WAC 173-200
Chloroform c	67-66-3		--			7	ug/L	01-Dec-90	WAC 173-200
2,4-D	94-75-7	30-Jul-92	70	ug/L	FR v. 56 No. 20	70	ug/L	01-Dec-90	WAC 173-200
Dalapon	75-99-0	17-Jan-94	200	ug/L	FR v. 57 No.138	200	ug/L	17-Jan-94	WAC 173-200
1,2-Dibromo-3-chloropropane	96-12-8	30-Jul-92	0.2	ug/L	FR v. 56 No. 20	0.2	ug/L	30-Jul-92	WAC 173-200
1,2-Dichlorobenzene	95-50-1	30-Jul-92	600	ug/L	FR v. 56 No. 20	600	ug/L	30-Jul-92	WAC 173-200
1,4-Dichlorobenzene c	106-46-7	9-Jan-89	75	ug/L	40 CFR 141	4	ug/L	01-Dec-90	WAC 173-200
1,1-Dichloroethane c	75-34-3		--			1	ug/L	01-Dec-90	WAC 173-200
1,2-Dichloroethane c	107-06-2	9-Jan-89	5	ug/L	40 CFR 141	0.5	ug/L	01-Dec-90	WAC 173-200
1,1-Dichloroethene	75-35-4	9-Jan-89	7	ug/L	40 CFR 141	7	ug/L	01-Dec-90	WAC 173-200
c-1,2-Dichloroethene	156-59-2	30-Jul-92	70	ug/L	FR v. 56 No. 20	70	ug/L	30-Jul-92	WAC 173-200
t-1,2-Dichloroethene	156-60-5	30-Jul-92	100	ug/L	FR v. 56 No. 20	100	ug/L	30-Jul-92	WAC 173-200
1,2-Dichloropropane c	78-87-5	30-Jul-92	5	ug/L	FR v. 56 No. 20	0.6	ug/L	01-Dec-90	WAC 173-200
1,3-Dichloropropene tot. c	542-75-6		--			0.2	ug/L	01-Dec-90	WAC 173-200
Di(ethylhexyl)adipate	103-23-1	17-Jan-94	400	ug/L	FR v. 57 No.138	400	ug/L	17-Jan-94	WAC 173-200
Dinoseb	88-85-7	17-Jan-94	7	ug/L	FR v. 57 No.138	7	ug/L	17-Jan-94	WAC 173-200
Diquat	231-36-7	17-Jan-94	20	ug/L	FR v. 57 No.138	20	ug/L	17-Jan-94	WAC 173-200
Endothall	145-73-3	17-Jan-94	100	ug/L	FR v. 57 No.138	100	ug/L	17-Jan-94	WAC 173-200
Endrin	72-20-8	17-Jan-94	2	ug/L	40 CFR 141	0.2	ug/L	01-Dec-90	WAC 173-200
Ethylbenzene	100-41-4	30-Jul-92	700	ug/L	FR v. 56 No. 20	700	ug/L	30-Jul-92	WAC 173-200
Ethylene dibromide c	106-93-4	30-Jul-92	0.05	ug/L	FR v. 56 No. 20	0.001	ug/L	01-Dec-90	WAC 173-200
Glyphosate	1071-83-6	17-Jan-94	70	ug/L	FR v. 57 No.138	70	ug/L	17-Jan-94	WAC 173-200
Heptachlor c	76-44-8	30-Jul-92	0.4	ug/L	FR v. 56 No. 20	0.02	ug/L	01-Dec-90	WAC 173-200
Heptachlor epoxide c	1024-57-3	30-Jul-92	0.2	ug/L	FR v. 56 No. 20	0.009	ug/L	01-Dec-90	WAC 173-200
Hexachlorobenzene	118-74-1	17-Jan-94	1	ug/L	FR v. 57 No.138	0.05	ug/L	01-Dec-90	WAC 173-200
Hexachlorocyclopentadiene (HEX	77-47-4	17-Jan-94	50	ug/L	FR v. 57 No.138	50	ug/L	17-Jan-94	WAC 173-200
Lindane c	58-89-9	30-Jul-92	0.2	ug/L	FR v. 56 No. 20	0.06	ug/L	01-Dec-90	WAC 173-200

Water Quality Standards

Analyte	CAS No.	Eff. Date	Federal Drinking Water Standards MCL		Ref.	Ground Water Quality Criteria Criterion*		Eff. Date	Ref.
Methoxychlor	72-43-5	30-Jul-92	40	ug/L	FR v. 56 No. 20	40	ug/L	30-Jul-92	WAC 173-200
Methylene Chloride c	75-09-2	17-Jan-94	5	ug/L	FR v. 57 No.138	5	ug/L	17-Jan-94	WAC 173-200
Oxamyl (vydate)	23135-22-0	17-Jan-94	200	ug/L	FR v. 57 No.138	200	ug/L	17-Jan-94	WAC 173-200
PAHs [Benzo(a)pyrene]		17-Jan-94	0.2	ug/l	FR v. 57 No.138	0.01	ug/L	17-Jan-94	WAC 173-200
PCBs c	27323-18-8	30-Jul-92	0.5	ug/L	FR v. 56 No. 20	0.01	ug/L	01-Dec-90	WAC 173-200
Pentachloropheno	87-86-5	1-Jan-93	1	ug/L	FR v. 56 No. 126	1	ug/L	01-Jan-93	WAC 173-200
Picloram	1918-02-1	17-Jan-94	500	ug/L	FR v. 57 No.138	500	ug/L	17-Jan-94	WAC 173-200
Simazine	122-34-9	17-Jan-94	4	ug/L	FR v. 57 No.138	4	ug/L	17-Jan-94	WAC 173-200
Styrene	100-42-5	30-Jul-92	100	ug/L	FR v. 56 No. 20	100	ug/L	30-Jul-92	WAC 173-200
2,3,7,8-Tetrachlorodibenzo-p-dioxir	1746-01-6	17-Jan-94	3E-05	ug/L	FR v. 57 No.138	0.0000006	ug/L	01-Dec-90	WAC 173-200
Tetrachloroethylene c	127-18-4	30-Jul-92	5	ug/L	FR v. 56 No. 20	0.8	ug/L	30-Jul-92	WAC 173-200
Toluene	108-88-3	30-Jul-92	1000	ug/L	FR v. 56 No. 20	1000	ug/L	30-Jul-92	WAC 173-200
Total Trihalomethanes c	75-27-4, 75-25-2	29-Nov-79	100	ug/L	40 CFR 141	--	--	--	--
Toxaphene c	8001-35-2	30-Jul-92	3	ug/L	FR v. 56 No. 20	0.08	ug/L	01-Dec-90	WAC 173-200
2,4,5-TP	93-72-1	30-Jul-92	50	ug/L	FR v. 56 No. 20	100	ug/L	01-Dec-90	WAC 173-200
1,2,4-Trichlorobenzene	120-82-1	17-Jan-94	70	ug/L	FR v. 57 No.138	70	ug/L	17-Jan-94	WAC 173-200
1,1,1-Trichloroethane	71-55-6	9-Jan-89	200	ug/L	40 CFR 141	200	ug/L	01-Dec-90	WAC 173-200
1,1,2-Trichloroethane	79-00-5	17-Jan-94	5	ug/L	FR v. 57 No.138	5	ug/L	17-Jan-94	WAC 173-200
Trichloroethylene (TCE) c	79-01-6	9-Jan-89	5	ug/L	40 CFR 141	3	ug/L	01-Dec-90	WAC 173-200
Vinyl chloride c	75-01-4	9-Jan-89	2	ug/L	40 CFR 141	0.02	ug/L	01-Dec-90	WAC 173-200
Xylenes (total)	1330-20-7	30-Jul-92	10000	ug/L	FR v. 56 No. 20	10000	ug/L	30-Jul-92	WAC 173-200
C. Radionuclides and Radioactivity									
Radium 226 & Radium 228		9-Jul-76	5	pCi/L	FR v. 41 No. 133	5	pCi/L	01-Dec-90	WAC 173-200
Radium 226	13982-63-3		--			3	pCi/L	01-Dec-90	WAC 173-200
Radium 228	15262-20-1		--			5	pCi/L	01-Dec-90	WAC 173-200
Gross Alpha particle activity		9-Jul-76	15	pCi/L	FR v. 41 No. 133	15	pCi/L	01-Dec-90	WAC 173-200
Tritium	10028-17-8	9-Jul-76	20,000	pCi/L	FR v. 41 No. 133	20,000	pCi/L	01-Dec-90	WAC 173-200
Strontium	7440-24-6	9-Jul-76	8	pCi/L	FR v. 41 No. 133	8	pCi/L	01-Dec-90	WAC 173-200
Gross Beta particle activity		9-Jul-76	50	pCi/L	FR v. 41 No. 133	50	pCi/L	01-Dec-90	WAC 173-200
D. Additional Carcinogens Listed in Groundwater Criteria									
Acrylamide	79-06-1		--			0.02	ug/L	01-Dec-90	WAC 173-200
Acrylonitrile	107-13-1		--			0.07	ug/L	01-Dec-90	WAC 173-200
Aldrin	309-00-2		--			0.005	ug/L	01-Dec-90	WAC 173-200
Aniline	62-53-3		--			14	ug/L	01-Dec-90	WAC 173-200
Aramite	140-57-8		--			3	ug/L	01-Dec-90	WAC 173-200
Azobenzene	103-33-3		--			0.7	ug/L	01-Dec-90	WAC 173-200
Benzidine	92-87-5		--			0.0004	ug/L	01-Dec-90	WAC 173-200
Benzo(a)pyrene	50-32-8		--			0.008	ug/L	01-Dec-90	WAC 173-200
Benzotrichloride	98-07-7		--			0.007	ug/L	01-Dec-90	WAC 173-200
Benzyl chloride	100-44-7		--			0.5	ug/L	01-Dec-90	WAC 173-200
Bis(chloroethyl)ether	111-44-4		--			0.07	ug/L	01-Dec-90	WAC 173-200
Bis(chloromethyl)ether	542-88-1		--			0.0004	ug/L	01-Dec-90	WAC 173-200
Carbazole	86-74-8		--			5	ug/L	01-Dec-90	WAC 173-200
4-Chloro-2-methyl analine	95-69-2		--			0.1	ug/L	01-Dec-90	WAC 173-200
4-Chloro-2-methyl analine hydrochlo	3165-93-3		--			0.2	ug/L	01-Dec-90	WAC 173-200
o-Chloronitrobenzene	88-73-3		--			3	ug/L	01-Dec-90	WAC 173-200
p-Chloronitrobenzene	100-00-5		--			5	ug/L	01-Dec-90	WAC 173-200
Chlorthaloni	1897-45-6		--			30	ug/L	01-Dec-90	WAC 173-200
Diallate	2303-16-4		--			1	ug/L	01-Dec-90	WAC 173-200
DDT (includes DDE and DDD)	50-29-3, 72-55-9, 72-54-8		--			0.3	ug/L	01-Dec-90	WAC 173-200
1,2-Dibromomethane	106-93-4		--			0.001	ug/L	01-Dec-90	WAC 173-200
3,3'-Dichlorobenzidine	91-94-1		--			0.2	ug/L	01-Dec-90	WAC 173-200
Dichlorovos	62-73-7		--			0.3	ug/L	01-Dec-90	WAC 173-200
Dieldrin	60-57-1		--			0.005	ug/L	01-Dec-90	WAC 173-200
3,3'-Dimethoxybenzidine	119-90-4		--			6.0	ug/L	01-Dec-90	WAC 173-200
3,3-Dimethylbenzidine	119-93-7		--			0.007	ug/L	01-Dec-90	WAC 173-200
1,2-Dimethylhydrazine	540-73-8		--			60	ug/L	01-Dec-90	WAC 173-200
2,4-Dinitrotoluene	121-14-2		--			0.1	ug/L	01-Dec-90	WAC 173-200
2,6-Dinitrotoluene	606-20-2		--			0.1	ug/L	01-Dec-90	WAC 173-200
1,4-Dioxane	123-91-1		--			7	ug/L	01-Dec-90	WAC 173-200
1,2-Diphenylhydrazine	122-66-7		--			0.09	ug/L	01-Dec-90	WAC 173-200

Water Quality Standards

Analyte	CAS No.	Eff. Date	Federal Drinking Water Standards MCL		Ref.	Ground Water Quality Criteria Criterion*		Eff. Date	Ref.
Direct Black 38	1937-37-7		--			0.009	ug/L	01-Dec-90	WAC 173-200
Direct Blue 6	2602-46-2		--			0.009	ug/L	01-Dec-90	WAC 173-200
Direct Brown 95	16071-86-6		--			0.009	ug/L	01-Dec-90	WAC 173-200
Epichlorohydrin	106-89-8		--			8	ug/L	01-Dec-90	WAC 173-200
Ethyl acrylate	140-88-5		--			2	ug/L	01-Dec-90	WAC 173-200
Ethylene thiourea	96-45-7		--			2	ug/L	01-Dec-90	WAC 173-200
Folpet	133-07-3		--			20	ug/L	01-Dec-90	WAC 173-200
Furazolidone	67-45-8		--			0.02	ug/L	01-Dec-90	WAC 173-200
Furium	531-82-8		--			0.002	ug/L	01-Dec-90	WAC 173-200
Furmecyclox	60568-05-0		--			3	ug/L	01-Dec-90	WAC 173-200
Hexachlorocyclohexane (alpha	319-84-6		--			0.001	ug/L	01-Dec-90	WAC 173-200
Hexachlorocyclohexane (technical	608-73-1		--			0.05	ug/L	01-Dec-90	WAC 173-200
Hexachlorodibenzo-p-dioxin, mix	34465-46-8		--			0.00001	ug/L	01-Dec-90	WAC 173-200
Hydrazine/hydrazine sufate	302-01-2/10034-93-2		--			0.03	ug/L	01-Dec-90	WAC 173-200
2-Methoxy-5-nitroanaline	99-59-2		--			2.0	ug/L	01-Dec-90	WAC 173-200
2-Methylanaline	95-53-4		--			0.2	ug/L	01-Dec-90	WAC 173-200
2-Methylanaline hydrochloride	636-21-5		--			0.5	ug/L	01-Dec-90	WAC 173-200
4,4'-Methylene bis(N,N'-dimethyl) an	101-61-1		--			2.0	ug/L	01-Dec-90	WAC 173-200
Mirex	2385-85-5		--			0.05	ug/L	01-Dec-90	WAC 173-200
Nitrofurazone	59-87-0		--			0.06	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodiethanolamine	1116-54-7		--			0.03	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodiethylamine	55-18-5		--			0.0005	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodimethylamine	62-75-9		--			0.002	ug/L	01-Dec-90	WAC 173-200
N-Nitrosodiphenylamine	86-30-6		--			17.0	ug/L	01-Dec-90	WAC 173-200
N-Nitroso-di-n-propylamine	621-64-7		--			0.01	ug/L	01-Dec-90	WAC 173-200
N-Nitrosopyrrolidine	930-55-2		--			0.04	ug/L	01-Dec-90	WAC 173-200
N-Nitroso-di-n-butylamine	924-16-3		--			0.02	ug/L	01-Dec-90	WAC 173-200
N-Nitroso-N-methylethylylamine	10595-95-6		--			0.004	ug/L	01-Dec-90	WAC 173-200
PBBs	59536-65-1		--			0.01	ug/L	01-Dec-90	WAC 173-200
o-Phenylenediamine	95-54-5		--			0.005	ug/L	01-Dec-90	WAC 173-200
Propylene oxide	75-56-9]		--			0.01	ug/L	01-Dec-90	WAC 173-200
p,a,a,a-Tetrachlorotoluene	5216-25-1		--			0.004	ug/L	01-Dec-90	WAC 173-200
2,4-Toluenediamine	95-80-7		--			0.002	ug/L	01-Dec-90	WAC 173-200
o-Toluidine	95-53-4		--			0.2	ug/L	01-Dec-90	WAC 173-200
2,4,6-Trichlorophenol	88-06-2		--			4.0	ug/L	01-Dec-90	WAC 173-200
Trimethyl phosphate	512-56-1		--			2.0	ug/L	01-Dec-90	WAC 173-200
Secondary Standards									
Aluminum	7429-90-5	30-Jul-92	0.05-0.2	mg/L	FR v. 56 No. 20	0.05-0.2	mg/L	30-Jul-92	WAC 173-200
Copper	7440-50-8	7-Dec-92	1.0	mg/L	FR v. 57 No. 125	1.0	mg/L	01-Dec-90	WAC 173-200
Iron	7439-89-6	2-Apr-86	0.3	mg/L	40 CFR 143	0.3	mg/L	01-Dec-90	WAC 173-200
Manganese	7439-96-5	2-Apr-86	0.05	mg/L	40 CFR 143	0.05	mg/L	01-Dec-90	WAC 173-200
Color		2-Apr-86	15	units	40 CFR 143	15	units	01-Dec-90	WAC 173-200
pH	12408-02-5	2-Apr-86	6.5-8.5	units	40 CFR 143	6.5-8.5	units	01-Dec-90	WAC 173-200
Specific Conductivity			--			700	uS/cm		WAC 246-290
Total Dissolved Solids		2-Apr-86	500	mg/L	40 CFR 143	500	mg/L	01-Dec-90	WAC 173-200
Chloride	16887-00-6	2-Apr-86	250	mg/L	40 CFR 143	250	mg/L	01-Dec-90	WAC 173-200
Fluoride	16984-48-8	2-Apr-86	2.0	mg/L	40 CFR 143	p			
Silver	7440-22-4	30-Jul-92	0.1	mg/L	FR v. 56 No. 20	p			
Sulfate	14808-79-8	2-Apr-86	250	mg/L	40 CFR 143	250	mg/L	01-Dec-90	WAC 173-200
Surfactants		2-Apr-86	0.5	mg/L	40 CFR 143	0.5	mg/L	01-Dec-90	WAC 173-200
Corrosivity		2-Apr-86	non-corrosive		40 CFR 143	non-corrosive		01-Dec-90	WAC 173-200
Odor-Threshold		2-Apr-86	3	units	40 CFR 143	3	units	01-Dec-90	WAC 173-200
Zinc	7440-66-6	2-Apr-86	5.0	mg/L	40 CFR 143	5.0	mg/L	01-Dec-90	WAC 173-200

NOTES: pCi/L=picocuries per liter; mg/L=milligrams per liter; mf/L=million fibers per liter
p=Listed as a Primary Standard; --'=no standard established; i=listed individually as groundwater criteria
c=Listed as a carcinogen in the Ground Water Criteria; MCL=Maximum Contaminant Level
*=Criteria shall be the most stringent concentration of the Federal MCLG, MCL; or State MCL; MCLG= Maximum Contaminant Level Goal
=treatment technique in lieu of an MCL; *= A Drinking Water Advisory, not an enforceable standard.
Ground Water Quality Criteria=Water Quality Standards for Ground Waters of the State of Washington

Compiled by KCSWD 1/12/94. Revised 10/5/09

Appendix B

Appendix B

Exceedance Reports

Table 3

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(December 1, 2009 to March 31, 2010)

Regional Aquifer & Channel Cc3

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-12	02/05/10	0.00226	SGW1
	MW-19	02/04/10	0.00189	SGW1
	MW-26	02/08/10	0.00331	SGW1
	MW-29	02/09/10	0.00475	SGW1
	MW-7	02/08/10	0.00618	SGW1
Iron (mg/L)	MW-29	02/09/10	0.707	F2, SGW2
Manganese (mg/L)	MW-19	02/04/10	0.558	F2, SGW2
	MW-26	02/08/10	0.0549	F2, SGW2
	MW-29	02/09/10	0.0895	F2, SGW2
	MW-7	02/08/10	0.129	F2, SGW2

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 3

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(April 1, 2010 to June 30, 2010)

Regional Aquifer & Channel Cc3

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-7	04/30/10	0.00597	SGW1
	MW-12	05/06/10	0.00225	SGW1
	MW-19	05/03/10	0.00173	SGW1
	MW-26	05/04/10	0.0033	SGW1
	MW-29	05/04/10	0.00467	SGW1
Iron (mg/L)	MW-29	05/04/10	0.451	F2, SGW2
Manganese (mg/L)	MW-7	04/30/10	0.122	F2
	MW-19	05/03/10	0.491	F2
	MW-29	05/04/10	0.0678	F2

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 3

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(July 1, 2010 to September 30, 2010)

Regional Aquifer & Channel Cc3

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-7	08/04/10	0.00608	SGW1
	MW-12	09/28/10	0.00207	SGW1
	MW-19	08/09/10	0.00223	SGW1
	MW-26	08/09/10	0.00332	SGW1
	MW-29	08/10/10	0.00473	SGW1
Iron (mg/L)	MW-29	08/10/10	0.708	F2, SGW2
Manganese (mg/L)	MW-7	08/04/10	0.14	F2, SGW2
	MW-19	08/09/10	1.35	F2, SGW2
	MW-26	08/09/10	0.0642	F2, SGW2
	MW-29	08/10/10	0.0928	F2, SGW2

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 3

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(October 1, 2010 to December 31, 2010)

Regional Aquifer & Channel Cc3

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-7	11/4/2010	0.00615	SGW1
	MW-12	11/9/2010	0.0022	SGW1
	MW-19	11/8/2010	0.00235	SGW1
	MW-26	11/9/2010	0.00331	SGW1
	MW-29	11/9/2010	0.00462	SGW1
Iron (mg/L)	MW-29	11/9/2010	0.736	F2, SGW2
Manganese (mg/L)	MW-7	11/4/2010	0.133 D	F2, SGW2
	MW-19	11/8/2010	1.29 D	F2, SGW2
	MW-26	11/9/2010	0.0608	F2, SGW2
	MW-29	11/9/2010	0.0946	F2, SGW2

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 4

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(December 1, 2009 to March 31, 2010)

Regional Aquifer & Channel Cc3

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Specific Conductance (Field)	(umhos/cm)	MW-19	2/4/2010	220	190
		MW-29	2/9/2010	225	190
Alkalinity	(mg/L)	MW-19	2/4/2010	109	100.0
		MW-29	2/9/2010	101	100.0
Chloride	(mg/L)	MW-19	2/4/2010	6.22	5.00
		MW-26	2/8/2010	5.27	5.00
		MW-27	2/5/2010	5.62	5.00
Nitrate	(mg/L)	MW-12	2/5/2010	0.719	0.055
		MW-27	2/5/2010	1.87	0.055
Sulfate	(mg/L)	MW-19	2/4/2010	18.4	14.0
Barium	(mg/L)	MW-19	2/4/2010	0.0191	0.016
Calcium	(mg/L)	MW-29	2/9/2010	18.9	18.0
Magnesium	(mg/L)	MW-19	2/4/2010	16.2	10.01
		MW-27	2/5/2010	11.2	10.01
Manganese	(mg/L)	MW-19	2/4/2010	0.558	0.178
Sodium	(mg/L)	MW-26	2/8/2010	8.69	7.38
Vanadium	(mg/L)	MW-12	2/5/2010	0.00509	0.002
		MW-27	2/5/2010	0.00296	0.002

Table 4

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(April 1, 2010 to June 30, 2010)

Regional Aquifer & Channel Cc3

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Specific Conductance (Field)	(umhos/cm)	MW-19	5/3/2010	220	190
		MW-29	5/4/2010	225	190
Total Solids	(mg/L)	MW-19	5/3/2010	162	160
Alkalinity	(mg/L)	MW-19	5/3/2010	104	100.0
		MW-29	5/4/2010	101	100.0
Chloride	(mg/L)	MW-19	5/3/2010	6.18	5.00
		MW-27	4/29/2010	5.44	5.00
Nitrate	(mg/L)	MW-12	5/6/2010	0.75	0.055
		MW-27	4/29/2010	2.58	0.055
Sulfate	(mg/L)	MW-19	5/3/2010	18.1	14.0
Barium	(mg/L)	MW-19	5/3/2010	0.0171	0.016
Magnesium	(mg/L)	MW-19	5/3/2010	15.1	10.01
		MW-27	4/29/2010	11.5	10.01
Manganese	(mg/L)	MW-19	5/3/2010	0.491	0.178
Vanadium	(mg/L)	MW-12	5/6/2010	0.00481	0.002
		MW-27	4/29/2010	0.00267	0.002

Table 4

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(July 1, 2010 to September 30, 2010)
Intrawell

Regional Aquifer & Channel Cc3

Parameter		Site ID	Sample Date	Sample Value	Limit Value
pH	(pH units)	MW-29	08/10/10	7.25	7.35-7.75
Total Solids	(mg/L)	MW-19	08/09/10	190	168.4
Alkalinity	(mg/L)	MW-19	08/09/10	107	106.8
Barium	(mg/L)	MW-19	08/09/10	0.035	0.03
Calcium	(mg/L)	MW-19	08/09/10	18.1	17.9
Magnesium	(mg/L)	MW-19	08/09/10	16.1	15.9
Manganese	(mg/L)	MW-19	08/09/10	1.35	0.706

Table 4

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(October 1, 2010 to December 31, 2010)
Intrawell

Regional Aquifer & Channel Cc3

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Barium	(mg/L)	MW-19	11/08/10	0.0643	0.03
Magnesium	(mg/L)	MW-19	11/08/10	16.2000	15.8929
Manganese	(mg/L)	MW-19	11/08/10	1.2900	0.7060

Table 5

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(December 1, 2009 to March 31, 2010)

Regional Aquifer & Channel Cc3

Component	Site ID	Date	ug/L
Chloromethane	MW-19	02/04/10	0.32 T
	MW-27	02/05/10	0.2 T
	MW-29	02/09/10	0.25 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 5

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(April 1, 2010 to June 30, 2010)

Regional Aquifer & Channel Cc3

Component	Site ID	Date	ug/L
Chloromethane	MW-29	05/04/10	0.27 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 5

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(July 1, 2010 to September 30, 2010)

Regional Aquifer & Channel Cc3

Component	Site ID	Date	ug/L
Chloromethane	MW-12	09/28/10	0.25 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 5

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(October 1, 2010 to December 31, 2010)

Regional Aquifer & Channel Cc3

Component	Site ID	Date	ug/L
Toluene	MW-19	11/08/10	0.946

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 7

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(December 1, 2009 to March 31, 2010)

Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
Arsenic	(mg/L)	MW-2	02/16/10	0.00103	SGW1
		MW-20	02/03/10	0.00156	SGW1
		MW-5D	02/11/10	0.00871	SGW1
		MW-9	02/04/10	0.00246	SGW1
Iron	(mg/L)	MW-21	02/03/10	0.718	F2, SGW2
		MW-5D	02/11/10	2.45	F2, SGW2
Manganese	(mg/L)	MW-2	02/16/10	0.0858	F2, SGW2
		MW-20	02/03/10	0.125	F2, SGW2
		MW-21	02/03/10	0.308	F2, SGW2
		MW-5D	02/11/10	1.12	F2, SGW2
Vinyl Chloride	(µg/L)	MW-2	02/16/10	0.29	SGW1
		MW-21	02/03/10	0.442	SGW1
		MW-5D	02/11/10	3.84	F1, SGW1

Groundwater Below Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
Arsenic	(mg/L)	MW-14	02/03/10	0.00282	SGW1
Manganese	(mg/L)	MW-14	02/03/10	0.0468	SGW2

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 7

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES

(April 1, 2010 to June 30, 2010)

Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
pH	(pH units)	MW-5D	04/30/10	6.45	F2, SGW2
Arsenic	(mg/L)	MW-2	04/30/10	0.00103	SGW1
		MW-5D	04/30/10	0.0833	F1, SGW1
		MW-9	05/03/10	0.00236	SGW1
		MW-20	05/04/10	0.00162	SGW1
		MW-21	05/05/10	0.00126	SGW1
Iron	(mg/L)	MW-5D	04/30/10	14.2	F2, SGW2
		MW-21	05/05/10	0.823	F2, SGW2
Manganese	(mg/L)	MW-2	04/30/10	0.11	F2, SGW2
		MW-5D	04/30/10	0.953	F2, SGW2
		MW-20	05/04/10	0.0737	F2, SGW2
		MW-21	05/05/10	0.396	F2, SGW2
Vinyl Chloride	(µg/L)	MW-2	04/30/10	0.391	SGW1
		MW-5D	04/30/10	6.82	F1, SGW1
		MW-21	05/05/10	0.334	SGW1

Groundwater Below Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
Arsenic	(mg/L)	MW-14	05/03/10	0.00269	SGW1

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 7

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(July 1, 2010 to September 30, 2010)

Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
Arsenic	(mg/L)	MW-2	08/03/10	0.00106	SGW1
		MW-5D	08/06/10	0.124	F1, SGW1
		MW-9	08/09/10	0.00252	SGW1
		MW-20	08/04/10	0.00146	SGW1
		MW-21	08/06/10	0.00155	SGW1
Iron	(mg/L)	MW-5D	08/06/10	13.8	F2, SGW2
		MW-21	08/06/10	1.03	F2, SGW2
Manganese	(mg/L)	MW-2	08/03/10	0.113	F2, SGW2
		MW-5D	08/06/10	0.848	F2, SGW2
		MW-20	08/04/10	0.128	F2, SGW2
		MW-21	08/06/10	0.523	F2, SGW2
Vinyl Chloride	(µg/L)	MW-2	08/03/10	0.353	SGW1
		MW-5D	08/06/10	5.85	F1, SGW1
		MW-21	08/06/10	0.324	SGW1

Groundwater Below Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
Arsenic	(mg/L)	MW-14	08/03/10	0.0029	SGW1
Manganese	(mg/L)	MW-14	08/03/10	0.0556	F2, SGW2

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 7

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(October 1, 2010 to December 31, 2010)

Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Value	Exceeded
Arsenic	(mg/L)	MW-5D	11/2/2010	0.119	F1, SGW1
		MW-9	11/8/2010	0.0024	SGW1
		MW-20	11/4/2010	0.00163	SGW1
		MW-21	11/2/2010	0.00101	SGW1
Iron	(mg/L)	MW-5D	11/2/2010	14.1	F2, SGW2
		MW-21	11/2/2010	0.654	F2, SGW2
Manganese	(mg/L)	MW-2	11/5/2010	0.0894 D	F2, SGW2
		MW-5D	11/2/2010	0.78	F2, SGW2
		MW-20	11/4/2010	0.068 D	F2, SGW2
		MW-21	11/2/2010	0.292	F2, SGW2
Vinyl Chloride	(µg/L)	MW-2	11/5/2010	0.244	SGW1
		MW-5D	11/2/2010	6.39	F1, SGW1
		MW-21	11/2/2010	0.327	SGW1

Groundwater Below Cc2

Parameter	Site ID	Sample Date	Value	Exceeded
No exceedances this quarter.				

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 8

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(December 1, 2009 to March 31, 2010)

Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Specific Conductance (field)	(std units)	MW-2	2/16/2010	440	187.06
		MW-21	2/3/2010	480	187.06
		MW-5D	2/11/2010	450	187.06
Total Solids	(mg/L)	MW-2	2/16/2010	296	158.5
		MW-21	2/3/2010	287	158.5
		MW-5D	2/11/2010	330	158.5
Total Dissolved Solids	(mg/L)	MW-2	2/16/2010	290	153.4
		MW-21	2/3/2010	284	153.4
		MW-5D	2/11/2010	316	153.4
Total Organic Carbon	(mg/L)	MW-21	2/3/2010	2.78	2.20
		MW-5D	2/11/2010	3.90	2.20
Alkalinity	(mg/L)	MW-2	2/16/2010	257	80
		MW-21	2/3/2010	276	80
		MW-5D	2/11/2010	267	80
Chloride	(mg/L)	MW-21	2/3/2010	4.54	4.3
		MW-5D	2/11/2010	5.68	4.3
Nitrate	(mg/L)	MW-2	2/16/2010	0.501	0.110
		MW-21	2/3/2010	0.193	0.110
		MW-9	2/4/2010	0.134	0.110
Arsenic	(mg/L)	MW-5D	2/11/2010	0.0087	0.005
Barium	(mg/L)	MW-21	2/3/2010	0.0168	0.011
		MW-5D	2/11/2010	0.0136	0.011
Calcium	(mg/L)	MW-2	2/16/2010	27.0	18.000
		MW-21	2/3/2010	34.5	18.000
		MW-5D	2/11/2010	39	18.000
Iron	(mg/L)	MW-21	2/3/2010	0.718	0.510
		MW-5D	2/11/2010	2.45	0.510
Magnesium	(mg/L)	MW-2	2/16/2010	30	13.0
		MW-21	2/3/2010	43.2	13.0
		MW-5D	2/11/2010	26.3	13.0
Manganese	(mg/L)	MW-21	2/3/2010	0.308	0.280
		MW-5D	2/11/2010	1.12	0.280
Nickle	(mg/L)	MW-2	2/16/2010	0.015	0.010
Potassium	(mg/L)	MW-21	2/3/2010	2.92	2.90
Sodium	(mg/L)	MW-2	2/16/2010	8.53	8.23
		MW-21	2/3/2010	11.8	8.23
		MW-5D	2/11/2010	13.4	8.23
Vanadium	(mg/L)	MW-2	2/16/2010	0.00347	0.002
		MW-9	2/4/2010	0.00491	0.002

Table 8

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(April 1, 2010 to June 30, 2010)

Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Specific Conductance (field)	(std units)	MW-2	4/30/2010	375	187.06
		MW-21	5/5/2010	390	187.06
		MW-5D	4/30/2010	235	187.06
Total Solids	(mg/L)	MW-2	4/30/2010	291	158.47
		MW-21	5/5/2010	295	158.47
		MW-5D	4/30/2010	322	158.47
Total Dissolved Solids	(mg/L)	MW-2	4/30/2010	286	153.4
		MW-21	5/5/2010	278	153.4
		MW-5D	4/30/2010	282	153.4
Total Organic Carbon	(mg/L)	MW-5D	4/30/2010	2.51	2.2
Alkalinity	(mg/L)	MW-2	4/30/2010	251	80
		MW-21	5/5/2010	260	80
		MW-5D	4/30/2010	231	80
Chloride	(mg/L)	MW-21	5/5/2010	4.95	4.3
		MW-5D	4/30/2010	4.43	4.3
		MW-9	5/3/2010	4.41	
Nitrate	(mg/L)	MW-2	4/30/2010	0.461	0.11
		MW-21	5/5/2010	0.174	0.11
		MW-9	5/3/2010	0.186	0.11
Arsenic	(mg/L)	MW-5D	4/30/2010	0.0833	0.005
Barium	(mg/L)	MW-2	4/30/2010	0.0126	0.011
		MW-21	5/5/2010	0.0164	0.011
		MW-5D	4/30/2010	0.015	0.011
Calcium	(mg/L)	MW-2	4/30/2010	30.4	18
		MW-21	5/5/2010	29.6	18
		MW-5D	4/30/2010	32.9	18
Iron	(mg/L)	MW-21	5/5/2010	0.823	0.51
		MW-5D	4/30/2010	14.2	0.51
Magnesium	(mg/L)	MW-2	4/30/2010	40.3	13
		MW-21	5/5/2010	36.8	13
		MW-5D	4/30/2010	28.5	13
Manganese	(mg/L)	MW-21	5/5/2010	0.396	0.28
		MW-5D	4/30/2010	0.953	0.28
Sodium	(mg/L)	MW-2	4/30/2010	11.2	8.23
		MW-21	5/5/2010	11.3	8.23
		MW-5D	4/30/2010	16.8	8.23
Vanadium	(mg/L)	MW-2	4/30/2010	0.00391	0.002
		MW-9	5/3/2010	0.00457	0.002

Table 8

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(July1, 2010 to September 30, 2010)
Interwell
Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Specific Conductance (field)	(std units)	MW-2	8/3/2010	360	187.06
		MW-21	8/6/2010	350	187.06
		MW-5D	8/6/2010	320	187.06
Alkalinity	(mg/L)	MW-2	8/3/2010	245	80
		MW-21	8/6/2010	247	80
		MW-5D	8/6/2010	199	80
Arsenic	(mg/L)	MW-5D	8/6/2010	0.124	0.005
Barium	(mg/L)	MW-2	8/3/2010	0.0131	0.011
		MW-21	8/6/2010	0.0177	0.011
		MW-5D	8/6/2010	0.0157	0.011
Calcium	(mg/L)	MW-2	8/3/2010	35.8	18
		MW-21	8/6/2010	36.9	18
		MW-5D	8/6/2010	32.5	18
Chloride	(mg/L)	MW-9	8/9/2010	4.4	4.3
Iron	(mg/L)	MW-21	8/6/2010	1.03	0.51
		MW-5D	8/6/2010	13.8	0.51
Magnesium	(mg/L)	MW-2	8/3/2010	40	13
		MW-21	8/6/2010	38.8	13
		MW-5D	8/6/2010	22.5	13
Manganese	(mg/L)	MW-21	8/6/2010	0.523	0.28
		MW-5D	8/6/2010	0.848	0.28
Nitrate	(mg/L)	MW-2	8/3/2010	0.339	0.11
		MW-21	8/6/2010	0.264	0.11
		MW-9	8/9/2010	0.199	0.11
Potassium	(mg/L)	MW-21	8/6/2010	2.91	2.9
Sodium	(mg/L)	MW-2	8/3/2010	11.5	8.23
		MW-21	8/6/2010	12.3	8.23
		MW-5D	8/6/2010	15.2	8.23
Total Dissolved Solids	(mg/L)	MW-2	8/3/2010	275	153.41
		MW-21	8/6/2010	277	153.41
		MW-5D	8/6/2010	236	153.41
Total Organic Carbon	(mg/L)	MW-2	8/3/2010	2.82	2.2
		MW-21	8/6/2010	2.41	2.2
		MW-5D	8/6/2010	3.56	2.2
Total Solids	(mg/L)	MW-2	8/3/2010	288	158.42
		MW-21	8/6/2010	300	158.42
		MW-5D	8/6/2010	270	158.42
Total Suspended Solids	(mg/L)	MW-5D	8/6/2010	29.6	9.7
Vanadium	(mg/L)	MW-2	8/3/2010	0.00403	0.002
		MW-9	8/9/2010	0.00464	0.002

Table 8

VASHON LANDFILL GW SUMMARY OF PREDICTION LIMIT EXCEEDANCES
(October 1, 2010 to December 31, 2010)
Interwell
Groundwater Within Channel Cc2

Parameter		Site ID	Sample Date	Sample Value	Limit Value
Specific Conductance (field)	(std units)	MW-2	11/5/2010	380	187.06
		MW-21	11/2/2010	380	187.06
		MW-5D	11/2/2010	350	187.06
Alkalinity	(mg/L)	MW-2	11/5/2010	238	80
		MW-21	11/2/2010	208	80
		MW-5D	11/2/2010	209	80
Arsenic	(mg/L)	MW-5D	11/2/2010	0.119	0.005
Barium	(mg/L)	MW-2	11/5/2010	0.0126	0.011
		MW-21	11/2/2010	0.016	0.011
		MW-5D	11/2/2010	0.0184	0.011
Calcium	(mg/L)	MW-2	11/5/2010	28.9	18
		MW-21	11/2/2010	28.8	18
		MW-5D	11/2/2010	29.7	18
Chloride	(mg/L)	MW-9	11/8/2010	4.53	4.3
Iron	(mg/L)	MW-21	11/2/2010	0.654	0.51
		MW-5D	11/2/2010	14.1	0.51
Magnesium	(mg/L)	MW-2	11/5/2010	34.7	13
		MW-21	11/2/2010	30.6	13
		MW-5D	11/2/2010	21.7	13
Manganese	(mg/L)	MW-21	11/2/2010	0.292	0.28
		MW-5D	11/2/2010	0.78	0.28
Nitrate	(mg/L)	MW-2	11/5/2010	0.356	0.11
		MW-21	11/2/2010	0.12	0.11
		MW-9	11/8/2010	0.176	0.11
Sodium	(mg/L)	MW-2	11/5/2010	10.2	8.23
		MW-21	11/2/2010	10	8.23
		MW-5D	11/2/2010	14.4	8.23
Total Dissolved Solids	(mg/L)	MW-2	11/5/2010	256	153.41
		MW-21	11/2/2010	237	153.41
		MW-5D	11/2/2010	229	153.41
Total Organic Carbon	(mg/L)	MW-2	11/5/2010	2.21	2.2
		MW-21	11/2/2010	2.45	2.2
		MW-5D	11/2/2010	3.27	2.2
Total Solids	(mg/L)	MW-2	11/5/2010	262	158.42
		MW-21	11/2/2010	252	158.42
		MW-5D	11/2/2010	255	158.42
Total Suspended Solids	(mg/L)	MW-21	11/2/2010	13.6	9.7
		MW-5D	11/2/2010	10.4	9.7
Vanadium	(mg/L)	MW-2	11/5/2010	0.00387	0.002
		MW-9	11/8/2010	0.00468	0.002

Table 9

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(December 1, 2009 to March 31, 2010)

Groundwater Within & Below Channel Cc2

Component	Site ID	Date	ug/L
1,1- Dichloroethane	MW-5D	02/11/10	0.25 T
1,2- Dichloropropane	MW-5D	02/11/10	0.509
Benzene	MW-5D	02/11/10	0.415
Chloromethane	MW-9	02/04/10	0.21 T
cis- 1,2- Dichloroethene	MW-21	02/03/10	0.611
	MW-5D	02/11/10	7.06
Dichlorodifluoromethane	MW-21	02/03/10	6.84
	MW-21	02/16/10	5.8
	MW-5D	02/11/10	1.04
Trichloroethene	MW-5D	02/11/10	0.25 T
Trichlorofluoromethane	MW-21	02/03/10	6.62
	MW-2	02/16/10	5.06
Vinyl Chloride	MW-21	02/03/10	0.442
	MW-2	02/16/10	0.29
	MW-5D	02/11/10	3.84

See Analytical Data Qualifier Page for Data Qualifier Information.

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(December 1, 2009 to March 31, 2010)
Detections in Blanks

Component	Site ID	Date	ug/L
Acetone	VOA Trip Blank	12/18/10	5.77 B
	VOA Trip Blank	02/10/10	14 BT
Chloromethane	VOA Trip Blank	01/19/10	0.36 BT
	VOA Trip Blank	01/22/10	0.35 BT
	VOA Trip Blank	02/17/10	0.2 T
Toluene	FIELD BLANK	02/04/10	0.39 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 9

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(April 1, 2010 to June 30, 2010)

Groundwater Within & Below Channel Cc2

Component	Site ID	Date	ug/L
1,1-Dichloroethane	MW-5D	04/30/10	0.21 T
1,2-Dichloropropane	MW-5D	04/30/10	0.27 T
Benzene	MW-5D	04/30/10	0.51
Chloromethane	MW-20	05/04/10	0.25 T
cis- 1,2- Dichloroethene	MW-5D	04/30/10	8.49
	MW-21	05/05/10	0.785
Dichlorodifluoromethane	MW-2	04/30/10	7.94
	MW-5D	04/30/10	1.25
	MW-21	05/05/10	6.64
trans-1,2-Dichloroethene	MW-5D	04/30/10	0.22 T
Trichlorofluoromethane	MW-2	04/30/10	5.02
	MW-21	05/05/10	5.41
Vinyl Chloride	MW-2	04/30/10	0.391
	MW-5D	04/30/10	6.82
	MW-21	05/05/10	0.334

See Analytical Data Qualifier Page for Data Qualifier Information.

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(April 1, 2010 to June 30, 2010)

Detections in Blanks

Component	Site ID	Date	ug/L
Methylene Chloride	VOA Trip Blank	04/22/10	0.22 T
	VOA Trip Blank	04/29/10	0.421
	VOA Trip Blank	04/29/10	0.802
	VOA Trip Blank	05/06/10	0.24 T
Toluene	Field Blank	05/06/10	0.25 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 9

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(July 1, 2010 to September 30, 2010)

Groundwater Within & Below Channel Cc2

Component	Site ID	Date	ug/L
Benzene	MW-5D	08/06/10	0.434
Chloromethane	MW-2	08/03/10	0.25 T
	MW-5D	08/06/10	0.27 T
cis- 1,2- Dichloroethene	MW-21	08/06/10	0.731
	MW-5D	08/06/10	10.2
Dichlorodifluoromethane	MW-2	08/03/10	5.94
	MW-21	08/06/10	5.54
	MW-5D	08/06/10	1.44
Methylene Chloride	MW-21	08/06/10	0.3 T
trans-1,2-Dichloroethene	MW-5D	08/06/10	0.26 T
Trichlorofluoromethane	MW-2	08/03/10	3.95
	MW-21	08/06/10	4.35
Vinyl Chloride	MW-2	08/03/10	0.353
	MW-21	08/06/10	0.324
	MW-5D	08/06/10	5.85

See Analytical Data Qualifier Page for Data Qualifier Information.

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(July 1, 2010 to September 30, 2010)

Detections in Blanks

Component	Site ID	Date	ug/L
Chloromethane	VOA Trip Blank	07/30/10	0.23 T
Methylene Chloride	VOA Trip Blank	09/24/10	0.3 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 9

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(October 1, 2010 to December 31, 2010)

Groundwater Within & Below Channel Cc2

Component	Site ID	Date	ug/L
Acetone	MW-8	11/9/2010	4.94 B
	MW-9	11/8/2010	4.32 B
Benzene	MW-5D	11/2/2010	0.45
Chloromethane	MW-8	11/9/2010	0.829
	MW-21	11/2/2010	0.33 T
	MW-5D	11/2/2010	0.27 T
cis- 1,2- Dichloroethene	MW-21	11/2/2010	0.77
	MW-5D	11/2/2010	10.2
Dichlorodifluoromethane	MW-2	11/5/2010	9.04
	MW-21	11/2/2010	7.5
	MW-5D	11/2/2010	2.39
trans-1,2-Dichloroethene	MW-5D	11/2/2010	0.28 T
Trichlorofluoromethane	MW-2	11/5/2010	3.94
	MW-21	11/2/2010	4.15
Vinyl Chloride	MW-2	11/5/2010	0.244
	MW-21	11/2/2010	0.327
	MW-5D	11/2/2010	6.39

See Analytical Data Qualifier Page for Data Qualifier Information.

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS
(October 1, 2010 to December 31, 2010)

Detections in Blanks

Component	Site ID	Date	ug/L
Acetone	VOA Trip Blank	11/3/2010	11.4 B

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 11

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(December 1, 2009 to March 31, 2010)

Groundwater Within & Adjacent to Channel Cc1

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-10	02/02/10	0.00169	SGW1
	MW-13	02/09/10	0.00171	SGW1

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 11

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(April 1, 2010 to June 30, 2010)

Groundwater Within & Adjacent to Channel Cc1

Parameter	Site ID	Sample Date	Value	Exceeded
Arsenic (mg/L)	MW-10	04/29/10	0.00166	SGW1
	MW-13	05/06/10	0.00172	SGW1

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 11

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(July 1, 2010 to September 30, 2010)

Groundwater Within & Adjacent to Channel Cc1

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-10	08/09/10	0.00196	SGW1
	MW-13	08/05/10	0.00174	SGW1

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 11

VASHON LANDFILL GW SUMMARY OF EXCEEDANCES
(October 1, 2010 to December 31, 2010)

Groundwater Within & Adjacent to Channel Cc1

Parameter	Site ID	Sample Date	Sample Value	Standard(s) Exceeded
Arsenic (mg/L)	MW-10	11/9/2010	0.00173	SGW1
	MW-13	11/10/2010	0.00192	SGW1

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 12

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(December 1, 2009 to March 31, 2010)

Within & Adjacent to Channel Cc1

Component	Site ID	Date	ug/L
No VOA detects in CC1			

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 12

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(April 1, 2010 to June 30, 2010)

Within & Adjacent to Channel Cc1

Component	Site ID	Date	ug/L
No VOA detects in CC1			

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 12

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(July 1, 2010 to September 30, 2010)

Within & Adjacent to Channel Cc1

Component	Site ID	Date	ug/L
No VOA detects in CC1			

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 12

VASHON LANDFILL GW VOLATILE ORGANIC COMPOUND DETECTIONS

(October 1, 2010 to December 31, 2010)

Groundwater Within & Adjacent to Channel Cc1

Component	Site ID	Date	ug/L
Acetone	MW-13	11/10/2010	6.52 B
Chloromethane	MW-13	11/10/10	0.35 T

See Analytical Data Qualifier Page for Data Qualifier Information.

Table 13

VASHON ISLAND LANDFILL SEEPS/SURFACE WATER
(December 1, 2009 to March 31, 2010)

SUMMARY OF SURFACE WATER QUALITY CRITERIA EXCEEDANCES

Parameter		Site ID	Sample Date	Sample Value	Reg. Limit	Standard(s) Exceeded
Hardness	(mg/L)	SW-B	03/29/10	30.2	--	For Reference
		SW-D	03/29/10	32.8	--	For Reference
		SW-W1	01/21/10	90.5	--	For Reference
		SW-W2	01/21/10	373	--	For Reference
		SW-W3	01/21/10	142	--	For Reference
Turbidity (field)	(ntu)	SW-B	03/29/10	10.8	5 above bkgrd	SSWC
		SW-D	03/29/10	15.9	5 above bkgrd	SSWC
		SW-W1	01/21/10	14	5 above bkgrd	SSWC
		SW-W2	01/21/10	14.5	5 above bkgrd	SSWC
Fecal Coliforms	(CFU/100 mL)	SW-B	03/29/10	680	100	SSWC, FA, FC
		SW-D	03/29/10	4000	100	SSWC, FA, FC
Alkalinity	(mg/L)	SW-B	03/29/10	29.7	20	FC
		SW-D	03/29/10	33.5	20	FC
		SW-W1	01/21/10	92.6	20	FC
		SW-W2	01/21/10	390	20	FC
		SW-W3	01/21/10	154	20	FC
Ammonia	(mg/L)	SW-W1	01/21/10	0.0205	0.0061	SSWC, FC
Copper	(mg/L)	SW-B	03/29/10	0.00752	0.00408	SSWF, SSWC, FA, FC
		SW-D	03/29/10	0.00735	0.00438	SSWF, SSWC, FA, FC
Iron, total	(mg/L)	SW-W1	01/21/10	3.78	1	FC
		SW-W2	01/21/10	1.86	1	FC

FC Federal Chronic Surface Water Criteria
FA Federal Acute Surface Water Criteria
SSWC State ChronicSurface Water Criteria
SSWA State Acute Surface Water Criteria
* Total Metals
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13 continued

SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES IN SEEPS
(December 1, 2009 to March 31, 2010)

Parameter		Site ID	Sample Date	Value	Standard(s) Exceeded
Acrylonitrile	(µg/L)	SW-W3	01/21/10	0.083 T	SGW1
Turbidity (field)	(NTU)	SW-W1	01/21/10	11.4	F1
		SW-W2	01/21/10	12.6	F1
		SW-W3	01/21/10	7.08	F1
Turbidity (lab)	(NTU)	SW-W1	01/21/10	14	F1
		SW-W2	01/21/10	14.5	F1
		SW-W3	01/21/10	6.72	F1
Arsenic	(mg/L)	SW-W1	01/21/10	0.00695	SGW1
		SW-W2	01/21/10	0.0022	SGW1
		SW-W3	01/21/10	0.00284	SGW1
Iron	(mg/L)	SW-W1	01/21/10	3.78	F2, SGW2
		SW-W2	01/21/10	1.86	F2, SGW2
		SW-W3	01/21/10	0.744	F2, SGW2
Manganese	(mg/L)	SW-W1	01/21/10	1.41	F2, SGW2
		SW-W2	01/21/10	0.422	F2, SGW2
		SW-W3	01/21/10	0.414	F2, SGW2

F1 Primary Federal Drinking Water Quality Standard
F2 Secondary Federal Drinking Water Quality Standard
SGW State of Washington Ground Water Quality Standard
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13

VASHON ISLAND LANDFILL SEEPS/SURFACE WATER
(April 1, 2010 to June 30, 2010)

SUMMARY OF SURFACE WATER QUALITY CRITERIA EXCEEDANCES

Parameter		Site ID	Sample Date	Value	Reg. Limit	Standard(s) Exceeded
Hardness	(mg/L)	SW-B	04/27/10	30.3	--	For Reference
		SW-D	04/27/10	30.2	--	For Reference
		SW-W1	04/19/10	95.8	--	For Reference
		SW-W2	04/19/10	401	--	For Reference
		SW-W3	04/19/10	154	--	For Reference
pH (filed)	(pH units)	SW-D	04/27/10	6.43	6.5- 8.5	SSWC, FC
		SW-W3	04/19/10	10.71	6.5- 8.5	SSWC, FC
Dissolved Oxygen (field)	(mg/L)	SW-D	04/27/10	7.19	min 8 mg/L	SSWC
Turbidity (field)	(ntu)	SW-W1	04/19/10	6.01	5 above bg	SSWC
		SW-W2	04/19/10	7.95	5 above bg	SSWC
		SW-W3	04/19/10	9.41	5 above bg	SSWC
Fecal Coliforms	(CFU/100 mL)	SW-B	04/27/10	200	100	SSWC
		SW-D	04/27/10	460	100	SSWC, FA, FC
Alkalinity	(mg/L)	SW-B	04/27/10	19.1	min 20 mg/L	FC
Ammonia	(mg/L)	SW-D	04/27/10	0.0345	0.0010	SSWF, SSWC, FA, FC
		SW-W1	04/19/10	0.018 T	0.0055	SSWC, FC
Copper	(mg/L)	SW-B	04/27/10	0.00603	0.00409	SSWF, SSWC, FA, FC
		SW-D	04/27/10	0.00453	0.00408	SSWC, FC
Iron, total	(mg/L)	SW-W1	04/19/10	3.2	1	FC
		SW-W2	04/19/10	2.32	1	FC
		SW-W3	04/19/10	1.37	1	FC

FC Federal Chronic Surface Water Criteria
FA Federal Acute Surface Water Criteria
SSWC State ChronicSurface Water Criteria
SSWA State Acute Surface Water Criteria
* Total Metals
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13 continued

SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES IN SEEPS
(April 1, 2010 to June 30, 2010)

Parameter		Site ID	Sample Date	Value	Standard(s) Exceeded
pH (filed)	(pH units)	SW-W3	04/19/10	10.71	F2, SGW2
Turbidity (field)	(NTU)	SW-W1	04/19/10	6.01	F1
		SW-W2	04/19/10	7.95	F1
		SW-W3	04/19/10	9.41	F1
Turbidity (lab)	(NTU)	SW-W1	04/19/10	7.48	F1
		SW-W2	04/19/10	12.4	F1
		SW-W3	04/19/10	11.5	F1
Arsenic	(mg/L)	SW-W1	04/19/10	0.00251	SGW1
		SW-W2	04/19/10	0.00117	SGW1
		SW-W3	04/19/10	0.00212	SGW1
Iron	(mg/L)	SW-W1	04/19/10	0.31	F2, SGW2
Manganese	(mg/L)	SW-W1	04/19/10	0.375	F2, SGW2
		SW-W3	04/19/10	0.202	F2, SGW2
Vinyl Chloride	(µg/L)	SW-W3	04/19/10	0.0394	SGW1

F1 Primary Federal Drinking Water Quality Standard
F2 Secondary Federal Drinking Water Quality Standard
SGW State of Washington Ground Water Quality Standard
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13

VASHON ISLAND LANDFILL SEEPS/SURFACE WATER
(July 1, 2010 to September 30, 2010)

SUMMARY OF SURFACE WATER QUALITY CRITERIA EXCEEDANCES

Parameter		Site ID	Sample Date	Value	Reg. Limit	Standard(s) Exceeded
Hardness	(mg/L)	SW-D	09/28/10	38.8	--	For Reference
		SW-W1	09/16/10	117	--	For Reference
		SW-W2	09/16/10	467	--	For Reference
		SW-W3	09/16/10	197	--	For Reference
Turbidity (field)	(ntu)	SW-W1	08/16/10	34.5	5 above bg	SSWC
		SW-W2	08/16/10	17.2	5 above bg	SSWC
		SW-W3	08/16/10	9.14	5 above bg	SSWC
Fecal Coliforms	(CFU/100 mL)	SW-D	09/28/10	1600	100	SSWC, FA, FC
Ammonia	(mg/L)	SW-D	9/28/2010	0.0791	0.0026	SSWF, SSWC, FA, FC
Copper, total	(mg/L)	SW-D	9/28/2010	0.00914	0.00505	SSWF, SSWC, FA, FC
Iron, total	(mg/L)	SW-W1	08/16/10	9.27	1	FC
		SW-W2	08/16/10	2.29	1	FC
		SW-W3	08/16/10	1.23	1	FC
Zinc, total	(mg/L)	SW-D	9/28/2010	0.412	0.0469	SSWF, SSWC, FA, FC

FC Federal Chronic Surface Water Criteria
FA Federal Acute Surface Water Criteria
SSWC State ChronicSurface Water Criteria
SSWA State Acute Surface Water Criteria
* Total Metals
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13 continued

SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES IN SEEPS
(July 1, 2010 to September 30, 2010)

Parameter		Site ID	Sample Date	Value	Standard(s) Exceeded
Turbidity (field)	(NTU)	SW-W1	08/16/10	34.5	F1
		SW-W2	08/16/10	17.2	F1
		SW-W3	08/16/10	9.14	F1
Turbidity (lab)	(NTU)	SW-W1	08/16/10	7.12	F1
		SW-W2	08/16/10	11.6	F1
		SW-W3	08/16/10	7.43	F1
Arsenic	(mg/L)	SW-W1	08/16/10	0.00835	SGW1
		SW-W2	08/16/10	0.00153	SGW1
		SW-W3	08/16/10	0.0027	SGW1
Iron	(mg/L)	SW-W1	08/16/10	1.01	F2, SGW2
Manganese	(mg/L)	SW-W1	08/16/10	1.41	F2, SGW2
		SW-W2	08/16/10	0.629	F2, SGW2
		SW-W3	08/16/10	0.201	F2, SGW2
Vinyl Chloride	(µg/L)	SW-W3	08/16/10	0.0456	SGW1

F1 Primary Federal Drinking Water Quality Standard
F2 Secondary Federal Drinking Water Quality Standard
SGW State of Washington Ground Water Quality Standard
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13

VASHON ISLAND LANDFILL SEEPS/SURFACE WATER
(July 1, 2010 to September 30, 2010)

SUMMARY OF SURFACE WATER QUALITY CRITERIA EXCEEDANCES

Parameter		Site ID	Sample Date	Value	Reg. Limit	Standard(s) Exceeded
Hardness	(mg/L)	SW-D	09/28/10	38.8	--	For Reference
		SW-W1	09/16/10	117	--	For Reference
		SW-W2	09/16/10	467	--	For Reference
		SW-W3	09/16/10	197	--	For Reference
Turbidity (field)	(ntu)	SW-W1	08/16/10	34.5	5 above bg	SSWC
		SW-W2	08/16/10	17.2	5 above bg	SSWC
		SW-W3	08/16/10	9.14	5 above bg	SSWC
Fecal Coliforms	(CFU/100 mL)	SW-D	09/28/10	1600	100	SSWC, FA, FC
Ammonia	(mg/L)	SW-D	9/28/2010	0.0791	0.0026	SSWF, SSWC, FA, FC
Copper, total	(mg/L)	SW-D	9/28/2010	0.00914	0.00505	SSWF, SSWC, FA, FC
Iron, total	(mg/L)	SW-W1	08/16/10	9.27	1	FC
		SW-W2	08/16/10	2.29	1	FC
		SW-W3	08/16/10	1.23	1	FC
Zinc, total	(mg/L)	SW-D	9/28/2010	0.412	0.0469	SSWF, SSWC, FA, FC

FC Federal Chronic Surface Water Criteria
FA Federal Acute Surface Water Criteria
SSWC State ChronicSurface Water Criteria
SSWA State Acute Surface Water Criteria
* Total Metals
See Analytical Data Qualifier Page for Data Qualifier Information

Table 13 continued

SUMMARY OF GROUNDWATER QUALITY CRITERIA EXCEEDANCES IN SEEPS
(July 1, 2010 to September 30, 2010)

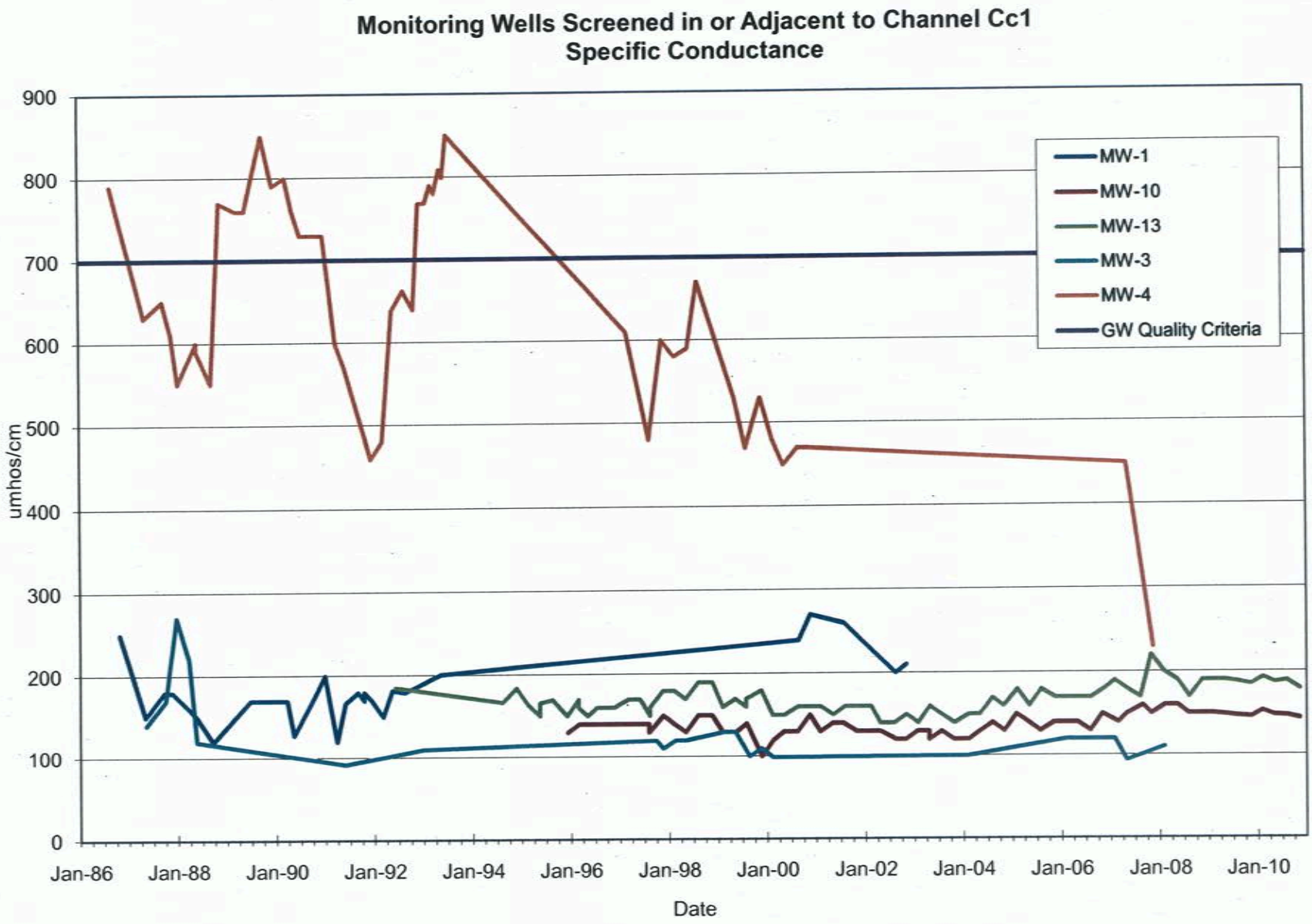
Parameter		Site ID	Sample Date	Value	Standard(s) Exceeded
Turbidity (field)	(NTU)	SW-W1	08/16/10	34.5	F1
		SW-W2	08/16/10	17.2	F1
		SW-W3	08/16/10	9.14	F1
Turbidity (lab)	(NTU)	SW-W1	08/16/10	7.12	F1
		SW-W2	08/16/10	11.6	F1
		SW-W3	08/16/10	7.43	F1
Arsenic	(mg/L)	SW-W1	08/16/10	0.00835	SGW1
		SW-W2	08/16/10	0.00153	SGW1
		SW-W3	08/16/10	0.0027	SGW1
Iron	(mg/L)	SW-W1	08/16/10	1.01	F2, SGW2
Manganese	(mg/L)	SW-W1	08/16/10	1.41	F2, SGW2
		SW-W2	08/16/10	0.629	F2, SGW2
		SW-W3	08/16/10	0.201	F2, SGW2
Vinyl Chloride	(µg/L)	SW-W3	08/16/10	0.0456	SGW1

F1 Primary Federal Drinking Water Quality Standard
F2 Secondary Federal Drinking Water Quality Standard
SGW State of Washington Ground Water Quality Standard
See Analytical Data Qualifier Page for Data Qualifier Information

Appendix C

Appendix C

Time Concentration Plots for Groundwater in and Adjacent to Channel Cc1


Monitoring Wells Screened in or Adjacent to Channel Cc1
Specific Conductance
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900
800
700
600
500
400
300
200
100
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
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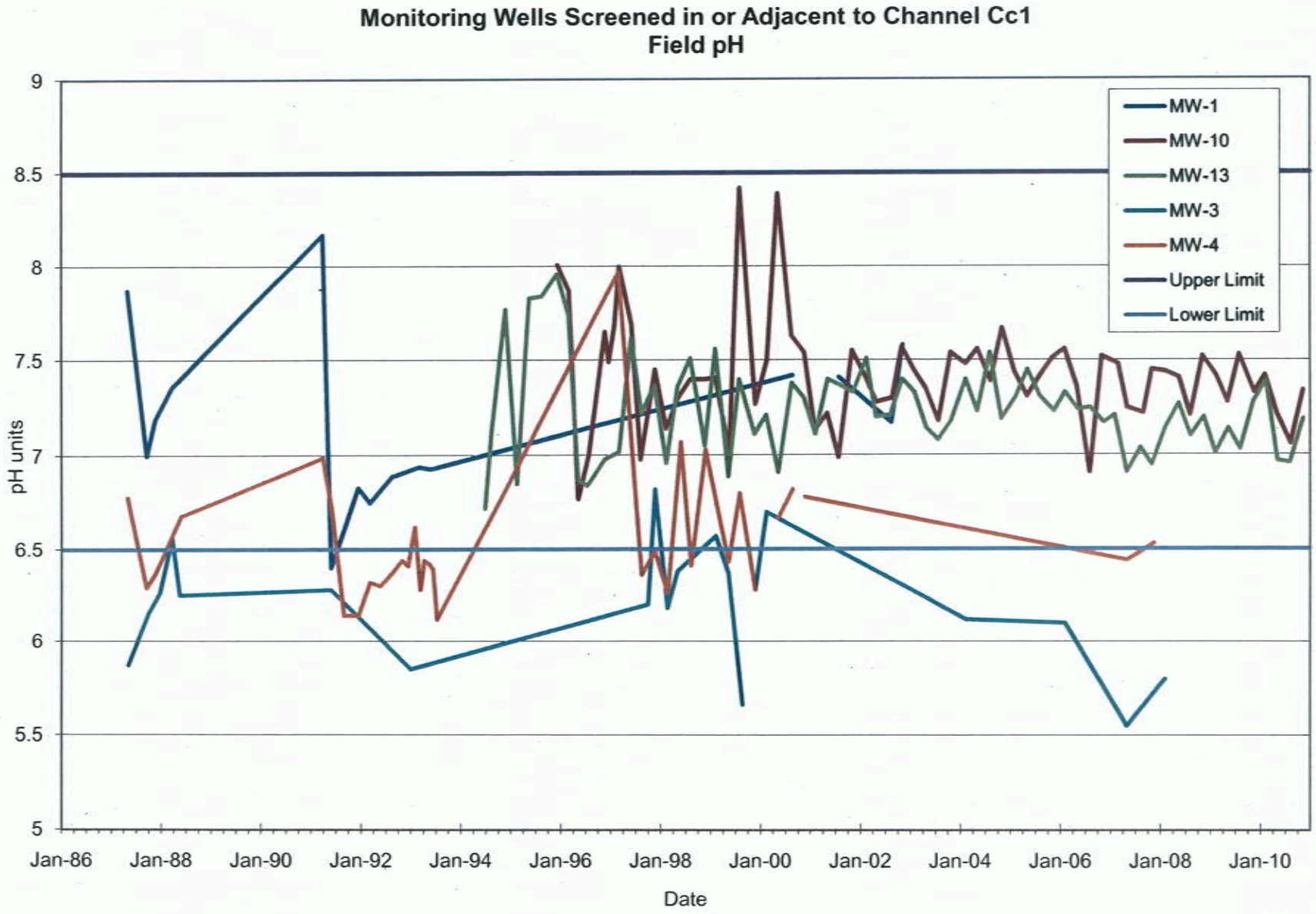
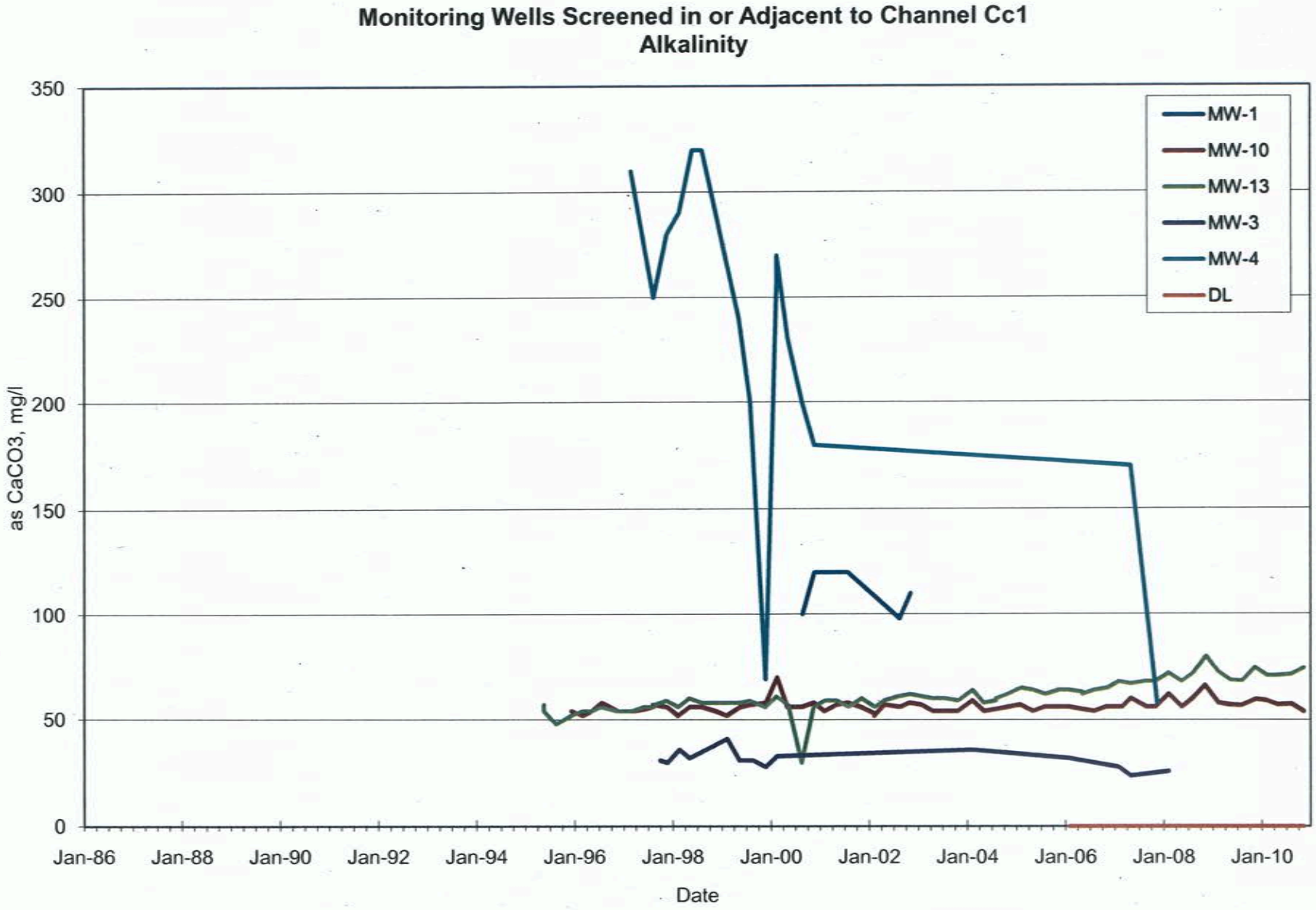
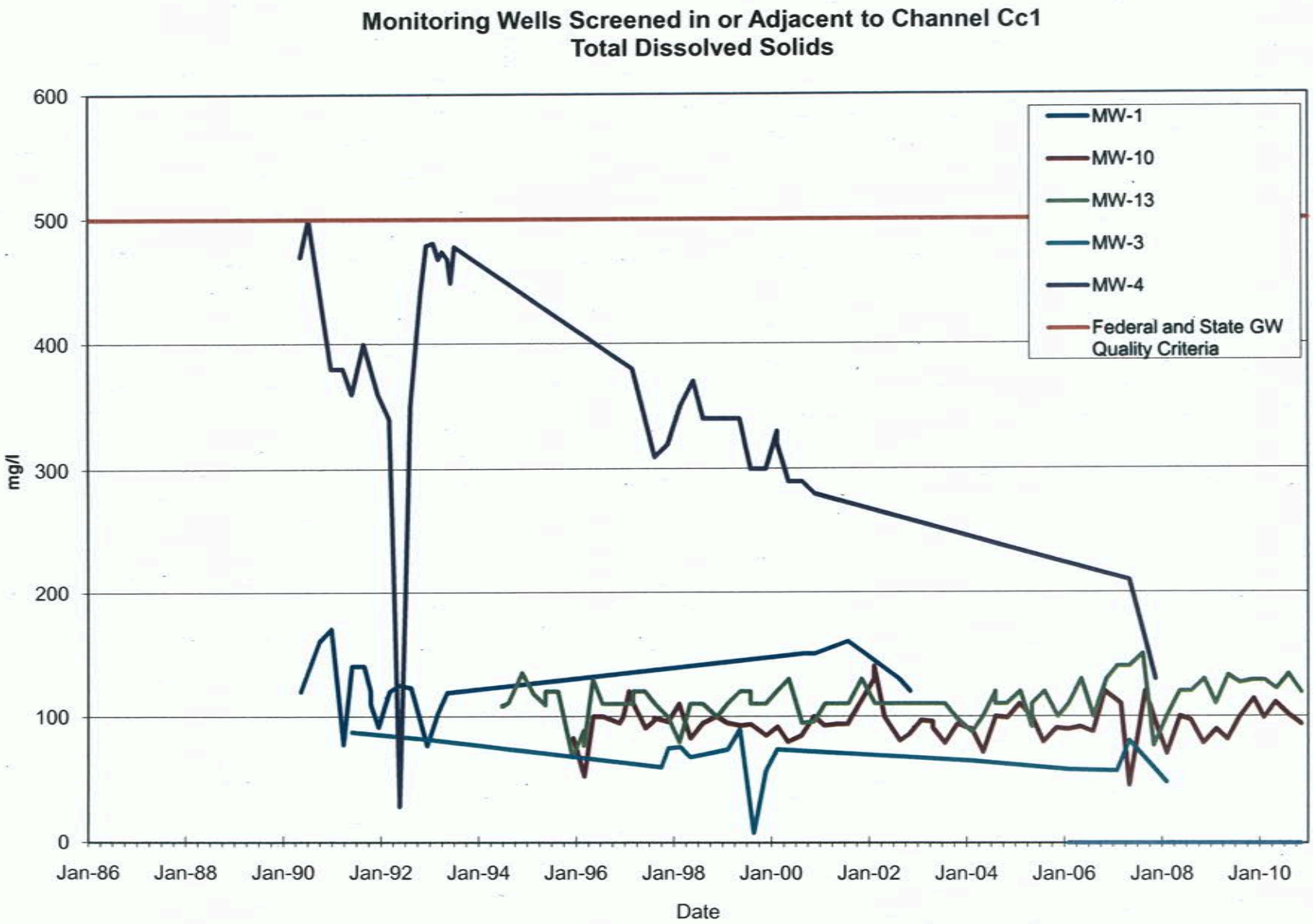
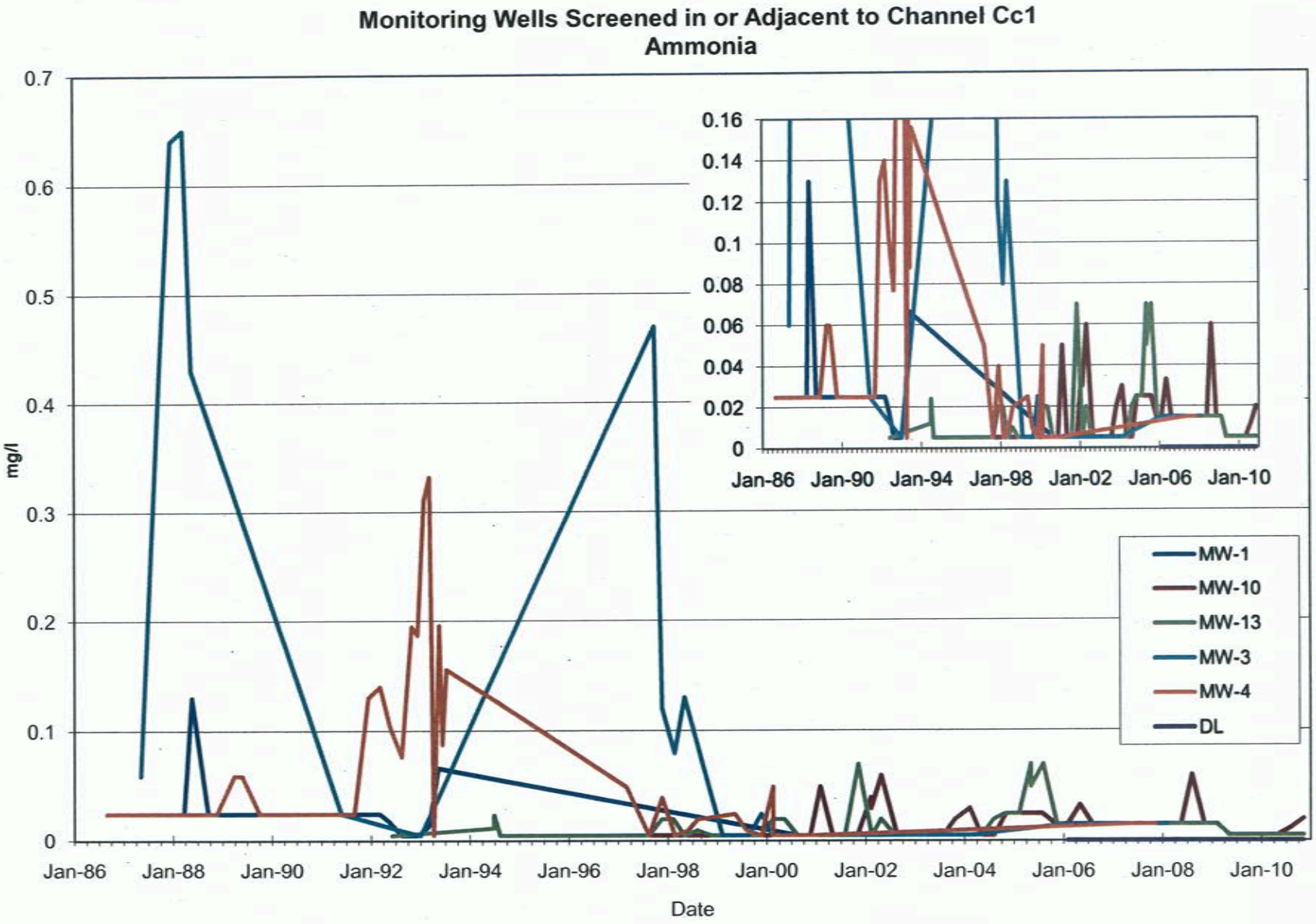
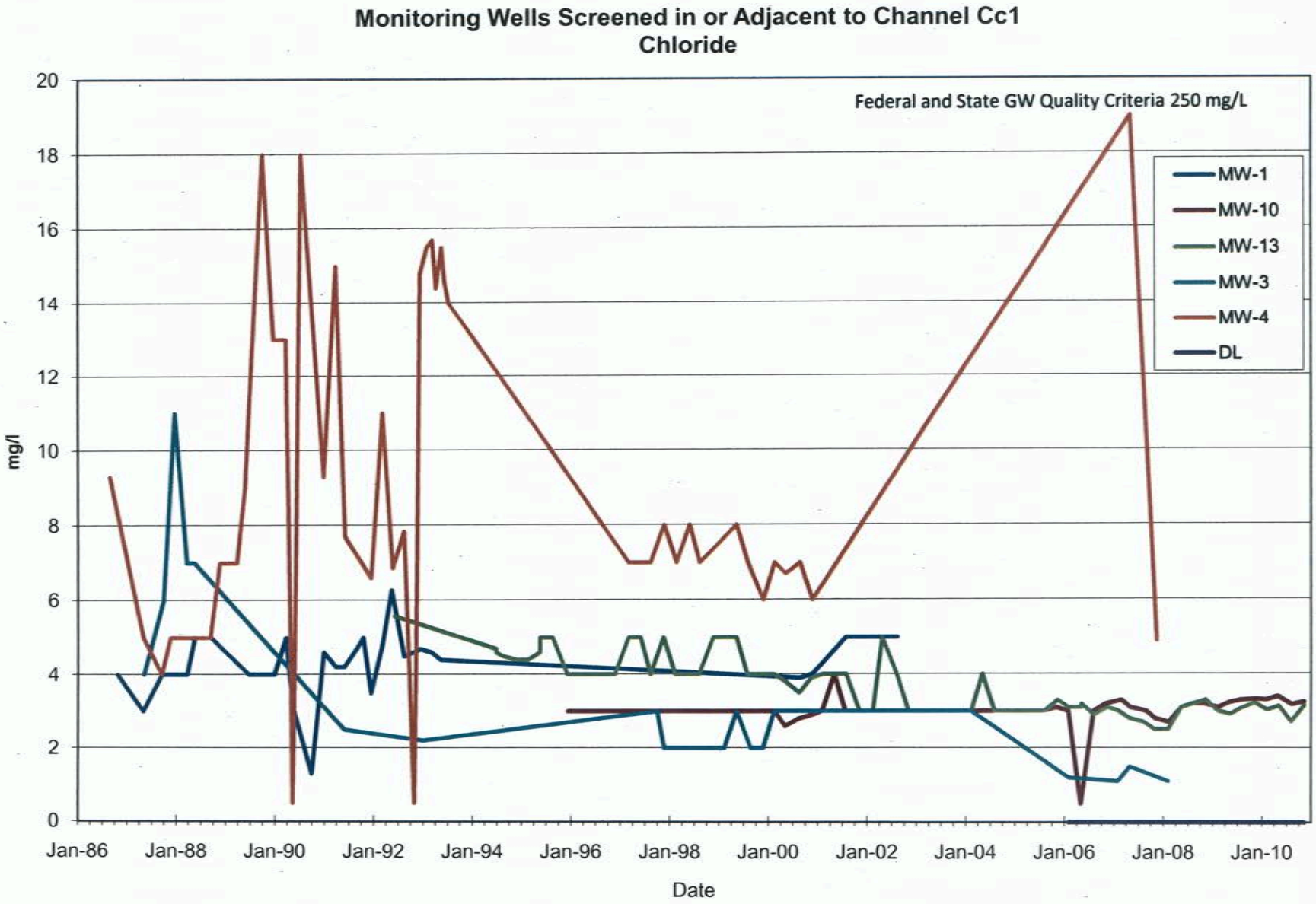
MW-10
MW-13
MW-3
MW-4
GW Quality Criteria

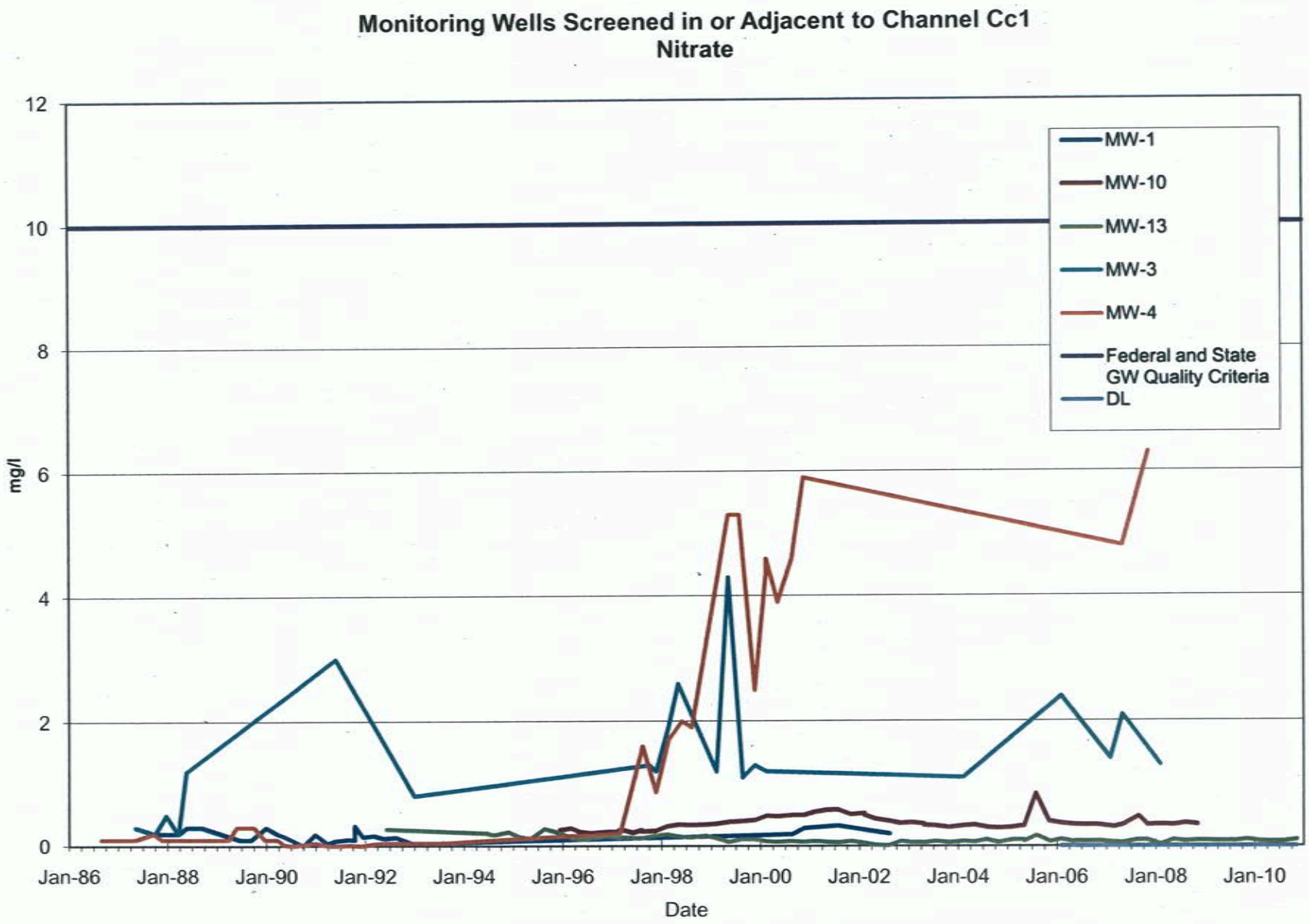

Monitoring Wells Screened in or Adjacent to Channel Cc1
Field pH
9
8.5
8
7.5
7
6.5
6
5.5
5
pH units
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
Upper Limit
Lower Limit

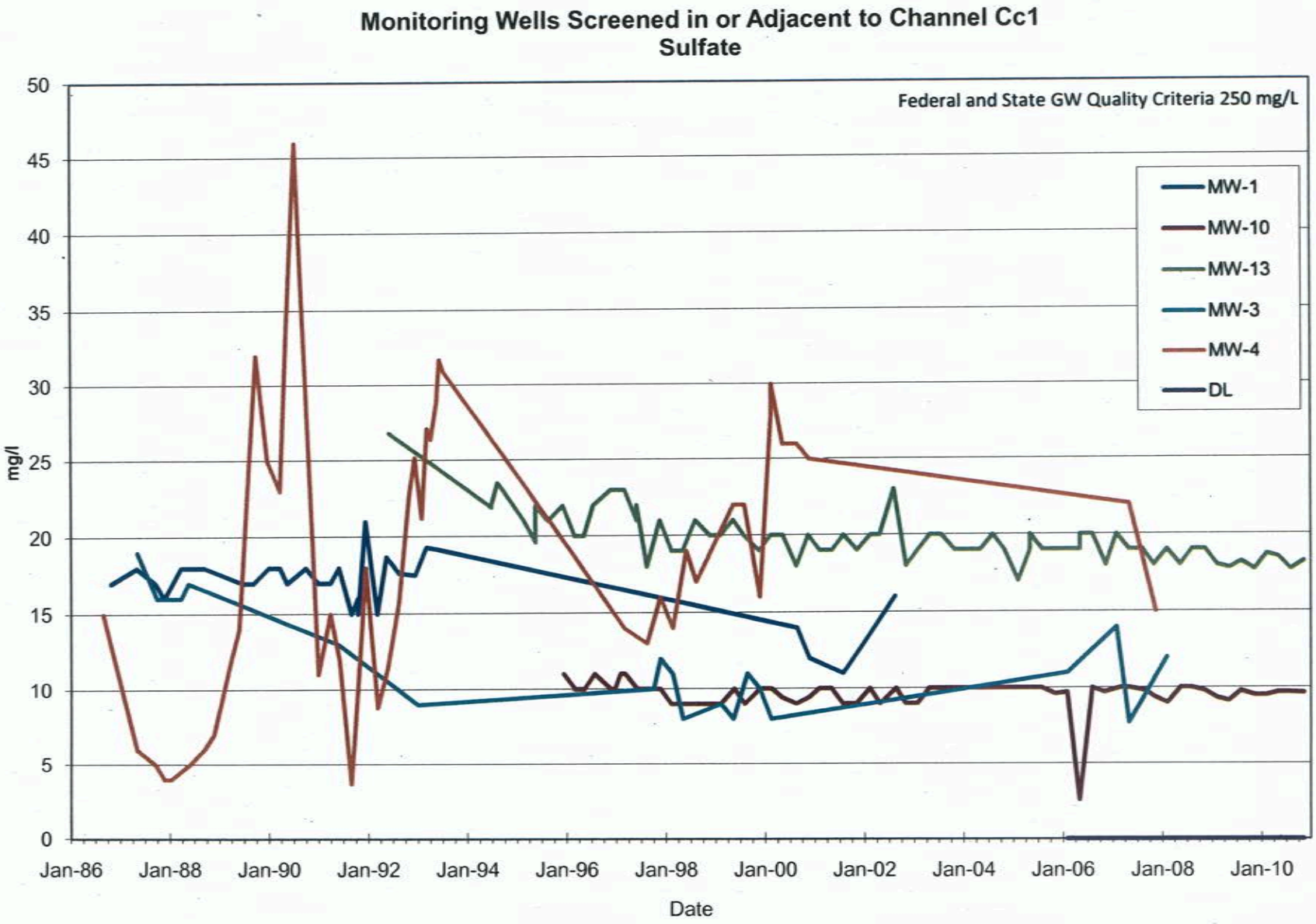

Monitoring Wells Screened in or Adjacent to Channel Cc1
Alkalinity
350
300
250
200
150
100
50
0
as CaCO3, mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
DL

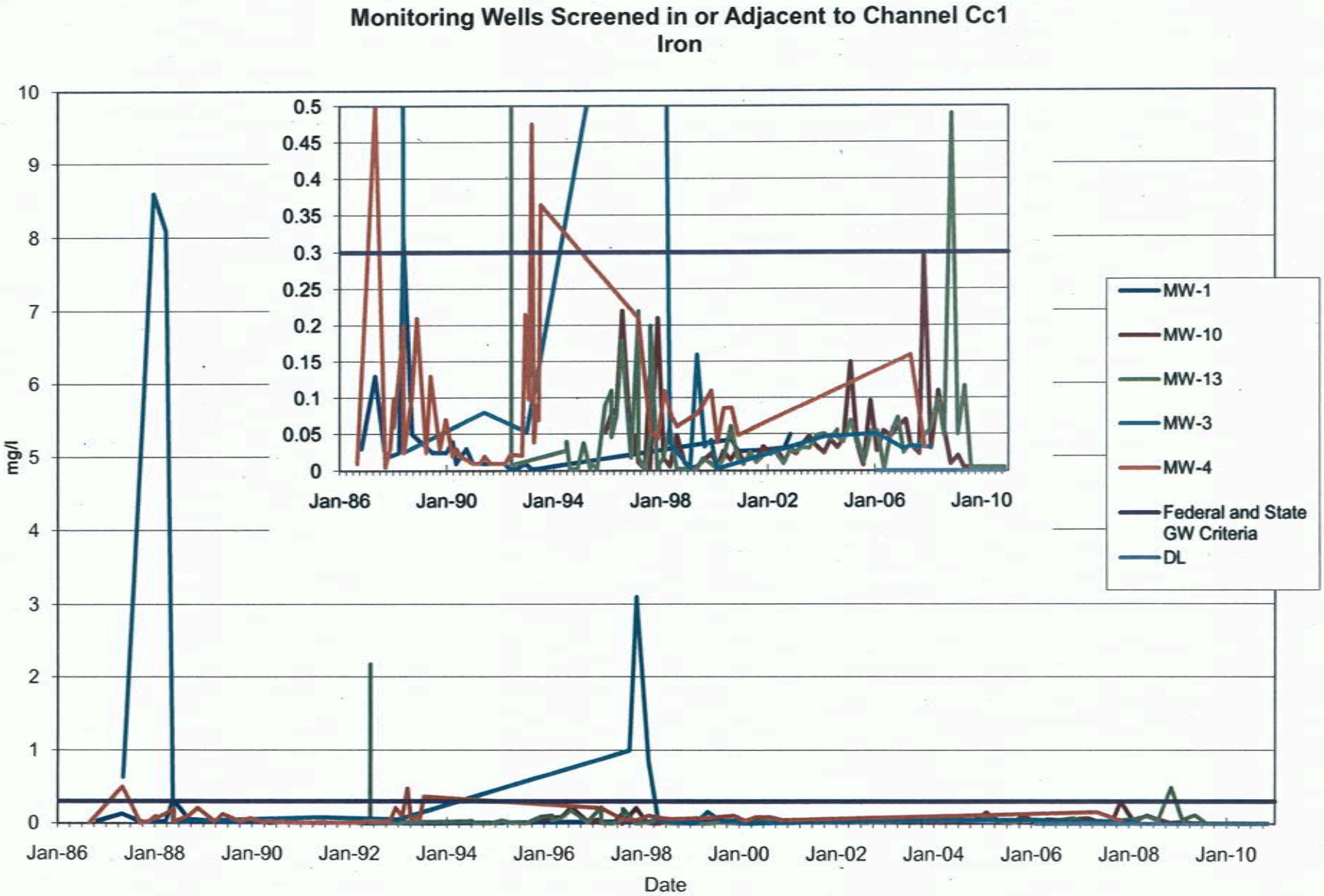

Monitoring Wells Screened in or Adjacent to Channel Cc1
Total Dissolved Solids
600
500
400
300
200
100
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
Federal and State GW Quality Criteria

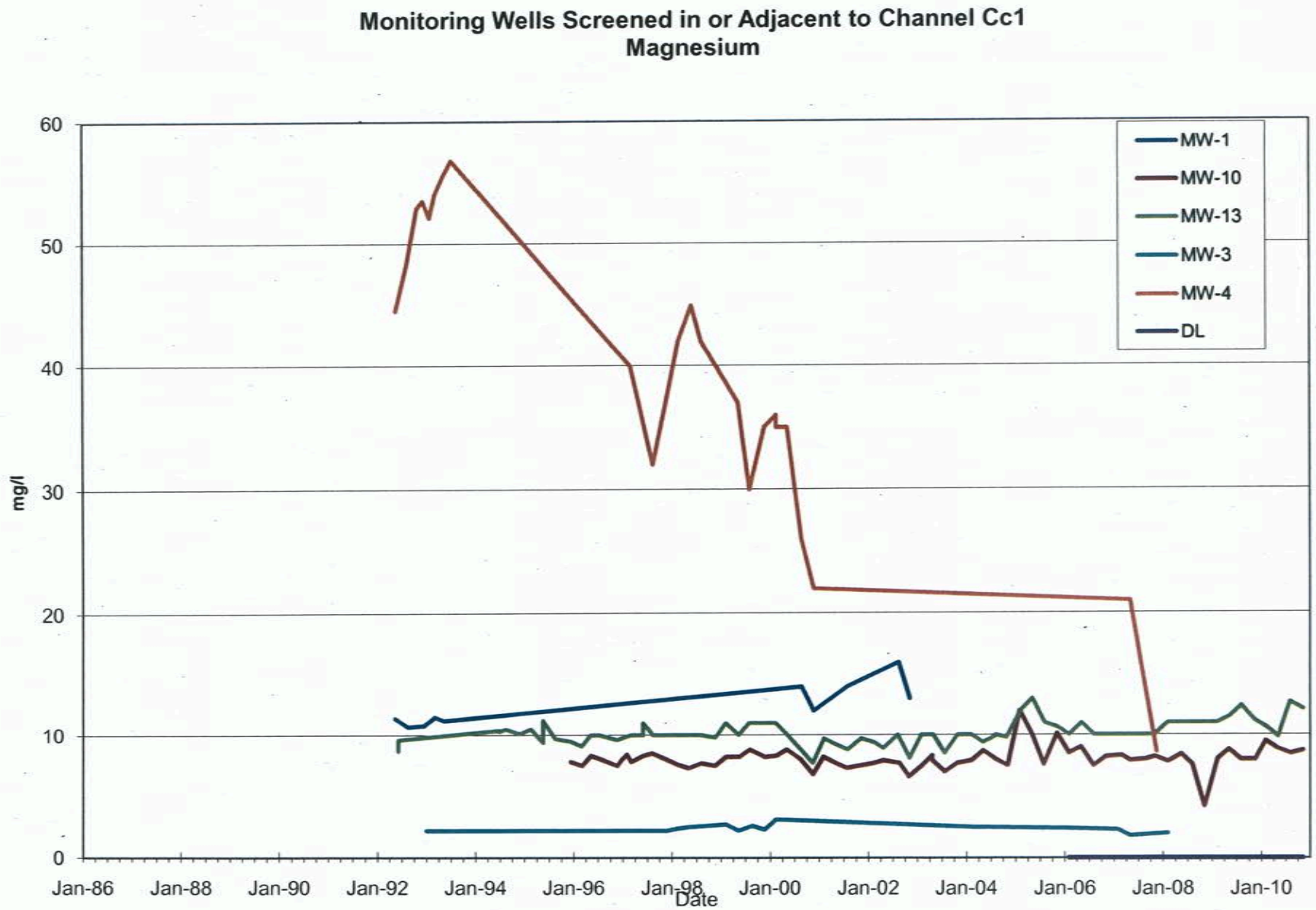

Monitoring Wells Screened in or Adjacent to Channel Cc1
Ammonia
mg/l
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan-86
Jan-90
Jan-94
Jan-98
Jan-02
Jan-06
Jan-10
MW-1
MW-10
MW-13
MW-3
MW-4
DL

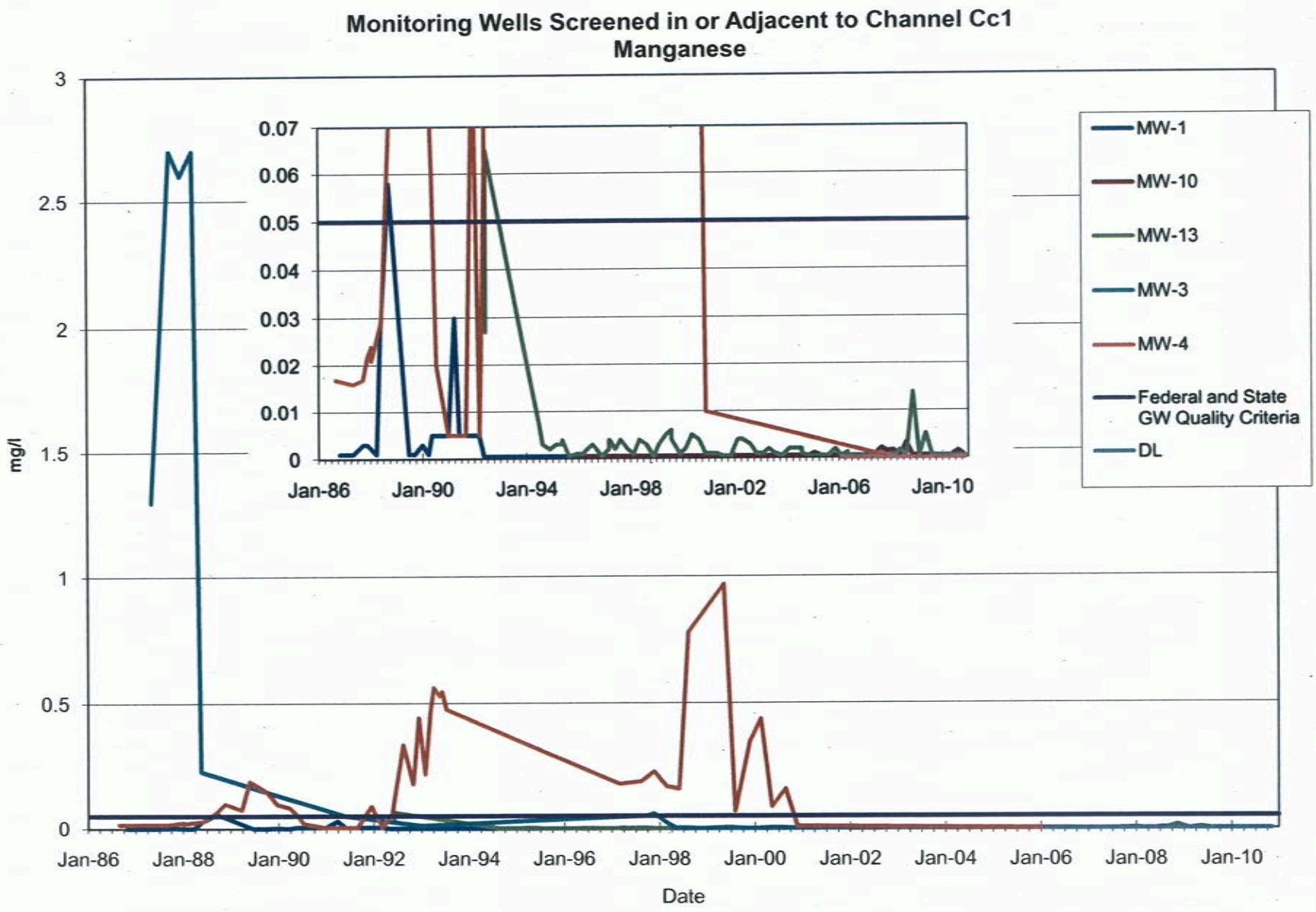

Monitoring Wells Screened in or Adjacent to Channel Cc1
Chloride
Federal and State GW Quality Criteria 250 mg/L
MW-1
MW-10
MW-13
MW-3
MW-4
DL
mg/l
0
2
4
6
8
10
12
14
16
18
20
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

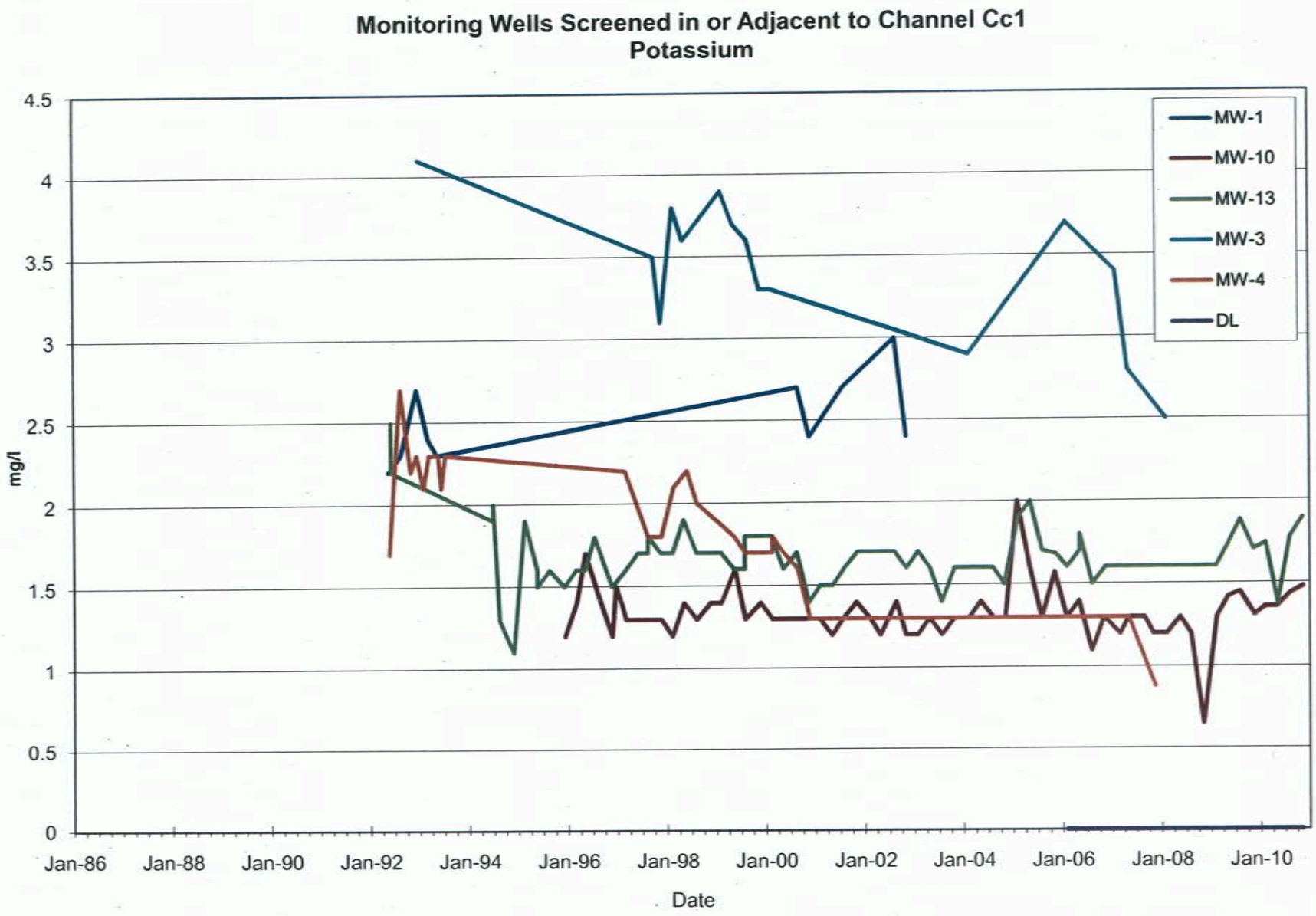

Monitoring Wells Screened in or Adjacent to Channel Cc1
Nitrate
12
10
8
6
4
2
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
Federal and State GW Quality Criteria
DL

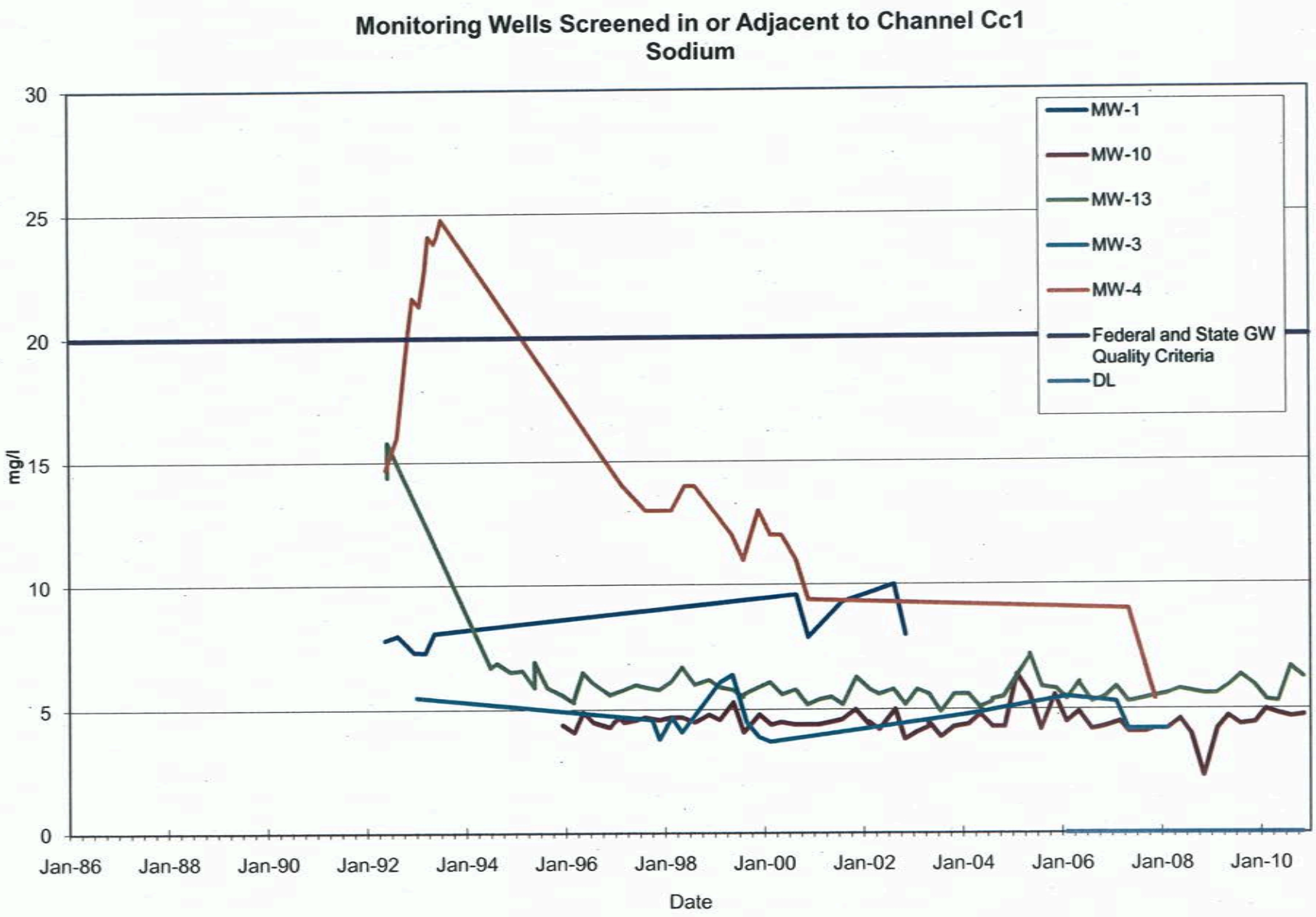

Monitoring Wells Screened in or Adjacent to Channel Cc1
Sulfate
Federal and State GW Quality Criteria 250 mg/L
MW-1
MW-10
MW-13
MW-3
MW-4
DL
mg/l
50
45
40
35
30
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

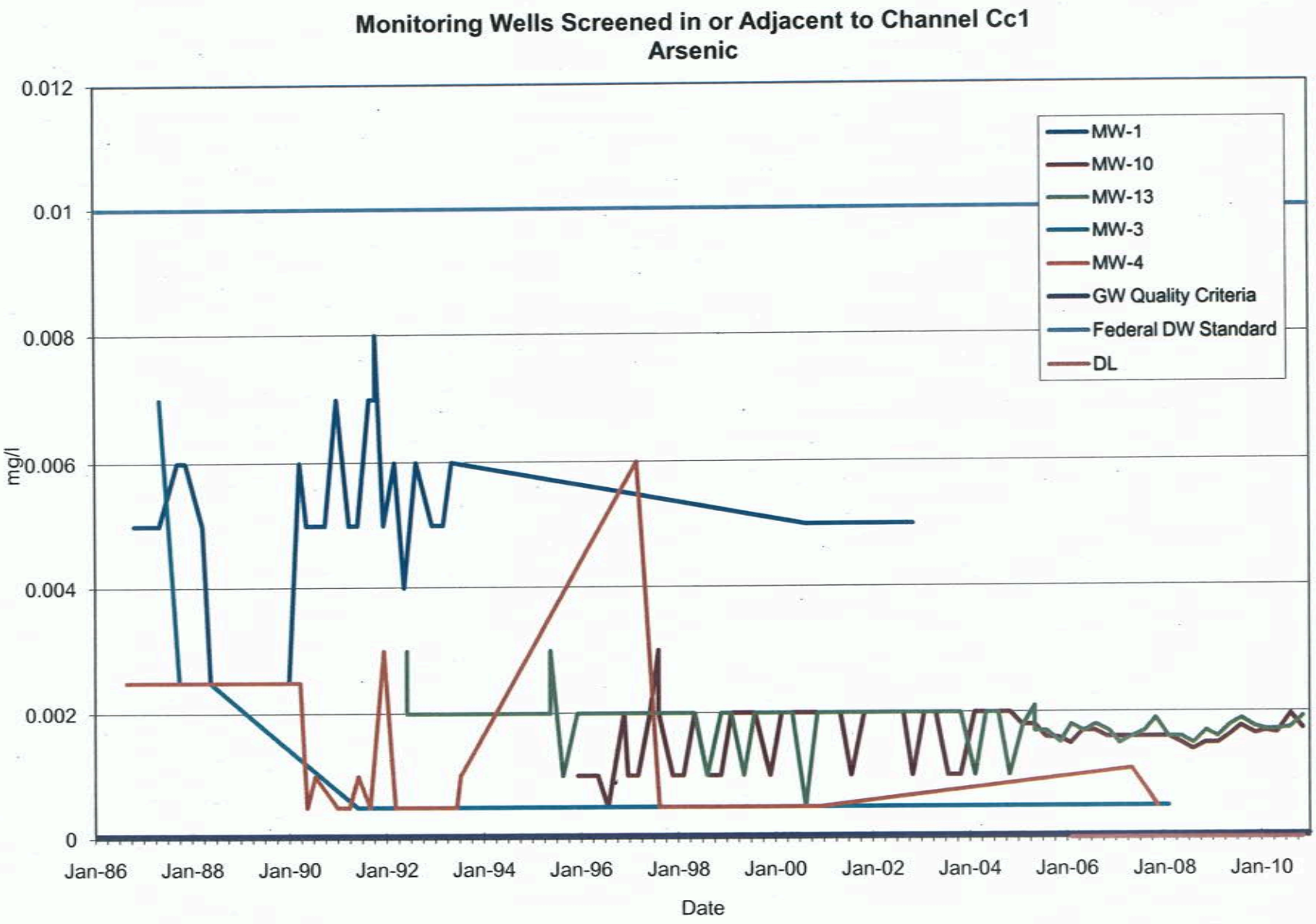

Monitoring Wells Screened in or Adjacent to Channel Cc1
Iron
mg/l
Date
MW-1
MW-10
MW-13
MW-3
MW-4
Federal and State GW Criteria
DL

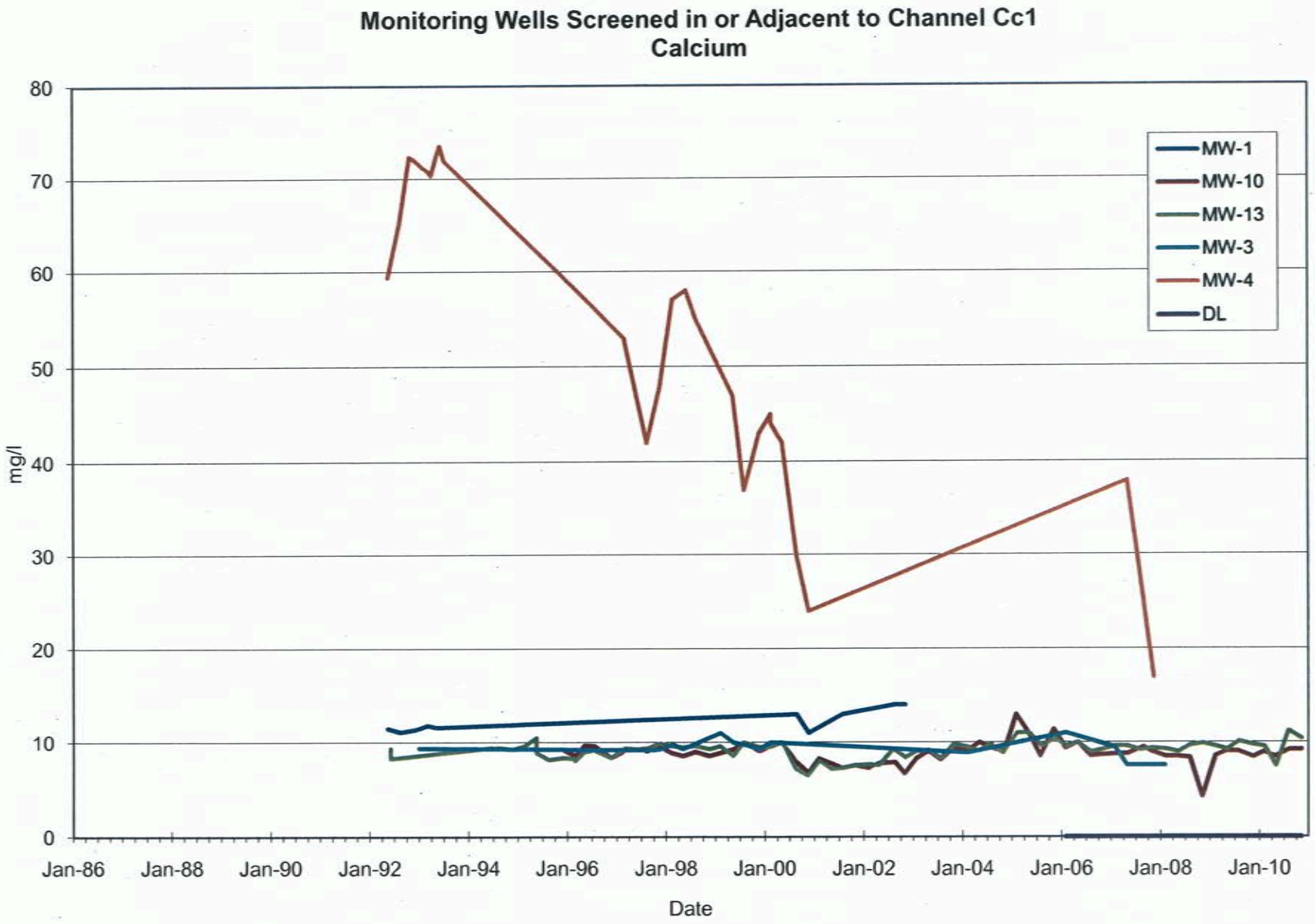

Monitoring Wells Screened in or Adjacent to Channel Cc1
Magnesium
mg/l
60
50
40
30
20
10
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
DL


Monitoring Wells Screened in or Adjacent to Channel Cc1
Manganese
mg/l
3
2.5
2
1.5
1
0.5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-86
Jan-90
Jan-94
Jan-98
Jan-02
Jan-06
Jan-10
MW-1
MW-10
MW-13
MW-3
MW-4
Federal and State GW Quality Criteria
DL


Monitoring Wells Screened in or Adjacent to Channel Cc1
Potassium
mg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
DL


Monitoring Wells Screened in or Adjacent to Channel Cc1
Sodium
30
25
20
15
10
5
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
Federal and State GW Quality Criteria
DL

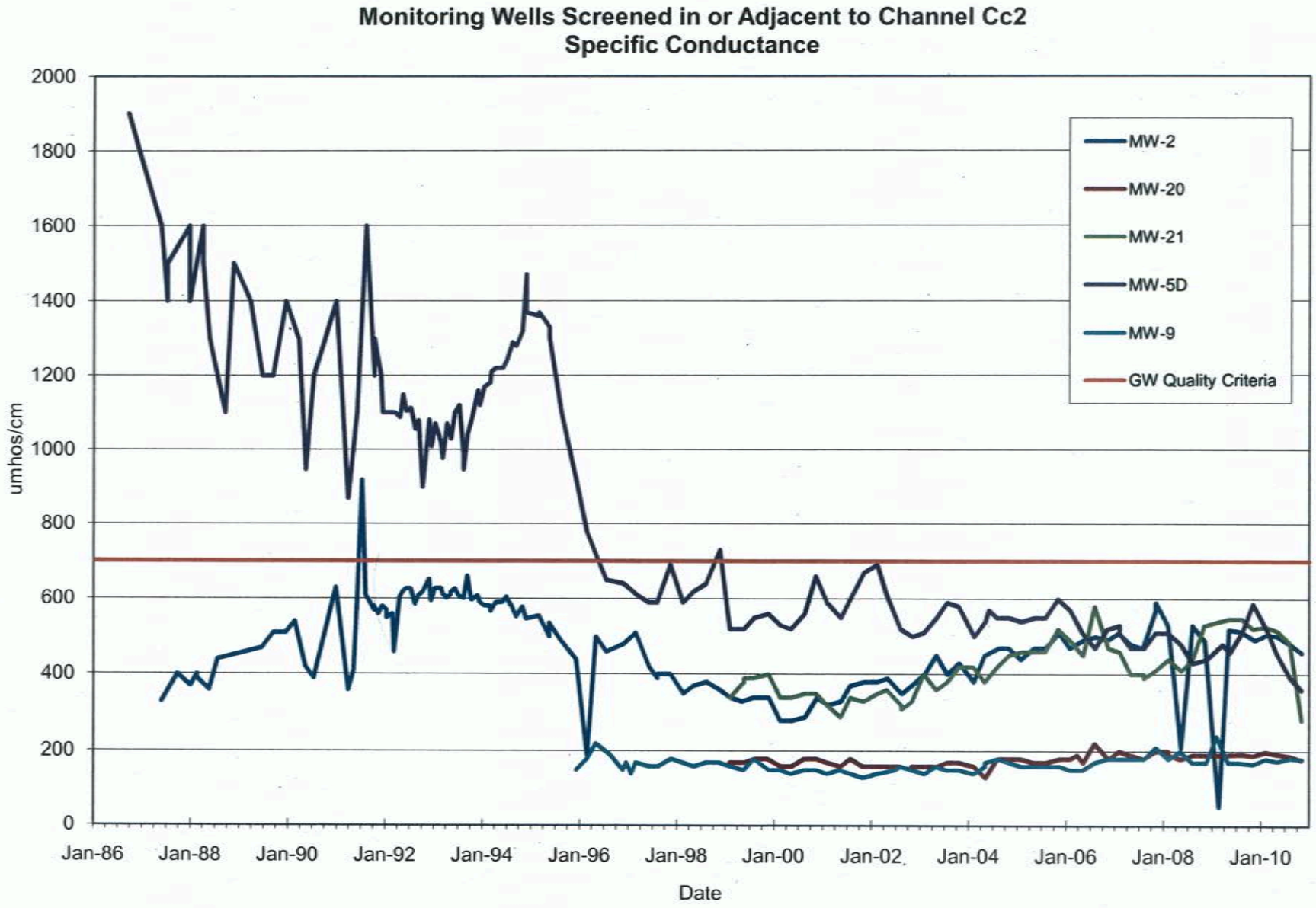

Monitoring Wells Screened in or Adjacent to Channel Cc1
Arsenic
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-1
MW-10
MW-13
MW-3
MW-4
GW Quality Criteria
Federal DW Standard
DL

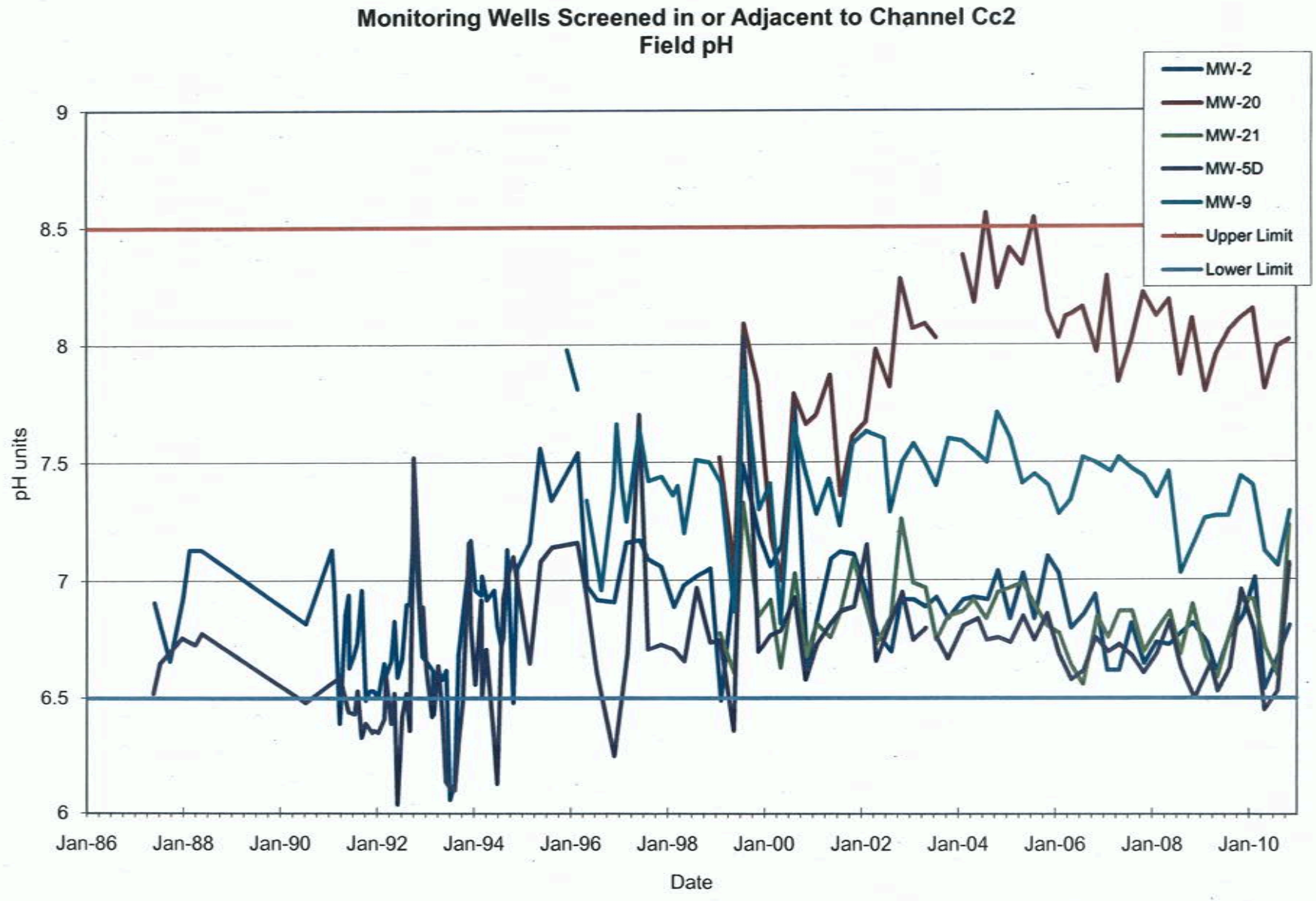

Monitoring Wells Screened in or Adjacent to Channel Cc1
Calcium
80
70
60
50
40
30
20
10
0
mg/l
MW-1
MW-10
MW-13
MW-3
MW-4
DL
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

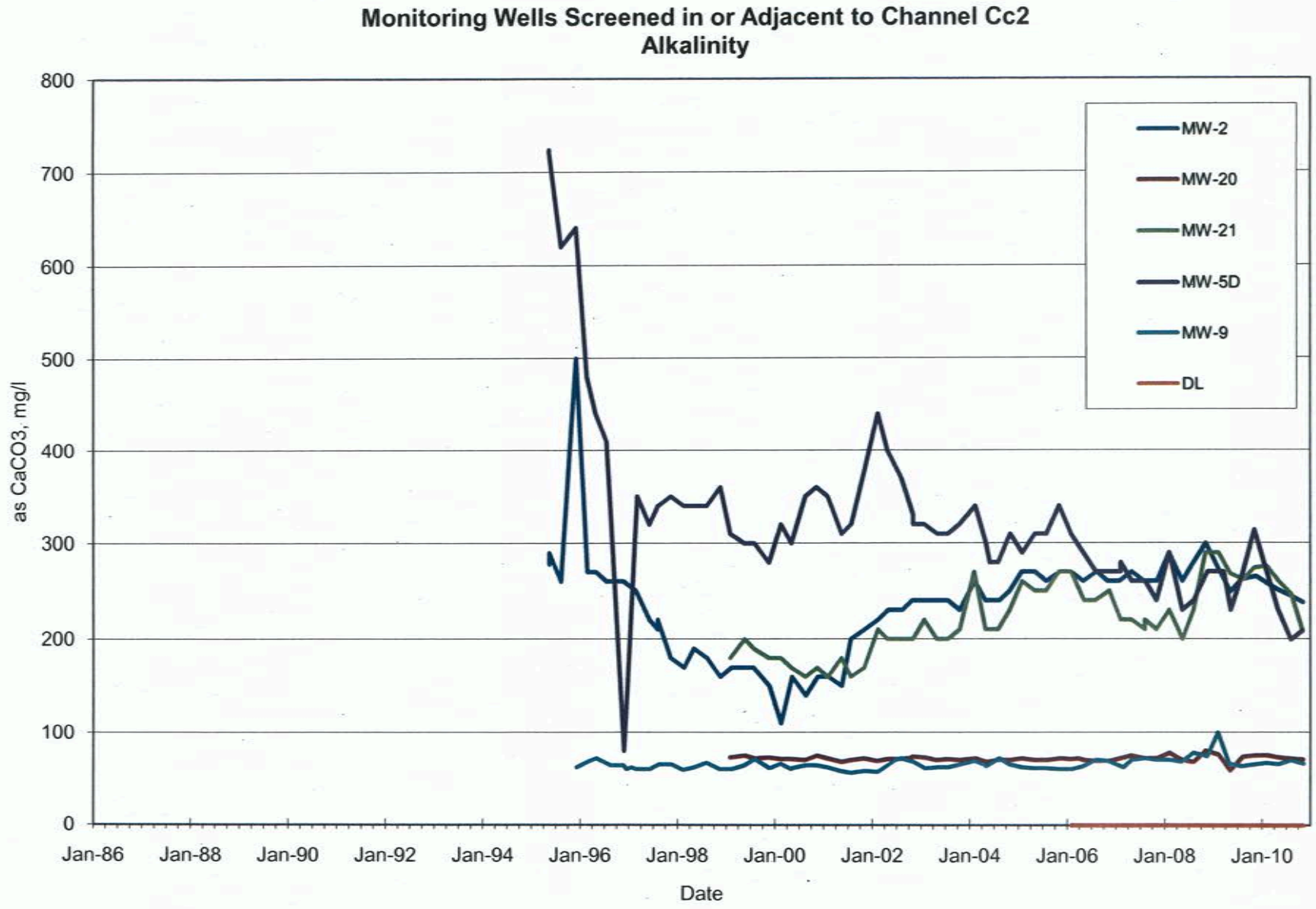
Appendix D

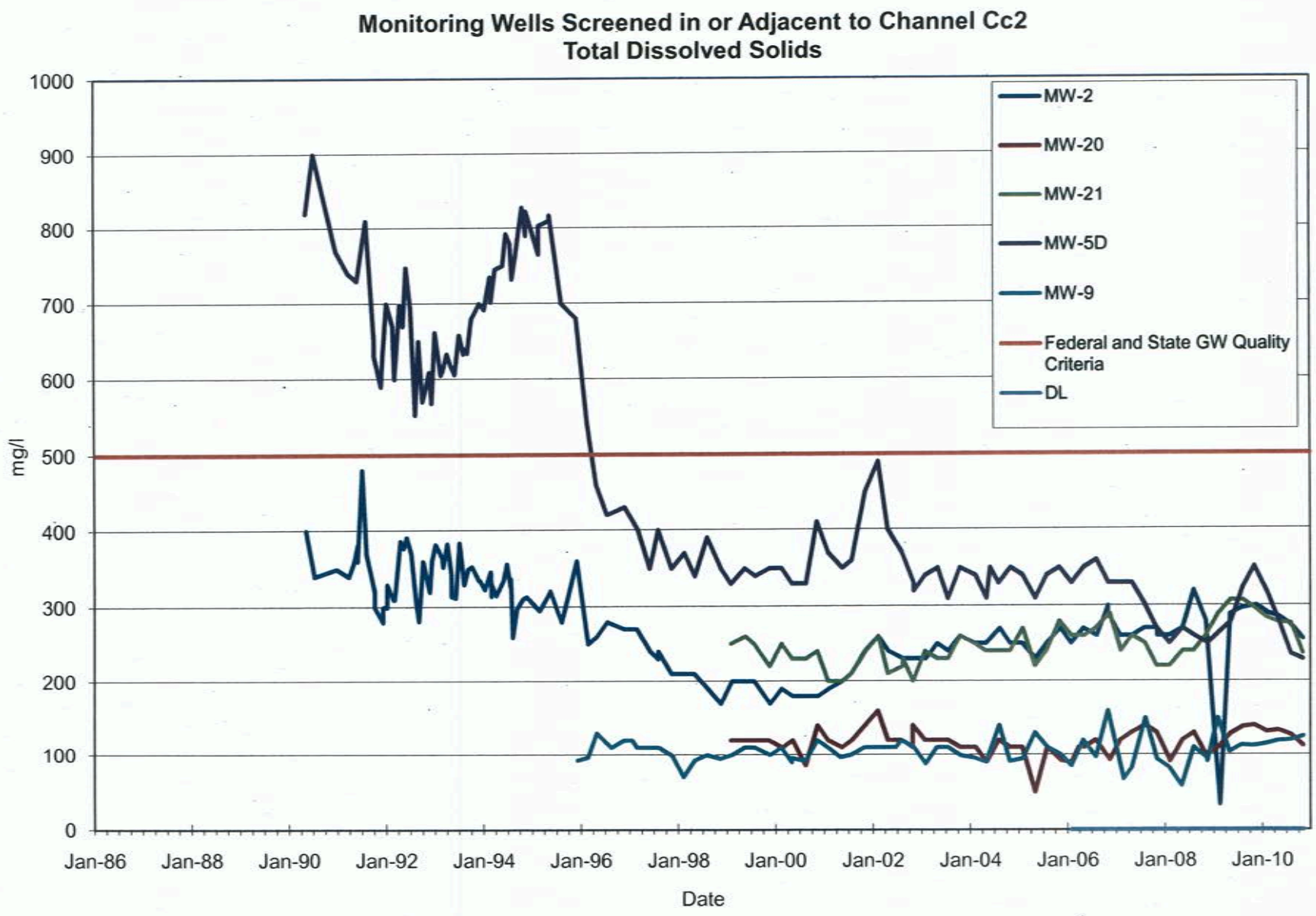
Appendix D

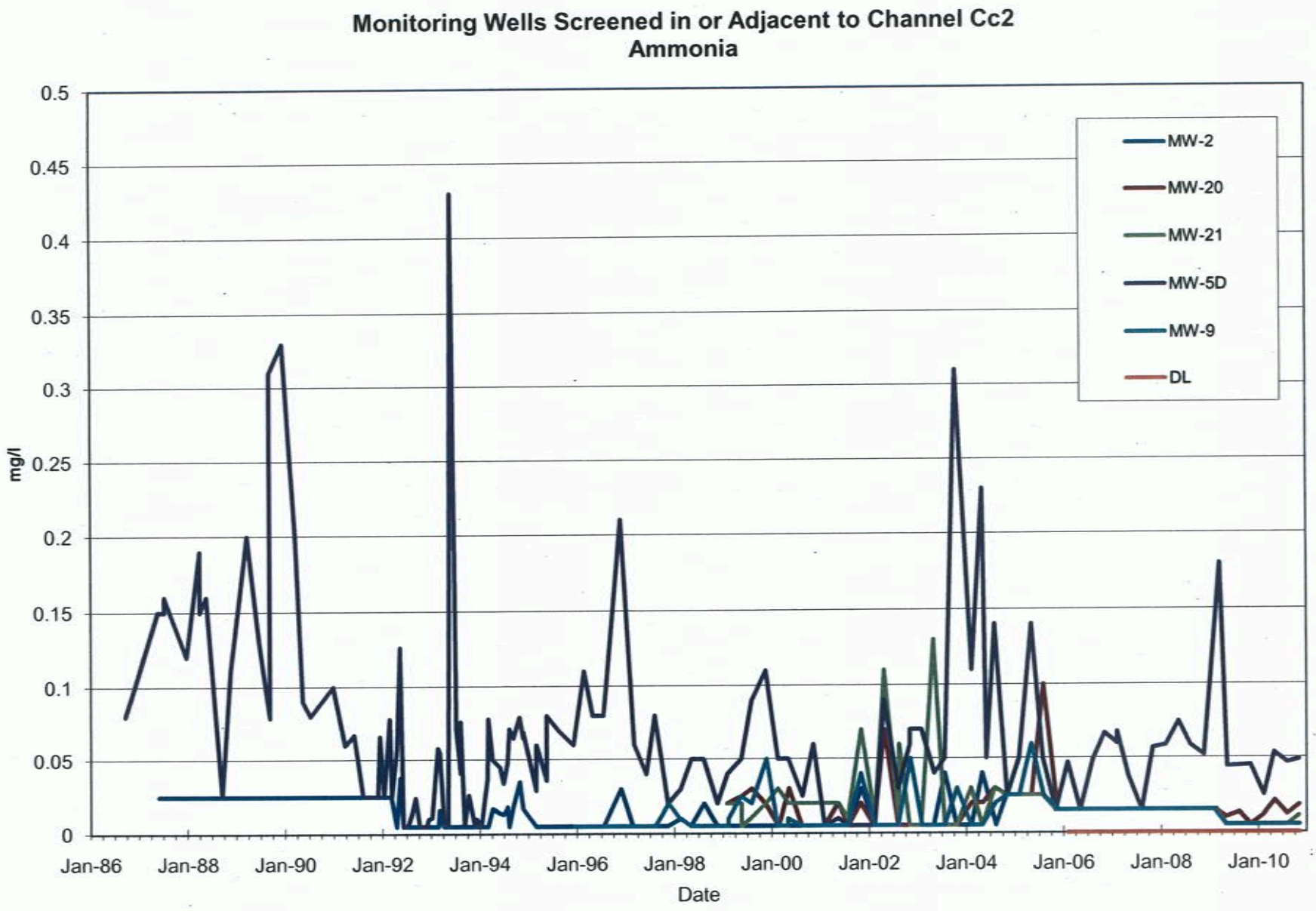
Time Concentration Plots for Groundwater in Channel Cc2

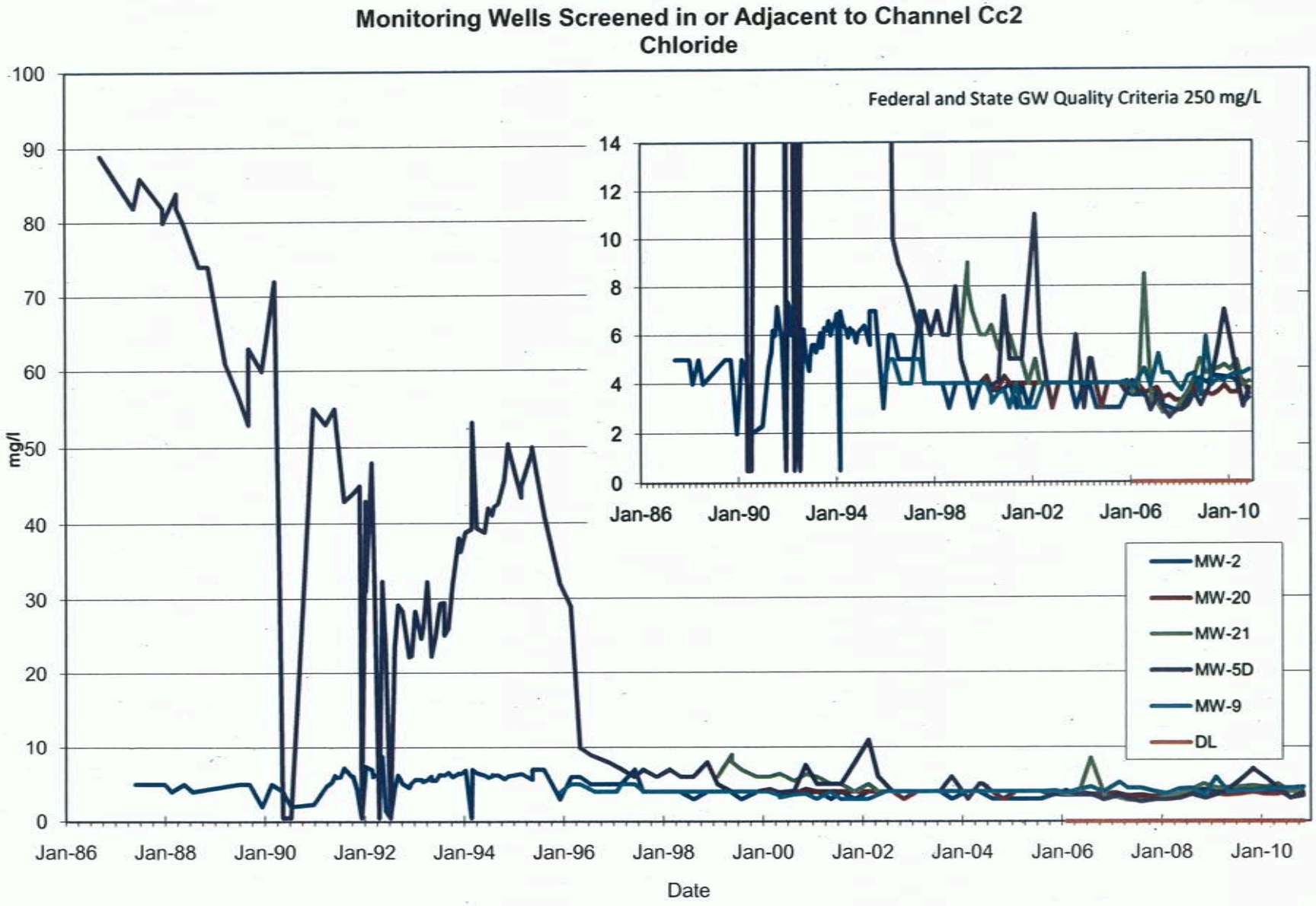

Monitoring Wells Screened in or Adjacent to Channel Cc2
Specific Conductance
umhos/cm
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
GW Quality Criteria

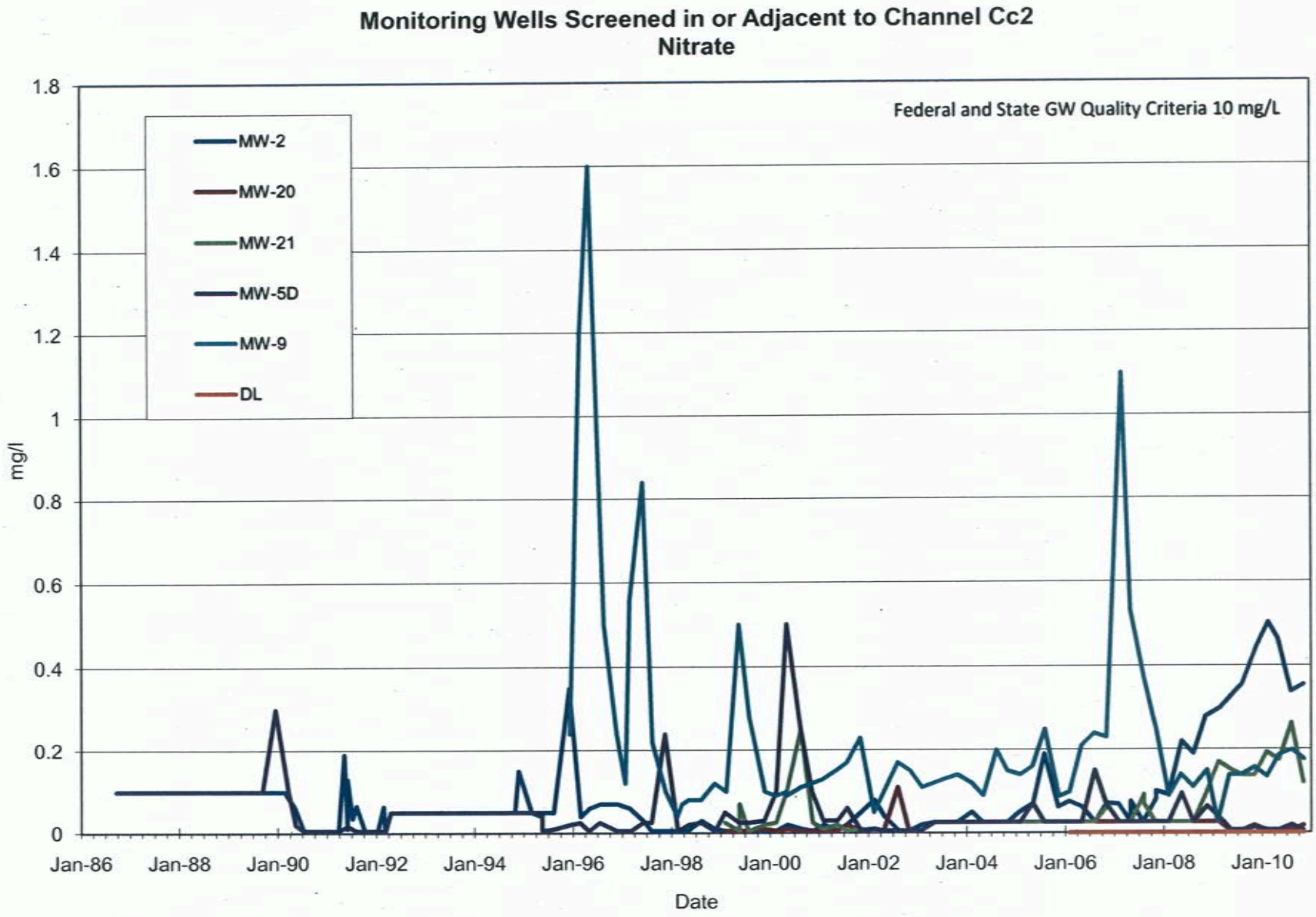

Monitoring Wells Screened in or Adjacent to Channel Cc2
Field pH
MW-2
MW-20
MW-21
MW-5D
MW-9
Upper Limit
Lower Limit
9
8.5
8
7.5
7
6.5
6
pH units
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

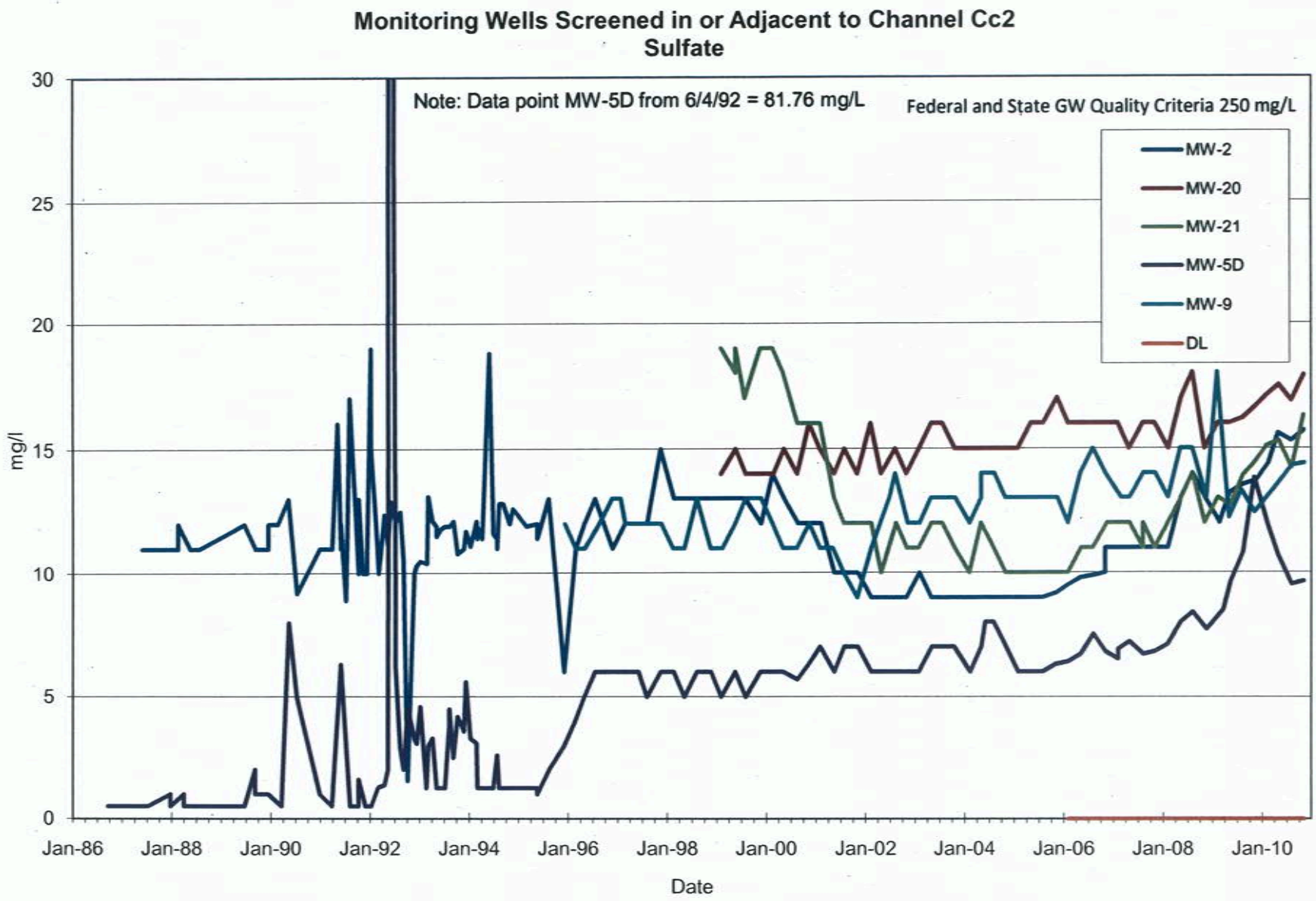

Monitoring Wells Screened in or Adjacent to Channel Cc2
Alkalinity
800
700
600
500
400
300
200
100
0
as CaCO3, mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

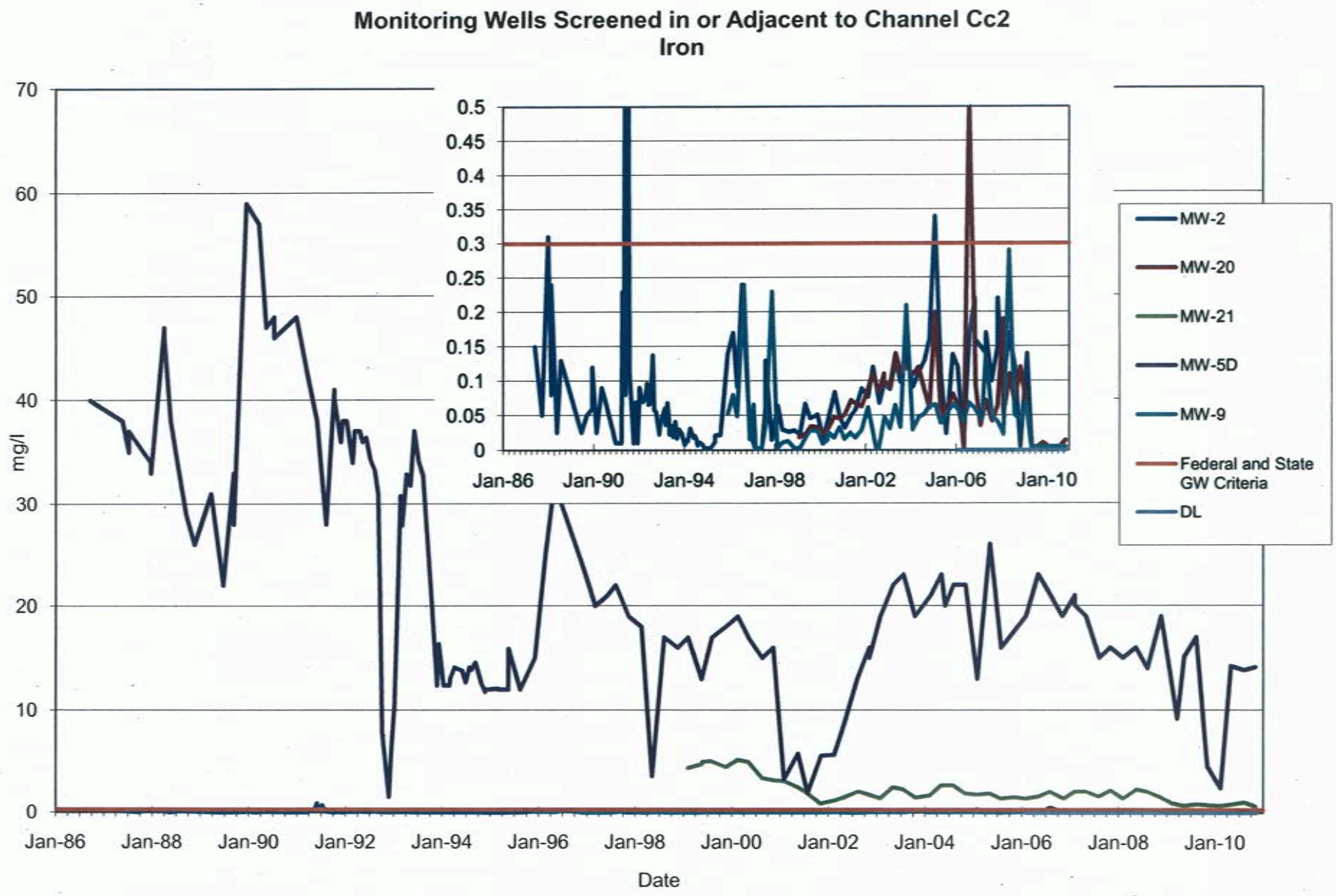

Monitoring Wells Screened in or Adjacent to Channel Cc2
Total Dissolved Solids
1000
900
800
700
600
500
400
300
200
100
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
Federal and State GW Quality Criteria
DL

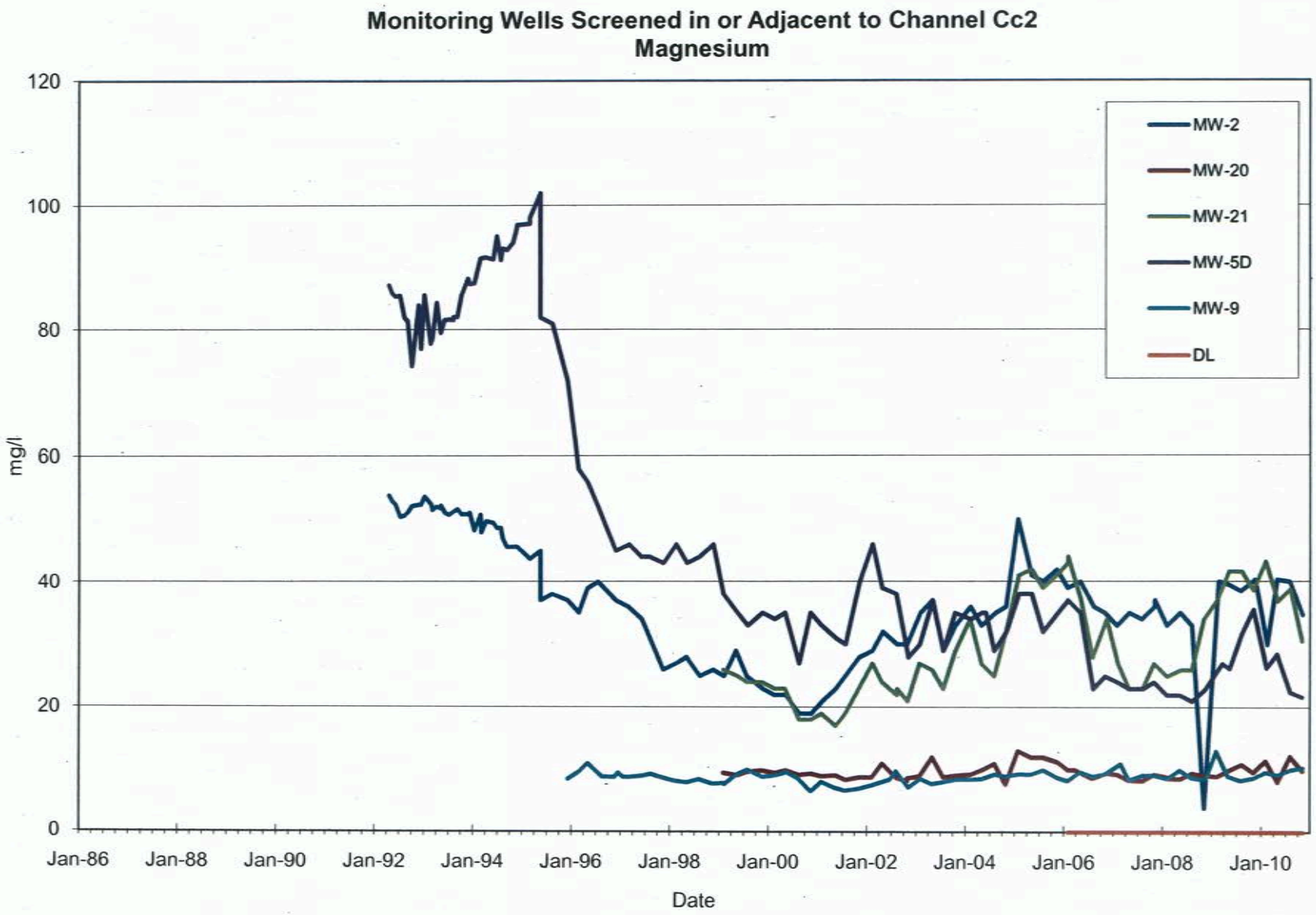

Monitoring Wells Screened in or Adjacent to Channel Cc2
Ammonia
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

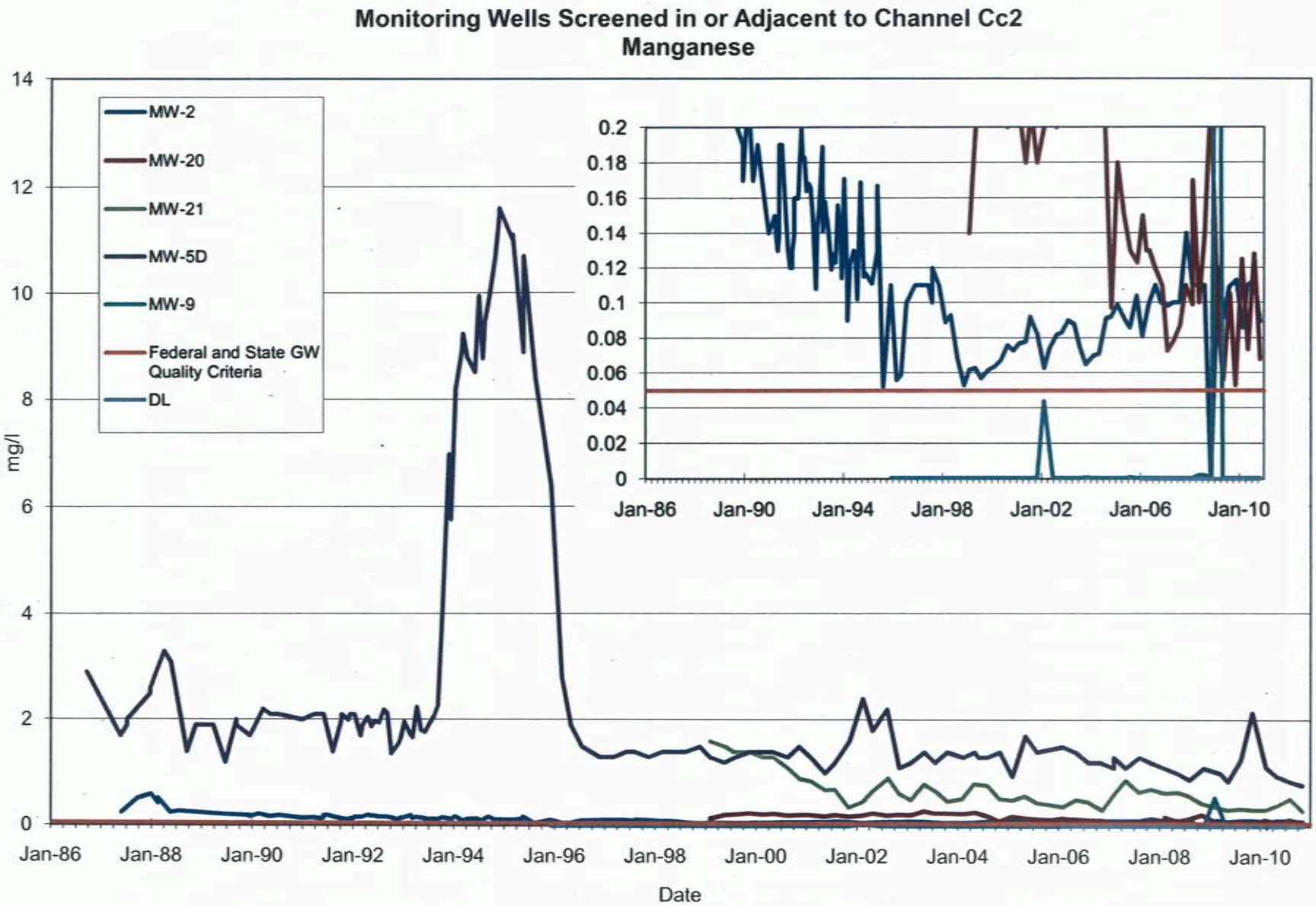

Monitoring Wells Screened in or Adjacent to Channel Cc2
Chloride
Federal and State GW Quality Criteria 250 mg/L
mg/l
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

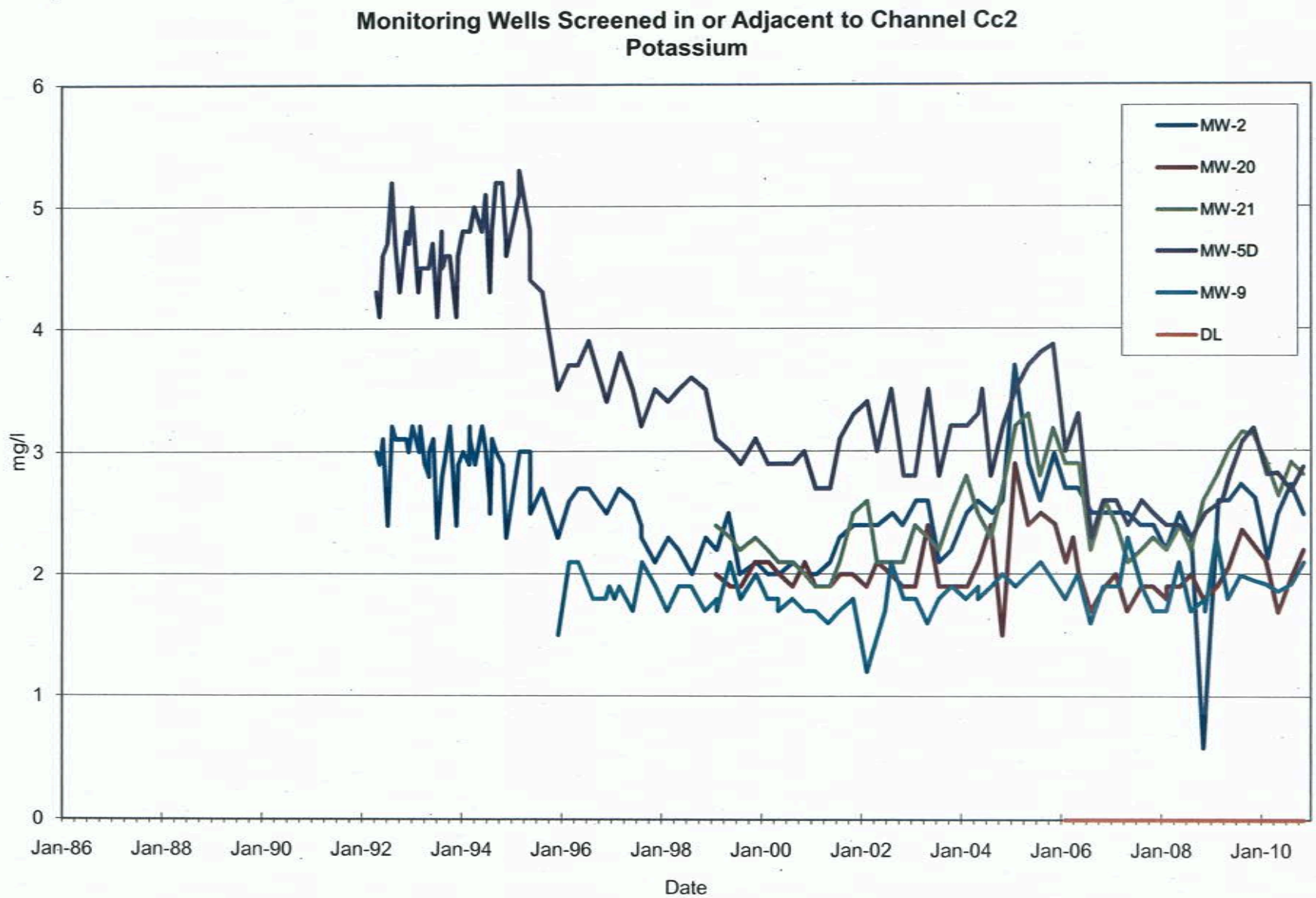

Monitoring Wells Screened in or Adjacent to Channel Cc2
Nitrate
Federal and State GW Quality Criteria 10 mg/L
MW-2
MW-20
MW-21
MW-5D
MW-9
DL
mg/l
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

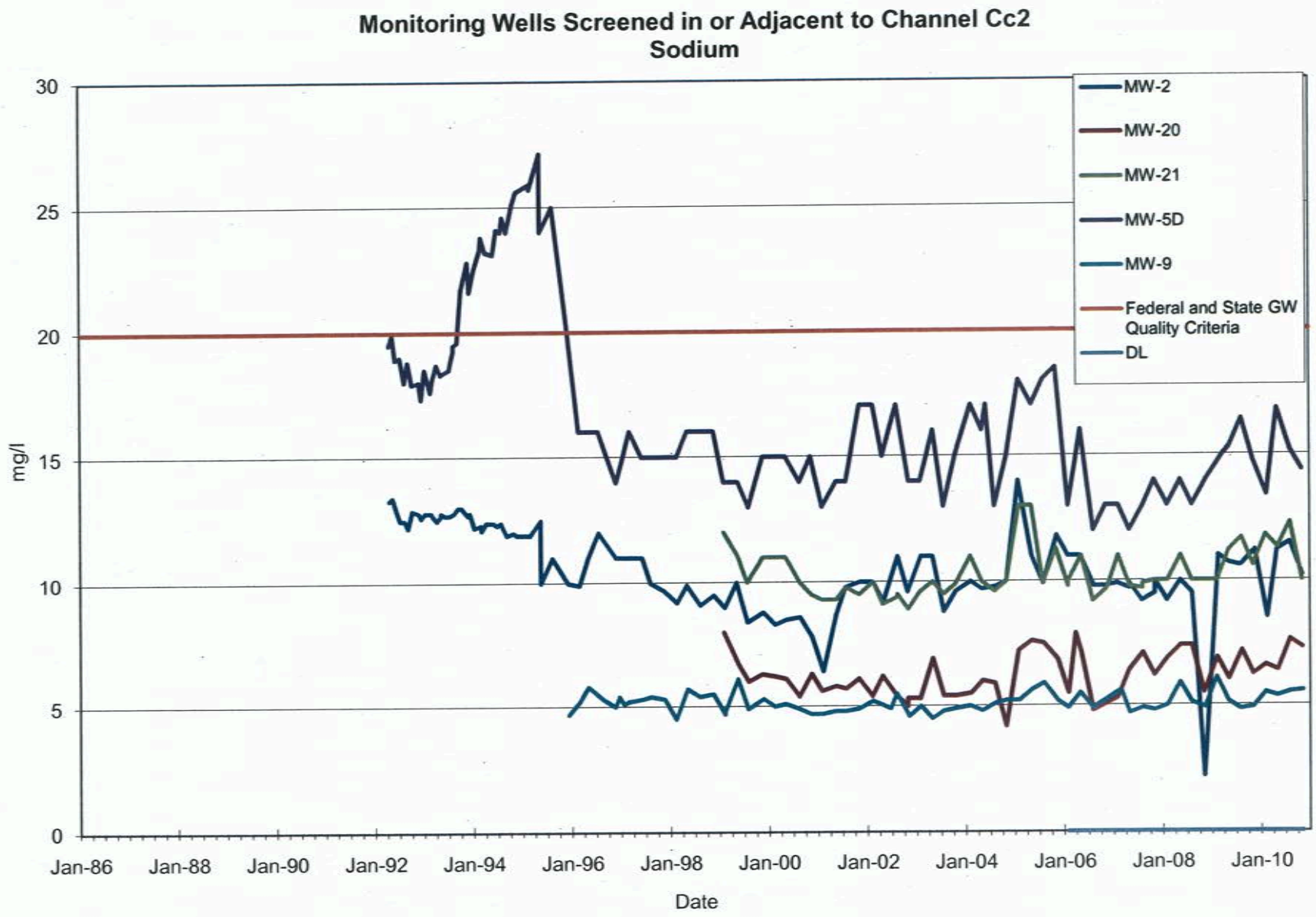

Monitoring Wells Screened in or Adjacent to Channel Cc2
Sulfate
Note: Data point MW-5D from 6/4/92 = 81.76 mg/L
Federal and State GW Quality Criteria 250 mg/L
MW-2
MW-20
MW-21
MW-5D
MW-9
DL
mg/l
30
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

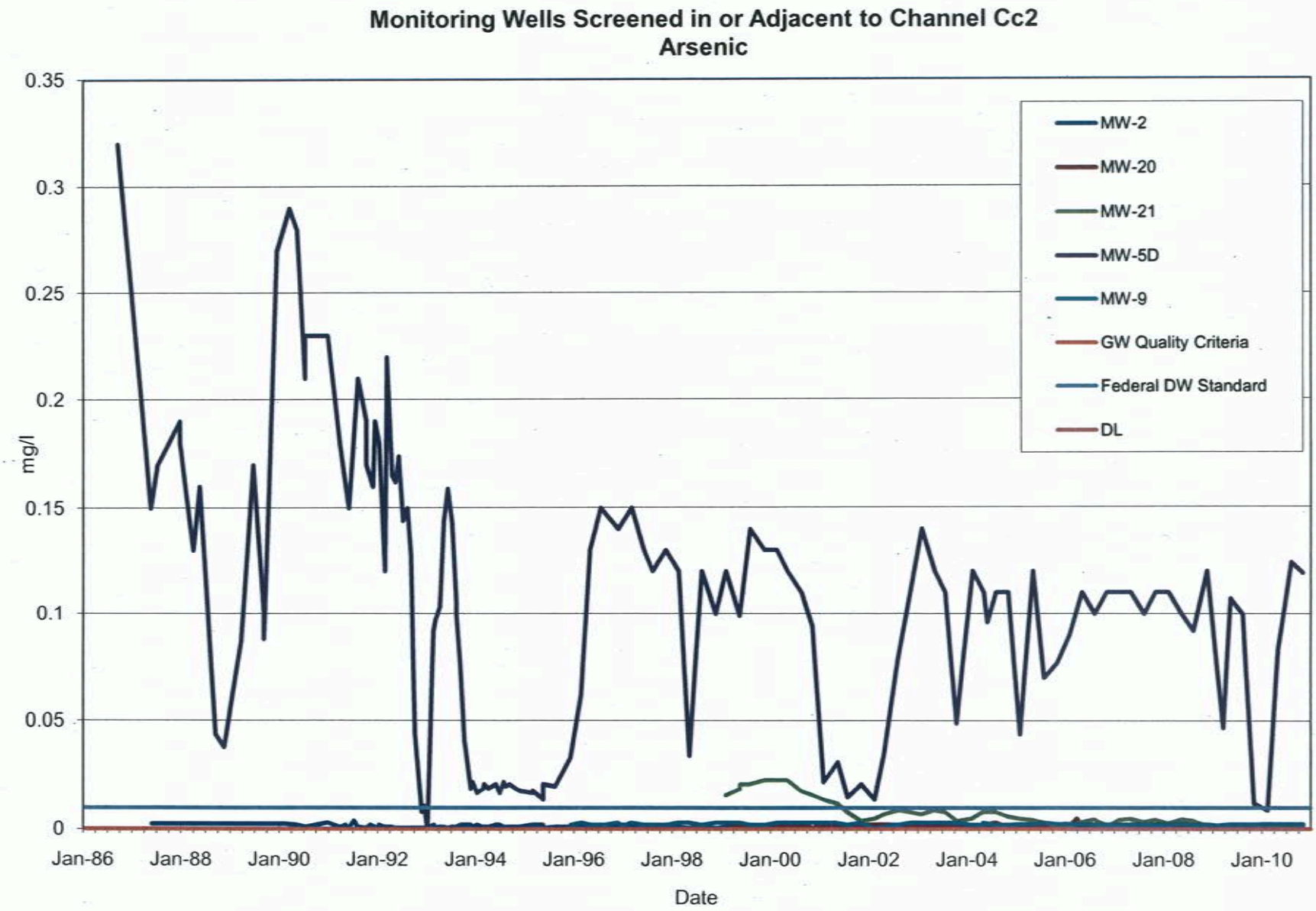

Monitoring Wells Screened in or Adjacent to Channel Cc2
Iron
mg/l
Date
70
60
50
40
30
20
10
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
MW-2
MW-20
MW-21
MW-5D
MW-9
Federal and State GW Criteria
DL

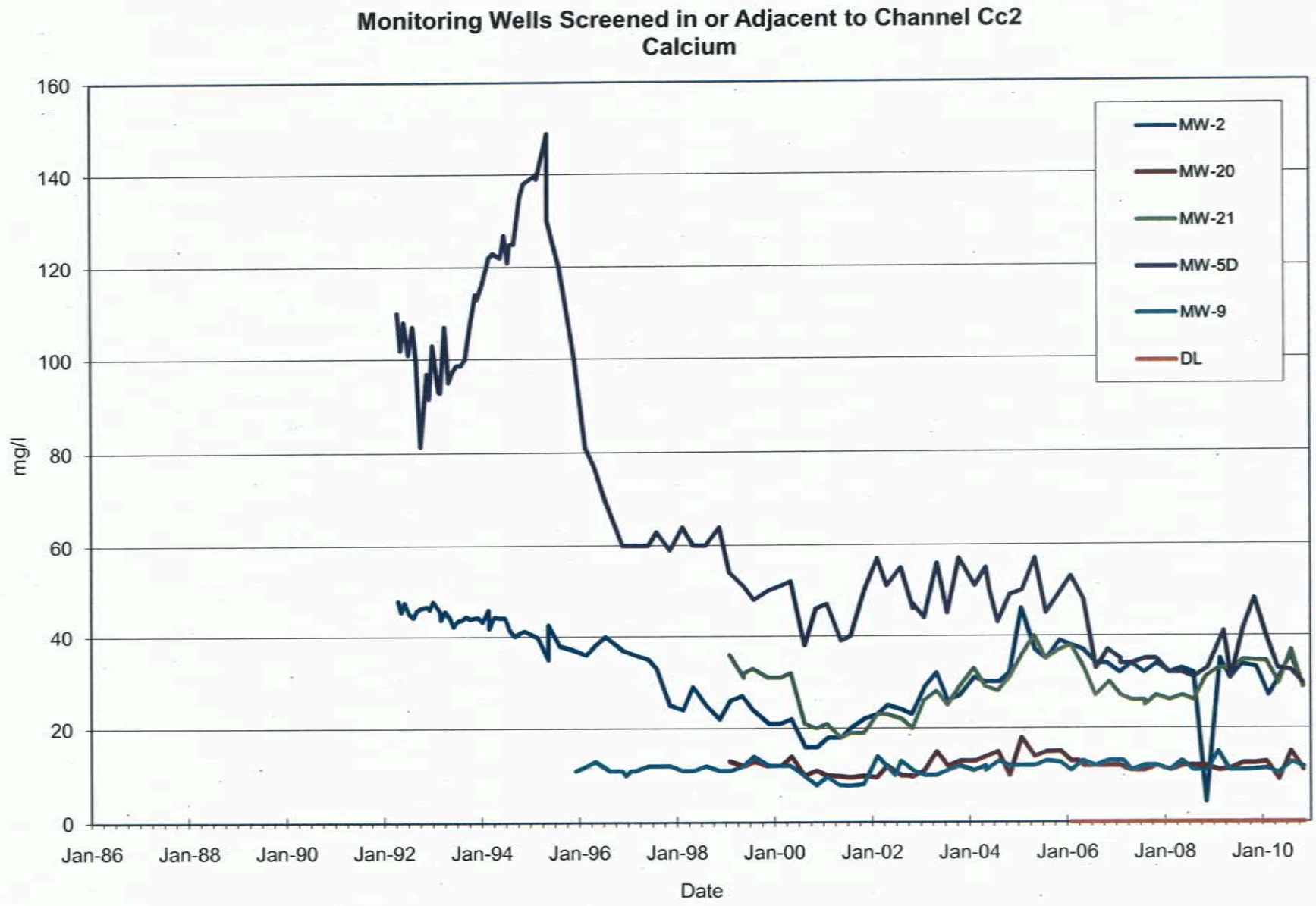

Monitoring Wells Screened in or Adjacent to Channel Cc2
Magnesium
120
100
80
60
40
20
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

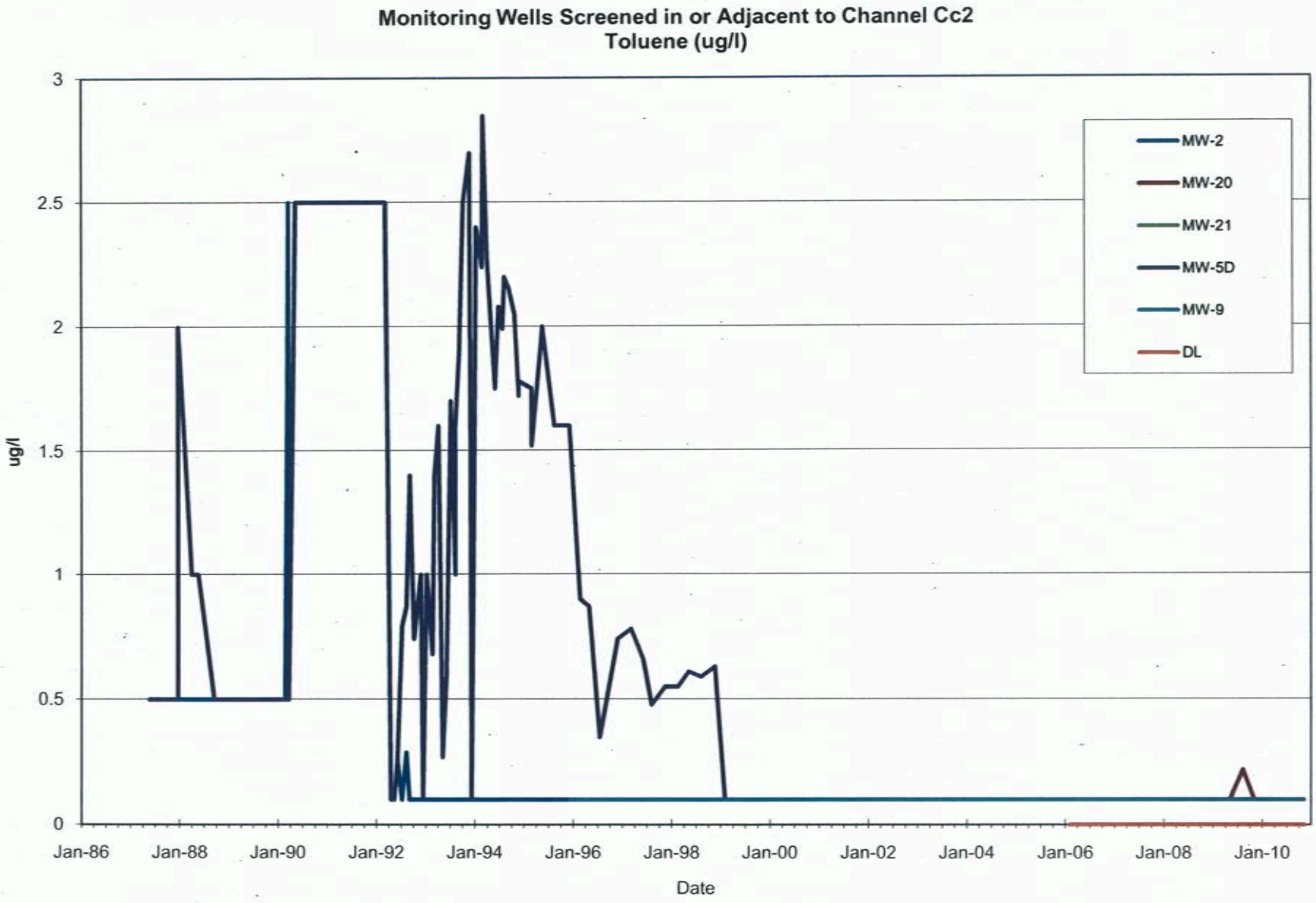

Monitoring Wells Screened in or Adjacent to Channel Cc2
Manganese
MW-2
MW-20
MW-21
MW-5D
MW-9
Federal and State GW Quality Criteria
DL
mg/l
Date
14
12
10
8
6
4
2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0

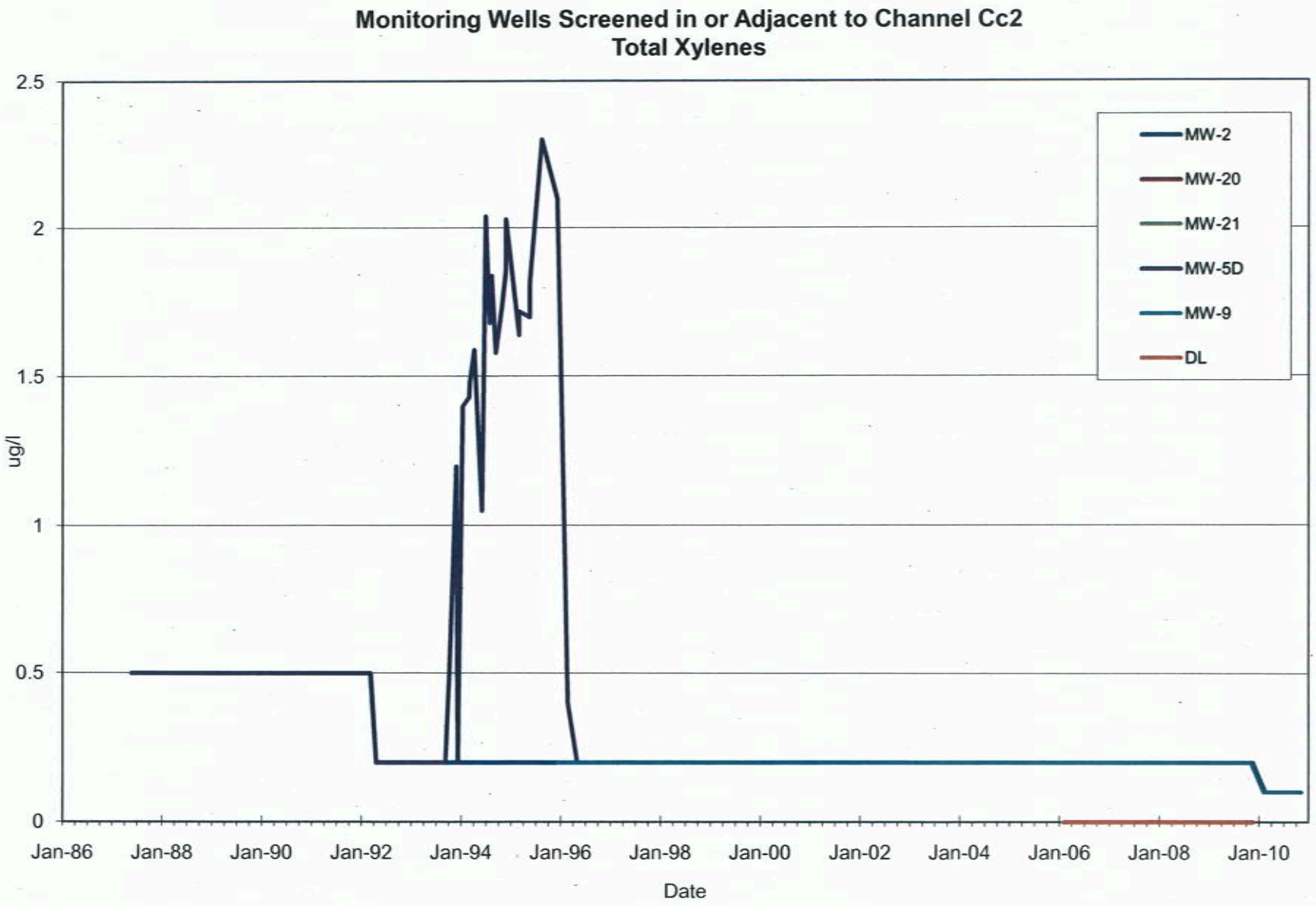

Monitoring Wells Screened in or Adjacent to Channel Cc2
Potassium
mg/l
0
1
2
3
4
5
6
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

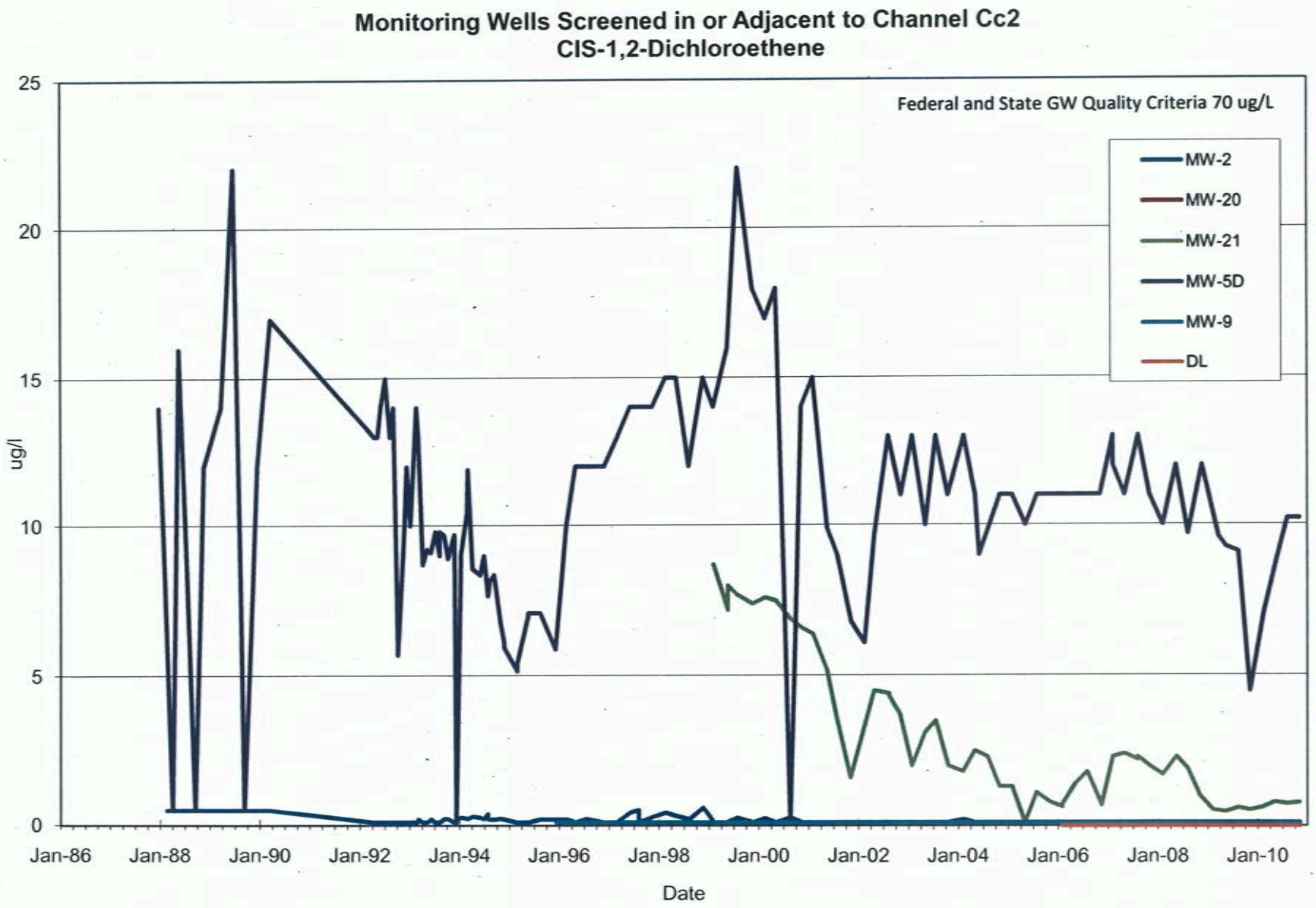

Monitoring Wells Screened in or Adjacent to Channel Cc2
Sodium
30
25
20
15
10
5
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
Federal and State GW Quality Criteria
DL

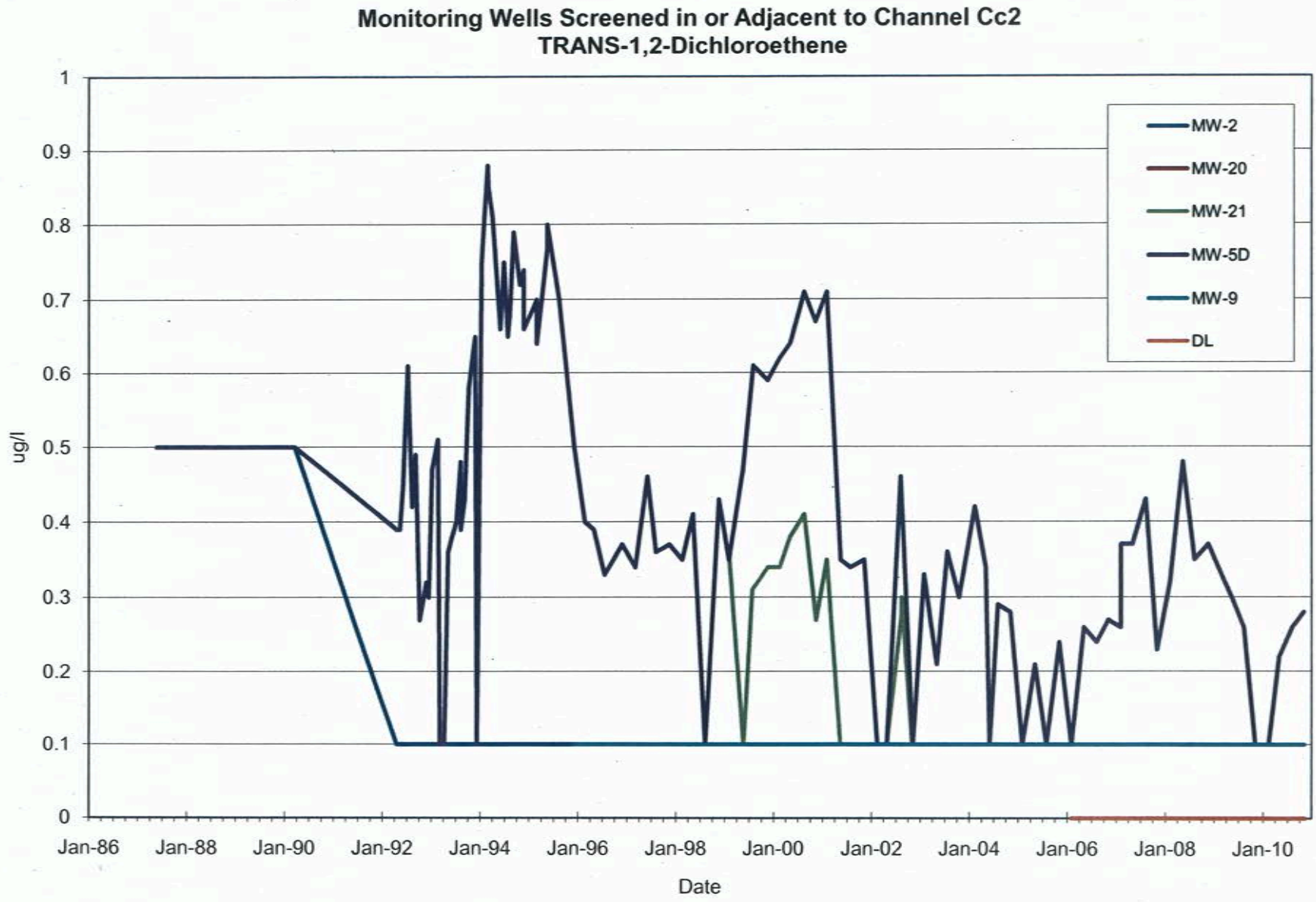

Monitoring Wells Screened in or Adjacent to Channel Cc2
Arsenic
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
GW Quality Criteria
Federal DW Standard
DL

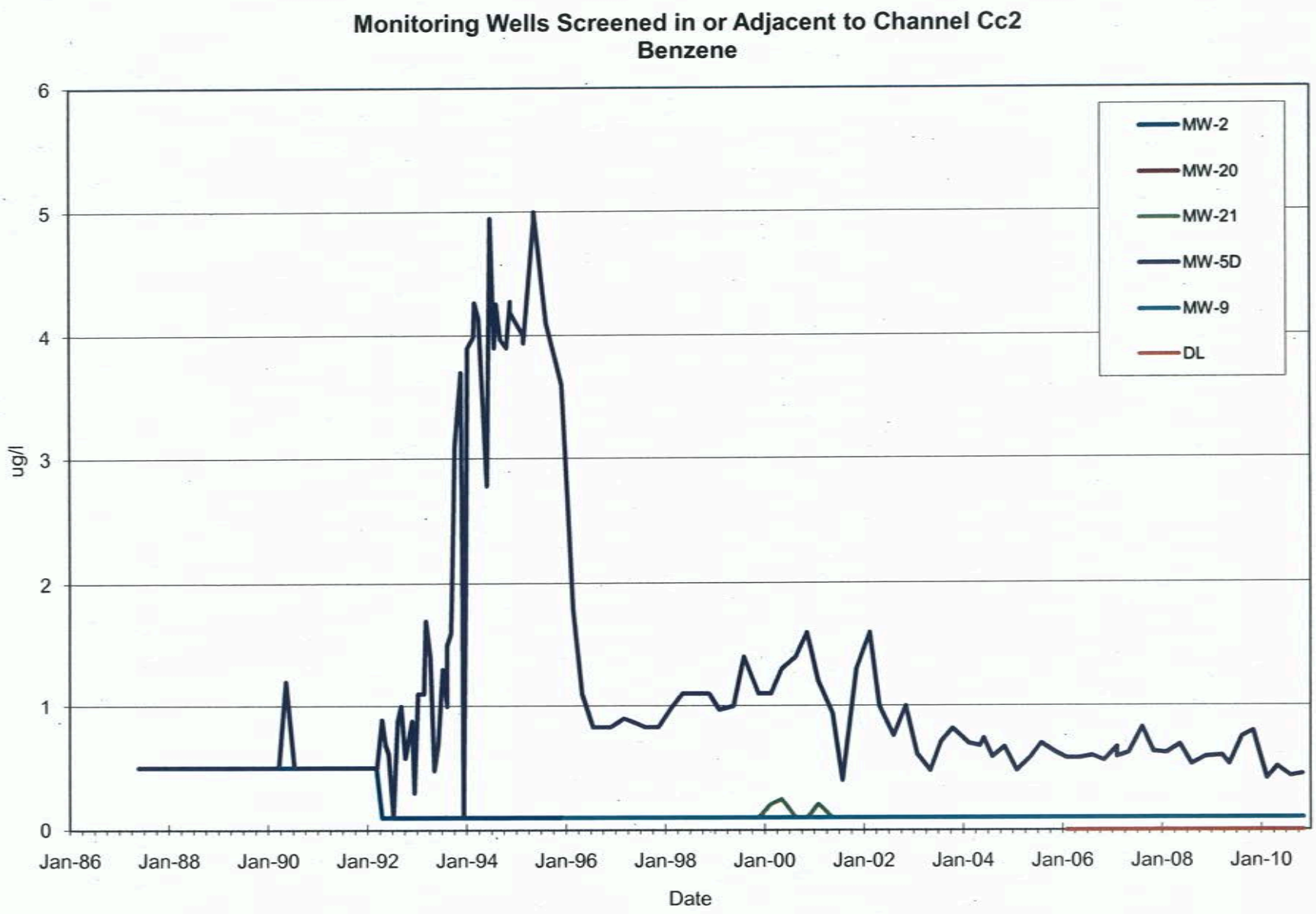

Monitoring Wells Screened in or Adjacent to Channel Cc2
Calcium
160
140
120
100
80
60
40
20
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

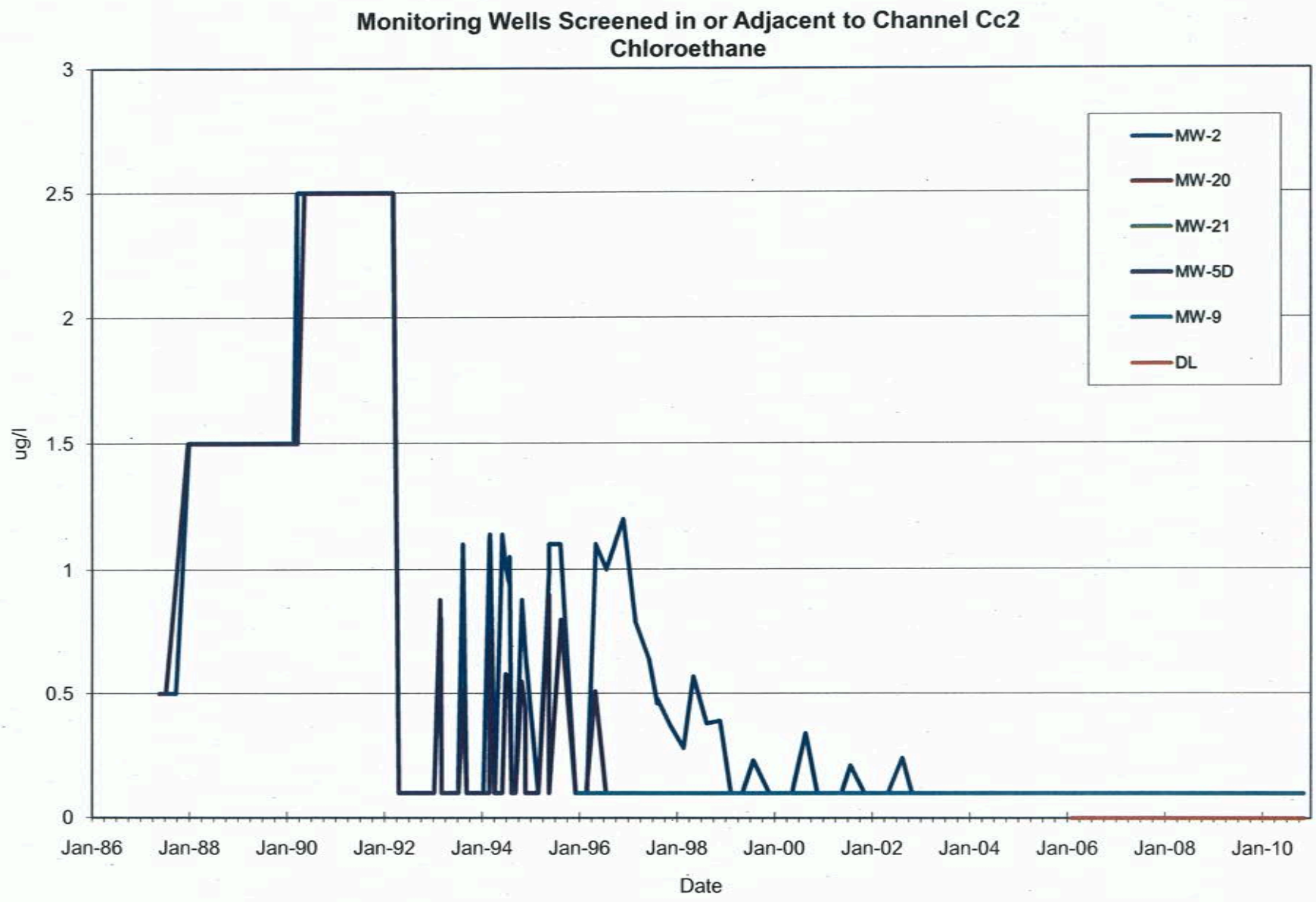

Monitoring Wells Screened in or Adjacent to Channel Cc2
Toluene (ug/l)
ug/l
3
2.5
2
1.5
1
0.5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

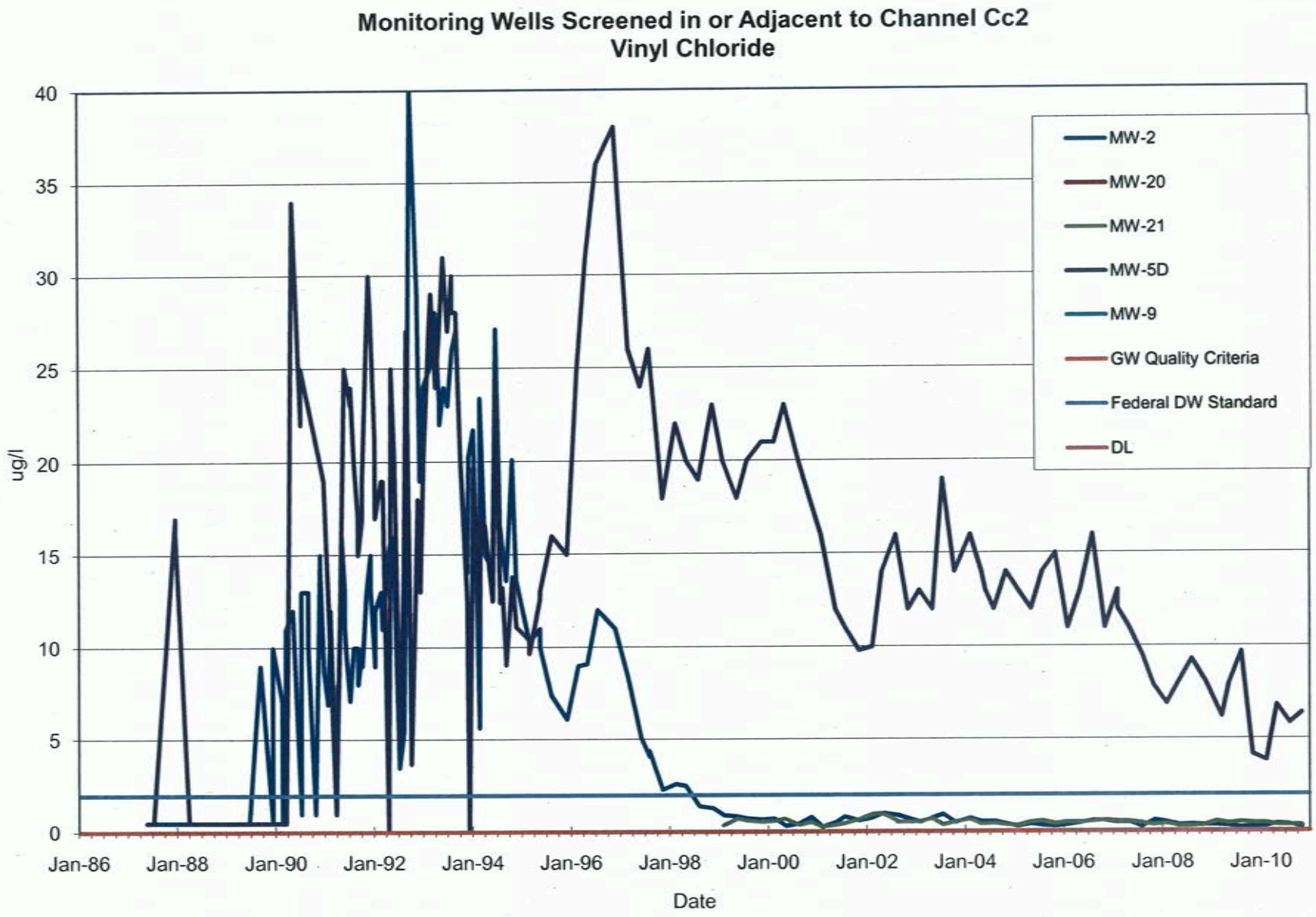

Monitoring Wells Screened in or Adjacent to Channel Cc2
Total Xylenes
2.5
2
1.5
1
0.5
0
ug/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

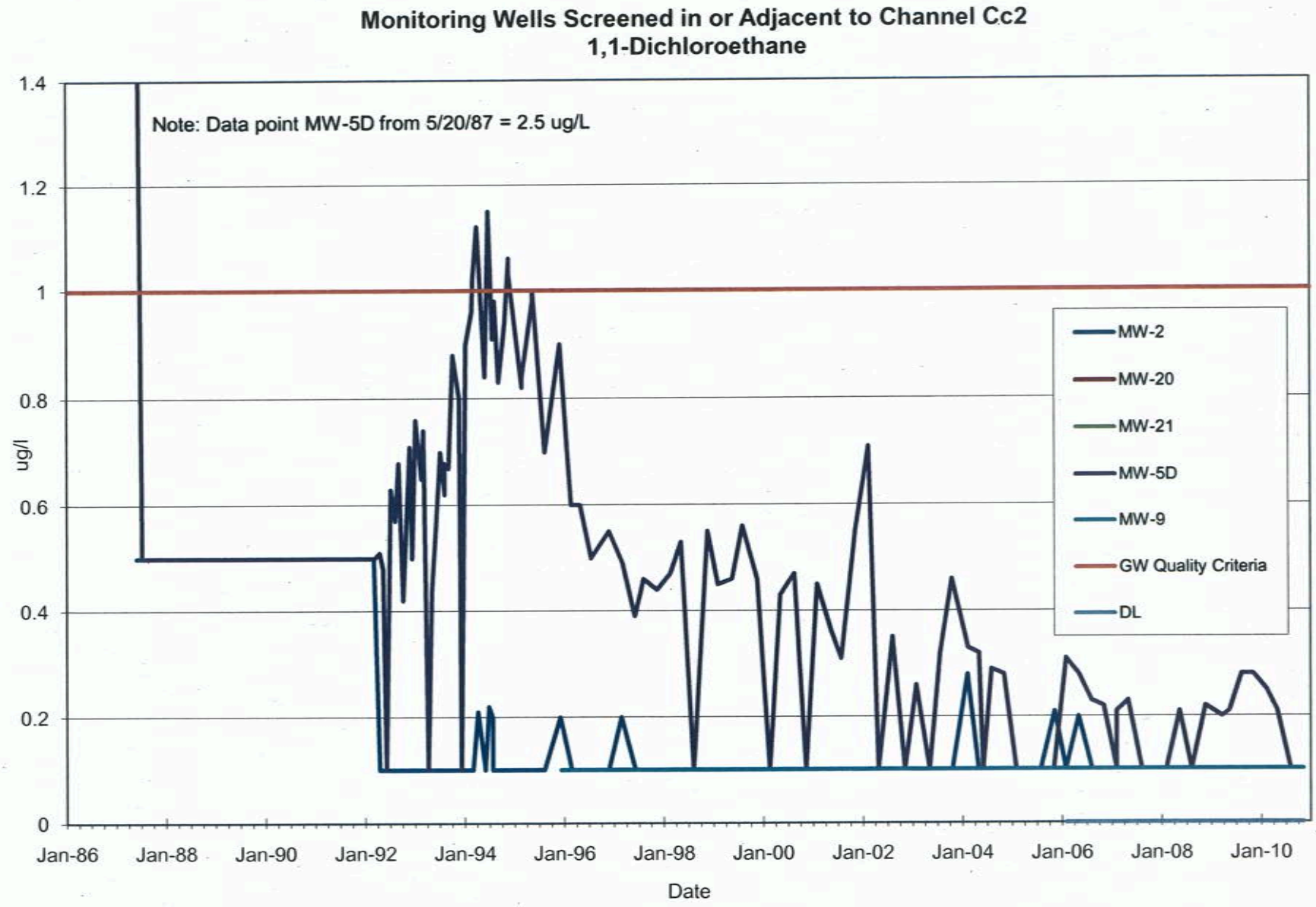

Monitoring Wells Screened in or Adjacent to Channel Cc2
CIS-1,2-Dichloroethene
Federal and State GW Quality Criteria 70 ug/L
MW-2
MW-20
MW-21
MW-5D
MW-9
DL
ug/l
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

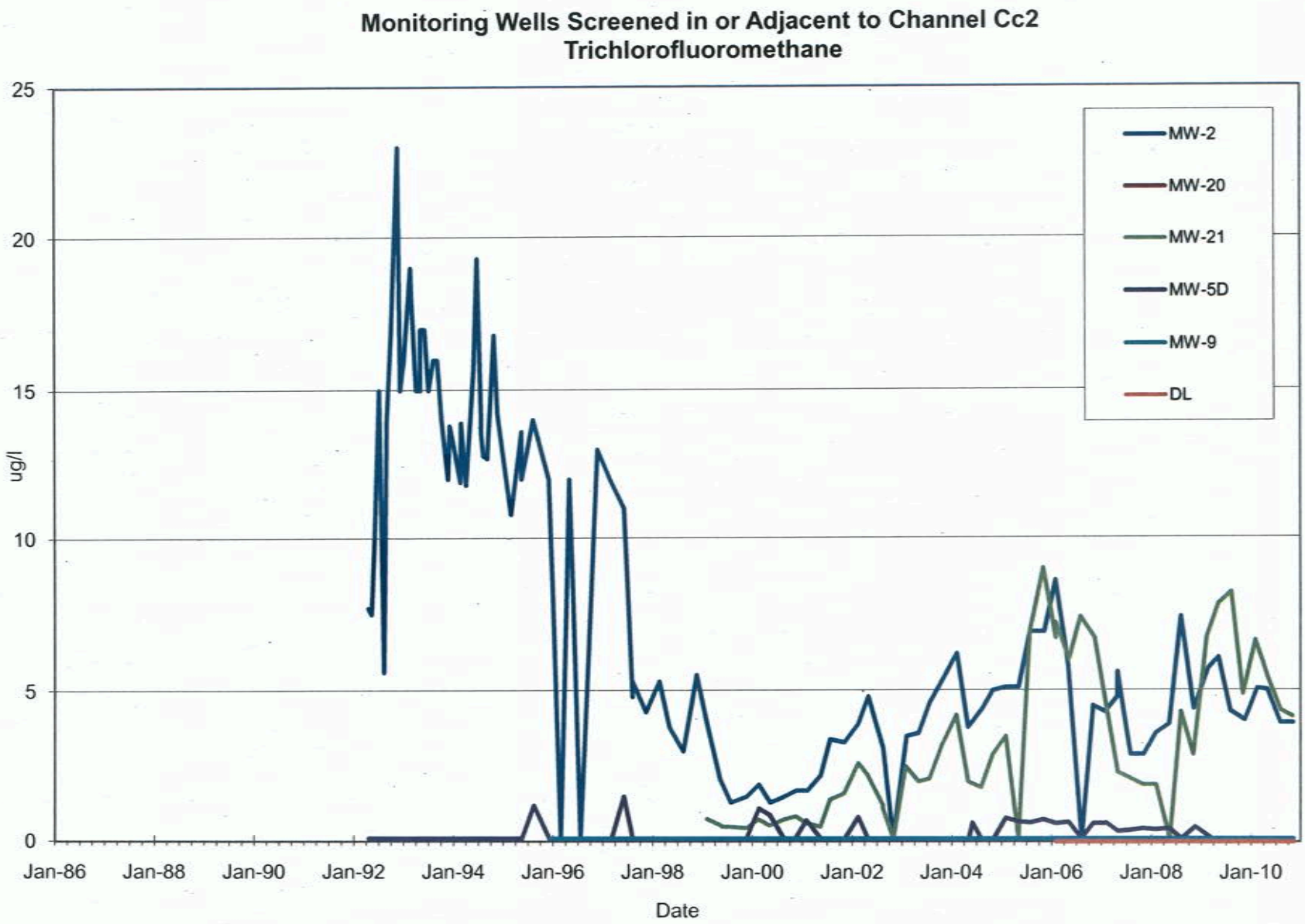

Monitoring Wells Screened in or Adjacent to Channel Cc2
TRANS-1,2-Dichloroethene
ug/l
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

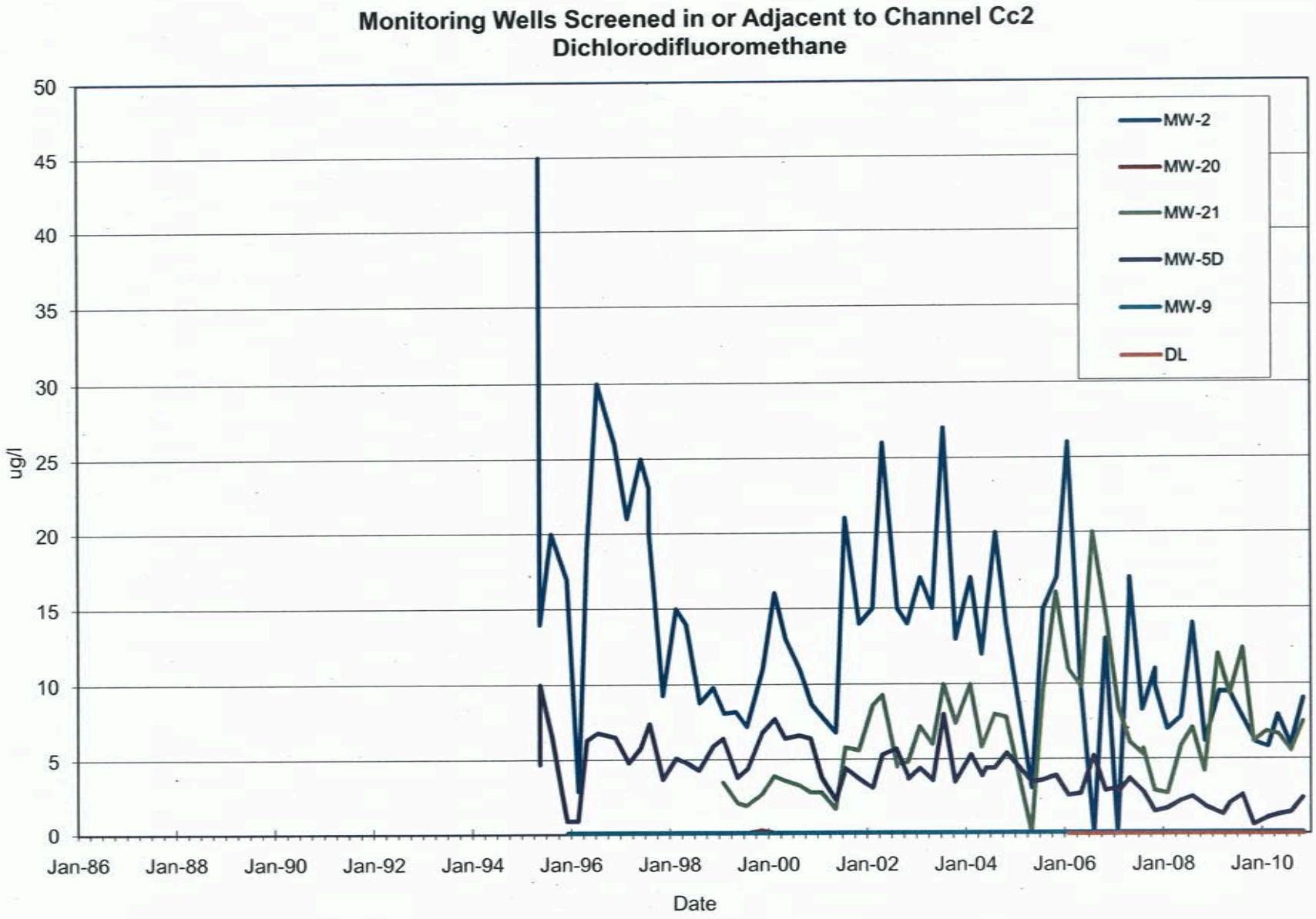

Monitoring Wells Screened in or Adjacent to Channel Cc2
Benzene
MW-2
MW-20
MW-21
MW-5D
MW-9
DL
ug/l
0
1
2
3
4
5
6
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

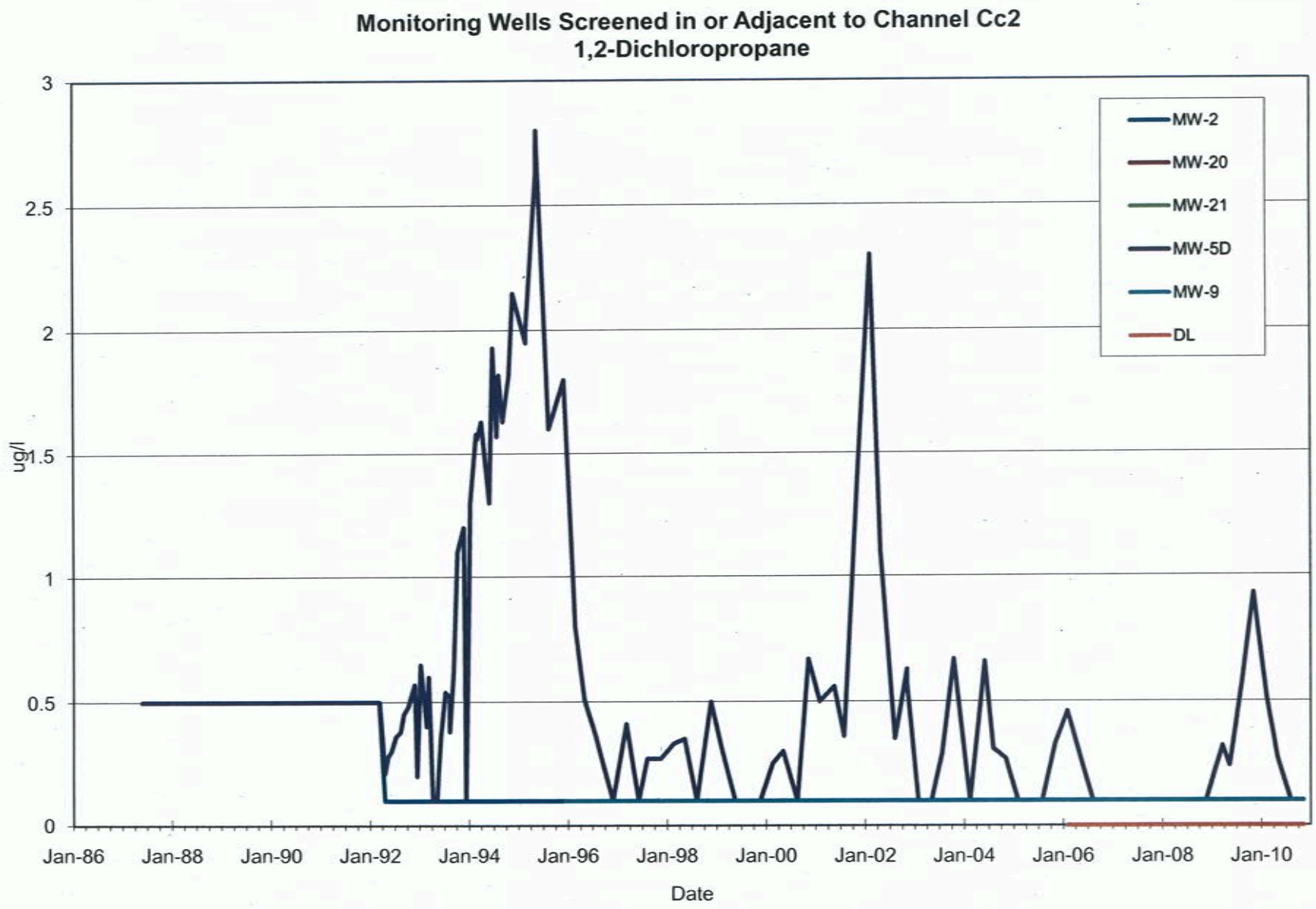

Monitoring Wells Screened in or Adjacent to Channel Cc2
Chloroethane
3
2.5
2
1.5
1
0.5
0
ug/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

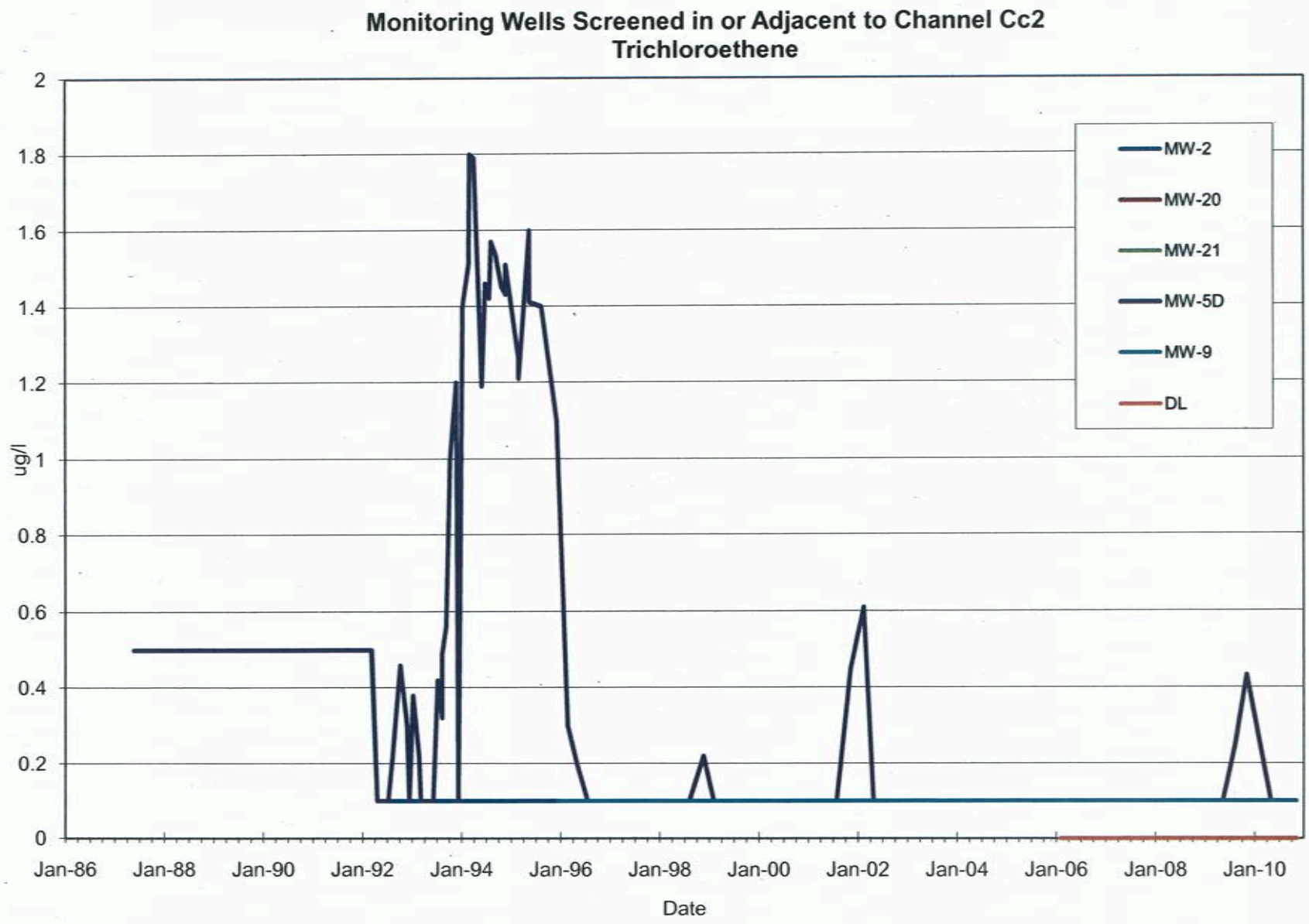

Monitoring Wells Screened in or Adjacent to Channel Cc2
Vinyl Chloride
ug/l
40
35
30
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
GW Quality Criteria
Federal DW Standard
DL


Monitoring Wells Screened in or Adjacent to Channel Cc2
1,1-Dichloroethane
Note: Data point MW-5D from 5/20/87 = 2.5 ug/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
ug/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
GW Quality Criteria
DL


Monitoring Wells Screened in or Adjacent to Channel Cc2
Trichlorofluoromethane
25
20
15
10
5
0
ug/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL


Monitoring Wells Screened in or Adjacent to Channel Cc2
Dichlorodifluoromethane
ug/l
50
45
40
35
30
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

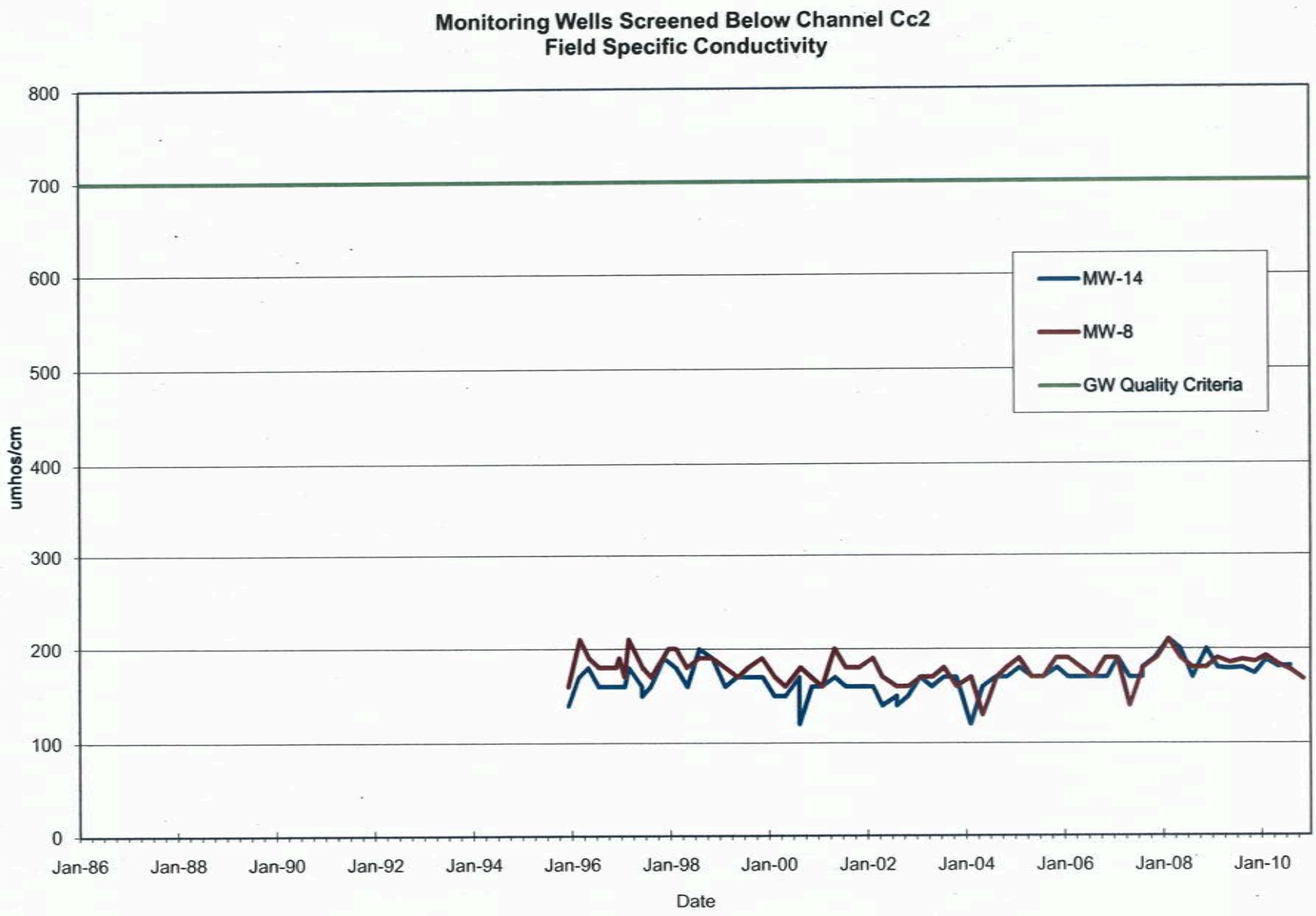

Monitoring Wells Screened in or Adjacent to Channel Cc2
1,2-Dichloropropane
ug/l
3
2.5
2
1.5
1
0.5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

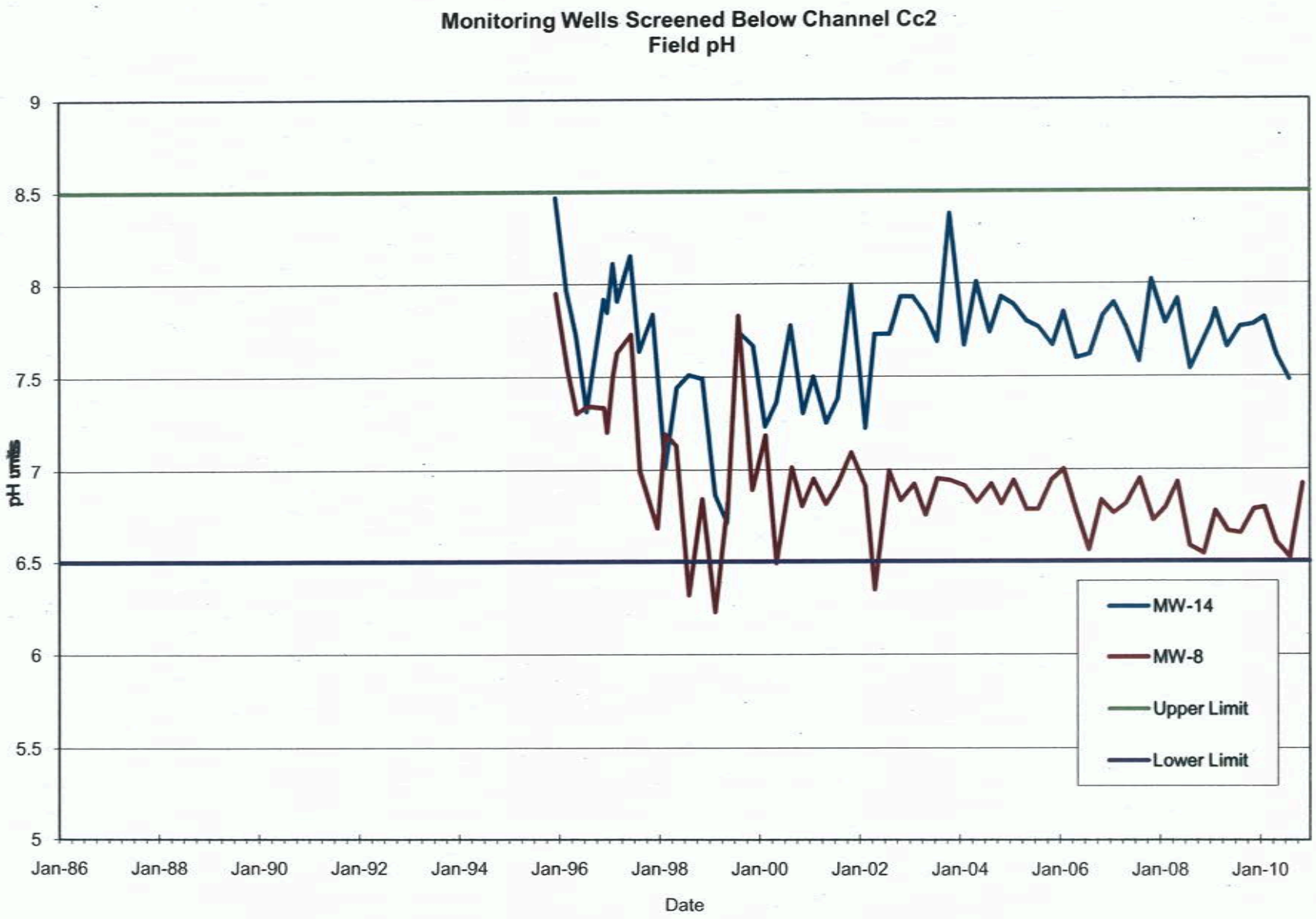

Monitoring Wells Screened in or Adjacent to Channel Cc2
Trichloroethene
ug/l
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-2
MW-20
MW-21
MW-5D
MW-9
DL

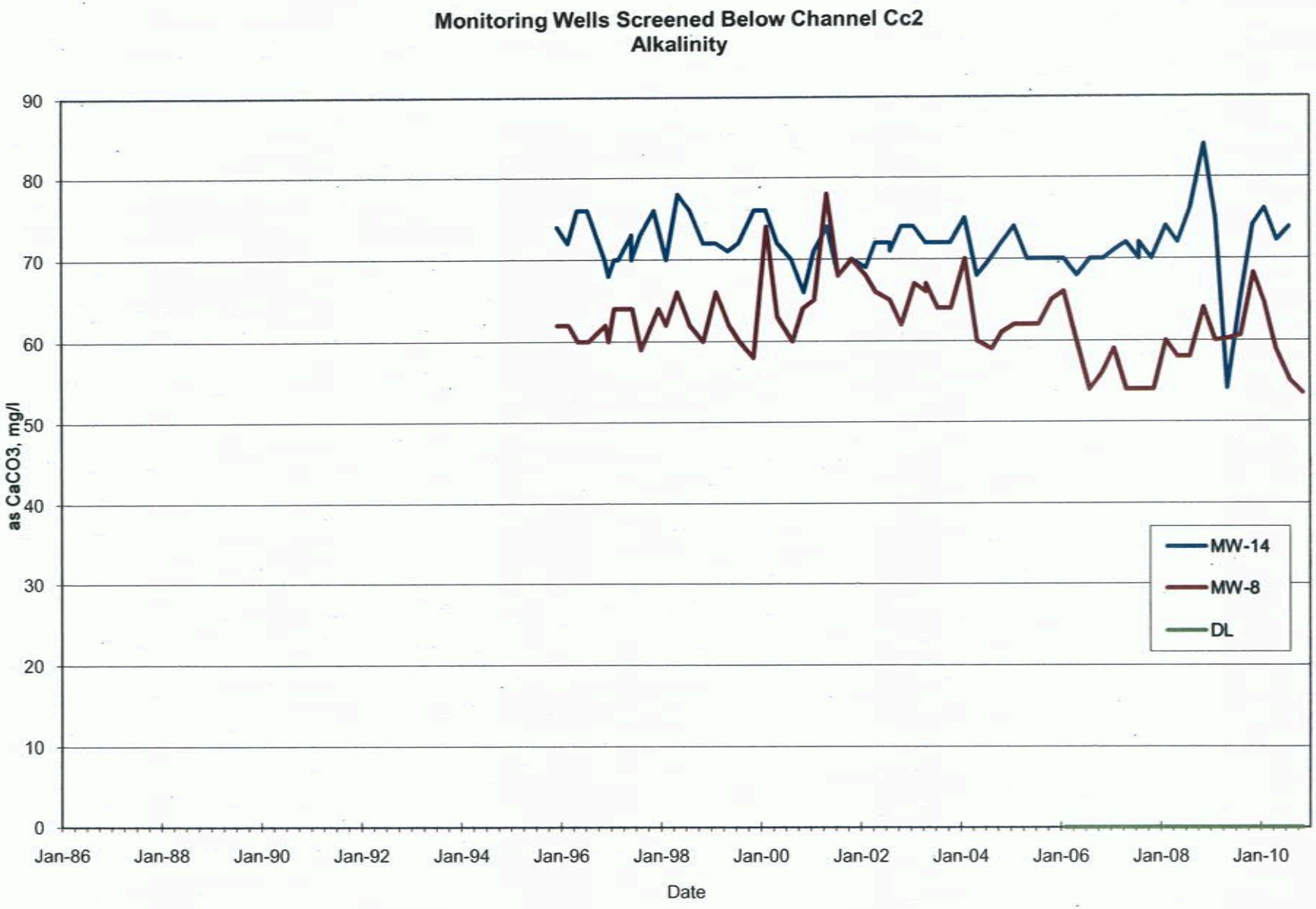
Appendix E

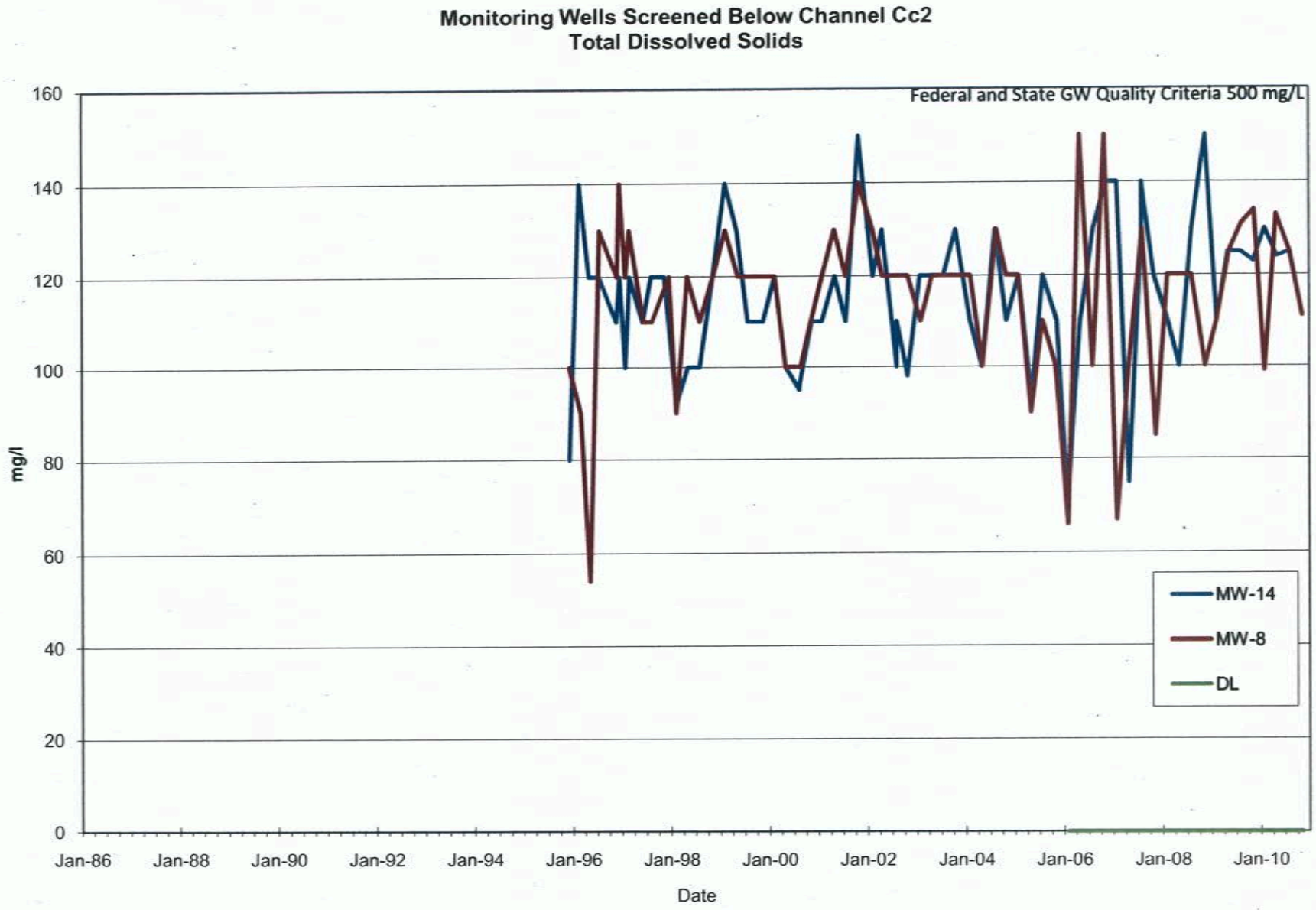
Appendix E

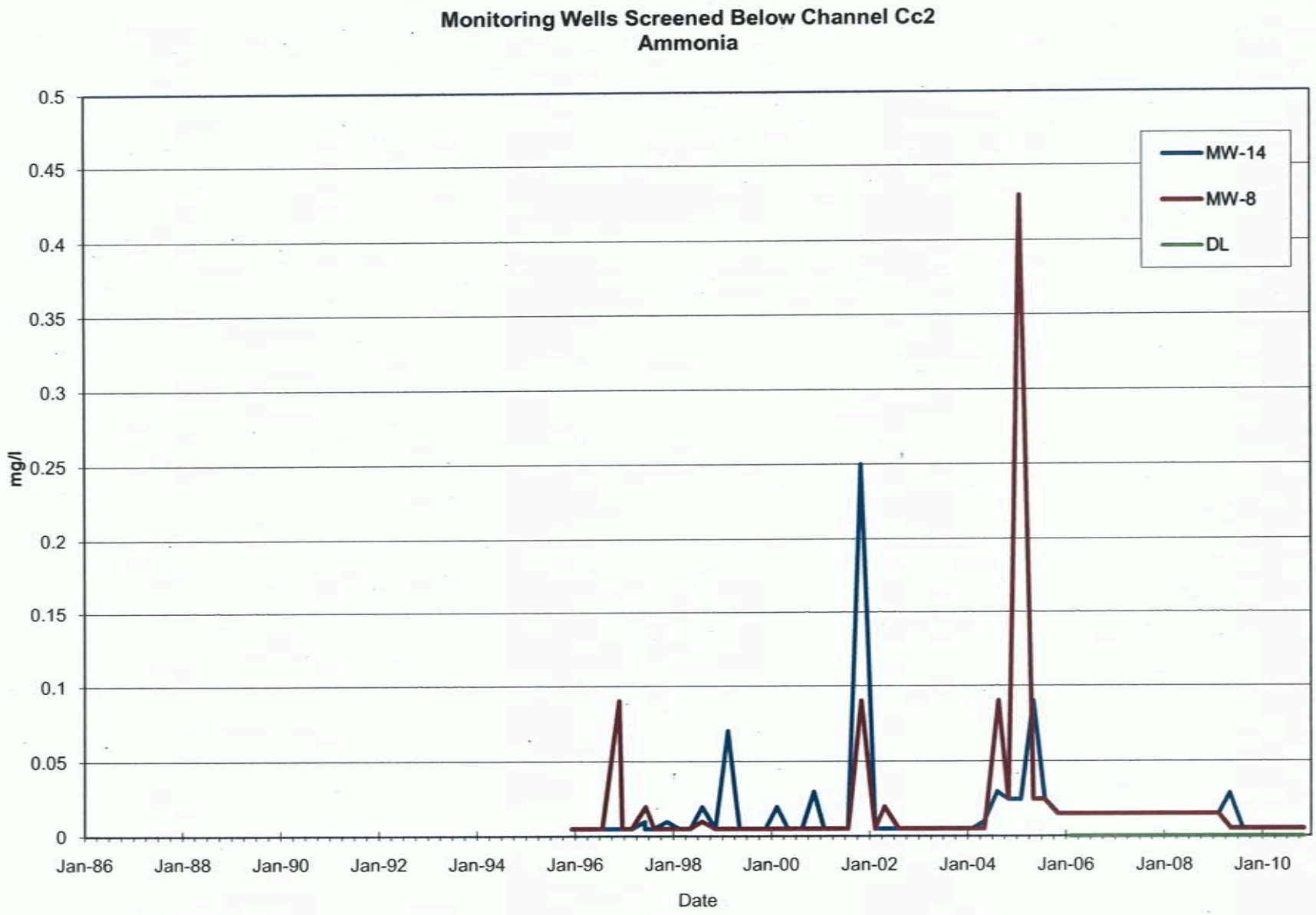
Time Concentration Plots for Groundwater beneath Channel Cc2

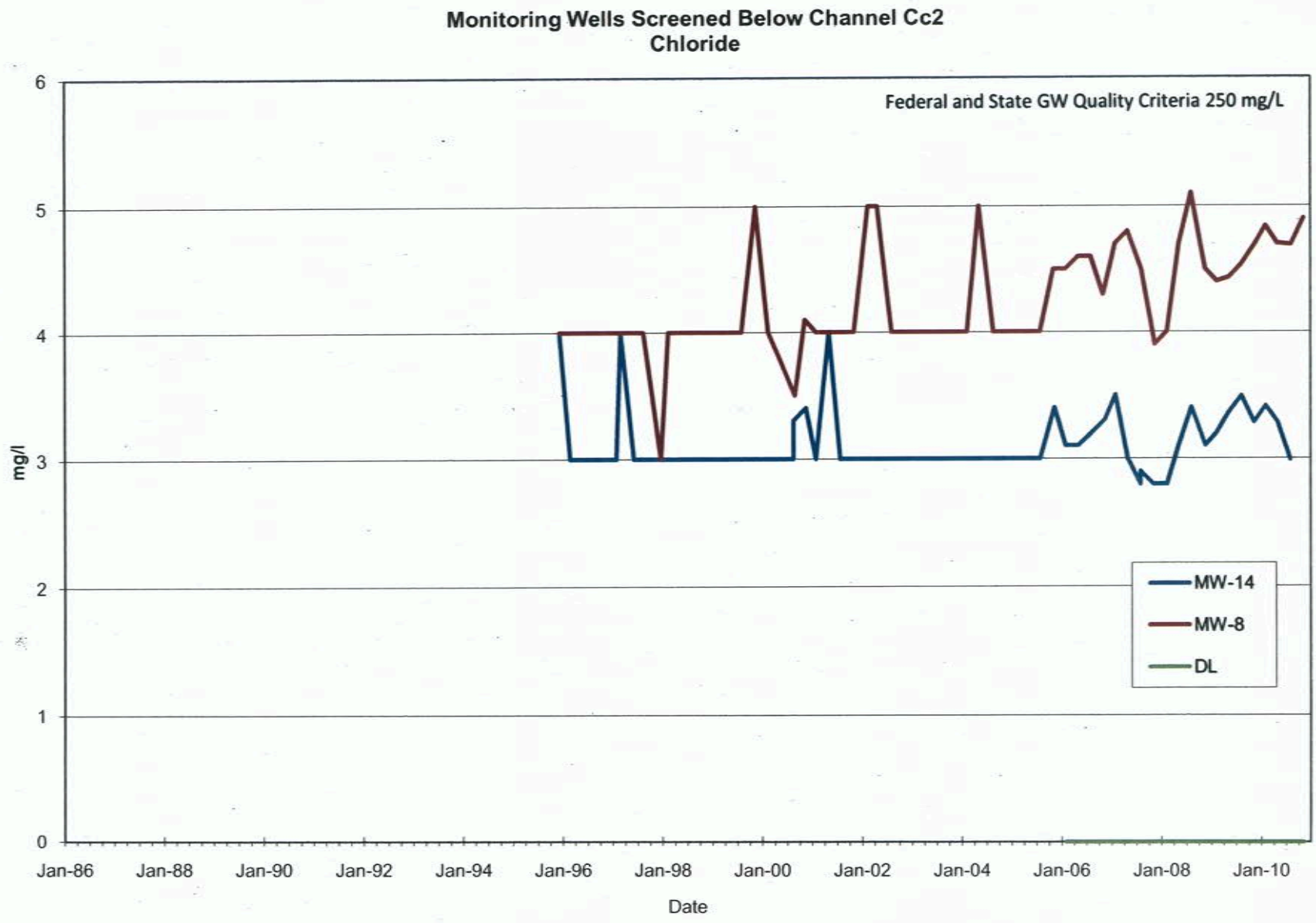

Monitoring Wells Screened Below Channel Cc2
Field Specific Conductivity
800
700
600
500
400
300
200
100
0
umhos/cm
MW-14
MW-8
GW Quality Criteria
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

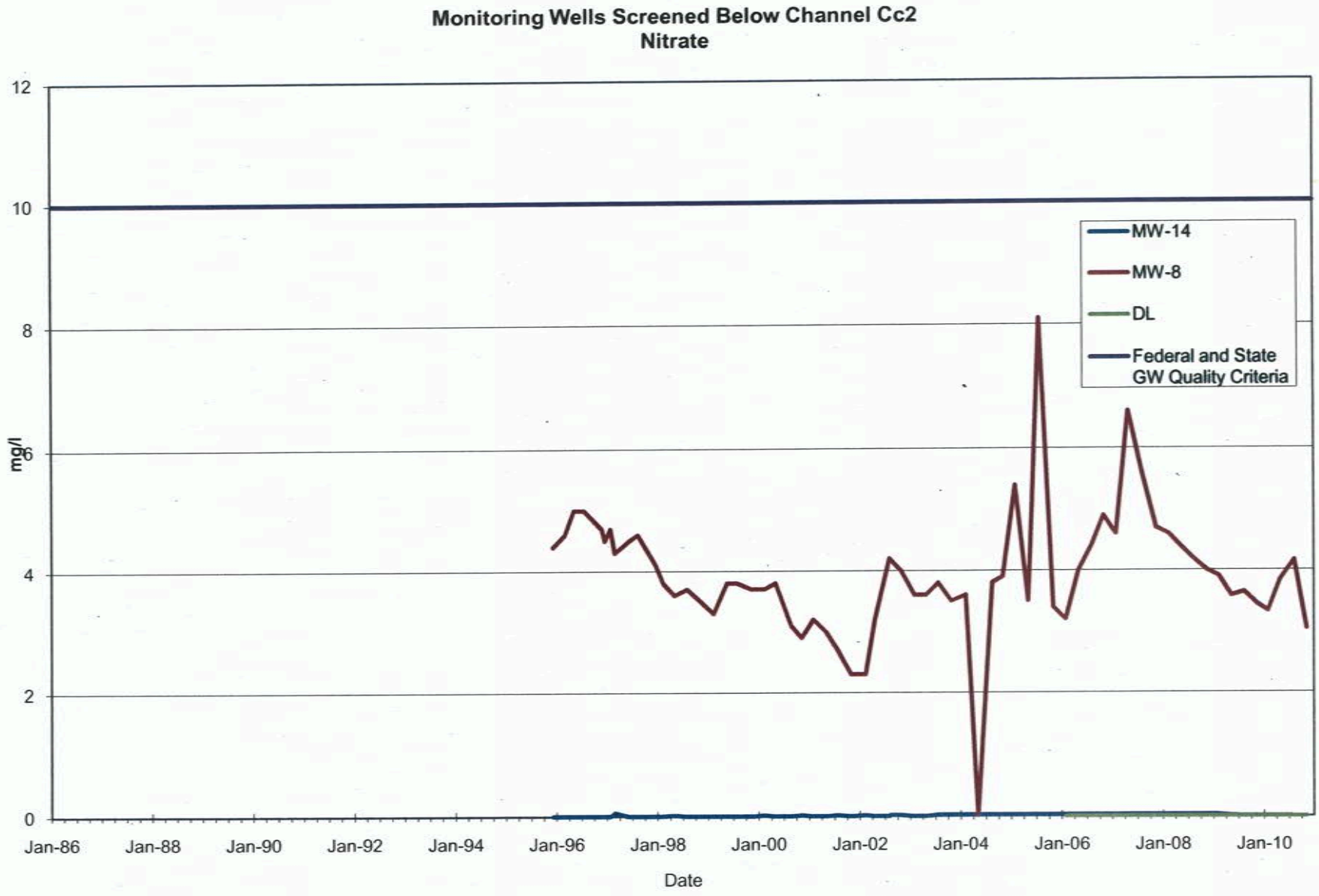

Monitoring Wells Screened Below Channel Cc2
Field pH
9
8.5
8
7.5
7
6.5
6
5.5
5
pH units
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
Upper Limit
Lower Limit

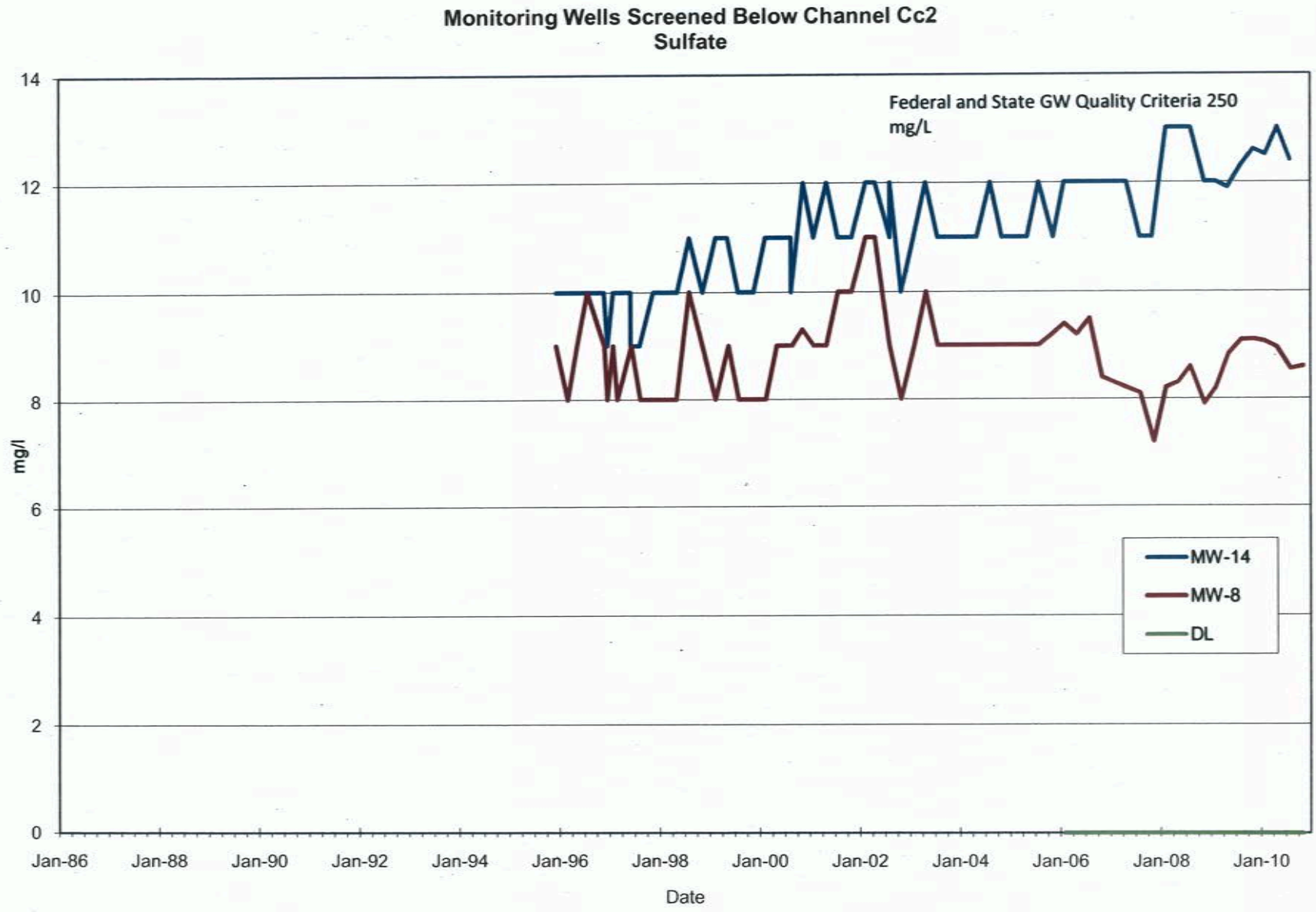

Monitoring Wells Screened Below Channel Cc2
Alkalinity
90
80
70
60
50
40
30
20
10
0
as CaCO3, mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
DL

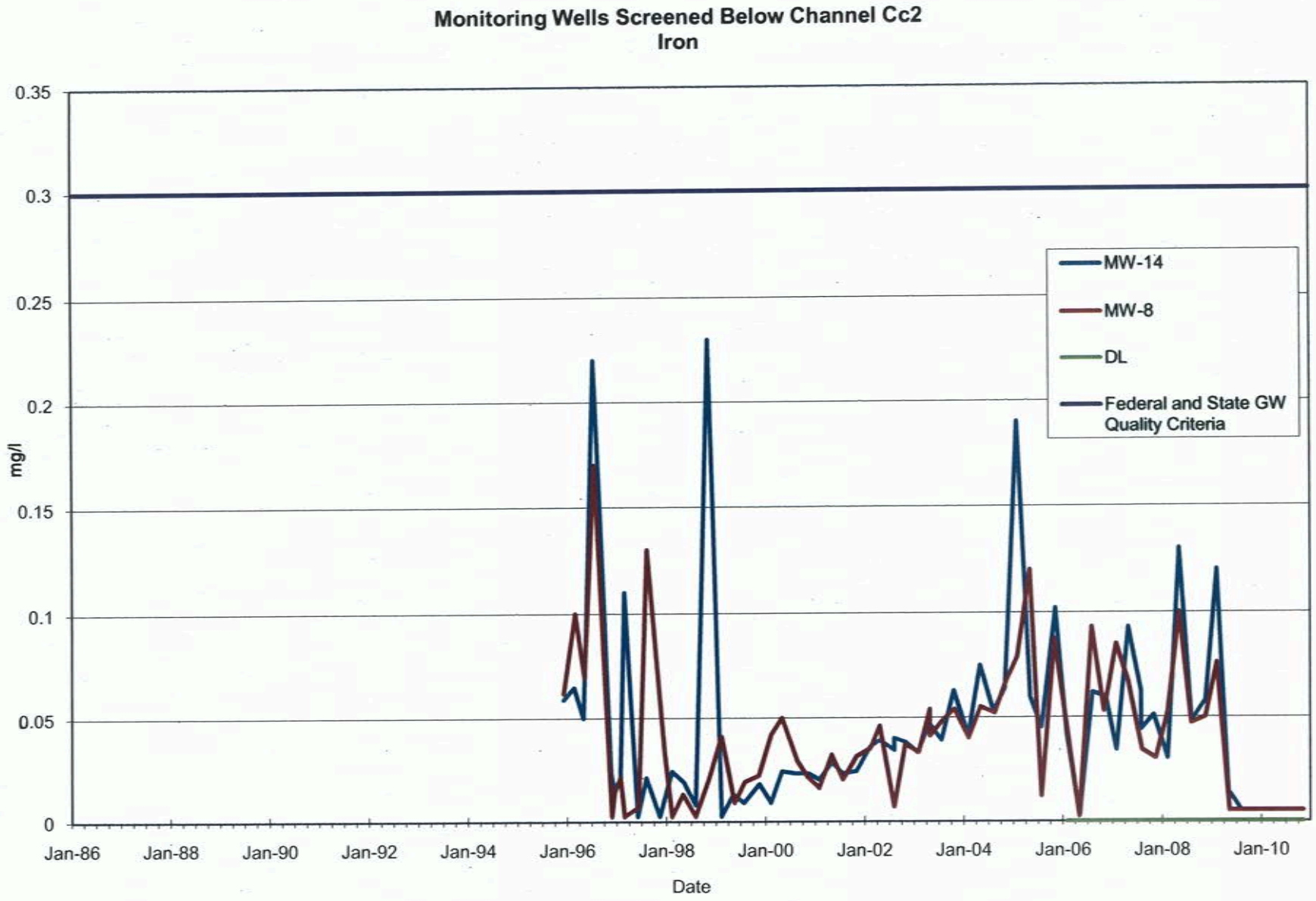

Monitoring Wells Screened Below Channel Cc2
Total Dissolved Solids
Federal and State GW Quality Criteria 500 mg/L
160
140
120
100
80
60
40
20
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
DL

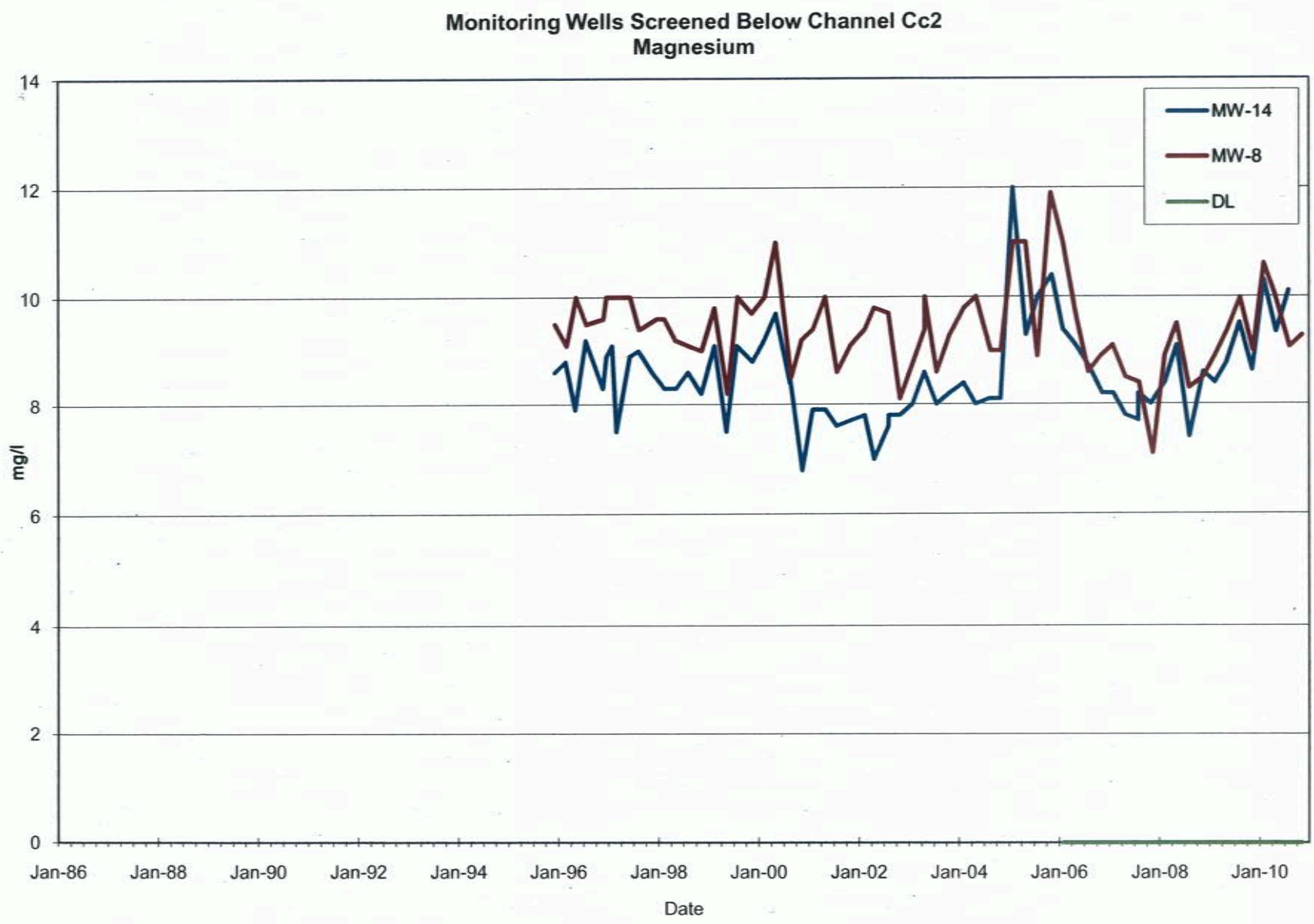

Monitoring Wells Screened Below Channel Cc2
Ammonia
MW-14
MW-8
DL
mg/l
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

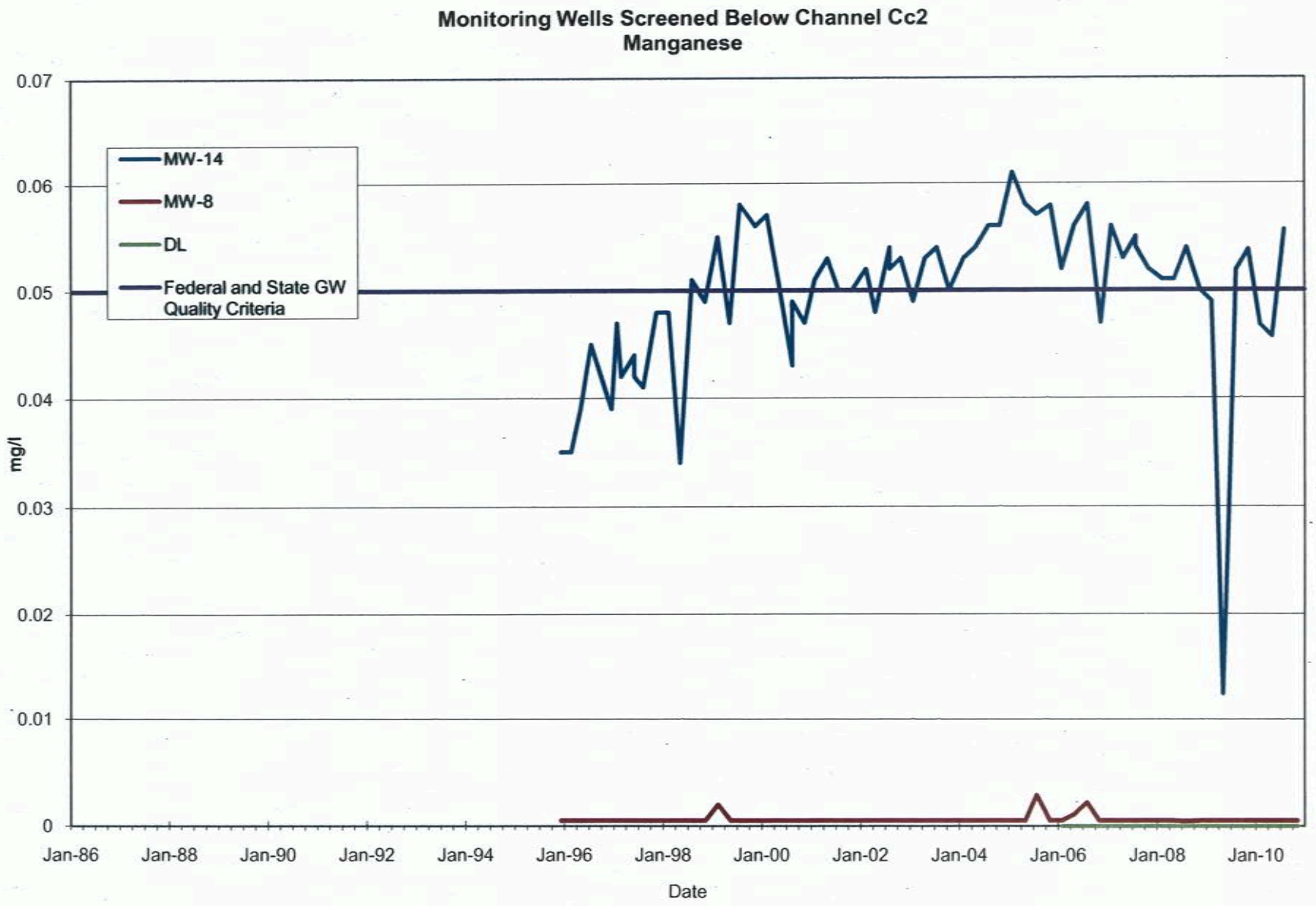

Monitoring Wells Screened Below Channel Cc2
Chloride
Federal and State GW Quality Criteria 250 mg/L
mg/l
6
5
4
3
2
1
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
DL

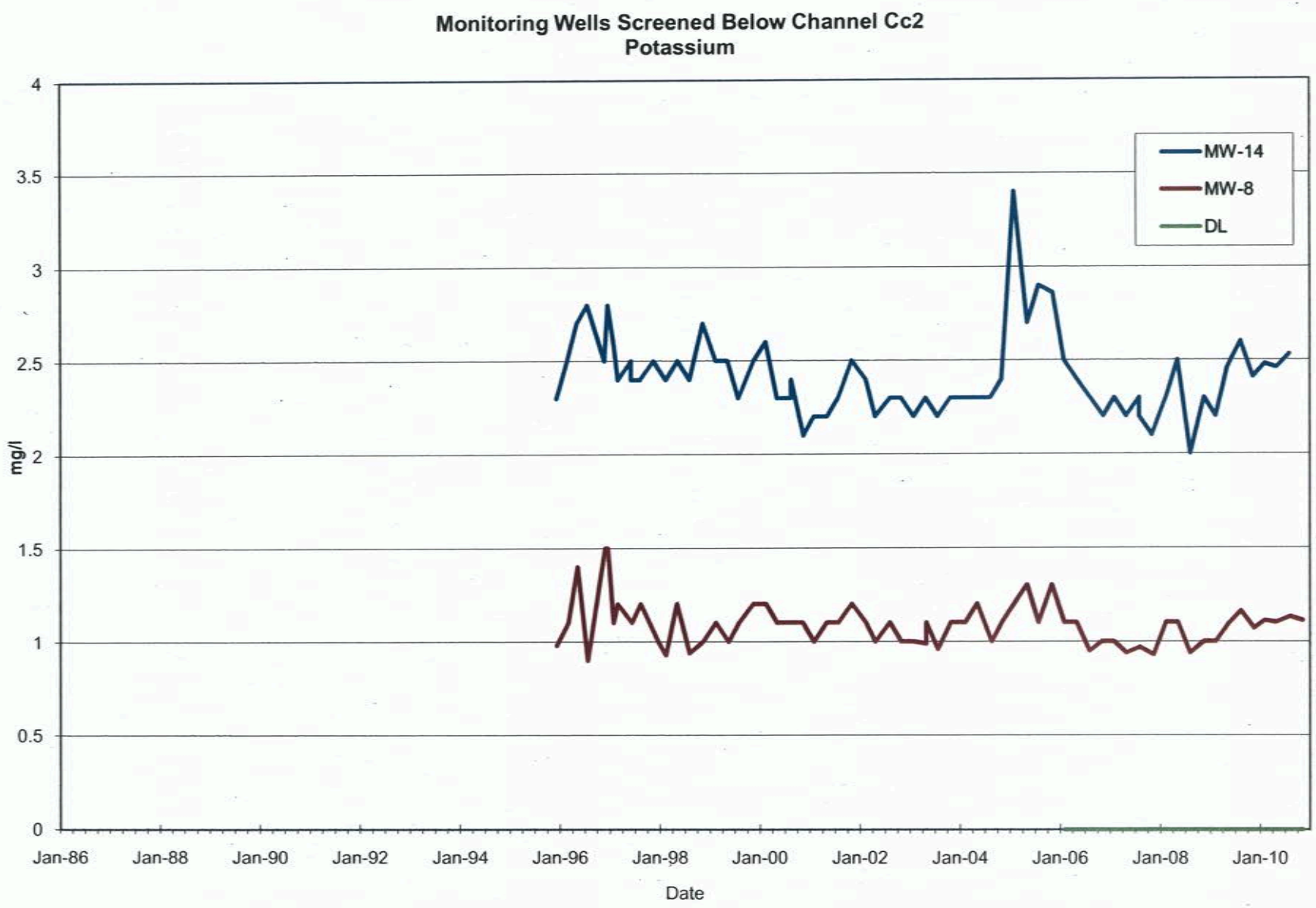

Monitoring Wells Screened Below Channel Cc2
Nitrate
12
10
8
6
4
2
0
mg/l
MW-14
MW-8
DL
Federal and State GW Quality Criteria
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

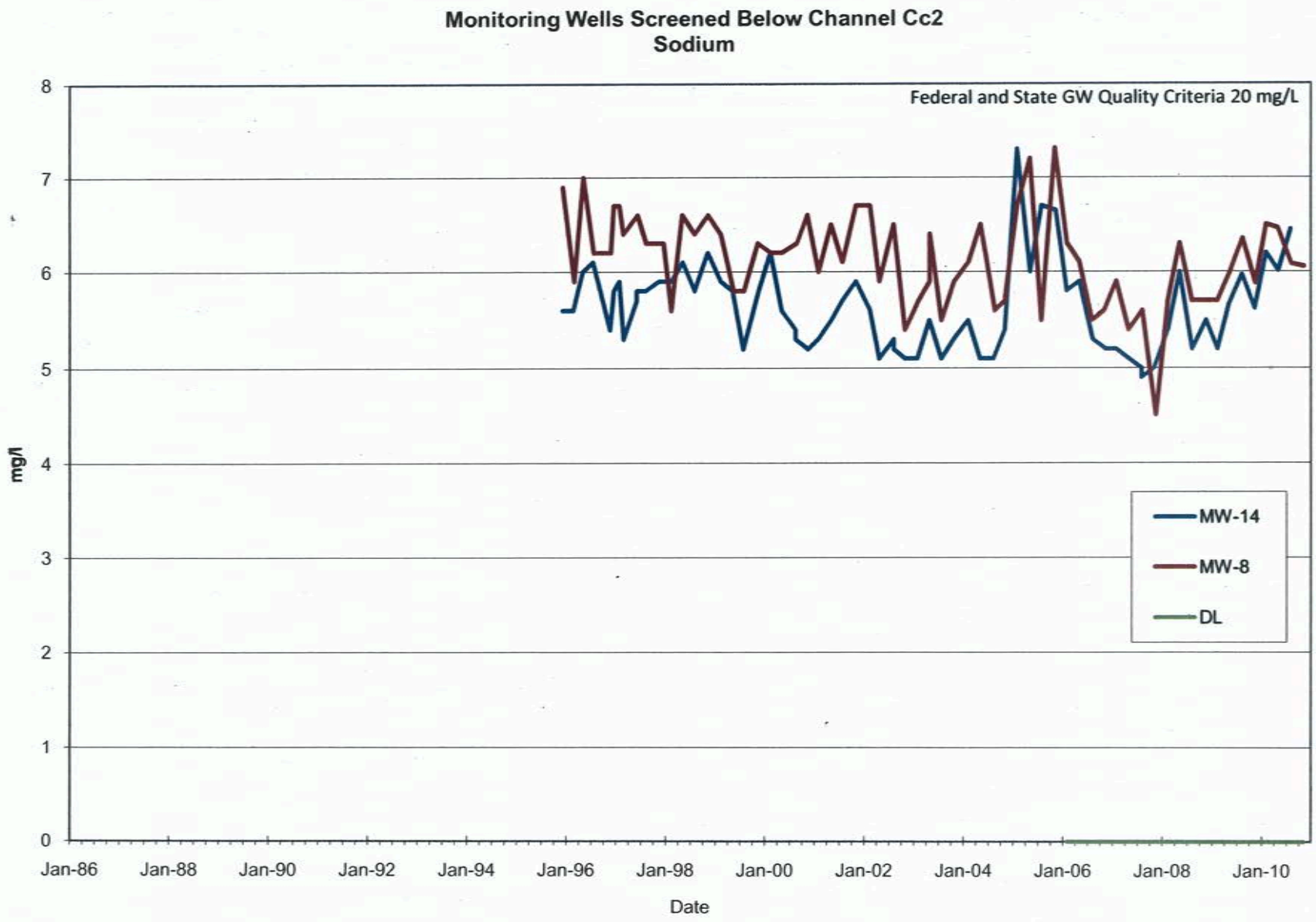

Monitoring Wells Screened Below Channel Cc2
Sulfate
Federal and State GW Quality Criteria 250 mg/L
MW-14
MW-8
DL
mg/l
0
2
4
6
8
10
12
14
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

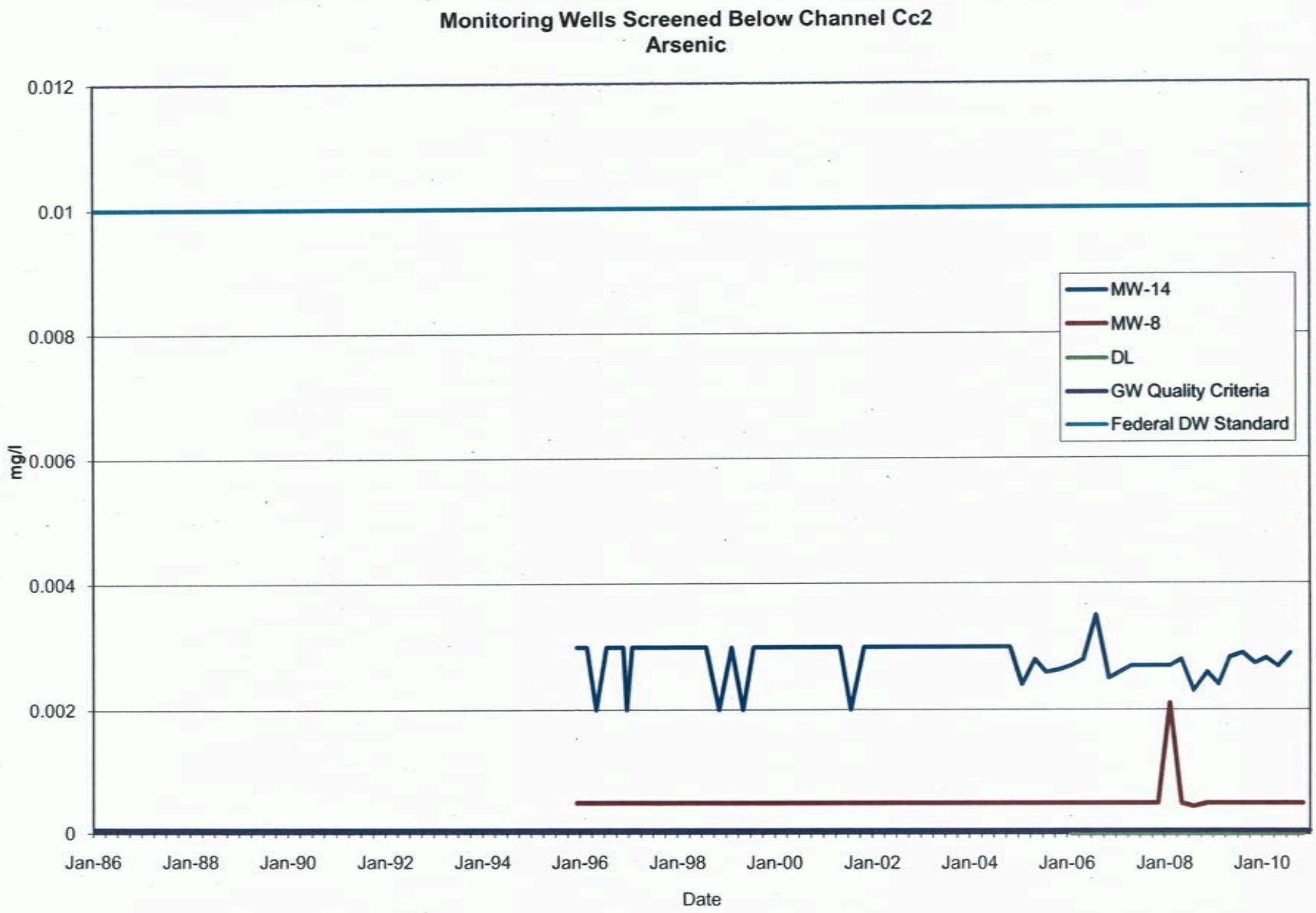

Monitoring Wells Screened Below Channel Cc2
Iron
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
DL
Federal and State GW Quality Criteria

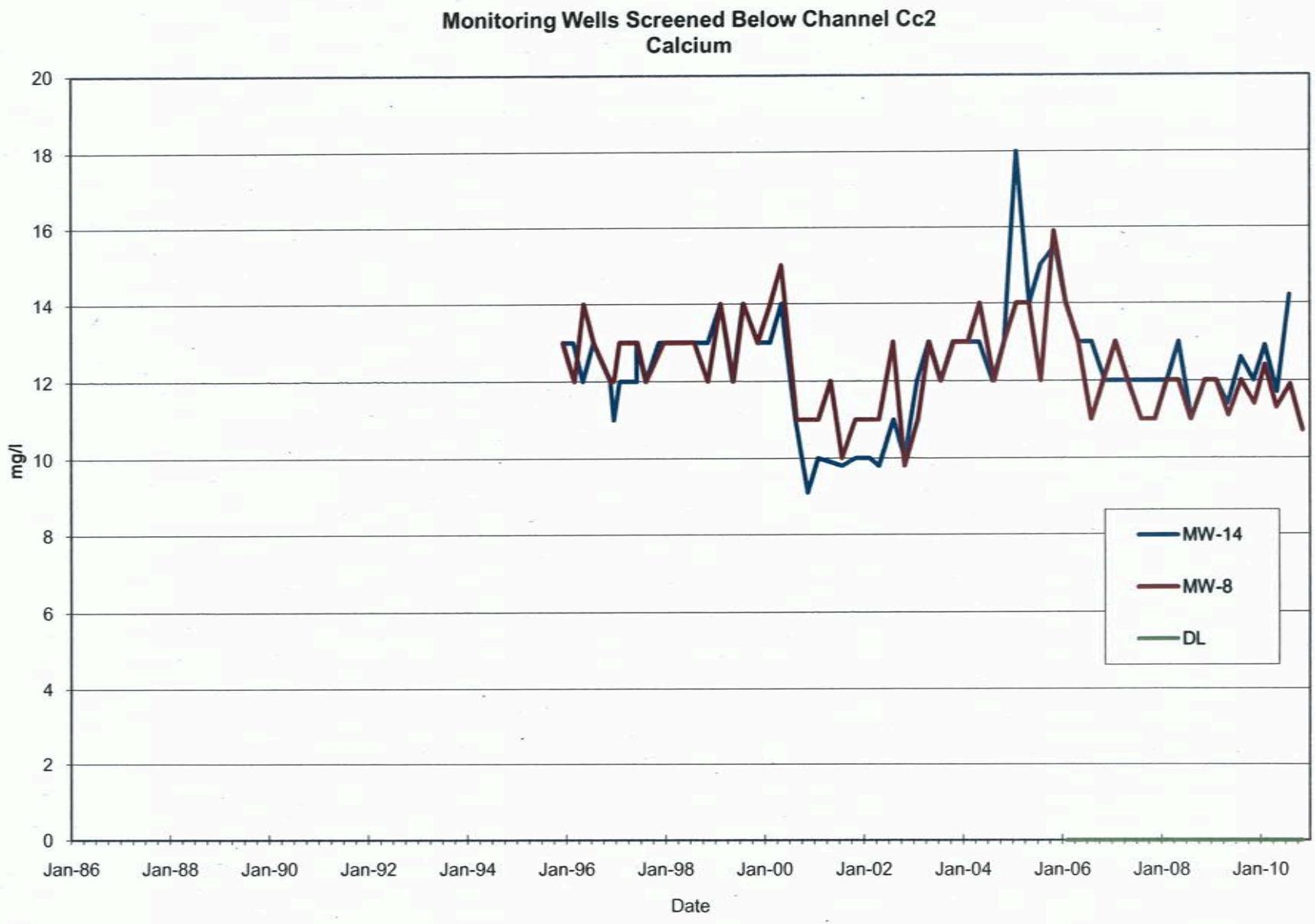

Monitoring Wells Screened Below Channel Cc2
Magnesium
MW-14
MW-8
DL
mg/l
14
12
10
8
6
4
2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened Below Channel Cc2
Manganese
MW-14
MW-8
DL
Federal and State GW Quality Criteria
mg/l
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened Below Channel Cc2
Potassium
MW-14
MW-8
DL
mg/l
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened Below Channel Cc2
Sodium
Federal and State GW Quality Criteria 20 mg/L
mg/l
8
7
6
5
4
3
2
1
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
DL

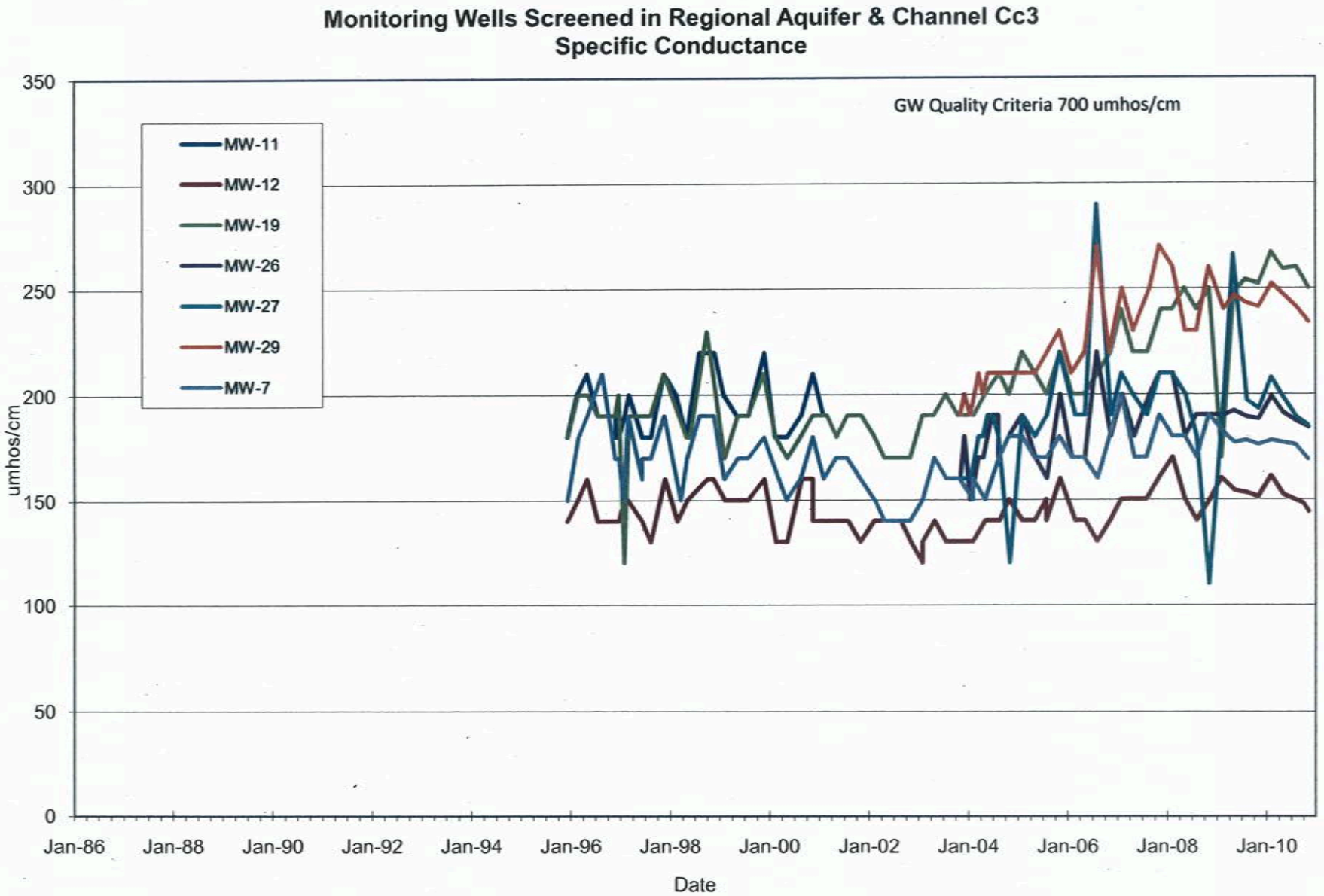

Monitoring Wells Screened Below Channel Cc2
Arsenic
0.012
0.01
0.008
0.006
0.004
0.002
0
mg/l
MW-14
MW-8
DL
GW Quality Criteria
Federal DW Standard
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

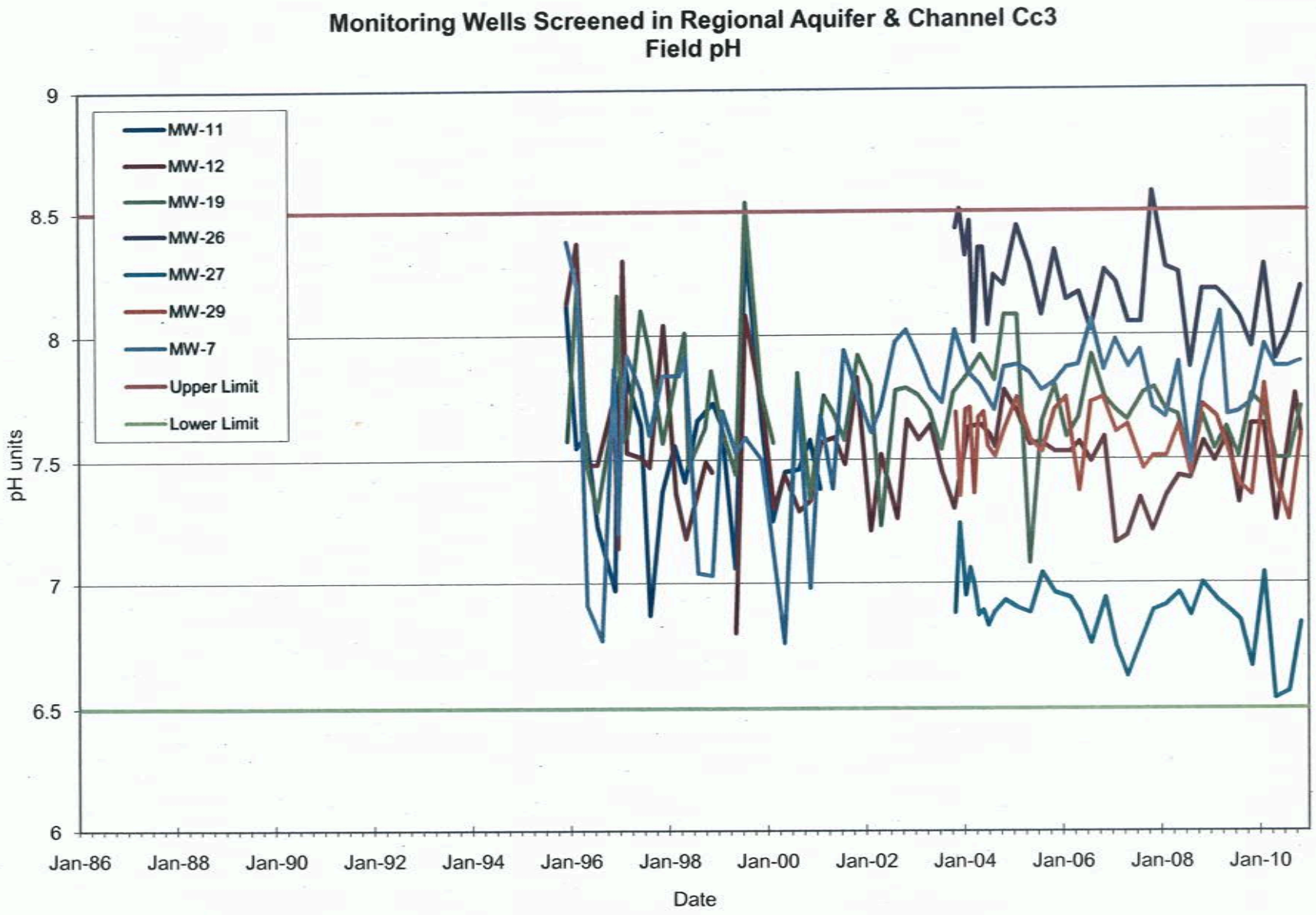

Monitoring Wells Screened Below Channel Cc2
Calcium
mg/l
20
18
16
14
12
10
8
6
4
2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-14
MW-8
DL

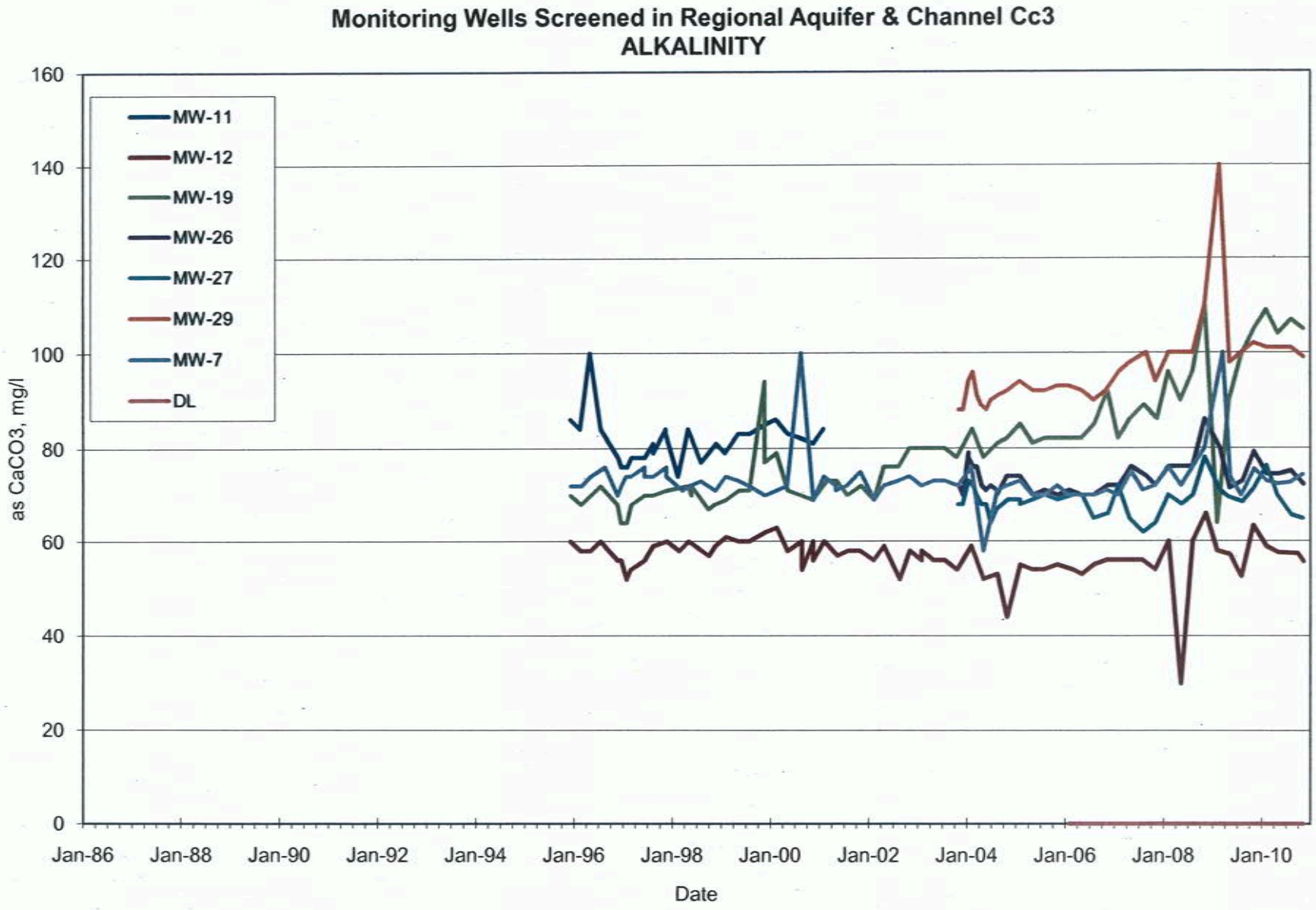
Appendix F

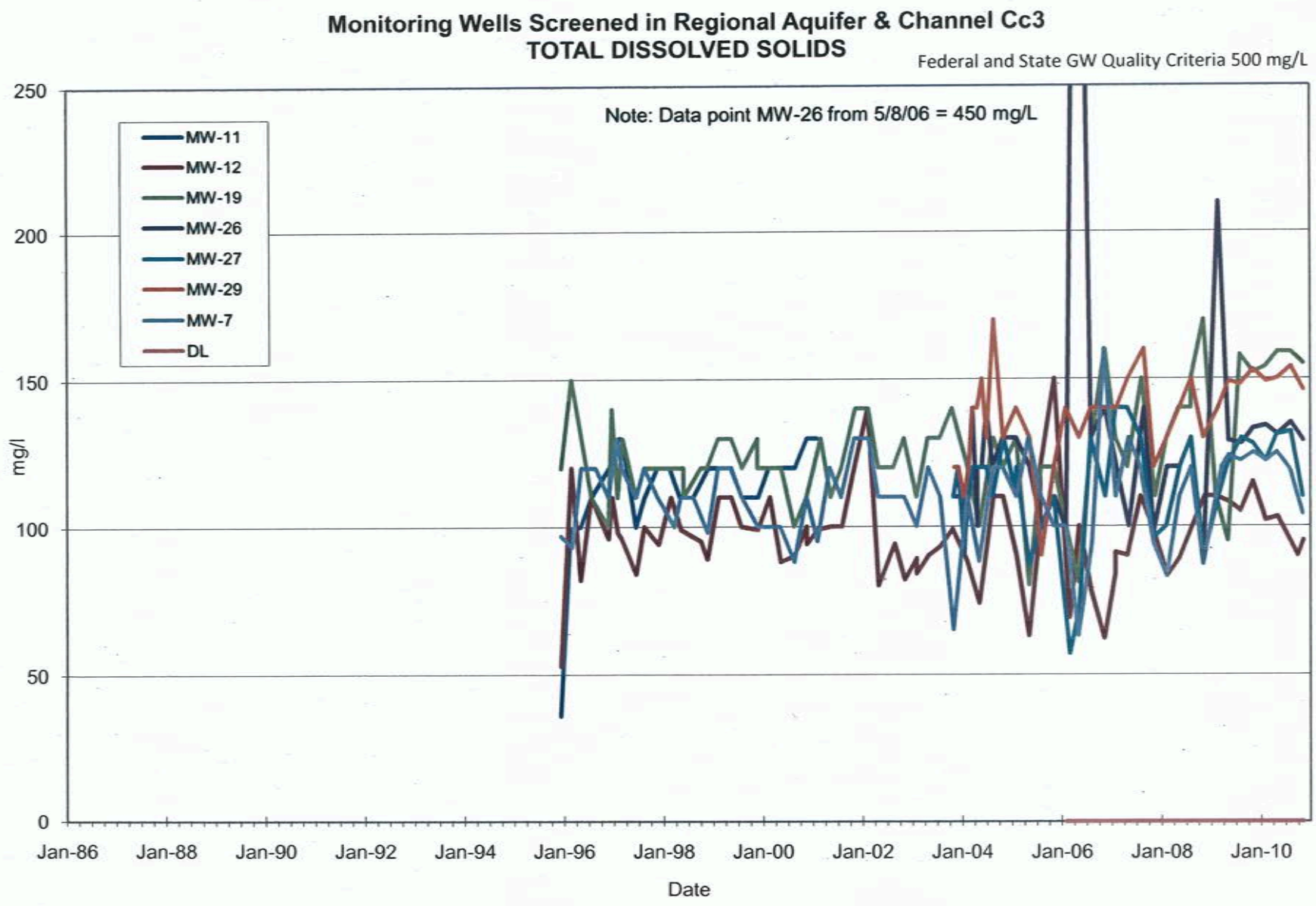
Appendix F

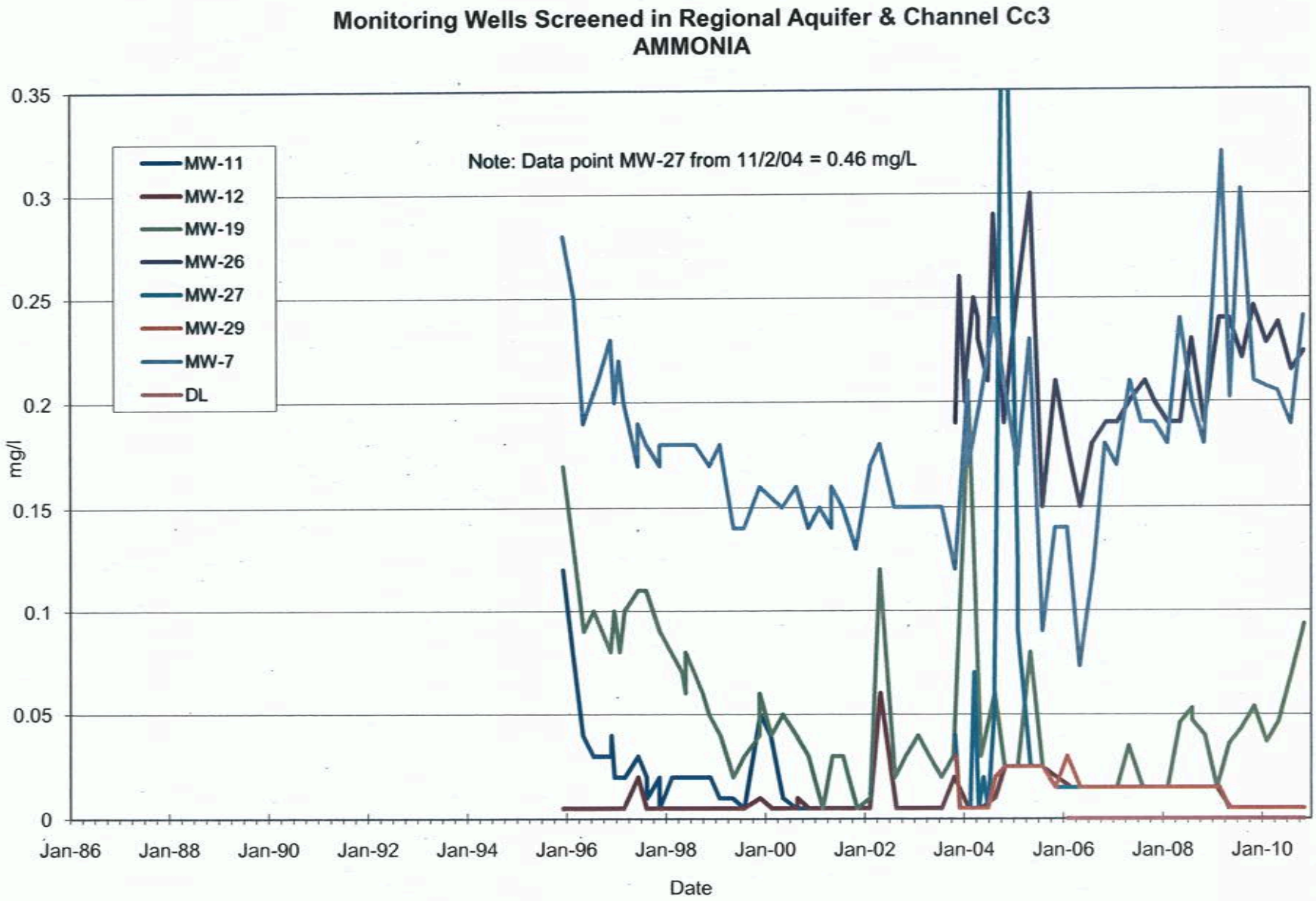
Time Concentration Plots for Regional Aquifer and Channel Cc3

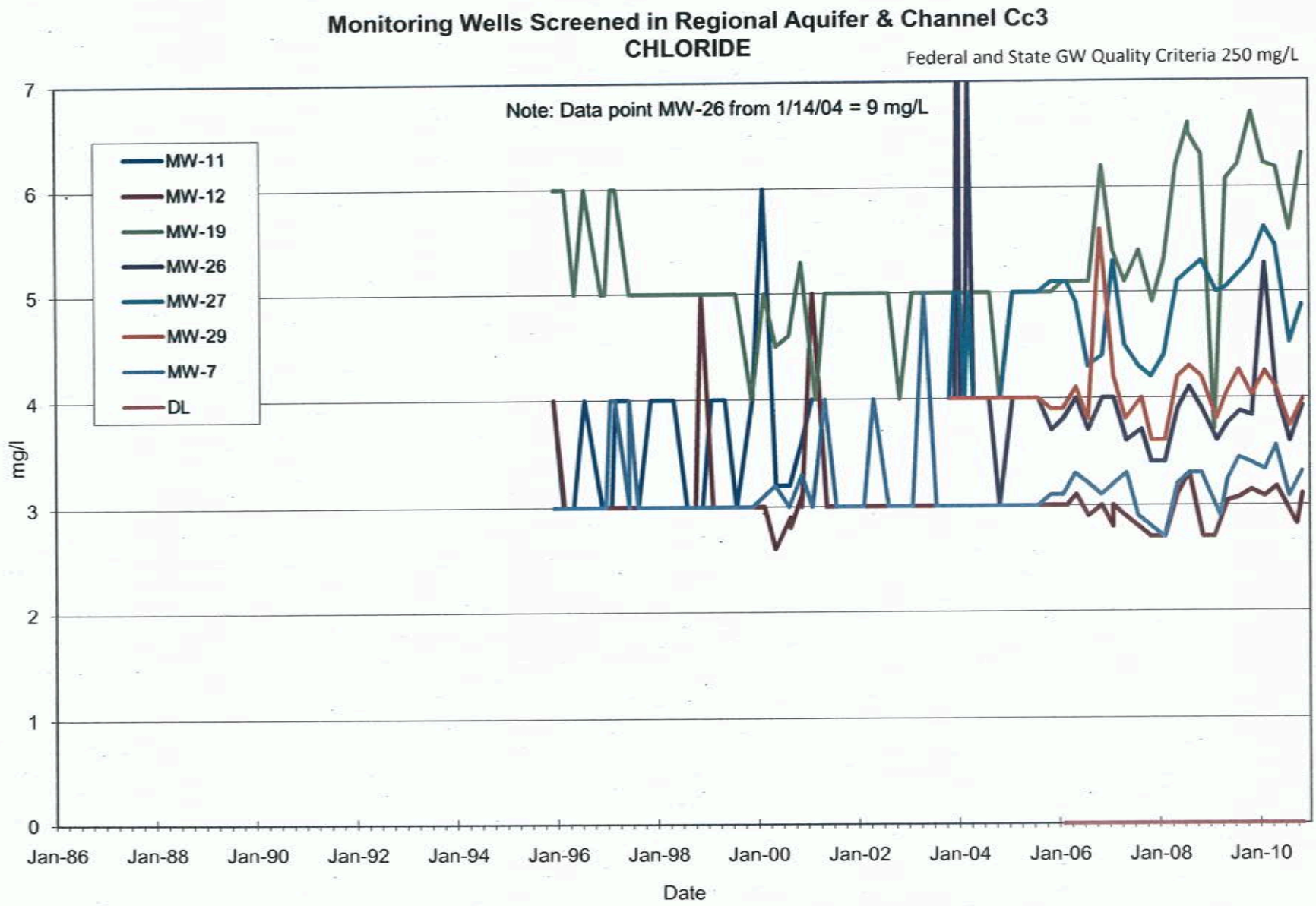

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
Specific Conductance
GW Quality Criteria 700 umhos/cm
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
umhos/cm
350
300
250
200
150
100
50
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

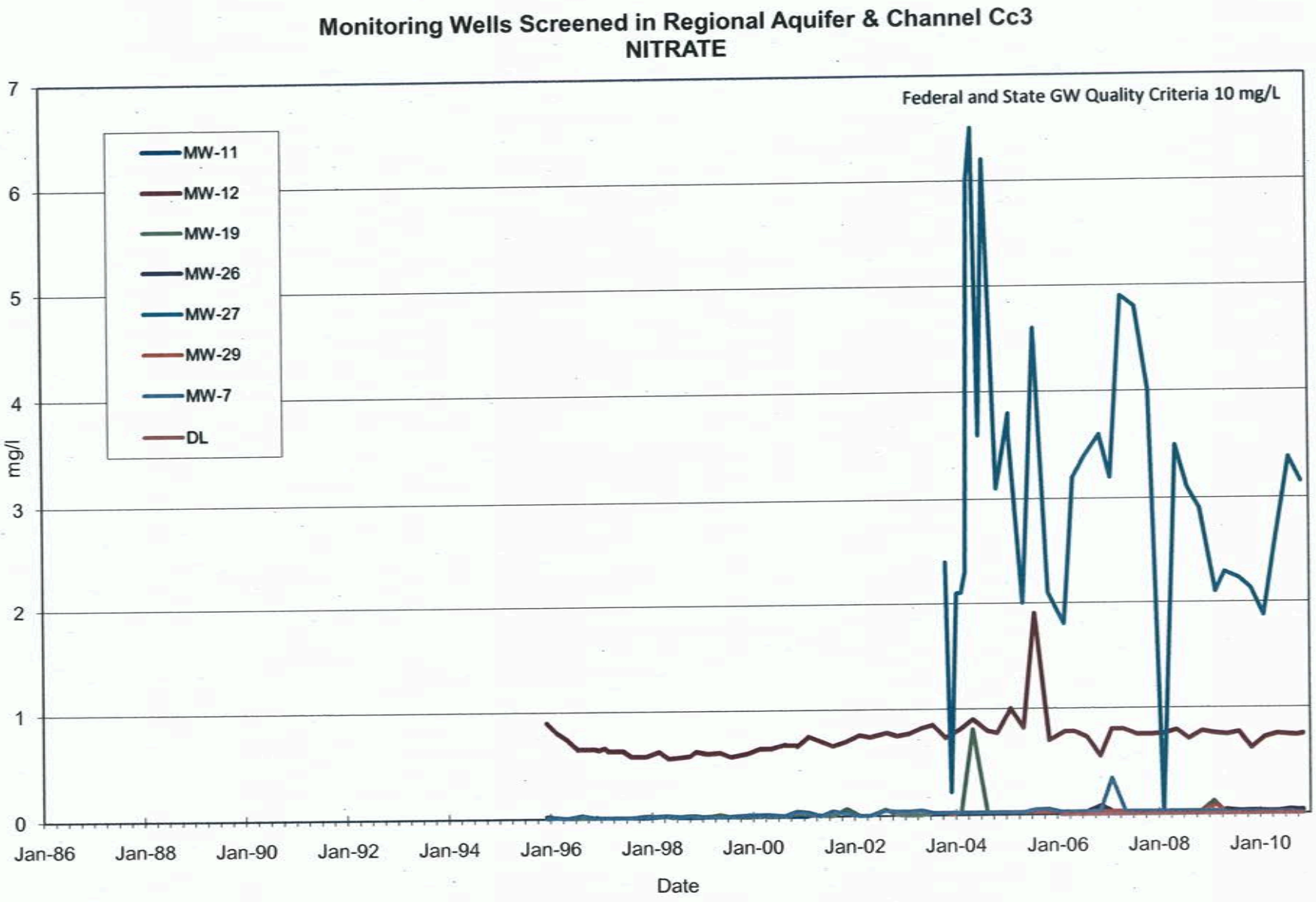

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
Field pH
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
Upper Limit
Lower Limit
pH units
9
8.5
8
7.5
7
6.5
6
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

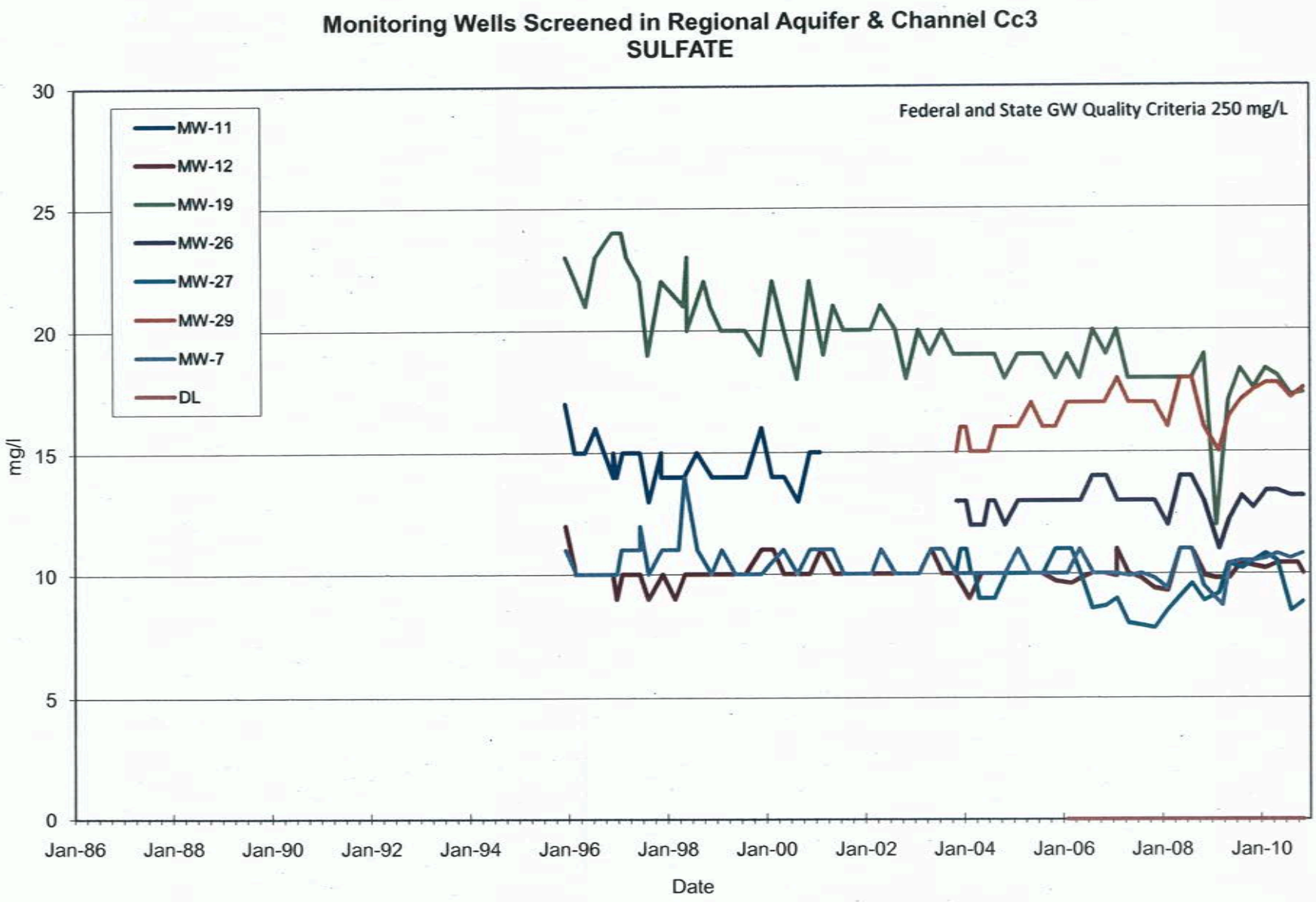

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
ALKALINITY
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
as CaCO3, mg/l
160
140
120
100
80
60
40
20
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

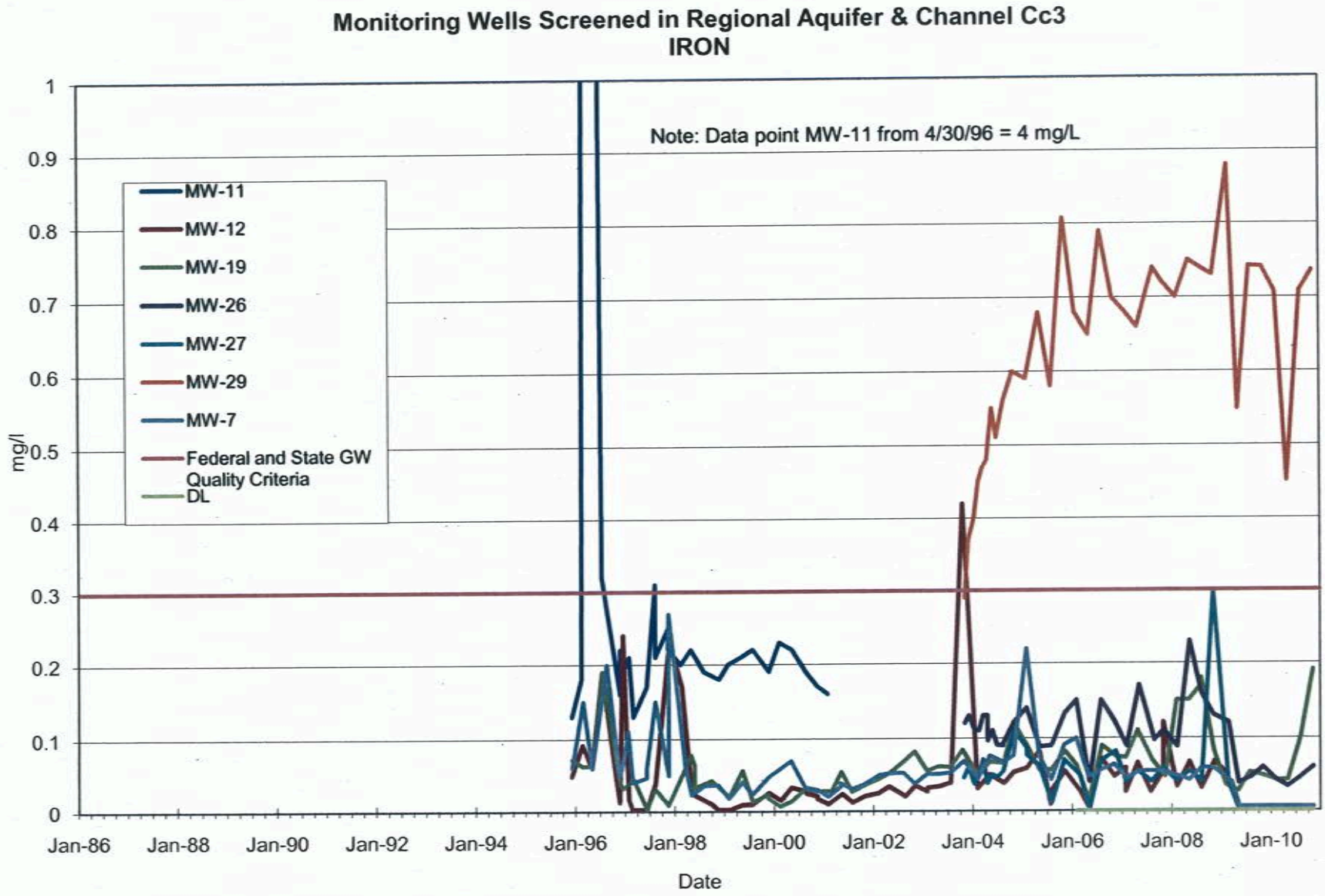

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
TOTAL DISSOLVED SOLIDS
Federal and State GW Quality Criteria 500 mg/L
Note: Data point MW-26 from 5/8/06 = 450 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
250
200
150
100
50
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

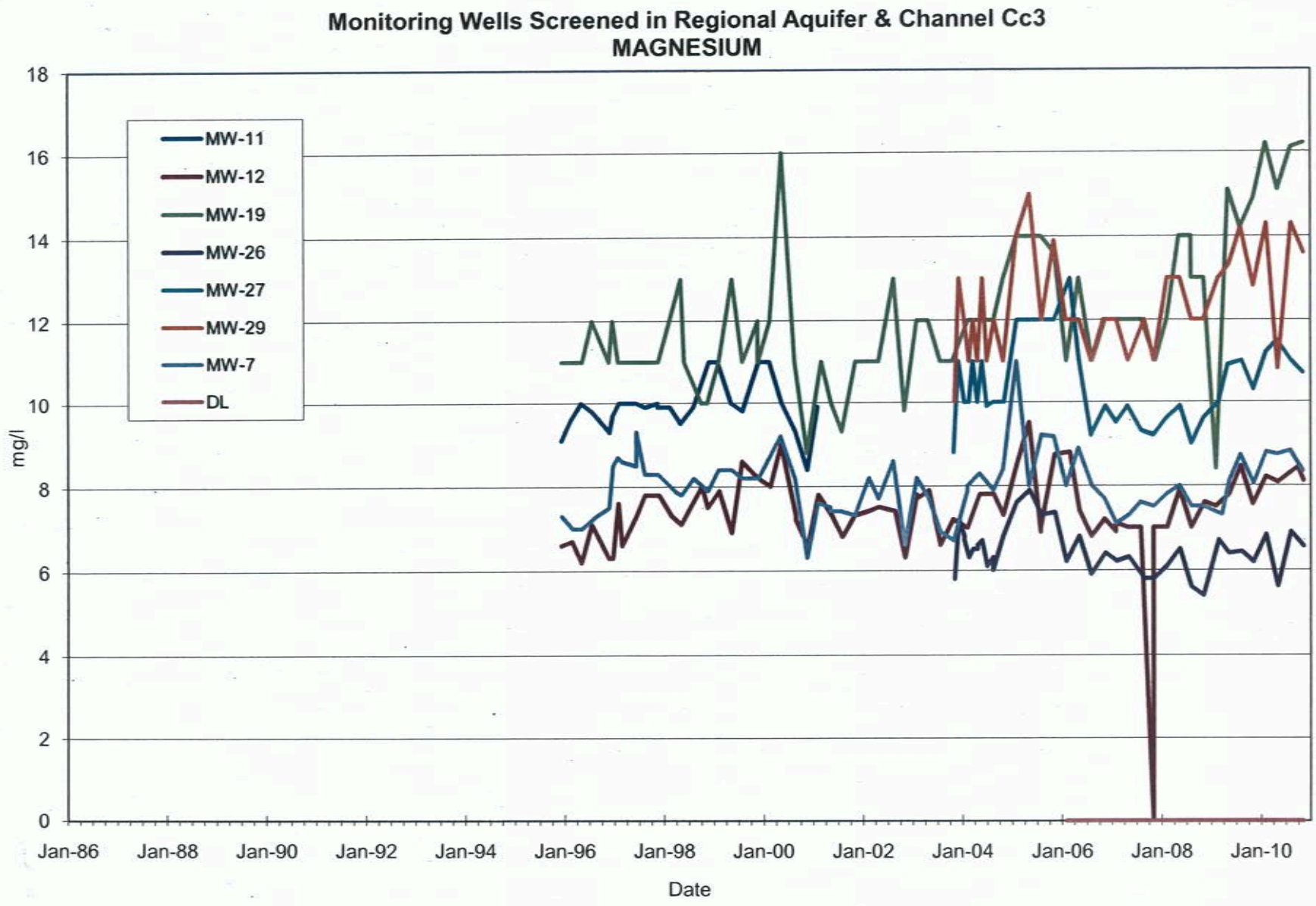

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
AMMONIA
Note: Data point MW-27 from 11/2/04 = 0.46 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

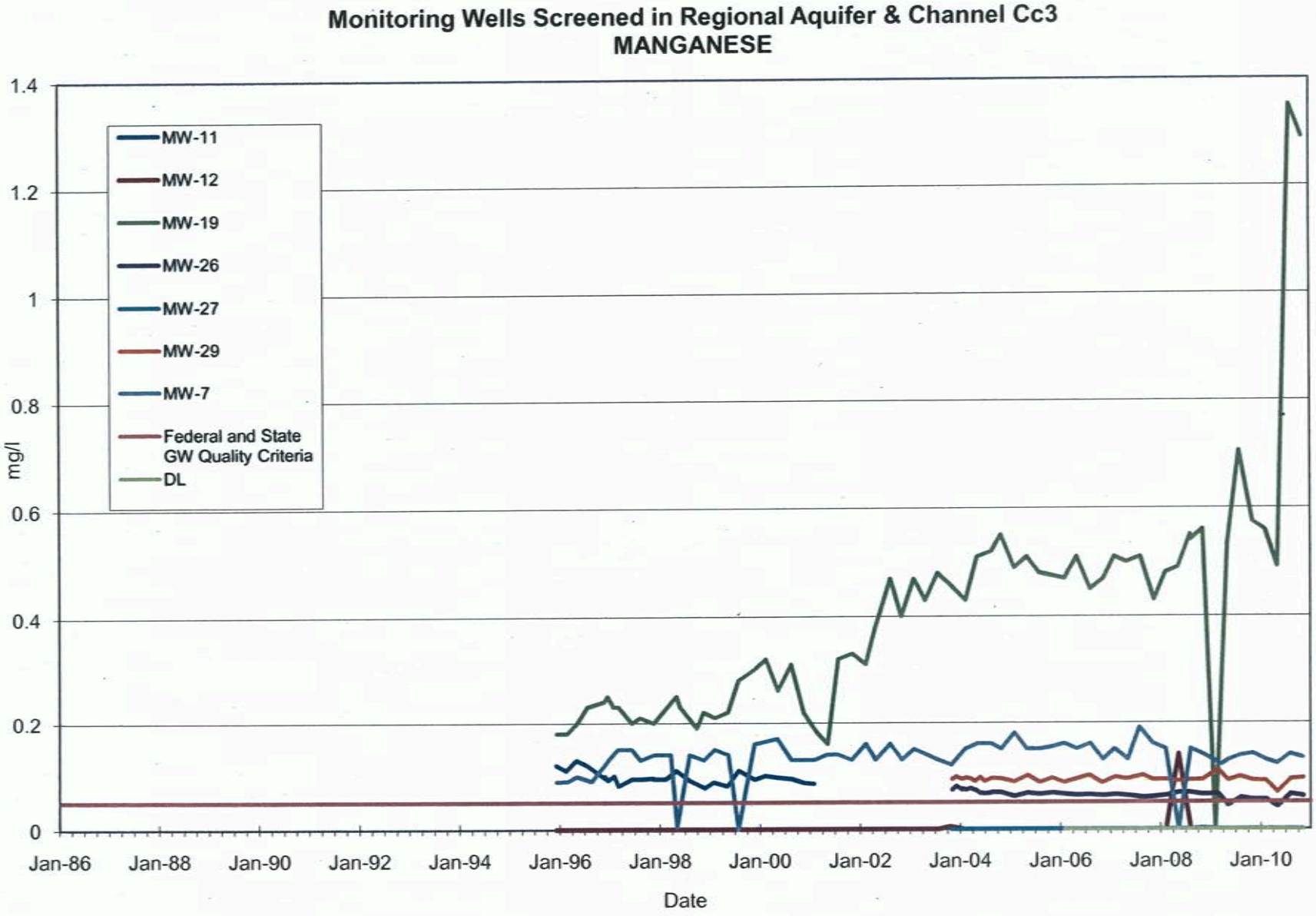

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
CHLORIDE
Federal and State GW Quality Criteria 250 mg/L
Note: Data point MW-26 from 1/14/04 = 9 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
0
1
2
3
4
5
6
7
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

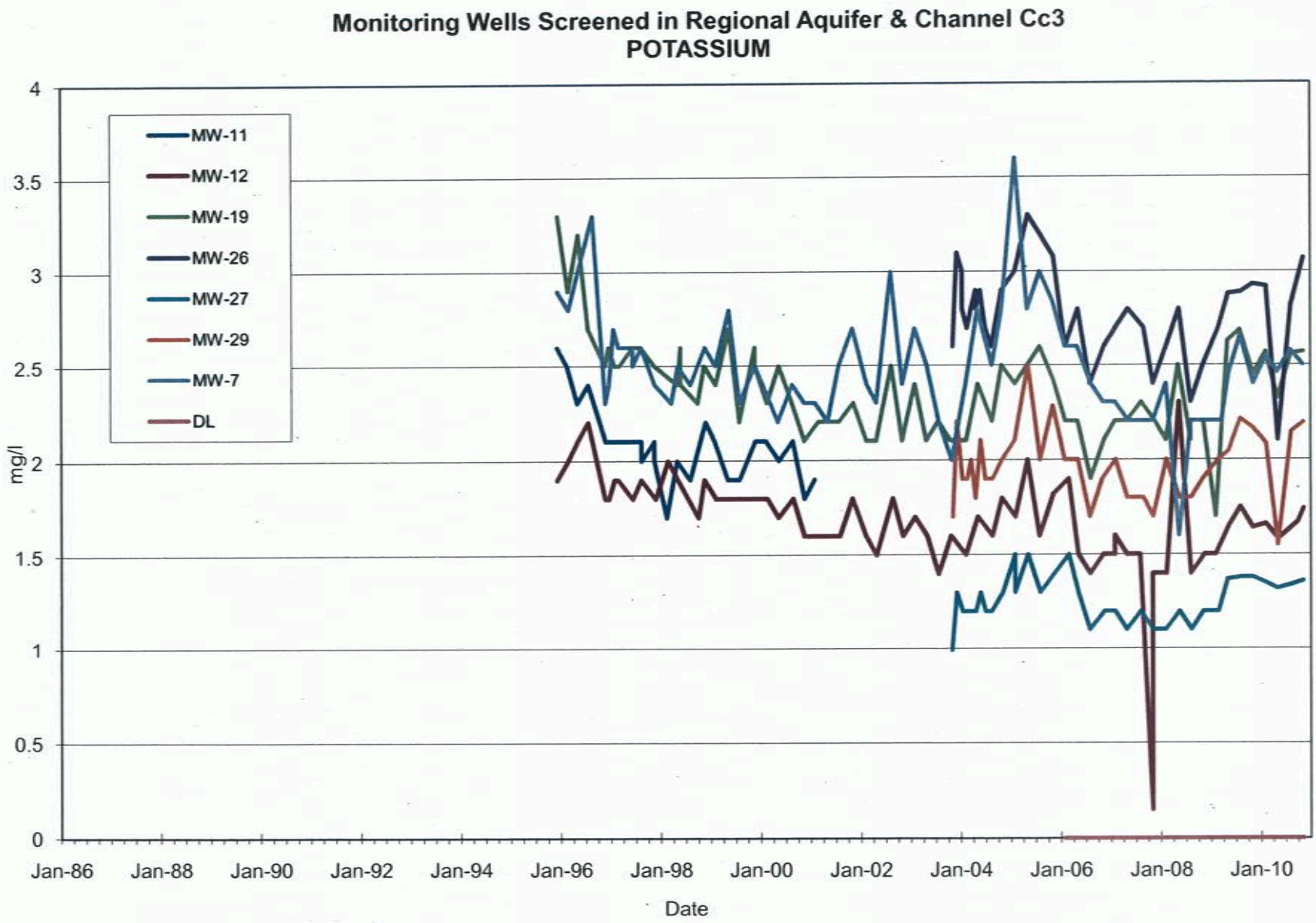

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
NITRATE
Federal and State GW Quality Criteria 10 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
0
1
2
3
4
5
6
7
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

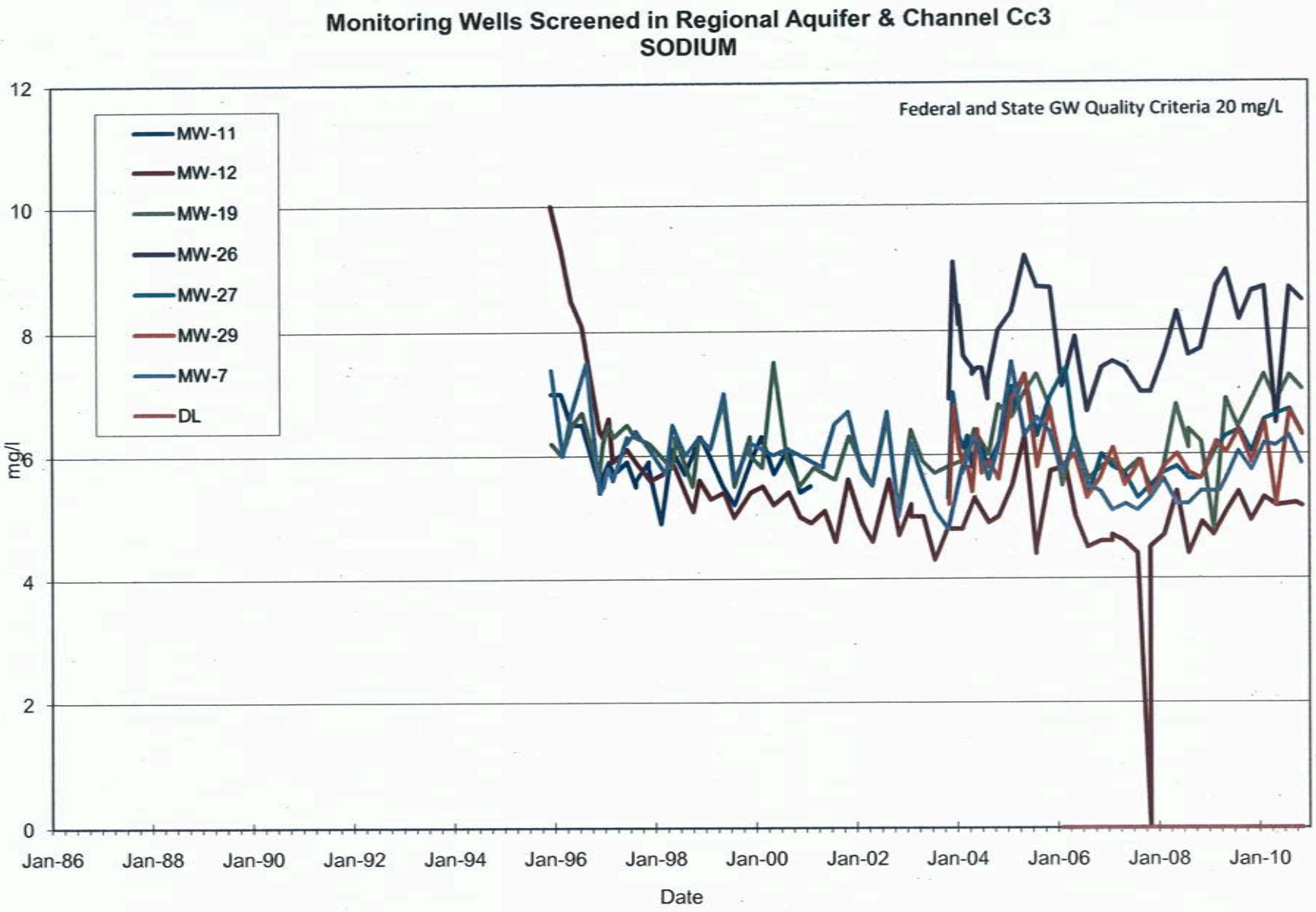

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
SULFATE
Federal and State GW Quality Criteria 250 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
30
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

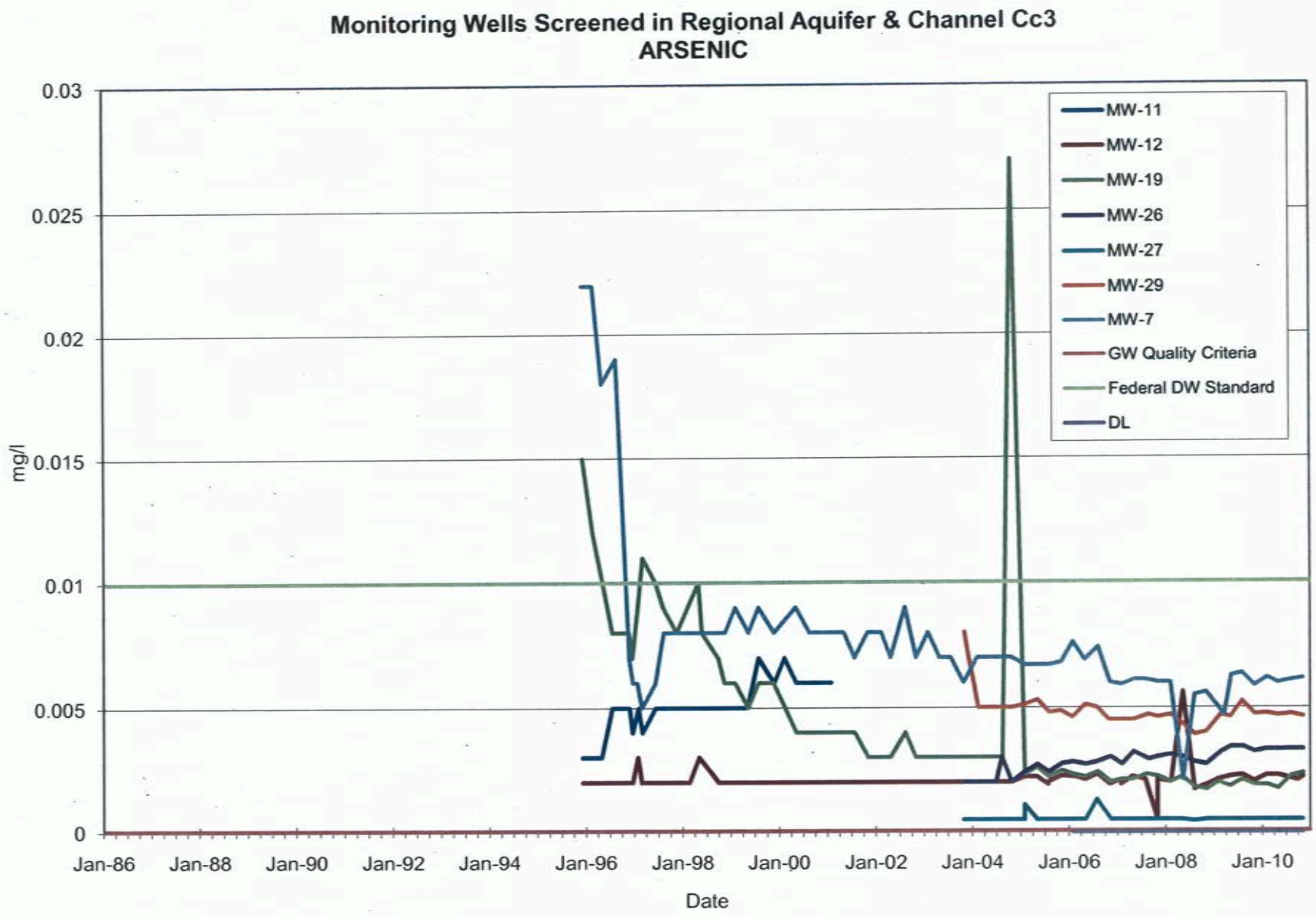

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
IRON
Note: Data point MW-11 from 4/30/96 = 4 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
Federal and State GW Quality Criteria
DL
mg/l
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

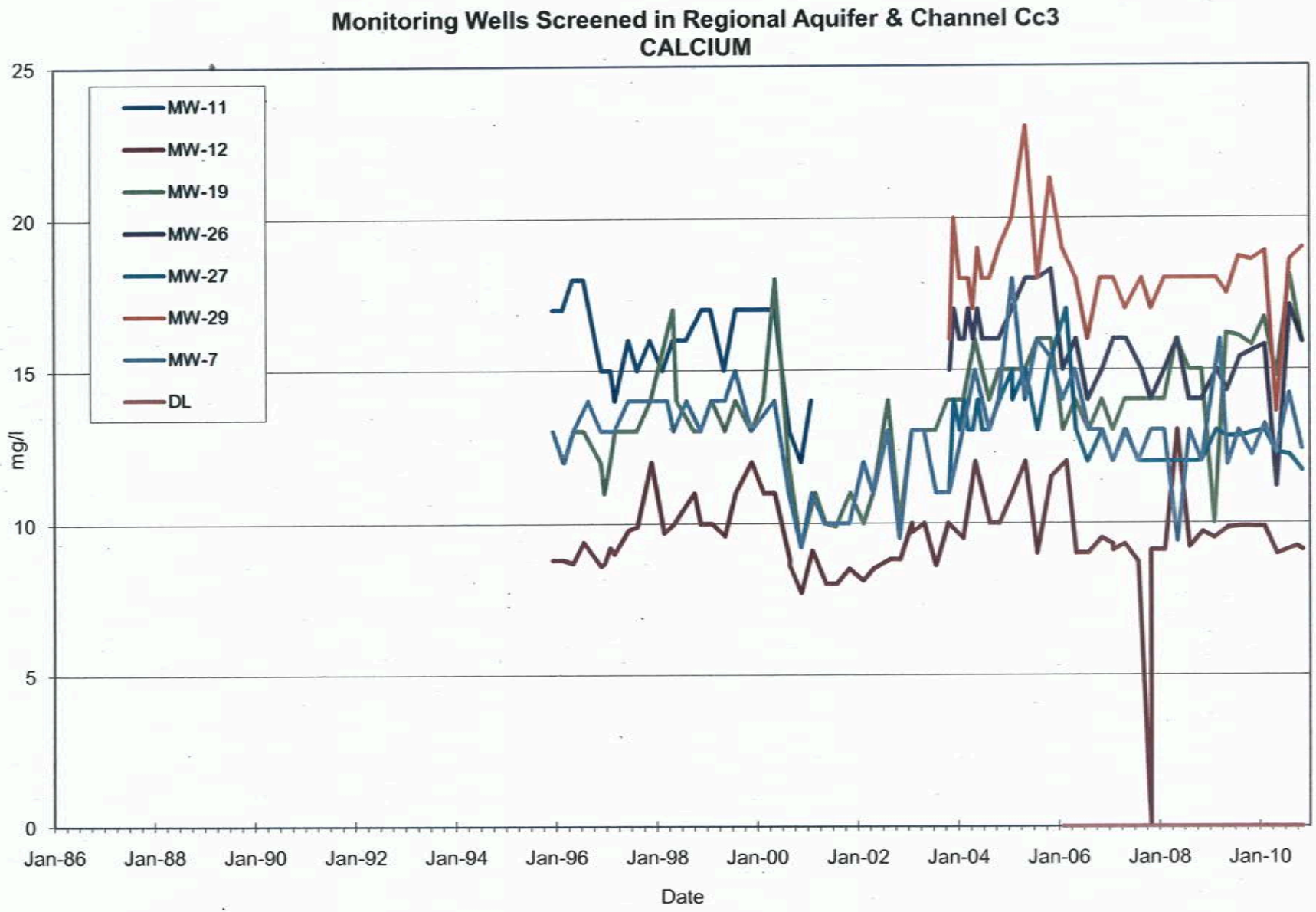

Monitoring Wells Screened in Regional Aquifer & Channel Cc3
MAGNESIUM
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
0
2
4
6
8
10
12
14
16
18
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened in Regional Aquifer & Channel Cc3
MANGANESE
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
Federal and State GW Quality Criteria
DL
mg/l
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened in Regional Aquifer & Channel Cc3
POTASSIUM
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened in Regional Aquifer & Channel Cc3
SODIUM
Federal and State GW Quality Criteria 20 mg/L
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
12
10
8
6
4
2
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date


Monitoring Wells Screened in Regional Aquifer & Channel Cc3
ARSENIC
0.03
0.025
0.02
0.015
0.01
0.005
0
mg/l
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
GW Quality Criteria
Federal DW Standard
DL


Monitoring Wells Screened in Regional Aquifer & Channel Cc3
CALCIUM
MW-11
MW-12
MW-19
MW-26
MW-27
MW-29
MW-7
DL
mg/l
25
20
15
10
5
0
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Date

Appendix G

Groundwater Velocity Calculations and Potentiometric Maps

Aspect consulting
earth + water

King County
Department of
Natural Resources and Parks
Solid Waste Division

April 27, 2010

Mr. Sendy Jimenez
King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

Re: Contract Number: E00065E07 J
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation
1st Quarter Data Collected February 2, 2010
Vashon Island Landfill
King County, Washington
Project No. 070074-007-04

Dear Mr. Jimenez:

Aspect Consulting, LLC submits this letter report on groundwater conditions measured during the 1st Quarter of 2010 for the middle channel deposit in Unit C (designated Cc2) perched zone and the regional aquifer beneath the Vashon Island Landfill (landfill), in accordance with King County Department of Natural Resources, Solid Waste Division (KCSWD) Contract Number E00065E07 J. KCSWD personnel measured groundwater elevations at the landfill on February 2, 2010. These measurements were received by Aspect Consulting on April 8, 2010 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the Cc2 perched zone and the regional aquifer;
2. Determine the groundwater flow direction and horizontal gradient for the Cc2 perched zone and the regional aquifer; and
3. Calculate the groundwater velocity of the Cc2 perched zone and the regional aquifer.

There have been no significant changes in the interpreted groundwater conditions since the previous report submitted for observations made during 4th Quarter of 2009.

Groundwater Elevation Data

KCSWD measured groundwater levels at 21 on-site wells completed at various depths near the landfill on February 2, 2010. Table 1 lists the well names, locations, reference point elevations, measured groundwater levels, and calculated groundwater elevations.

The water levels in MW-1 and MW-28 were reported as "dry". MW-1 was completed in the Cc1 perched zone and was not used for this analysis. MW-28 was completed in the regional

aquifer but has historically been dry, and was not used to determine either potentiometric surface or groundwater velocity for this monitoring event.

Cc2 Perched Zone

Three separate perching zones are identified in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004) within the upper lacustrine silt deposits identified as Unit C. Only the southern portion of the Cc2 middle channel deposit perched zone was identified as laterally extensive. Groundwater in Cc2 is measured by wells MW-2, MW-5D, MW-9, MW-20, and MW-21. Monitoring well MW-9 is not in hydraulic communication with the rest of the wells in the Cc2 perched zone located south of the landfill boundary, as described in the *Vashon Island Landfill Hydrogeologic Report Update* (see cross-section Figure 3.2). Figure 1 shows well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted groundwater flow directions in the Cc2 perched zone for the February 2, 2010 measurement event.

Regional Aquifer

Water levels at 7 of the 21 on-site wells measured the potentiometric surface in the regional aquifer. Wells MW-7, MW-12, MW-19, MW-25, MW-26, MW-27, and MW-29 are reported to be in hydraulic communication with the regional aquifer in the recent hydrogeologic report update. The regional aquifer includes the deepest channel deposit in Unit C (designated Cc3), and water-bearing Units D and F. Units D and F are separated by Unit E which is a semi-continuous, variably saturated aquitard. Figure 2 shows well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted groundwater flow directions measured at wells completed in the regional aquifer for the February 2, 2010 measurement event.

Wells MW-7, MW-12, MW-19, and MW-25 measured water levels at least 20 feet above the top of the screen and may be influenced by vertical gradients in the regional aquifer. Well MW-27, completed in Unit Cc3, is identified in the *Vashon Island Landfill Hydrogeologic Report Update* to be measuring a groundwater mound in the regional aquifer water table. The mounding phenomenon is likely due to local recharge from perched zones above.

Direction of Groundwater Flow

Groundwater elevations from measurements made on February 2, 2010 indicate that groundwater in the southern Cc2 perched zone generally flowed west-southwest (Figure 1).

Based on the current limited understanding of the regional aquifer and groundwater level measurements made on February 2, 2010, groundwater in the regional aquifer generally flowed radially away from MW-27 (Figure 2). Flow from MW-27 westward cannot be confirmed because there are no wells completed in the regional aquifer to the west of MW-27.

Groundwater Velocity

Horizontal groundwater velocity was calculated using the following formula:

$$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

where:
v = Groundwater velocity [L/t]
K = Hydraulic conductivity [L/t]
$\Delta H/\Delta L$ = Hydraulic gradient [L/L]
n_{eff} = Effective porosity [dimensionless]

Horizontal groundwater velocity was calculated for the southern Cc2 perched zone and for the regional aquifer directly beneath the landfill. Table 2 presents a summary of the hydraulic parameters that were used to calculate a groundwater velocity from the 1st Quarter 2010 data. On February 2, 2010, the average horizontal groundwater velocity within the southern Cc2 perched zone was 0.002 feet per day (ft/d), and the average groundwater velocity in the regional aquifer was 1.6 ft/d. The uncertainty of groundwater flow direction and velocity in the regional aquifer reflects the uncertainty detailed in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004).

Thank you for the opportunity to provide hydrogeologic consulting services to the King County Solid Waste Division. Please call Peter at (206) 780-7728 or John at (206) 780-7719, if you have any questions.

Sincerely,

Aspect consulting, LLC

Peter S. Bannister, PE
Senior Project Engineer
pbannister@aspectconsulting.com

John J. Strunk, LHG
Senior Associate Geologist
jstrunk@aspectconsulting.com

Attachments:
- Table 1: Measured Groundwater Elevations – 1st Quarter 2010
- Table 2: Groundwater Velocity Calculations – 1st Quarter 2010
- Figure 1: Groundwater Potentiometric Surface Map – 1st Quarter 2010 – Unit Cc2 Perched Zone
- Figure 2: Groundwater Potentiometric Surface Map – 1st Quarter 2010 – Regional Aquifer

W:\070074 KCSWD Geologic Environ\Deliverables\Vashon Island\2010Q1\VI_2010Q1 Ltr.doc

Table 1 - Measured Groundwater Elevations - 1st Quarter 2010

Vashon Island Landfill - King County, Washington

	Well Name	Northing (ft)	Easting (ft)	Reference Point Elevation (ft MSL)	Measured Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)
Wells Completed in Cc2 Perched Zone	MW-2	124	2359	314.28	74.80	239.48
	MW-5D	322	2209	357.20	117.40	239.80
	MW-9	1284	2269	402.57	166.41	236.16
	MW-20	333	2739	367.21	124.25	242.96
	MW-21	95	2218	345.66	107.40	238.26
Wells Completed in the Regional Aquifer	MW-7	583	2988	373.25	193.74	179.51
	MW-12	134	2371	312.39	144.03	168.36
	MW-19	1292	2270	403.83	245.76	158.07
	MW-25	1525	3168	399.22	244.08	155.14
	MW-26	1531	2450	403.40	247.35	156.05
	MW-27	906	2333	383.06	189.22	193.84
	MW-28	1609	2654	395.59	DRY	"dry"
	MW-29	1452	2917	410.57	244.81	165.76
Wells Completed in Other Perched Zones	MW-1	1369	2987	403.60	DRY	"dry"
	MW-3	132	2360	314.87	40.55	274.32
	MW-4	712	2117	374.21	108.03	266.18
	MW-8	972	2217	383.42	177.31	206.11
	MW-10	1597	2407	407.51	145.66	261.85
	MW-13	614	2987	374.07	102.50	271.57
	MW-14	713	2127	375.68	154.99	220.69
	MW-24	603	2988	373.93	89.44	284.49

Notes:

1. Water level measurements made February 2, 2010 by KCSWD personnel.
2. Coordinates in feet based on local grid. Elevations in feet above mean sea level (ft MSL) based on landfill datum.
3. The water levels in MW-1 and MW-28 were reported as "dry".
4. The water level in MW-14 was low compared to the historical range.

King County

Table 2 - Groundwater Velocity Calculations - 1st Quarter 2010

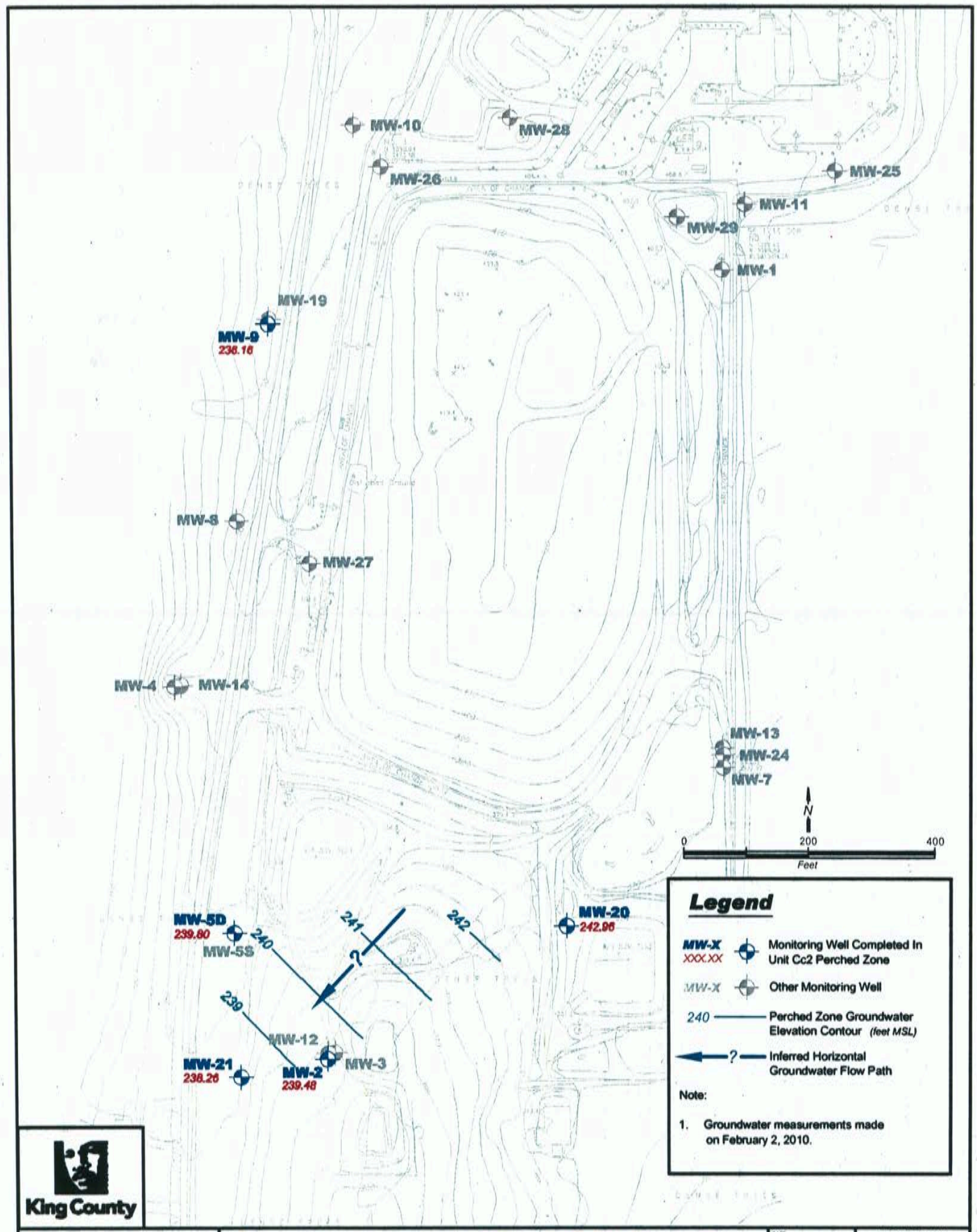
Vashon Island Landfill - King County, Washington

Groundwater Zone Beneath Landfill	Horizontal Hydraulic Conductivity			Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity	Horizontal Groundwater Velocity (ft/d)	General Direction of Groundwater Flow
	Range	(cm/s)	(ft/d)				
Southern Cc2 Perched Zone	Low	1.9E-06	0.01	0.008	30%	0.0001	West-Southwest
	High	1.6E-04	0.45	0.008	20%	0.02	
	Average	1.7E-05	0.05	0.008	25%	0.002	
Regional Aquifer	Low	1.0E-03	3	0.05	30%	0.4	Radially away from MW-27
	High	1.0E-02	28	0.05	20%	6.5	
	Average	3.2E-03	9	0.05	25%	1.6	

Notes:

1. The southern Cc2 Perched Zone potentiometric surface is measured by wells MW-2, MW-5D, MW-9, MW-20, and MW-21 per *Vashon Island Landfill Hydrogeologic Report Update*, December 2004, Berryman & Henigar. Well MW-9 is assumed not to be in hydraulic communication with the other wells.
2. The Regional Aquifer potentiometric surface is measured by wells MW-7, MW-12, MW-19, MW-25, MW-26, MW-27, and MW-29 per *Vashon Island Landfill Hydrogeologic Report Update*.
3. Horizontal hydraulic conductivity values derived from *Vashon Island Landfill Monitoring Well Construction Report*, December 1996, King County Solid Waste Division. Average hydraulic conductivity values are the geometric mean of the high and low values.
4. Horizontal hydraulic gradients based on average of gradients calculated between monitoring well with highest groundwater elevation and other monitoring wells shown on Figure 1 and Figure 2.
5. Effective porosity values were adopted from *Potentiometric Surface Maps and Ground Water Velocity Estimates: 4th Quarter Ground Water Data Collected October 14, 2003 - Vashon Island Landfill, King County, Washington*, January 6, 2004, HWA Geosciences, Inc.

King County

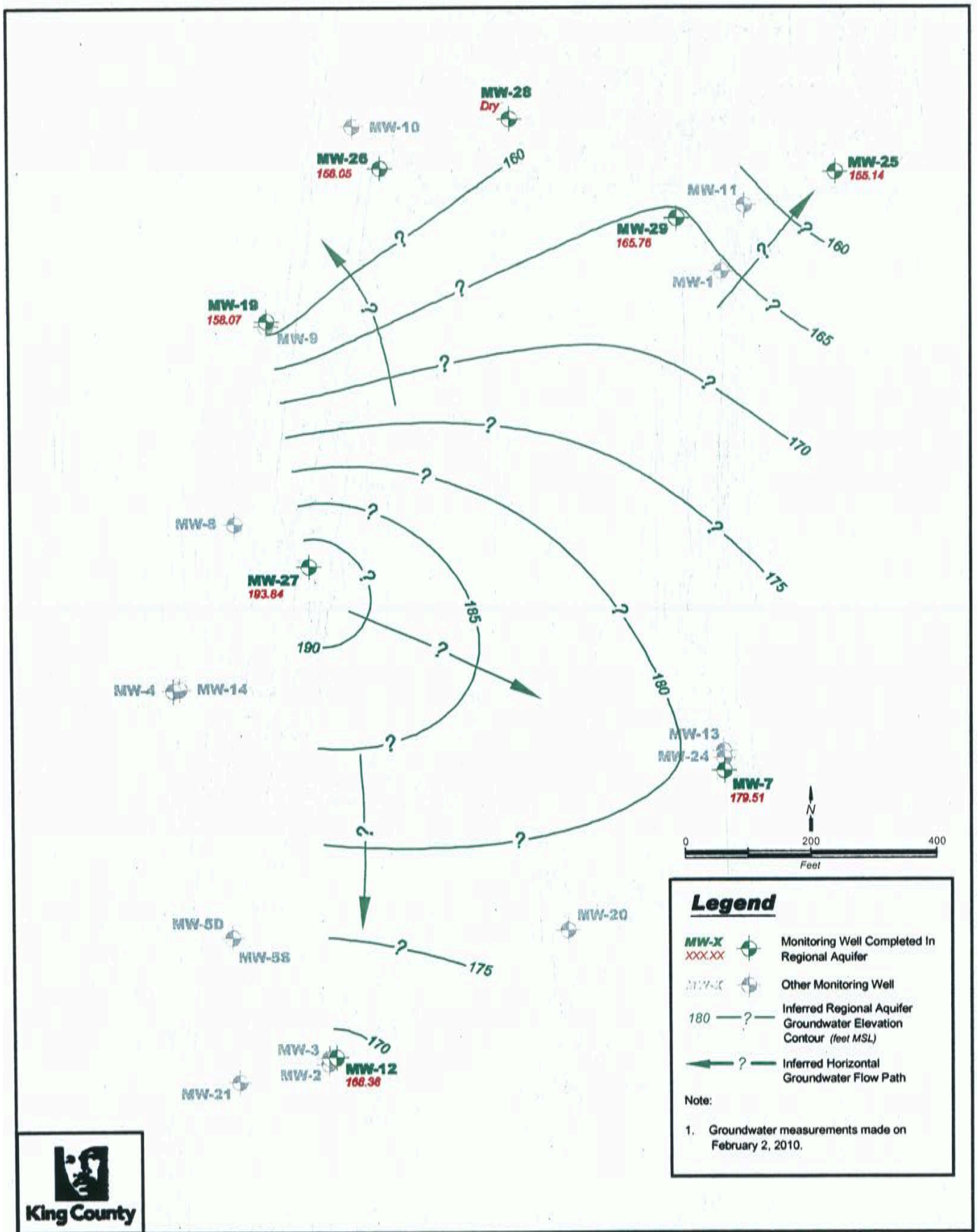


King County

Aspect consulting
earth+water
www.aspectconsulting.com
a limited liability company

Groundwater Potentiometric Surface Map
1st Quarter 2010 - Unit Cc2 Perched Zone
Vashon Island Landfill
King County, Washington

DATE April 2010	PROJECT NO. 070074
DESIGNED BY PSB	
DRAWN BY PMB	FIGURE NO. 1
REVISED BY	



King County

Aspect consulting
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Groundwater Potentiometric Surface Map
1st Quarter 2010 - Regional Aquifer
Vashon Island Landfill
King County, Washington

DATE April 2010	PROJECT NO. 070074
DESIGNED BY PSB	
DRAWN BY PMB	FIGURE NO. 2
REVISED BY -	

Q:\King County\070074 King County Landfill P Maps\2010-04 Vashon Island-Q1\W1_2010Q1_RA_v2004.dwg

Aspect CONSULTING

King County
Department of
Natural Resources and Parks

July 15, 2010

Mr. Sendy Jimenez
King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

Re: Contract Number: E00065E07 J
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation
2nd Quarter Data Collected April 29, 2010
Vashon Island Landfill
King County, Washington
Project No. 070074-007-04

Dear Mr. Jimenez:

Aspect Consulting, LLC submits this letter report on groundwater conditions measured during the 2nd Quarter of 2010 for the middle channel deposit in Unit C (designated Cc2) perched zone and the regional aquifer beneath the Vashon Island Landfill (landfill), in accordance with King County Department of Natural Resources, Solid Waste Division (KCSWD) Contract Number E00065E07 J. KCSWD personnel measured groundwater elevations at the landfill on April 29, 2010. These measurements were received by Aspect Consulting on June 29, 2010 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the Cc2 perched zone and the regional aquifer;
2. Determine the groundwater flow direction and horizontal gradient for the Cc2 perched zone and the regional aquifer; and
3. Calculate the groundwater velocity of the Cc2 perched zone and the regional aquifer.

There have been no significant changes in the interpreted groundwater conditions since the previous report submitted for observations made during 1st Quarter of 2010.

Groundwater Elevation Data

KCSWD measured groundwater levels at 21 on-site wells completed at various depths near the landfill on April 29, 2010. Table 1 lists the well names, locations, reference point elevations, measured groundwater levels, and calculated groundwater elevations.

The water levels in MW-1 and MW-28 were reported as "dry". MW-1 was completed in the Cc1 perched zone and was not used for this analysis. MW-28 was completed in the regional aquifer but has historically been dry, and was not used to determine either potentiometric surface or groundwater velocity for this monitoring event.

Cc2 Perched Zone

Three separate perching zones are identified in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004) within the upper lacustrine silt deposits identified as Unit C. Only the southern portion of the Cc2 middle channel deposit perched zone was identified as laterally extensive. Groundwater in Cc2 is measured by wells MW-2, MW-5D, MW-9, MW-20, and MW-21. Monitoring well MW-9 is not in hydraulic communication with the rest of the wells in the Cc2 perched zone located south of the landfill boundary, as described in the *Vashon Island Landfill Hydrogeologic Report Update* (see cross-section Figure 3.2). Figure 1 shows well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted groundwater flow directions in the Cc2 perched zone for the April 29, 2010 measurement event.

Regional Aquifer

Water levels at 7 of the 21 on-site wells measured the potentiometric surface in the regional aquifer. Wells MW-7, MW-12, MW-19, MW-25, MW-26, MW-27, and MW-29 are reported to be in hydraulic communication with the regional aquifer in the recent hydrogeologic report update. The regional aquifer includes the deepest channel deposit in Unit C (designated Cc3), and water-bearing Units D and F. Units D and F are separated by Unit E which is a semi-continuous, variably saturated aquitard. Figure 2 shows well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted groundwater flow directions measured at wells completed in the regional aquifer for the April 29, 2010 measurement event.

Wells MW-7, MW-12, MW-19, and MW-25 measured water levels at least 20 feet above the top of the screen and may be influenced by vertical gradients in the regional aquifer. Well MW-27, completed in Unit Cc3, is identified in the *Vashon Island Landfill Hydrogeologic Report Update* to be measuring a groundwater mound in the regional aquifer water table. The mounding phenomenon is likely due to local recharge from perched zones above.

Direction of Groundwater Flow

Groundwater elevations from measurements made on April 29, 2010 indicate that groundwater in the southern Cc2 perched zone generally flowed west-southwest (Figure 1).

Based on the current limited understanding of the regional aquifer and groundwater level measurements made on April 29, 2010, groundwater in the regional aquifer generally flowed radially away from MW-27 (Figure 2). Flow from MW-27 westward cannot be confirmed because there are no wells completed in the regional aquifer to the west of MW-27.

Groundwater Velocity

Horizontal groundwater velocity was calculated using the following formula:

$$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

where:
v = Groundwater velocity [L/t]
K = Hydraulic conductivity [L/t]
$\Delta H/\Delta L$ = Hydraulic gradient [L/L]
n_{eff} = Effective porosity [dimensionless]

Horizontal groundwater velocity was calculated for the southern Cc2 perched zone and for the regional aquifer directly beneath the landfill. Table 2 presents a summary of the hydraulic parameters that were used to calculate a groundwater velocity from the 2nd Quarter 2010 data. On April 29, 2010, the average horizontal groundwater velocity within the southern Cc2 perched zone was 0.002 feet per day (ft/d), and the average groundwater velocity in the regional aquifer was 1.7 ft/d. The uncertainty of groundwater flow direction and velocity in the regional aquifer reflects the uncertainty detailed in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004).

Thank you for the opportunity to provide hydrogeologic consulting services to the King County Solid Waste Division. Please call Peter at (206) 780-7728 or John at (206) 780-7719, if you have any questions.

Sincerely,

Aspect consulting, LLC

Peter S. Bannister, PE
Senior Project Engineer
pbannister@aspectconsulting.com

John J. Strunk, LHG
Senior Associate Geologist
jstrunk@aspectconsulting.com

Attachments:
- Table 1: Measured Groundwater Elevations – 2nd Quarter 2010
- Table 2: Groundwater Velocity Calculations – 2nd Quarter 2010
- Figure 1: Groundwater Potentiometric Surface Map – 2nd Quarter 2010 – Unit Cc2 Perched Zone
- Figure 2: Groundwater Potentiometric Surface Map – 2nd Quarter 2010 – Regional Aquifer

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Table 1 - Measured Groundwater Elevations - 2nd Quarter 2010

Vashon Island Landfill - King County, Washington

	Well Name	Northing (ft)	Easting (ft)	Reference Point Elevation (ft MSL)	Measured Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)
Wells Completed in Cc2 Perched Zone	MW-2	124	2359	314.28	74.63	239.65
	MW-5D	322	2209	357.20	118.27	238.93
	MW-9	1284	2269	402.57	165.94	236.63
	MW-20	333	2739	367.21	124.00	243.21
	MW-21	95	2218	345.66	107.29	238.37
Wells Completed in the Regional Aquifer	MW-7	583	2988	373.25	193.77	179.48
	MW-12	134	2371	312.39	144.18	168.21
	MW-19	1292	2270	403.83	245.94	157.89
	MW-25	1525	3168	399.22	244.06	155.16
	MW-26	1531	2450	403.40	247.50	155.90
	MW-27	906	2333	383.06	188.07	194.99
	MW-28	1609	2654	395.59	dry	"dry"
	MW-29	1452	2917	410.57	244.81	165.76
Wells Completed in Other Perched Zones	MW-1	1369	2987	403.60	dry	"dry"
	MW-3	132	2360	314.87	40.78	274.09
	MW-4	712	2117	374.21	107.49	266.72
	MW-8	972	2217	383.42	176.88	206.54
	MW-10	1597	2407	407.51	145.90	261.61
	MW-13	614	2987	374.07	102.18	271.89
	MW-14	713	2127	375.68	152.10	223.58
	MW-24	603	2988	373.93	88.36	285.57

Notes:

1. Water level measurements made April 29, 2010 by KCSWD personnel.
2. Coordinates in feet based on local grid. Elevations in feet above mean sea level (ft MSL) based on landfill datum.
3. The water levels in MW-1 and MW-28 were reported as "dry".

King County

Table 2 - Groundwater Velocity Calculations - 2nd Quarter 2010

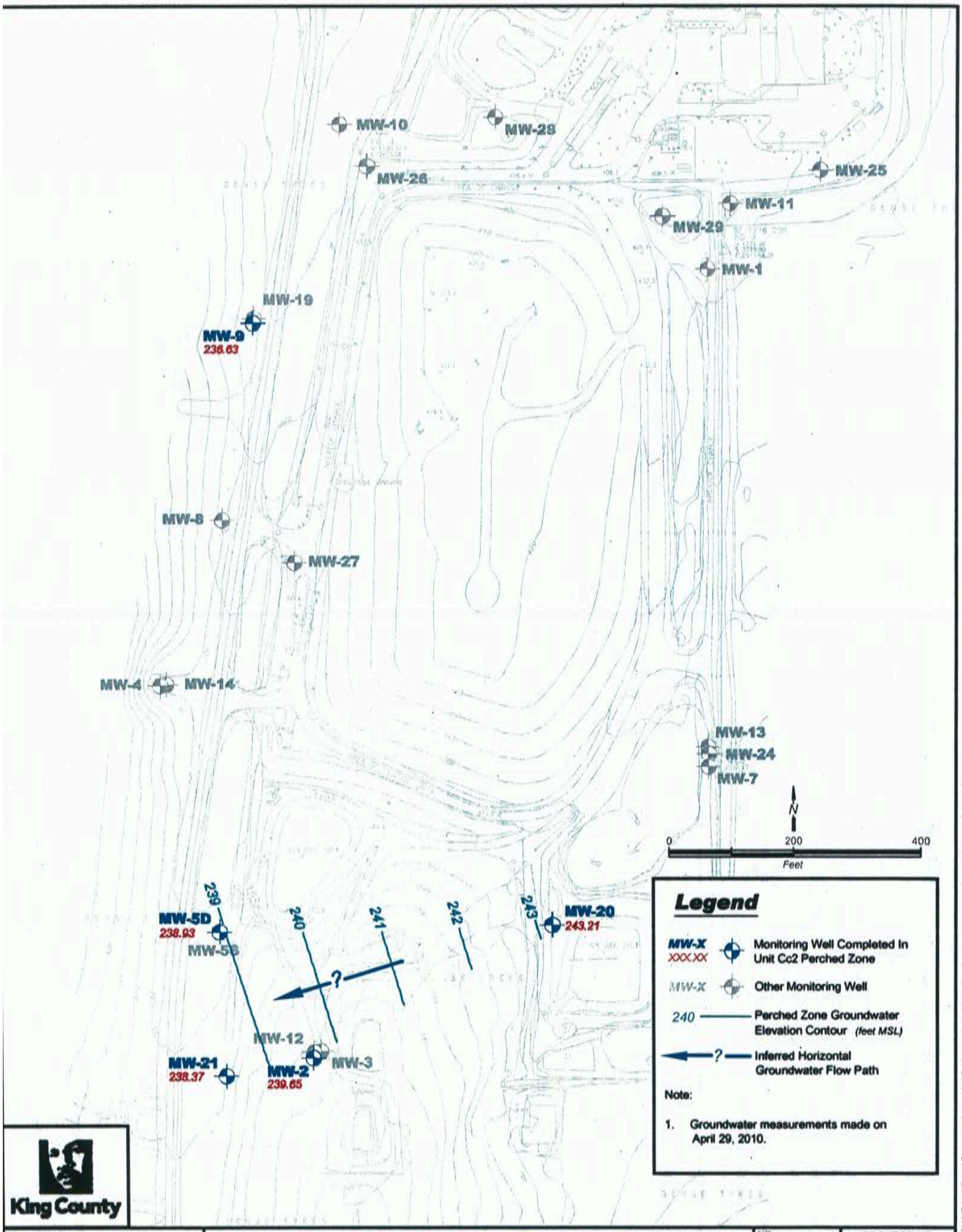
Vashon Island Landfill - King County, Washington

Groundwater Zone Beneath Landfill	Horizontal Hydraulic Conductivity			Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity	Horizontal Groundwater Velocity (ft/d)	General Direction of Groundwater Flow
	Range	(cm/s)	(ft/d)				
Southern Cc2 Perched Zone	Low	1.9E-06	0.01	0.009	30%	0.0002	West-Southwest
	High	1.6E-04	0.45	0.009	20%	0.02	
	Average	1.7E-05	0.05	0.009	25%	0.002	
Regional Aquifer	Low	1.0E-03	3	0.05	30%	0.5	Radially away from MW-27
	High	1.0E-02	28	0.05	20%	6.8	
	Average	3.2E-03	9	0.05	25%	1.7	

Notes:

1. The southern Cc2 Perched Zone potentiometric surface is measured by wells MW-2, MW-5D, MW-9, MW-20, and MW-21 per *Vashon Island Landfill Hydrogeologic Report Update*, December 2004, Berryman & Henigar. Well MW-9 is assumed not to be in hydraulic communication with the other wells.
2. The Regional Aquifer potentiometric surface is measured by wells MW-7, MW-12, MW-19, MW-25, MW-26, MW-27, and MW-29 per *Vashon Island Landfill Hydrogeologic Report Update*.
3. Horizontal hydraulic conductivity values derived from *Vashon Island Landfill Monitoring Well Construction Report*, December 1996, King County Solid Waste Division. Average hydraulic conductivity values are the geometric mean of the high and low values.
4. Horizontal hydraulic gradients based on average of gradients calculated between monitoring well with highest groundwater elevation and other monitoring wells shown on Figure 1 and Figure 2.
5. Effective porosity values were adopted from *Potentiometric Surface Maps and Ground Water Velocity Estimates: 4th Quarter Ground Water Data Collected October 14, 2003 - Vashon Island Landfill, King County, Washington*, January 6, 2004, HWA Geosciences, Inc.

King County



King County

Aspect consulting
earth+water
www.aspectconsulting.com
a limited liability company

Groundwater Potentiometric Surface Map
2nd Quarter 2010 - Unit Cc2 Perched Zone

Vashon Island Landfill
King County, Washington

DATE	July 2010
DESIGNED BY	PSB
DRAWN BY	PMB
REVISED BY	

PROJECT NO. 070074

FIGURE NO. 1

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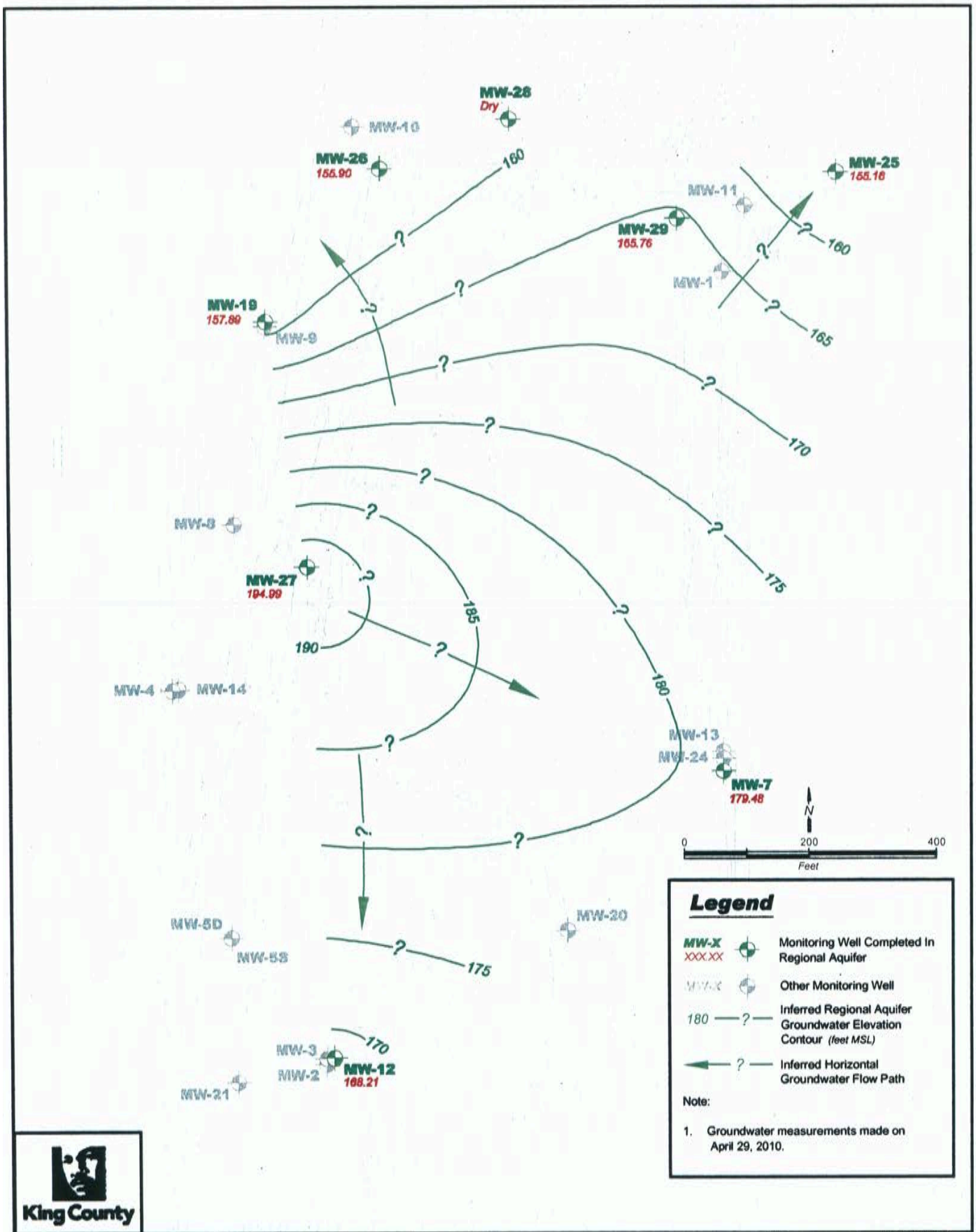

King County

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www.aspectconsulting.com
a limited liability company

Groundwater Potentiometric Surface Map
2nd Quarter 2010 - Regional Aquifer
Vashon Island Landfill
King County, Washington

DATE July 2010	PROJECT NO. 070074
DESIGNED BY PSB	
DRAWN BY PMB	FIGURE NO. 2
REVISED BY	

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Aspect CONSULTING

King County
Department of
Natural Resources and Parks

September 23, 2010

Mr. Sendy Jimenez
King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

Re: Contract Number: E00065E07 J
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation
3rd Quarter Data Collected August 3, 2010
Vashon Island Landfill
King County, Washington
Project No. 070074-007-04

Dear Mr. Jimenez:

Aspect Consulting, LLC submits this letter report on groundwater conditions measured during the 3rd Quarter of 2010 for the middle channel deposit in Unit C (designated Cc2) perched zone and the regional aquifer beneath the Vashon Island Landfill (landfill), in accordance with King County Department of Natural Resources, Solid Waste Division (KCSWD) Contract Number E00065E07 J. KCSWD personnel measured groundwater elevations at the landfill on August 3, 2010. These measurements were received by Aspect Consulting on August 26, 2010 and were used to:

1. Evaluate the potentiometric groundwater surface elevation for the Cc2 perched zone and the regional aquifer;
2. Determine the groundwater flow direction and horizontal gradient for the Cc2 perched zone and the regional aquifer; and
3. Calculate the groundwater velocity of the Cc2 perched zone and the regional aquifer.

There have been no significant changes in the interpreted groundwater conditions since the previous report submitted for observations made during 2nd Quarter of 2010.

Groundwater Elevation Data

KCSWD measured groundwater levels at 21 on-site wells completed at various depths near the landfill on August 3, 2010. Table 1 lists the well names, locations, reference point elevations, measured groundwater levels, and calculated groundwater elevations.

The water levels in wells MW-1, MW-3, and MW-28 were reported as "dry". MW-1 and MW-3 were completed in the Cc1 perched zone and were not used for this analysis. MW-1 has historically been reported dry. The water levels in MW-3 have been reported within 0.3 feet of the bottom of the well during 3rd and 4th Quarters of 2008 and 2009, and are interpreted to have been "dry"

during these monitoring events. MW-28 was completed in the regional aquifer but has historically been dry, and was not used to determine either potentiometric surface or groundwater velocity for this monitoring event.

Cc2 Perched Zone

Three separate perching zones are identified in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004) within the upper lacustrine silt deposits identified as Unit C. Only the southern portion of the Cc2 middle channel deposit perched zone was identified as laterally extensive. Groundwater in Cc2 is measured by wells MW-2, MW-5D, MW-9, MW-20, and MW-21. Monitoring well MW-9 is not in hydraulic communication with the rest of the wells in the Cc2 perched zone located south of the landfill boundary, as described in the *Vashon Island Landfill Hydrogeologic Report Update* (see cross-section Figure 3.2). Figure 1 shows well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted groundwater flow directions in the Cc2 perched zone for the August 3, 2010 measurement event.

Regional Aquifer

Water levels at 7 of the 21 on-site wells measured the potentiometric surface in the regional aquifer. Wells MW-7, MW-12, MW-19, MW-25, MW-26, MW-27, and MW-29 are reported to be in hydraulic communication with the regional aquifer in the recent hydrogeologic report update. The regional aquifer includes the deepest channel deposit in Unit C (designated Cc3), and water-bearing Units D and F. Units D and F are separated by Unit E which is a semi-continuous, variably saturated aquitard. Figure 2 shows well locations, groundwater elevations, groundwater potentiometric surface contours, and interpreted groundwater flow directions measured at wells completed in the regional aquifer for the August 3, 2010 measurement event.

Wells MW-7, MW-12, MW-19, and MW-25 measured water levels at least 20 feet above the top of the screen and may be influenced by vertical gradients in the regional aquifer. Well MW-27, completed in Unit Cc3, is identified in the *Vashon Island Landfill Hydrogeologic Report Update* to be measuring a groundwater mound in the regional aquifer water table. The mounding phenomenon is likely due to local recharge from perched zones above.

Direction of Groundwater Flow

Groundwater elevations from measurements made on August 3, 2010 indicate that groundwater in the southern Cc2 perched zone generally flowed west-southwest (Figure 1).

Based on the current limited understanding of the regional aquifer and groundwater level measurements made on August 3, 2010, groundwater in the regional aquifer generally flowed radially away from MW-27 (Figure 2). Flow from MW-27 westward cannot be confirmed because there are no wells completed in the regional aquifer to the west of MW-27.

Groundwater Velocity

Horizontal groundwater velocity was calculated using the following formula:

$$v = \frac{1}{n_{eff}} K \frac{\Delta H}{\Delta L}$$

where:
v = Groundwater velocity [L/t]
K = Hydraulic conductivity [L/t]
$\Delta H/\Delta L$ = Hydraulic gradient [L/L]
n_{eff} = Effective porosity [dimensionless]

Horizontal groundwater velocity was calculated for the southern Cc2 perched zone and for the regional aquifer directly beneath the landfill. Table 2 presents a summary of the hydraulic parameters that were used to calculate a groundwater velocity from the 3rd Quarter 2010 data. On August 3, 2010, the average horizontal groundwater velocity within the southern Cc2 perched zone was 0.002 feet per day (ft/d), and the average groundwater velocity in the regional aquifer was 1.7 ft/d. The uncertainty of groundwater flow direction and velocity in the regional aquifer reflects the uncertainty detailed in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004).

Thank you for the opportunity to provide hydrogeologic consulting services to the King County Solid Waste Division. Please call Peter at (206) 780-7728 or John at (206) 780-7719, if you have any questions.

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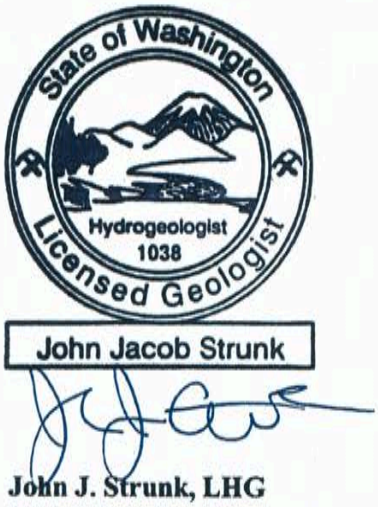

Peter S. Bannister, PE
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Table 1 - Measured Groundwater Elevations - 3rd Quarter 2010

Vashon Island Landfill - King County, Washington

	Well Name	Northing (ft)	Easting (ft)	Reference Point Elevation (ft MSL)	Measured Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)
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	MW-14	713	2127	375.68	151.88	223.80
	MW-24	603	2988	373.93	87.69	286.24

Notes:

1. Water level measurements made August 3, 2010 by KCSWD personnel.
2. Coordinates in feet based on local grid. Elevations in feet above mean sea level (ft MSL) based on landfill datum.
3. The water levels in wells MW-1, MW-3, and MW-28 were reported as "dry".

King County

Table 2 - Groundwater Velocity Calculations - 3rd Quarter 2010

Vashon Island Landfill - King County, Washington

Groundwater Zone Beneath Landfill	Horizontal Hydraulic Conductivity			Horizontal Hydraulic Gradient	Effective Porosity	Horizontal Groundwater Velocity	General Direction of Groundwater Flow
	Range	(cm/s)	(ft/d)	(ft/ft)		(ft/d)	
Southern Cc2 Perched Zone	Low	1.9E-06	0.01	0.009	30%	0.0002	West-Southwest
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Notes:

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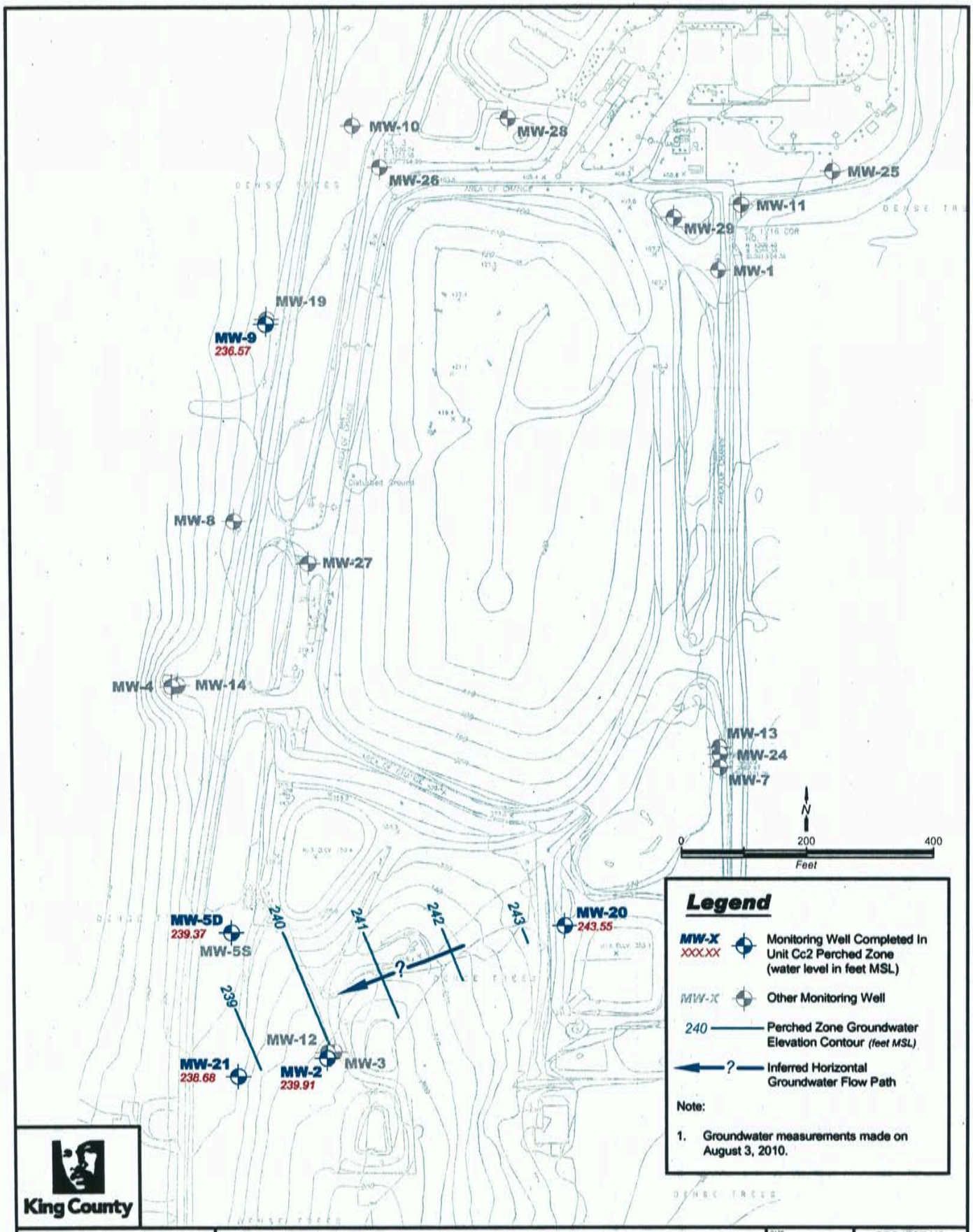
King County

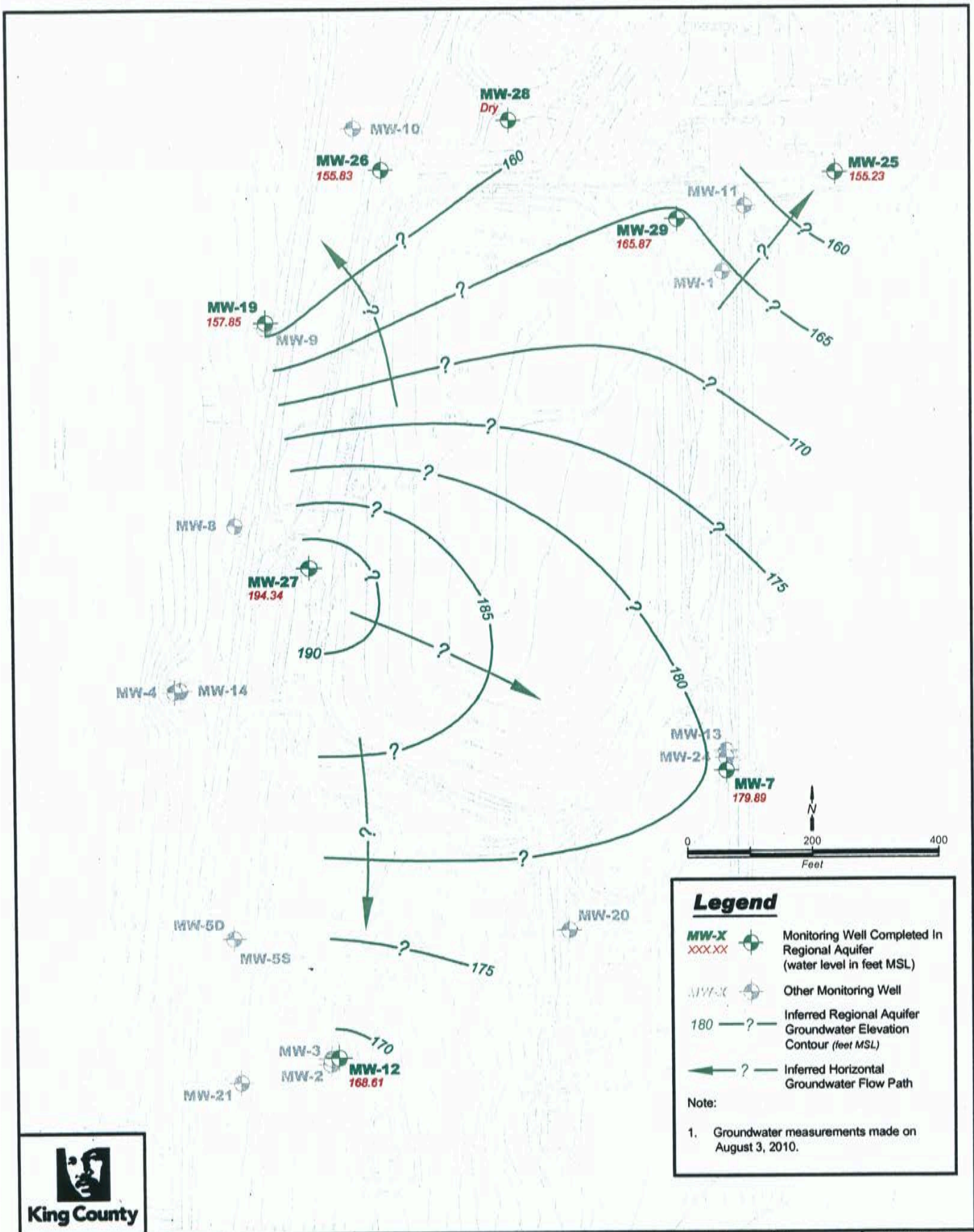


Aspect CONSULTING

Groundwater Potentiometric Surface Map
3rd Quarter 2010 - Unit Cc2 Perched Zone

Vashon Island Landfill
King County, Washington

DATE	Sept 2010
DESIGNED BY	PSB
DRAWN BY	PMB
REVISED BY	-
PROJECT NO.	070074
FIGURE NO.	1



King County

Aspect CONSULTING

Groundwater Potentiometric Surface Map
3rd Quarter 2010 - Regional Aquifer

Vashon Island Landfill

King County, Washington

DATE: Sept 2010	PROJECT NO. 070074
DESIGNED BY: PSB	
DRAWN BY: PMB	FIGURE NO. 2
REVISED BY:	

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Aspect CONSULTING

King County
Department of
Natural Resources and Parks

October 26, 2010

Mr. Sendy Jimenez
King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

Re: Contract Number: E00065E07 J
Potentiometric Groundwater Surface Mapping and Groundwater Velocity Calculation
4th Quarter Data Collected October 4, 2010
Vashon Island Landfill
King County, Washington
Project No. 070074-007-04

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during these monitoring events. MW-28 was completed in the regional aquifer but has historically been dry, and was not used to determine either potentiometric surface or groundwater velocity for this monitoring event.

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Direction of Groundwater Flow

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Based on the current limited understanding of the regional aquifer and groundwater level measurements made on October 4, 2010, groundwater in the regional aquifer generally flowed radially away from MW-27 (Figure 2). Flow from MW-27 westward cannot be confirmed because there are no wells completed in the regional aquifer to the west of MW-27.

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Horizontal groundwater velocity was calculated for the southern Cc2 perched zone and for the regional aquifer directly beneath the landfill. Table 2 presents a summary of the hydraulic parameters that were used to calculate a groundwater velocity from the 4th Quarter 2010 data. On October 4, 2010, the average horizontal groundwater velocity within the southern Cc2 perched zone was 0.002 feet per day (ft/d), and the average groundwater velocity in the regional aquifer was 1.7 ft/d. The uncertainty of groundwater flow direction and velocity in the regional aquifer reflects the uncertainty detailed in the *Vashon Island Landfill Hydrogeologic Report Update* (Berryman & Henigar, December 2004).

Thank you for the opportunity to provide hydrogeologic consulting services to the King County Solid Waste Division. Please call Peter at (206) 780-7728 or John at (206) 780-7719, if you have any questions.

Sincerely,

Aspect consulting, LLC

Peter S. Bannister, PE
Senior Engineer
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Table 1 - Measured Groundwater Elevations - 4th Quarter 2010

Vashon Island Landfill - King County, Washington

	Well Name	Northing (ft)	Easting (ft)	Reference Point Elevation (ft MSL)	Measured Depth to Groundwater (ft)	Groundwater Elevation (ft MSL)
Wells Completed in Cc2 Perched Zone	MW-2	124	2359	314.28	74.42	239.86
	MW-5D	322	2209	357.20	117.94	239.26
	MW-9	1284	2269	402.57	166.25	236.32
	MW-20	333	2739	367.21	123.90	243.31
	MW-21	95	2218	345.66	106.95	238.71
Wells Completed in the Regional Aquifer	MW-7	583	2988	373.25	193.09	180.16
	MW-12	134	2371	312.39	144.02	168.37
	MW-19	1292	2270	403.83	246.07	157.76
	MW-25	1525	3168	399.22	244.06	155.16
	MW-26	1531	2450	403.40	247.06	156.34
	MW-27	906	2333	383.06	188.93	194.13
	MW-28	1609	2654	395.59	dry	"dry"
	MW-29	1452	2917	410.57	244.76	165.81
Wells Completed in Other Perched Zones	MW-1	1369	2987	403.60	dry	"dry"
	MW-3	132	2360	314.87	dry	"dry"
	MW-4	712	2117	374.21	105.35	268.86
	MW-8	972	2217	383.42	176.81	206.61
	MW-10	1597	2407	407.51	145.46	262.05
	MW-13	614	2987	374.07	101.52	272.55
	MW-14	713	2127	375.68	151.83	223.85
	MW-24	603	2988	373.93	88.12	285.81

Notes:

1. Water level measurements made October 4, 2010 by KCSWD personnel.
2. Coordinates in feet based on local grid. Elevations in feet above mean sea level (ft MSL) based on landfill datum.
3. The water levels in wells MW-1, MW-3, and MW-28 were reported as "dry".

King County

Table 2 - Groundwater Velocity Calculations - 4th Quarter 2010

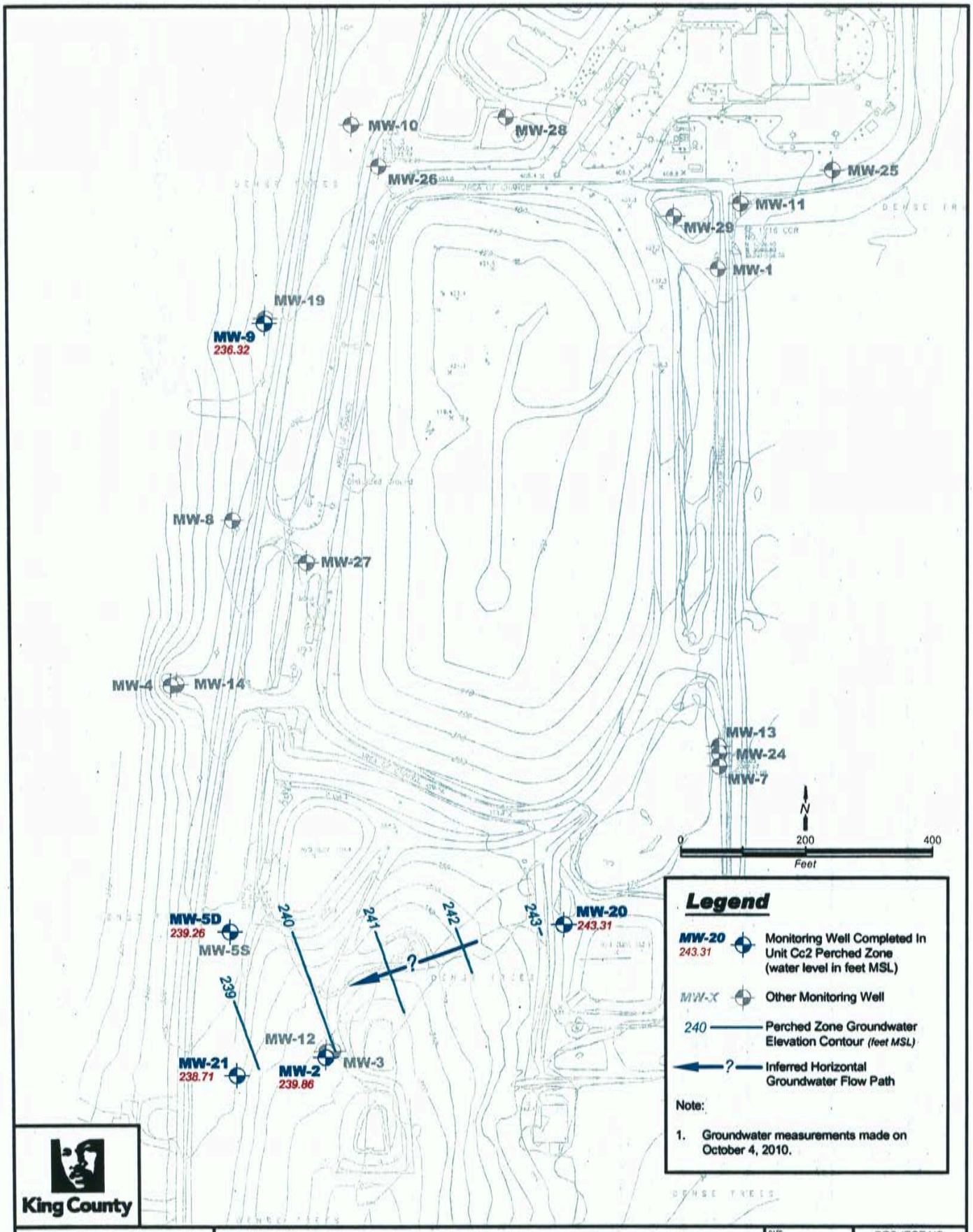
Vashon Island Landfill - King County, Washington

Groundwater Zone Beneath Landfill	Horizontal Hydraulic Conductivity			Horizontal Hydraulic Gradient (ft/ft)	Effective Porosity	Horizontal Groundwater Velocity (ft/d)	General Direction of Groundwater Flow
	Range	(cm/s)	(ft/d)				
Southern Cc2 Perched Zone	Low	1.9E-06	0.01	0.009	30%	0.0002	West-Southwest
	High	1.6E-04	0.45	0.009	20%	0.02	
	Average	1.7E-05	0.05	0.009	25%	0.002	
Regional Aquifer	Low	1.0E-03	3	0.05	30%	0.4	Radially away from MW-27
	High	1.0E-02	28	0.05	20%	6.6	
	Average	3.2E-03	9	0.05	25%	1.7	

Notes:

1. The southern Cc2 Perched Zone potentiometric surface is measured by wells MW-2, MW-5D, MW-9, MW-20, and MW-21 per *Vashon Island Landfill Hydrogeologic Report Update*, December 2004, Berryman & Henigar. Well MW-9 is assumed not to be in hydraulic communication with the other wells.
2. The Regional Aquifer potentiometric surface is measured by wells MW-7, MW-12, MW-19, MW-25, MW-26, MW-27, and MW-29 per *Vashon Island Landfill Hydrogeologic Report Update*.
3. Horizontal hydraulic conductivity values derived from *Vashon Island Landfill Monitoring Well Construction Report*, December 1996, King County Solid Waste Division. Average hydraulic conductivity values are the geometric mean of the high and low values.
4. Horizontal hydraulic gradients based on average of gradients calculated between monitoring well with highest groundwater elevation and other monitoring wells shown on Figure 1 and Figure 2.
5. Effective porosity values were adopted from *Potentiometric Surface Maps and Ground Water Velocity Estimates: 4th Quarter Ground Water Data Collected October 14, 2003 - Vashon Island Landfill, King County, Washington*, January 6, 2004, HWA Geosciences, Inc.

King County

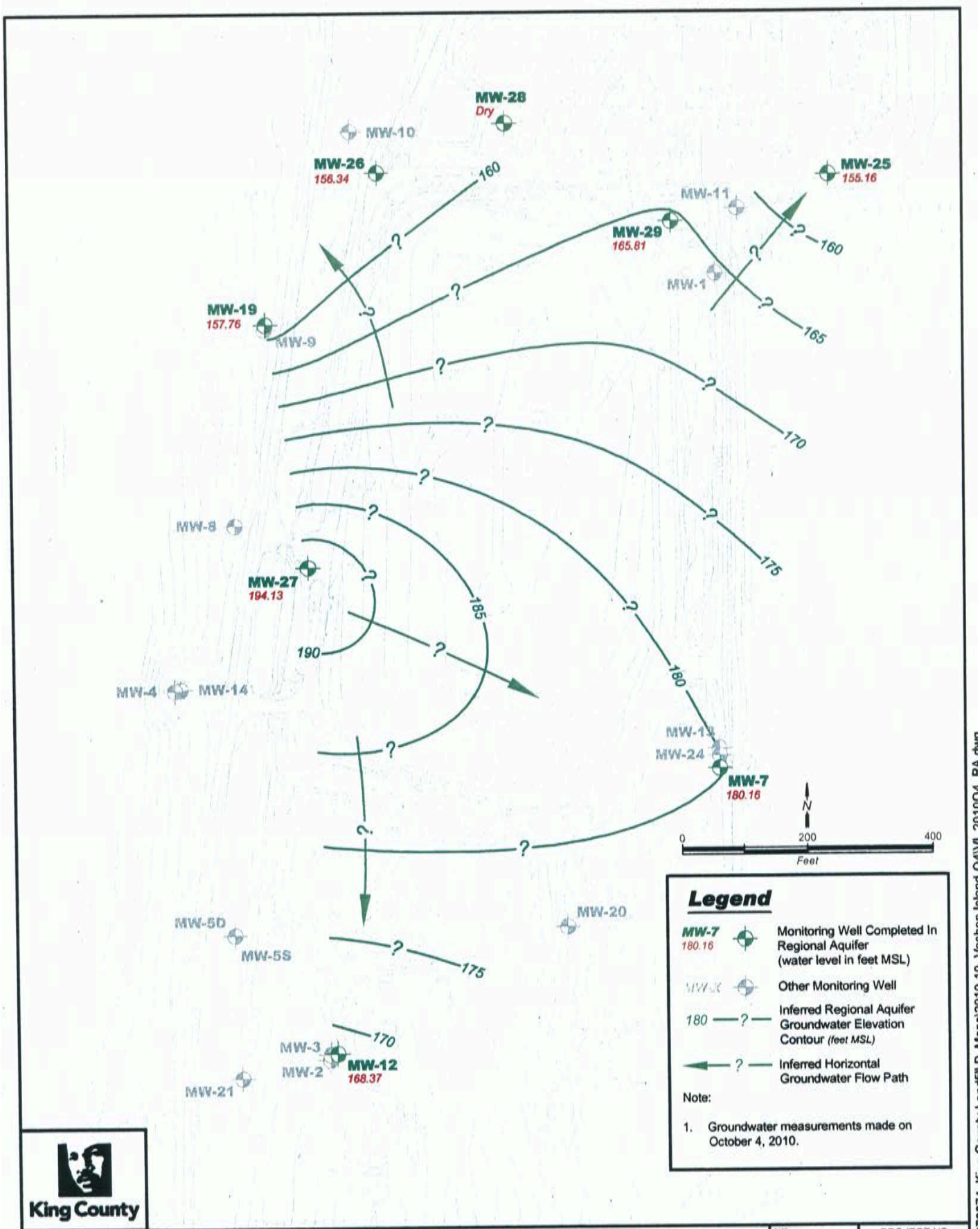


Aspect CONSULTING

Groundwater Potentiometric Surface Map
4th Quarter 2010 - Unit Cc2 Perched Zone

Vashon Island Landfill
King County, Washington

DATE	Oct 2010
DESIGNED BY	PSB
DRAWN BY	PMB
REVISED BY	
PROJECT NO.	070074
FIGURE NO.	1



King County

Aspect CONSULTING

Groundwater Potentiometric Surface Map
4th Quarter 2010 - Regional Aquifer

Vashon Island Landfill

King County, Washington

DATE Oct 2010	PROJECT NO. 070074
DESIGNED BY PSB	
DRAWN BY PMB	FIGURE NO. 2
REVISED BY	

Appendix H

Monitoring Well Keys

VASHON MONITORING WELLS RENAMING SCHEME

New Name	Old Names		
MW-1	MW-1	MW-1A	
MW-2	MW-2	MW-2B	
MW-3	MW-3	MW-3A	
MW-4	MW-4	MW-4A	
MW-5S	MW-5S	MW-5A	
MW-5D	MW-5D	MW-5B	
MW-6S	MW-6S	MW-6A	Decommissioned
MW-6D	MW-6D	MW-6B	Decommissioned
MW-7	MW-7C		
MW-8	MW-8B		
MW-9	MW-9B		
MW-10	MW-10A	MW-10B	
MW-11	MW-1C		Decommissioned
MW-12	MW-2C		
MW-13	MW-P3		
MW-14	MW-4B		
MW-19	MW-9C		
MW-24	MW-P4		
MW-20			
MW-21			
MW-25			
MW-26			
MW-27			
MW-28			
MW-29			

Appendix I

Groundwater Chemistry Data

Vashon Island Closed Landfill

Environmental Data

The Vashon Island Closed Landfill Groundwater Monitoring Data are available as Portable Document Format (PDF) files. To view PDF files you must have Adobe® Acrobat® Reader® software. With the Adobe® Acrobat® Reader® software, you can review and print PDF files across a broad range of hardware and operating systems.

Filename	Description
GWConv10.pdf	This file contains qualified data for Groundwater Conventional Parameters, such as pH, specific conductance, nitrate, chloride, etc…
GWFieldData10.pdf	This file contains qualified data for Groundwater Field Parameters such as pH, specific conductance, temperature, etc…
GWMetals10.pdf	This file contains qualified data for Groundwater Dissolved Metal Parameters such as arsenic, iron, manganese, radium 226/228 etc…
GWPestherbs10.pdf	This file contains qualified data for Groundwater Pesticide and Herbicide Parameters such as aroclor, endrin, 4,4'-DDT, toxaphene, etc…
GWSemivoas10.pdf	This file contains qualified data for the Groundwater Semivolatile parameters, included in Appendix III Assessment Monitoring
GWTotalMetals10.pdf	This file contains qualified data for Groundwater Total Metal Parameters
GWVoas10.pdf	This file contains qualified data for Groundwater Volatile Organic Compound Parameters, such as dichloroethane, methylene chloride, vinyl chloride, total xylenes, etc…
LSConv10.pdf	This file contains qualified data for Leachate Conventional Parameters, such as pH, specific conductance, nitrate, chloride, FOGs, etc…
LSField10.pdf	This file contains qualified data for Leachate Field Parameters such as pH, specific conductance, temperature, etc…
LSMetals10.pdf	This file contains qualified data for total and dissolved metals as well as radioactive parameters measured for in Leachate

LSPestherbs10.pdf	This file contains qualified data for Leachate Pesticide and Herbicide Parameters such as aroclor, endrin, 4,4'-DDT, toxaphene, etc…
LSVoas10.pdf	This file contains qualified data for Leachate Volatile Organic Compound Parameters, such as dichloroethane, methylene chloride, vinyl chloride, total xylenes, etc…
SWConv10.pdf	This file contains qualified data for Surface Water Conventional Parameters, such as pH, specific conductance, nitrate, chloride, etc…
SWField.pdf	This file contains qualified data for Surface Water Field Parameters such as pH, specific conductance, temperature, etc…
SWMetals10.pdf	This file contains qualified data for Surface Water Metal Parameters such as arsenic, iron, manganese, radium 226/228 etc…
SWPestherbs10.pdf	This file contains qualified data for Surface Water Pesticide and Herbicide Parameters such as aroclor, endrin, 4,4'-DDT, toxaphene, etc…
SWVoas10.pdf	This file contains qualified data for Surface Water Volatile Organic Compound Parameters, such as dichloroethane, methylene chloride, vinyl chloride, total xylenes, etc…

Appendix J

Appendix J

Ion Balance Calculations and Trilinear Diagrams

Table 2
Regional Aquifer & Channel Cc3

Site ID			MW-12			MW-19			MW-26			MW-27			MW-29		
Date			2/5/2010			2/4/2010			2/8/2010			2/5/2010			2/9/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.6			7.7			8.3			7.0			7.8		
Conductance			145			220			180			180			225		
TDSobs			102			154			134			122			149		
Calcium	40.1	2	9.9	0.49251	34.2	16.7	0.83333	32.4	15.8	0.78842	43.3	13.0	0.6487	34.3	18.9	0.94311	38.0
Magnesium	24.3	2	8.2	0.67558	46.9	16.2	1.33306	51.8	6.8	0.56202	30.8	11.2	0.92162	48.8	14.3	1.17671	47.4
Potassium	39.1	1	1.7	0.04246	2.9	2.6	0.06573	2.6	2.9	0.07468	4.1	1.4	0.03453	1.8	2.1	0.0532	2.1
Sodium	23.0	1	5.3	0.23054	16.0	7.3	0.31666	12.3	8.7	0.37799	20.7	6.6	0.28491	15.1	6.5	0.28317	11.4
Iron	55.8	2	0.005	0.00018	0.01	0.0	0.0015	0.1	0.0	0.0015	0.1	0.0	0.00018	0.0	0.7	0.02532	1.0
Manganese	54.9	2	0.005	0.00018	0.01	0.6	0.02031	0.8	0.1	0.002	0.1	0.0	0.00018	0.0	0.1	0.00326	0.1
Ammonia-N	14.0	1	0.005	0.00036	0.02	0.0	0.00263	0.1	0.2	0.01628	0.9	0.0	0.00036	0.0	0.0	0.00036	0.0
Total Cations (meq/L)				**1.4**			**2.6**			**1.8**			**1.9**			**2.5**	
Anions																	
Alkalinity, Total			58.9			109			74.4			76.2			101		
Carbonate	60.0	2	0.15396	0.00513	0.3	0.33449	0.01115	0.4	0.83664	0.02789	1.5	0.05019	0.00167	0.1	0.38086	0.0127	0.5
Bicarbonate	61.0	1	71.54	1.17269	76.7	132.30	2.16852	79.2	89.07	1.45989	76.1	92.86	1.5221	74.6	122.45	2.007	79.9
Chloride	35.5	1	3.1	0.08688	5.7	6.2	0.17544	6.4	5.3	0.14865	7.8	5.6	0.15852	7.8	4.3	0.11988	4.8
Nitrate-N	14.0	1	0.719	0.05133	3.36	0.0	0.00036	0.0	0.0	0.00178	0.1	1.9	0.1335	6.5	0.01	0.00036	0.0
Sulfate	96.1	2	10.2	0.21237	13.9	18.4	0.3831	14.0	13.4	0.279	14.6	10.8	0.22487	11.0	17.8	0.37061	14.8
Total Anions (meq/L)				**1.5**			**2.7**			**1.9**			**2.0**			**2.5**	
Total Ions (meq/L)				**3.0**			**5.3**			**3.7**			**3.9**			**5.0**	
Cation/Anion Ratio				**0.94**			**0.94**			**0.95**			**0.93**			**0.99**	
Percent Difference				**-2.9**			**-3.1**			**-2.5**			**-3.8**			**-0.5**	
TRILINEAR DIAGRAM DATA																	
sum (Ca, Mg, Na+K)				1.44			2.55			1.80			1.89			2.46	
Calcium					34.18			32.70			43.73			34.33			38.40
Magnesium					46.88			52.30			31.17			48.77			47.91
Sodium + Potassium					18.94			15.00			25.11			16.90			13.69
sum (SO_4, Cl, HCO_3+CO_3)				1.48			2.74			1.92			1.91			2.51	
Sulfate					14.378			13.991			14.566			11.791			14.764
Chloride					5.882			6.407			7.761			8.312			4.776
Bicarbonate + Carbonate					79.740			79.602			77.674			79.898			80.460

Table 2
Regional Aquifer & Channel Cc3

Site ID			MW-12			MW-19			MW-26			MW-27			MW-29		
Date			5/6/2010			5/3/2010			5/4/2010			4/29/2010			5/4/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.3			7.5			7.9			6.5			7.4		
Conductance			140			220			175			165			225		
TDSobs			103			159			131			131			150		
Calcium	40.1	2	9.0	0.4476	32.5	14.8	0.73852	31.3	11.2	0.55888	40.6	12.3	0.61377	32.6	13.6	0.67864	36.6
Magnesium	24.3	2	8.1	0.66488	48.2	15.1	1.24254	52.6	5.6	0.46163	33.5	11.5	0.94631	50.3	10.8	0.88871	48.0
Potassium	39.1	1	1.6	0.04041	2.9	2.3	0.05934	2.5	2.1	0.05371	3.9	1.3	0.03376	1.8	1.6	0.03964	2.1
Sodium	23.0	1	5.2	0.22488	16.3	6.8	0.29709	12.6	6.5	0.28273	20.5	6.6	0.28839	15.3	5.2	0.22575	12.2
Iron	55.8	2	0.005	0.00018	0.01	0.0	0.0015	0.1	0.0	0.00118	0.1	0.0	0.00018	0.0	0.5	0.01615	0.9
Manganese	54.9	2	0.001	1.8E-05	0.00	0.5	0.01787	0.8	0.0	0.00153	0.1	0.0	1.8E-05	0.0	0.1	0.00247	0.1
Ammonia-N	14.0	1	0.005	0.00036	0.03	0.0	0.00332	0.1	0.2	0.01699	1.2	0.0	0.00036	0.0	0.0	0.00036	0.0
Total Cations (meq/L)				**1.4**			**2.4**			**1.4**			**1.9**			**1.9**	
Anions																	
Alkalinity, Total			57.6			104			74.4			69.9			101		
Carbonate	60.0	2	0.06149	0.00205	0.1	0.19717	0.00657	0.2	0.35262	0.01175	0.6	0.01457	0.00049	0.0	0.15935	0.00531	0.2
Bicarbonate	61.0	1	70.15	1.14978	76.1	126.48	2.07312	78.8	90.05	1.47602	78.4	85.25	1.3973	71.5	122.90	2.01438	80.4
Chloride	35.5	1	3.2	0.08941	5.9	6.2	0.17432	6.6	4.1	0.11424	6.1	5.4	0.15344	7.9	4.1	0.11536	4.6
Nitrate-N	14.0	1	0.750	0.05354	3.54	0.0	0.00036	0.0	0.0	0.00157	0.1	2.6	0.18419	9.4	0.01	0.00036	0.0
Sulfate	96.1	2	10.4	0.21654	14.3	18.1	0.37686	14.3	13.4	0.279	14.8	10.5	0.21862	11.2	17.8	0.37061	14.8
Total Anions (meq/L)				**1.5**			**2.6**			**1.9**			**2.0**			**2.5**	
Total Ions (meq/L)				**2.9**			**5.0**			**3.3**			**3.8**			**4.4**	
Cation/Anion Ratio				**0.91**			**0.90**			**0.73**			**0.96**			**0.74**	
Percent Difference				**-4.6**			**-5.4**			**-15.5**			**-1.9**			**-15.0**	
TRILINEAR DIAGRAM DATA																	
sum (Ca, Mg, Na+K)				1.38			2.34			1.36			1.88			1.83	
Calcium					32.49			31.59			41.19			32.61			37.03
Magnesium					48.26			53.16			34.02			50.28			48.49
Sodium + Potassium					19.26			15.25			24.79			17.12			14.48
sum (SO_4, Cl, HCO_3+CO_3)				1.46			2.63			1.88			1.77			2.51	
Sulfate					14.854			14.324			14.832			12.352			14.791
Chloride					6.134			6.626			6.073			8.670			4.604
Bicarbonate + Carbonate					79.013			79.050			79.095			78.978			80.605

Table 2
Regional Aquifer & Channel Cc3

Site ID			MW-12			MW-19			MW-26			MW-27			MW-29		
Date			9/28/2010			8/9/2010			8/9/2010			8/10/2010			8/10/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.76			7.5			8.01			6.57			7.25		
Conductance			125			220			160			155			195		
TDSobs			90			159			135			132			154		
Calcium	40.1	2	9.22	0.46008	32.3	18.1	0.90319	33.9	17.1	0.85329	45.2	12.2	0.60878	33.1	18.6	0.92814	37.4
Magnesium	24.3	2	8.43	0.69368	48.7	16.1	1.32483	49.7	6.89	0.56696	30.0	11	0.90516	49.2	14.3	1.17671	47.5
Potassium	39.1	1	1.67	0.04271	3.0	2.56	0.06548	2.5	2.82	0.07213	3.8	1.34	0.03427	1.9	2.14	0.05473	2.2
Sodium	23.0	1	5.21	0.22662	15.9	7.27	0.31623	11.9	8.68	0.37756	20.0	6.72	0.2923	15.9	6.69	0.291	11.7
Iron	55.8	2	0.005	0.00018	0.01	0.101	0.00362	0.1	0.046	0.00165	0.1	0.0	0.00018	0.0	0.708	0.02535	1.0
Manganese	54.9	2	0.001	1.8E-05	0.00	1.35	0.04915	1.8	0.0642	0.00234	0.1	0.0	1.8E-05	0.0	0.0928	0.00338	0.1
Ammonia-N	14.0	1	0.005	0.00036	0.03	0.07	0.005	0.2	0.215	0.01535	0.8	0.0	0.00036	0.0	0.0	0.00036	0.0
Total Cations (meq/L)				**1.4**			**2.7**			**1.9**			**1.8**			**2.5**	
Anions																	
Alkalinity, Total			57.4			107			75.1			65.7			101		
Carbonate	60.0	2	0.19751	0.00658	0.4	0.20286	0.00676	0.3	0.4575	0.01525	0.8	0.01468	0.00049	0.0	0.10783	0.00359	0.1
Bicarbonate	61.0	1	69.63	1.14124	76.3	130.13	2.13292	80.2	90.69	1.48653	79.0	80.12	1.31331	70.6	123.00	2.0161	81.2
Chloride	35.5	1	2.82	0.07954	5.3	5.59	0.15767	5.9	3.59	0.10126	5.4	4.52	0.12749	6.9	3.73	0.10521	4.2
Nitrate-N	14.0	1	0.736	0.05255	3.51	0.019	0.00136	0.1	0.037	0.00264	0.1	3.38	0.24131	13.0	0.01	0.00036	0.0
Sulfate	96.1	2	10.4	0.21654	14.5	17.3	0.3602	13.5	13.2	0.27484	14.6	8.49	0.17677	9.5	17.2	0.35812	14.4
Total Anions (meq/L)				**1.5**			**2.7**			**1.9**			**1.9**			**2.5**	
Total Ions (meq/L)				**2.9**			**5.3**			**3.8**			**3.7**			**5.0**	
Cation/Anion Ratio				**0.95**			**1.00**			**1.00**			**0.99**			**1.00**	
Percent Difference				**-2.5**			**0.2**			**0.2**			**-0.5**			**-0.1**	
TRILINEAR DIAGRAM DATA																	
sum (Ca, Mg, Na+K)				1.42			2.61			1.87			1.84			2.45	
Calcium					32.33			34.61			45.63			33.08			37.87
Magnesium					48.74			50.77			30.32			49.18			48.02
Sodium + Potassium					18.93			14.63			24.05			17.74			14.11
sum (SO_4, Cl, HCO_3+CO_3)				1.44			2.66			1.88			1.62			2.48	
Sulfate					14.997			13.554			14.635			10.925			14.423
Chloride					5.509			5.933			5.392			7.879			4.237
Bicarbonate + Carbonate					79.495			80.513			79.972			81.196			81.340

Table 2
Regional Aquifer & Channel Cc3

Site ID			MW-12			MW-19			MW-26			MW-27			MW-29		
Date			11/9/2010			11/8/2010			11/9/2010			11/5/2010			11/9/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.6			7.71			8.19			6.84			7.6		
Conductance			145			215			160			165			205		
TDSobs			95			155			129			110			146		
Calcium	40.1	2	9.1	0.45459	32.7	15.9	0.79341	31.0	15.9	0.79341	44.1	11.7	0.58383	32.9	19	0.9481	39.1
Magnesium	24.3	2	8.11	0.66735	48.0	16.2	1.33306	52.1	6.55	0.53898	29.9	10.7	0.88048	49.6	13.6	1.11911	46.1
Potassium	39.1	1	1.74	0.0445	3.2	2.57	0.06573	2.6	3.07	0.07852	4.4	1.36	0.03478	2.0	2.19	0.05601	2.3
Sodium	23.0	1	5.16	0.22445	16.1	7.04	0.30622	12.0	8.48	0.36886	20.5	6.33	0.27534	15.5	6.3	0.27403	11.3
Iron	55.8	2	0.005	0.00018	0.01	0.191	0.00684	0.3	0.0602	0.00216	0.1	0.0	0.00018	0.0	0.736	0.02636	1.1
Manganese	54.9	2	0.001	1.8E-05	0.00	1.3	0.04696	1.8	0.0608	0.00221	0.1	0.0	1.8E-05	0.0	0.0946	0.00344	0.1
Ammonia-N	14.0	1	0.005	0.00036	0.03	0.0933	0.00666	0.3	0.224	0.01599	0.9	0.0	0.00036	0.0	0.0	0.00036	0.0
Total Cations (meq/L)				**1.4**			**2.6**			**1.8**			**1.8**			**2.4**	
Anions																	
Alkalinity, Total			55.7			105			72.2			64.9			99		
Carbonate	60.0	2	0.13283	0.00443	0.3	0.32221	0.01074	0.4	0.66226	0.02208	1.2	0.02699	0.0009	0.0	0.2361	0.00787	0.3
Bicarbonate	61.0	1	67.68	1.1094	75.8	127.44	2.08894	79.0	86.74	1.42171	77.6	79.12	1.2969	70.3	120.30	1.97183	80.2
Chloride	35.5	1	3.1	0.08744	6.0	6.31	0.17798	6.7	3.92	0.11057	6.0	4.87	0.13736	7.4	3.98	0.11226	4.6
Nitrate-N	14.0	1	0.747	0.05333	3.65	0.0	0.00278	0.1	0.0	0.00207	0.1	3.15	0.22489	12.2	0.01	0.00036	0.0
Sulfate	96.1	2	10	0.20821	14.2	17.4	0.36228	13.7	13.2	0.27484	15.0	8.84	0.18406	10.0	17.6	0.36645	14.9
Total Anions (meq/L)				**1.5**			**2.6**			**1.8**			**1.8**			**2.5**	
Total Ions (meq/L)				**2.9**			**5.2**			**3.6**			**3.6**			**4.9**	
Cation/Anion Ratio				**0.95**			**0.97**			**0.98**			**0.96**			**0.99**	
Percent Difference				**-2.5**			**-1.6**			**-0.9**			**-1.9**			**-0.6**	
TRILINEAR DIAGRAM DATA																	
sum (Ca, Mg, Na+K)				1.39			2.50			1.78			1.77			2.40	
Calcium					32.68			31.76			44.58			32.90			39.55
Magnesium					47.98			53.36			30.28			49.62			46.68
Sodium + Potassium					19.34			14.89			25.14			17.48			13.77
sum (SO_4, Cl, HCO_3+CO_3)				1.41			2.64			1.83			1.62			2.46	
Sulfate					14.772			13.723			15.025			11.367			14.906
Chloride					6.204			6.742			6.045			8.483			4.566
Bicarbonate + Carbonate					79.024			79.535			78.930			80.150			80.528

Table 6

Groundwater Within and BelowChannel Cc2

Site ID			MW-20			MW-21			MW-2			MW-5D			MW-14			MW-8		
Date			2/3/2010			2/3/2010			2/16/2010			2/11/2010			2/3/2010			2/2/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			8.2			6.9			7.0			6.8			7.8			6.8		
Conductance			175			480			440			450			190			160		
TDSobs			131			284			290			316			130			99		
Calcium	40.1	2	12.8	0.63872	33.1	34.5	1.72156	29.2	27.0	1.34731	31.7	39.0	1.94611	39.8	12.9	0.64371	35.2	12.4	0.61876	34.3
Magnesium	24.3	2	11.5	0.94631	49.0	43.2	3.55482	60.2	30.0	2.46863	58.2	26.3	2.16416	44.2	10.3	0.84756	46.4	10.6	0.87225	48.4
Potassium	39.1	1	2.1	0.05397	2.8	2.9	0.07468	1.3	2.1	0.05448	1.3	2.8	0.07187	1.5	2.5	0.06343	3.5	1.1	0.02839	1.6
Sodium	23.0	1	6.6	0.28708	14.9	11.8	0.51327	8.7	8.5	0.37103	8.7	13.4	0.58287	11.9	6.2	0.26969	14.8	6.5	0.28273	15.7
Iron	55.8	2	0.005	0.00018	0.01	0.718	0.02571	0.44	0.0	0.00018	0.00	2.5	0.08774	1.79	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.125	0.00455	0.24	0.308	0.01121	0.19	0.1	0.00312	0.07	1.1	0.04077	0.83	0.047	0.0017	0.09	0.005	0.00018	0.01
Ammonia-N	14.0	1	0.011	0.00079	0.04	0.005	0.00036	0.01	0.005	0.00036	0.01	0.025	0.00178	0.04	0.005	0.00036	0.02	0.005	0.00036	0.02
Total Cations (meq/L)				**1.9**			**5.9**			**4.2**			**4.9**			**1.8**			**1.8**	
Anions																				
Alkalinity, Total			75.3			276			257			267			76.1			64.6		
Carbonate	60.0	2	0.63077	0.02103	1.1	0.13795	0.0046	0.1	0.158	0.00527	0.1	0.09895	0.0033	0.1	0.3004	0.01001	0.5	0.02394	0.0008	0.0
Bicarbonate	61.0	1	90.58	1.48475	75.6	336.44	5.51457	92.3	313.22	5.13396	91.8	325.54	5.3359	92.8	92.23	1.51176	80.5	78.76	1.29101	69.6
Chloride	35.5	1	3.6	0.10182	5.2	4.5	0.12806	2.1	4.2	0.11818	2.1	5.7	0.16021	2.8	3.4	0.09618	5.1	4.8	0.13652	7.4
Nitrate-N	14.0	1	0.005	0.00036	0.018	0.193	0.01378	0.231	0.501	0.03577	0.640	0.005	0.00036	0.006	0.005	0.00036	0.02	3.330	0.23774	12.82
Sulfate	96.1	2	17.1	0.35604	18.1	15.1	0.31439	5.3	14.4	0.29982	5.4	11.9	0.24777	4.3	12.5	0.26026	13.9	9.1	0.18864	10.2
Total Anions (meq/L)				**2.0**			**6.0**			**5.6**			**5.7**			**1.9**			**1.9**	
Total Ions (meq/L)				**3.9**			**11.9**			**9.8**			**10.6**			**3.7**			**3.7**	
Cation/Anion Ratio				**0.98**			**0.99**			**0.76**			**0.85**			**0.97**			**0.97**	
Percent Difference				**-0.8**			**-0.6**			**-13.7**			**-8.0**			**-1.4**			**-1.4**	
TRILINEAR DIAGRAM DATA																				
sum (Ca, Mg, Na+K)				1.93			5.86			4.24			4.77			1.82			1.80	
Calcium					33.16			29.36			31.77			40.84			35.28			34.33
Magnesium					49.13			60.62			58.20			45.42			46.46			48.40
Sodium + Potassium					17.71			10.03			10.03			13.74			18.26			17.26
sum (SO_4, Cl, HCO_3+CO_3)				1.96			5.96			5.56			5.75			1.88			1.62	
Sulfate					18.131			5.274			5.395			4.311			13.857			11.666
Chloride					5.186			2.148			2.127			2.788			5.121			8.443
Bicarbonate + Carbonate					76.683			92.578			92.478			92.901			81.022			79.891

Table 6

Site ID			MW-9			MW-7		
Date			2/4/2010			2/8/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.4			8.0		
Conductance			140			165		
TDSobs			115			122		
Calcium	40.1	2	11.4	0.56886	34.4	13.2	0.65868	37.9
Magnesium	24.3	2	9.7	0.79737	48.2	8.8	0.72413	41.7
Potassium	39.1	1	1.9	0.04911	3.0	2.6	0.06522	3.8
Sodium	23.0	1	5.5	0.2388	14.4	6.2	0.26838	15.5
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.005	0.00018	0.01	0.129	0.0047	0.27
Ammonia-N	14.0	1	0.005	0.00036	0.02	0.207	0.01478	0.85
Total Cations (meq/L)				**1.7**			**1.7**	
Anions								
Alkalinity, Total			66.6			72.9		
Carbonate	60.0	2	0.10036	0.00335	0.2	0.39624	0.01321	0.7
Bicarbonate	61.0	1	81.05	1.32845	76.6	88.13	1.44457	81.5
Chloride	35.5	1	4.3	0.12129	7.0	3.3	0.09393	5.3
Nitrate-N	14.0	1	0.134	0.00957	0.55	0.016	0.00114	0.064
Sulfate	96.1	2	13.0	0.27067	15.6	10.6	0.2207	12.4
Total Anions (meq/L)				**1.7**			**1.8**	
Total Ions (meq/L)				**3.4**			**3.5**	
Cation/Anion Ratio				**0.95**			**0.98**	
Percent Difference				**-2.3**			**-1.1**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.65			1.72	
Calcium					34.39			38.38
Magnesium					48.20			42.19
Sodium + Potassium					17.41			19.44
sum (SO_4, Cl, HCO_3+CO_3)				1.72			1.77	
Sulfate					15.702			12.452
Chloride					7.036			5.299
Bicarbonate + Carbonate					77.261			82.249

Table 6
Groundwater Within and BelowChannel Cc2

Site ID			MW-20			MW-21			MW-2			MW-5D			MW-14			MW-8		
Date			5/4/2010			5/5/2010			4/30/2010			4/30/2010			5/3/2010			4/29/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.8			6.7			6.5			6.5			7.6			6.6		
Conductance			175			390			375			235			165			160		
TDSobs			133			278			286			282			124			133		
Calcium	40.1	2	9.1	0.45409	31.3	29.6	1.47705	28.9	30.4	1.51697	28.2	32.9	1.64172	30.8	11.7	0.58383	34.8	11.3	0.56387	33.2
Magnesium	24.3	2	8.2	0.67147	46.3	36.8	3.02818	59.3	40.3	3.31619	61.5	28.5	2.3452	43.9	9.4	0.76939	45.8	10.0	0.82288	48.5
Potassium	39.1	1	1.7	0.04322	3.0	2.6	0.06752	1.3	2.5	0.06369	1.2	2.8	0.07213	1.4	2.5	0.06292	3.7	1.1	0.02813	1.7
Sodium	23.0	1	6.4	0.27795	19.2	11.3	0.49152	9.6	11.2	0.48717	9.0	16.8	0.73076	13.7	6.0	0.26142	15.6	6.5	0.28099	16.6
Iron	55.8	2	0.005	0.00018	0.01	0.823	0.02947	0.58	0.0	0.00018	0.00	14.2	0.50853	9.53	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.074	0.00268	0.18	0.396	0.01442	0.28	0.1	0.004	0.07	1.0	0.03469	0.65	0.046	0.00166	0.10	0.001	1.8E-05	0.00
Ammonia-N	14.0	1	0.021	0.0015	0.10	0.005	0.00036	0.01	0.005	0.00036	0.01	0.053	0.00381	0.07	0.005	0.00036	0.02	0.005	0.00036	0.02
Total Cations (meq/L)				**1.5**			**5.1**			**5.4**			**5.3**			**1.7**			**1.7**	
Anions																				
Alkalinity, Total			73			260			251			231			72.2			58.9		
Carbonate	60.0	2	0.28165	0.00939	0.5	0.08202	0.00273	0.0	0.05232	0.00174	0.0	0.03914	0.0013	0.0	0.17618	0.00587	0.3	0.0141	0.00047	0.0
Bicarbonate	61.0	1	88.49	1.45039	75.3	317.03	5.19648	91.7	306.11	5.0175	91.4	281.74	4.618	93.0	87.73	1.43791	79.6	71.83	1.17735	66.5
Chloride	35.5	1	3.6	0.10211	5.3	5.0	0.13962	2.5	4.1	0.11565	2.1	4.4	0.12495	2.5	3.3	0.09252	5.1	4.7	0.13257	7.5
Nitrate-N	14.0	1	0.005	0.00036	0.019	0.174	0.01242	0.219	0.461	0.03291	0.599	0.005	0.00036	0.007	0.005	0.00036	0.02	3.830	0.27343	15.45
Sulfate	96.1	2	17.5	0.36436	18.9	15.3	0.31856	5.6	15.6	0.32481	5.9	10.7	0.22278	4.5	13.0	0.27067	15.0	9.0	0.18635	10.5
Total Anions (meq/L)				**1.9**			**5.7**			**5.5**			**5.0**			**1.8**			**1.8**	
Total Ions (meq/L)				**3.4**			**10.8**			**10.9**			**10.3**			**3.5**			**3.5**	
Cation/Anion Ratio				**0.75**			**0.90**			**0.98**			**1.07**			**0.93**			**0.96**	
Percent Difference				**-14.1**			**-5.2**			**-1.0**			**3.6**			**-3.7**			**-2.1**	
TRILINEAR DIAGRAM DATA																				
sum (Ca, Mg, Na+K)				1.45			5.06			5.38			4.79			1.68			1.70	
Calcium					31.39			29.17			28.18			34.28			34.80			33.25
Magnesium					46.41			59.80			61.59			48.96			45.86			48.52
Sodium + Potassium					22.20			11.04			10.23			16.76			19.33			18.23
sum (SO_4, Cl, HCO_3+CO_3)				1.93			5.66			5.46			4.97			1.81			1.50	
Sulfate					18.916			5.631			5.949			4.485			14.979			12.450
Chloride					5.301			2.468			2.118			2.516			5.120			8.857
Bicarbonate + Carbonate					75.783			91.901			91.933			92.999			79.901			78.693

Table 6

Site ID			MW-9			MW-7		
Date			5/3/2010			4/30/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.1			7.9		
Conductance			150			155		
TDSobs			119			125		
Calcium	40.1	2	10.4	0.51896	33.2	12.3	0.61377	36.5
Magnesium	24.3	2	9.3	0.76445	48.9	8.7	0.71919	42.8
Potassium	39.1	1	1.9	0.04757	3.0	2.5	0.06292	3.7
Sodium	23.0	1	5.4	0.23271	14.9	6.1	0.26664	15.9
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.001	1.8E-05	0.00	0.122	0.00444	0.26
Ammonia-N	14.0	1	0.005	0.00036	0.02	0.205	0.01464	0.87
Total Cations (meq/L)				**1.6**			**1.7**	
Anions								
Alkalinity, Total			65.3			72.3		
Carbonate	60.0	2	0.0517	0.00172	0.1	0.31997	0.01067	0.6
Bicarbonate	61.0	1	79.56	1.30408	75.5	87.56	1.43512	81.0
Chloride	35.5	1	4.4	0.12439	7.2	3.6	0.10013	5.7
Nitrate-N	14.0	1	0.186	0.01328	0.77	0.016	0.00114	0.064
Sulfate	96.1	2	13.6	0.28316	16.4	10.8	0.22487	12.7
Total Anions (meq/L)				**1.7**			**1.8**	
Total Ions (meq/L)				**3.3**			**3.5**	
Cation/Anion Ratio				**0.91**			**0.95**	
Percent Difference				**-4.9**			**-2.6**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.56			1.66	
Calcium					33.19			36.92
Magnesium					48.89			43.26
Sodium + Potassium					17.92			19.82
sum (SO_4, Cl, HCO_3+CO_3)				1.71			1.77	
Sulfate					16.527			12.699
Chloride					7.260			5.655
Bicarbonate + Carbonate					76.213			81.647

Table 6

Groundwater Within and BelowChannel Cc2

Site ID			MW-20			MW-21			MW-2			MW-5D			MW-14			MW-8		
Date			8/4/2010			8/6/2010			8/3/2010			8/6/2010			8/3/2010			8/9/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.99			6.6			6.67			6.53			7.48			6.52		
Conductance			160			350			360			320			150			145		
TDSobs			127			277			275			236			125			125		
Calcium	40.1	2	15	0.7485	35.0	36.9	1.84132	32.3	35.8	1.78643	31.6	32.5	1.62176	34.3	14.2	0.70858	37.5	11.9	0.59381	36.3
Magnesium	24.3	2	12.2	1.00391	46.9	38.8	3.19276	56.0	40	3.2915	58.2	22.5	1.85147	39.1	10.1	0.8311	44.0	9.07	0.74635	45.7
Potassium	39.1	1	1.97	0.05039	2.4	2.91	0.07443	1.3	2.73	0.06982	1.2	2.68	0.06855	1.4	2.53	0.06471	3.4	1.13	0.0289	1.8
Sodium	23.0	1	7.63	0.33189	15.5	12.3	0.53502	9.4	11.5	0.50022	8.8	15.2	0.66116	14.0	6.45	0.28056	14.9	6.08	0.26447	16.2
Iron	55.8	2	0.005	0.00018	0.01	1.03	0.03689	0.65	0.0	0.00018	0.00	13.8	0.49421	10.45	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.128	0.00466	0.22	0.523	0.01904	0.33	0.113	0.00411	0.07	0.848	0.03087	0.65	0.0556	0.00202	0.11	0.001	1.8E-05	0.00
Ammonia-N	14.0	1	0.012	0.00086	0.04	0.005	0.00036	0.01	0.005	0.00036	0.01	0.0467	0.00333	0.07	0.005	0.00036	0.02	0.005	0.00036	0.02
Total Cations (meq/L)				**2.1**			**5.7**			**5.7**			**4.7**			**1.9**			**1.6**	
Anions																				
Alkalinity, Total			71.6			247			245			199			73.8			55		
Carbonate	60.0	2	0.41674	0.01389	0.7	0.05912	0.00197	0.0	0.06889	0.0023	0.0	0.04054	0.00135	0.0	0.13364	0.00445	0.2	0.01095	0.00036	0.0
Bicarbonate	61.0	1	86.50	1.41789	74.7	301.22	4.93728	92.1	298.76	4.89697	91.9	242.70	3.97805	93.3	89.76	1.47132	80.9	67.08	1.09947	64.4
Chloride	35.5	1	4.09	0.11536	6.1	3.89	0.10972	2.0	3.13	0.08829	1.7	3.04	0.08575	2.0	2.99	0.08434	4.6	4.69	0.13229	7.7
Nitrate-N	14.0	1	0.005	0.00036	0.019	0.264	0.01885	0.351	0.339	0.0242	0.454	0.018	0.00129	0.030	0.005	0.00036	0.02	4.16	0.29699	17.40
Sulfate	96.1	2	16.9	0.35187	18.5	14.2	0.29566	5.5	15.3	0.31856	6.0	9.53	0.19842	4.7	12.4	0.25818	14.2	8.55	0.17802	10.4
Total Anions (meq/L)				**1.9**			**5.4**			**5.3**			**4.3**			**1.8**			**1.7**	
Total Ions (meq/L)				**4.0**			**11.1**			**11.0**			**9.0**			**3.7**			**3.3**	
Cation/Anion Ratio				**1.13**			**1.06**			**1.06**			**1.11**			**1.04**			**0.96**	
Percent Difference				**6.0**			**3.0**			**2.9**			**5.2**			**1.9**			**-2.2**	
TRILINEAR DIAGRAM DATA																				
sum (Ca, Mg, Na+K)				2.13			5.64			5.65			4.20			1.88			1.63	
Calcium					35.06			32.63			31.63			38.59			37.59			36.35
Magnesium					47.03			56.57			58.28			44.05			44.09			45.69
Sodium + Potassium					17.91			10.80			10.09			17.36			18.32			17.96
sum (SO_4, Cl, HCO_3+CO_3)				1.90			5.34			5.31			4.26			1.82			1.41	
Sulfate					18.529			5.532			6.004			4.654			14.199			12.624
Chloride					6.075			2.053			1.664			2.011			4.638			9.381
Bicarbonate + Carbonate					75.396			92.415			92.333			93.335			81.163			77.995

Table 6

Site ID			MW-9			MW-7		
Date			8/9/2010			8/4/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.06			7.87		
Conductance			150			150		
TDSobs			120			119		
Calcium	40.1	2	12.7	0.63373	36.1	14.2	0.70858	39.5
Magnesium	24.3	2	10.1	0.8311	47.4	8.83	0.7266	40.5
Potassium	39.1	1	1.92	0.04911	2.8	2.58	0.06599	3.7
Sodium	23.0	1	5.52	0.24011	13.7	6.29	0.2736	15.3
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.001	1.8E-05	0.00	0.14	0.0051	0.28
Ammonia-N	14.0	1	0.005	0.00036	0.02	0.189	0.01349	0.75
Total Cations (meq/L)				**1.8**			**1.8**	
Anions								
Alkalinity, Total			69.7			72.6		
Carbonate	60.0	2	0.04807	0.0016	0.1	0.32129	0.01071	0.6
Bicarbonate	61.0	1	84.94	1.39219	76.1	87.92	1.44107	81.9
Chloride	35.5	1	4.4	0.12411	6.8	3.08	0.08688	4.9
Nitrate-N	14.0	1	0.199	0.01421	0.78	0.017	0.00121	0.069
Sulfate	96.1	2	14.3	0.29774	16.3	10.6	0.2207	12.5
Total Anions (meq/L)				**1.8**			**1.8**	
Total Ions (meq/L)				**3.6**			**3.6**	
Cation/Anion Ratio				**0.96**			**1.02**	
Percent Difference				**-2.1**			**0.9**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.75			1.77	
Calcium					36.13			39.93
Magnesium					47.38			40.94
Sodium + Potassium					16.49			19.13
sum (SO_4, Cl, HCO_3+CO_3)				1.82			1.76	
Sulfate					16.399			12.544
Chloride					6.836			4.938
Bicarbonate + Carbonate					76.766			82.518

Table 6
Groundwater Within and BelowChannel Cc2

Site ID			MW-20			MW-21			MW-2			MW-5D			MW-14			MW-8		
Date			11/4/2010			11/2/2010			11/5/2010			11/2/2010			1/0/1900			11/9/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			8.02			7.23			6.81			7.07			0.0			6.92		
Conductance			160			380			380			350			0			165		
TDSobs			112			237			256			229			0			111		
Calcium	40.1	2	11.1	0.55389	31.6	28.8	1.43713	32.0	28.9	1.44212	30.0	29.7	1.48204	32.9	0.0	0	#DIV/0!	10.7	0.53393	33.6
Magnesium	24.3	2	9.95	0.81876	46.8	30.6	2.518	56.0	34.7	2.85538	59.4	21.7	1.78564	39.6	0.0	0	#DIV/0!	9.28	0.76363	48.0
Potassium	39.1	1	2.2	0.05627	3.2	2.81	0.07187	1.6	2.49	0.06369	1.3	2.87	0.0734	1.6	0.0	0	#DIV/0!	1.11	0.02839	1.8
Sodium	23.0	1	7.3	0.31753	18.1	10	0.43498	9.7	10.2	0.44368	9.2	14.4	0.62637	13.9	0.0	0	#DIV/0!	6.05	0.26316	16.6
Iron	55.8	2	0.015	0.00054	0.03	0.654	0.02342	0.52	0.0	0.00018	0.00	14.1	0.50495	11.21	0.000	0	#DIV/0!	0.005	0.00018	0.01
Manganese	54.9	2	0.068	0.00248	0.14	0.292	0.01063	0.24	0.1	0.00325	0.07	0.78	0.0284	0.63	0.000	0	#DIV/0!	0.001	1.8E-05	0.00
Ammonia-N	14.0	1	0.018	0.00129	0.07	0.011	0.00079	0.02	0.005	0.00036	0.01	0.0488	0.00348	0.08	0.000	0	#DIV/0!	0.005	0.00036	0.02
Total Cations (meq/L)				**1.8**			**4.5**			**4.8**			**4.5**			**0.0**			**1.6**	
Anions																				
Alkalinity, Total			70.7			208			238			209			0			53.5		
Carbonate	60.0	2	0.44062	0.01469	0.8	0.21208	0.00707	0.2	0.09236	0.00308	0.1	0.14751	0.00492	0.1	0	0	#DIV/0!	0.02674	0.00089	0.1
Bicarbonate	61.0	1	85.36	1.3991	74.1	253.33	4.1523	89.8	290.17	4.7562	91.3	254.68	4.17445	93.0	0.00	0	#DIV/0!	65.22	1.06895	66.6
Chloride	35.5	1	3.55	0.10013	5.3	4.07	0.1148	2.5	3.38	0.09534	1.8	3.79	0.1069	2.4	0.0	0	#DIV/0!	4.9	0.13821	8.6
Nitrate-N	14.0	1	0.017	0.00121	0.064	0.12	0.00857	0.185	0.356	0.02542	0.488	0.005	0.00036	0.008	0.000	0	#DIV/0!	3.04	0.21703	13.53
Sulfate	96.1	2	17.9	0.37269	19.7	16.3	0.33938	7.3	15.7	0.32689	6.3	9.65	0.20092	4.5	0.0	0	#DIV/0!	8.6	0.17906	11.2
Total Anions (meq/L)				**1.9**			**4.6**			**5.2**			**4.5**			**0.0**			**1.6**	
Total Ions (meq/L)				**3.6**			**9.1**			**10.0**			**9.0**			**0.0**			**3.2**	
Cation/Anion Ratio				**0.93**			**0.97**			**0.92**			**1.00**			**#DIV/0!**			**0.99**	
Percent Difference				**-3.8**			**-1.4**			**-4.0**			**0.2**			**#DIV/0!**			**-0.5**	
TRILINEAR DIAGRAM DATA																				
sum (Ca, Mg, Na+K)				1.75			4.46			4.80			3.97			0.00			1.59	
Calcium					31.72			32.21			30.01			37.35			#DIV/0!			33.60
Magnesium					46.88			56.43			59.43			45.01			#DIV/0!			48.05
Sodium + Potassium					21.40			11.36			10.56			17.64			#DIV/0!			18.35
sum (SO_4, Cl, HCO_3+CO_3)				1.89			4.61			5.18			4.49			0.00			1.39	
Sulfate					19.755			7.356			6.309			4.478			#DIV/0!			12.909
Chloride					5.308			2.488			1.840			2.382			#DIV/0!			9.964
Bicarbonate + Carbonate					74.938			90.156			91.851			93.140			#DIV/0!			77.127

Table 6

Site ID			MW-9			MW-7		
Date			11/8/2010			11/4/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.29			7.89		
Conductance			155			150		
TDSobs			125			104		
Calcium	40.1	2	11.7	0.58383	33.6	12.4	0.61876	37.6
Magnesium	24.3	2	10.4	0.85579	49.3	8.34	0.68628	41.7
Potassium	39.1	1	2.1	0.05371	3.1	2.5	0.06394	3.9
Sodium	23.0	1	5.56	0.24185	13.9	5.84	0.25403	15.4
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.001	1.8E-05	0.00	0.133	0.00484	0.29
Ammonia-N	14.0	1	0.005	0.00036	0.02	0.241	0.01721	1.05
Total Cations (meq/L)				**1.7**			**1.6**	
Anions								
Alkalinity, Total			66			74.3		
Carbonate	60.0	2	0.07725	0.00257	0.1	0.34419	0.01147	0.6
Bicarbonate	61.0	1	80.36	1.31723	74.8	89.95	1.4743	81.7
Chloride	35.5	1	4.53	0.12777	7.3	3.31	0.09336	5.2
Nitrate-N	14.0	1	0.176	0.01257	0.71	0.005	0.00036	0.020
Sulfate	96.1	2	14.4	0.29982	17.0	10.8	0.22487	12.5
Total Anions (meq/L)				**1.8**			**1.8**	
Total Ions (meq/L)				**3.5**			**3.4**	
Cation/Anion Ratio				**0.99**			**0.91**	
Percent Difference				**-0.7**			**-4.6**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.74			1.62	
Calcium					33.65			38.12
Magnesium					49.32			42.28
Sodium + Potassium					17.03			19.59
sum (SO_4, Cl, HCO_3+CO_3)				1.75			1.80	
Sulfate					17.158			12.465
Chloride					7.312			5.175
Bicarbonate + Carbonate					75.530			82.360

Table 10

Groundwater Within or Adjacent to Channel Cc1

Site ID			**MW-10**			**MW-13**		
Date			2/2/2010			2/9/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.4			7.4		
Conductance			130			180		
TDSobs			99			129		
Calcium	40.1	2	9.0	0.4476	30.3	9.6	0.47705	29.3
Magnesium	24.3	2	9.5	0.77926	52.7	10.6	0.87225	53.6
Potassium	39.1	1	1.4	0.03478	2.4	1.7	0.0445	2.7
Sodium	23.0	1	5.0	0.21618	14.6	5.4	0.23271	14.3
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Ammonia-N	14.0	1	0.005	0.00036	0.02	0.005	0.00036	0.02
Total Cations (meq/L)				**1.5**			**1.6**	
Anions								
Alkalinity, Total			59			70.9		
Carbonate	60.0	2	0.0931	0.0031	0.2	0.10441	0.00348	0.2
Bicarbonate	61.0	1	71.79	1.17672	78.5	86.29	1.41431	74.5
Chloride	35.5	1	3.3	0.09336	6.2	3.0	0.08547	4.5
Nitrate-N	14.0	1	0.41	0.02906	1.94	0.081	0.00579	0.305
Sulfate	96.1	2	9.5	0.19759	13.2	18.7	0.38935	20.5
Total Anions (meq/L)				**1.5**			**1.9**	
Total Ions (meq/L)				**3.0**			**3.5**	
Cation/Anion Ratio				**0.99**			**0.86**	
Percent Difference				**-0.7**			**-7.7**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.48			1.63	
Calcium					30.29			29.33
Magnesium					52.73			53.63
Sodium + Potassium					16.98			17.04
sum (SO_4, Cl, HCO_3+CO_3)				1.47			1.89	
Sulfate					13.434			20.572
Chloride					6.348			4.516
Bicarbonate + Carbonate					80.218			74.912

Table 10

Groundwater Within or Adjacent to Channel Cc1

Site ID			**MW-10**			**MW-13**		
Date			4/29/2010			5/6/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.2			7.0		
Conductance			130			170		
TDSobs			111			122		
Calcium	40.1	2	8.5	0.42315	30.3	7.5	0.37475	25.8
Magnesium	24.3	2	8.9	0.72825	52.2	9.8	0.80889	55.8
Potassium	39.1	1	1.4	0.03478	2.5	1.4	0.0353	2.4
Sodium	23.0	1	4.8	0.20922	15.0	5.3	0.23054	15.9
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.001	1.8E-05	0.00	0.001	1.8E-05	0.00
Ammonia-N	14.0	1	0.005	0.00036	0.03	0.005	0.00036	0.02
Total Cations (meq/L)				**1.4**			**1.5**	
Anions								
Alkalinity, Total			57			71		
Carbonate	60.0	2	0.0568	0.00189	0.1	0.03981	0.00133	0.1
Bicarbonate	61.0	1	69.42	1.13794	77.7	86.54	1.41846	74.7
Chloride	35.5	1	3.4	0.0959	6.5	3.1	0.08829	4.7
Nitrate-N	14.0	1	0.38	0.0272	1.86	0.072	0.00511	0.269
Sulfate	96.1	2	9.7	0.20134	13.8	18.5	0.38519	20.3
Total Anions (meq/L)				**1.5**			**1.9**	
Total Ions (meq/L)				**2.9**			**3.3**	
Cation/Anion Ratio				**0.95**			**0.76**	
Percent Difference				**-2.4**			**-13.4**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.40			1.45	
Calcium					30.32			25.85
Magnesium					52.19			55.81
Sodium + Potassium					17.49			18.34
sum (SO4, Cl, HCO3+CO3)				1.44			1.89	
Sulfate					14.010			20.345
Chloride					6.673			4.663
Bicarbonate + Carbonate					79.316			74.992

Table 10

Groundwater Within or Adjacent to Channel Cc1

Site ID			**MW-10**			**MW-13**		
Date			8/9/2010			8/5/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.06			6.96		
Conductance			120			155		
TDSobs			101			134		
Calcium	40.1	2	9.22	0.46008	32.9	11.2	0.55888	28.8
Magnesium	24.3	2	8.45	0.69533	49.8	12.7	1.04505	53.9
Potassium	39.1	1	1.44	0.03683	2.6	1.77	0.04527	2.3
Sodium	23.0	1	4.68	0.20357	14.6	6.67	0.29013	15.0
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.00148	5.4E-05	0.00	0.001	1.8E-05	0.00
Ammonia-N	14.0	1	0.012	0.00086	0.06	0.005	0.00036	0.02
Total Cations (meq/L)				**1.4**			**1.9**	
Anions								
Alkalinity, Total			57.4			71.5		
Carbonate	60.0	2	0.0396	0.00132	0.1	0.03918	0.00131	0.1
Bicarbonate	61.0	1	69.95	1.14651	78.2	87.15	1.42848	76.0
Chloride	35.5	1	3.18	0.0897	6.1	2.71	0.07644	4.1
Nitrate-N	14.0	1	0.369	0.02634	1.80	0.076	0.00543	0.289
Sulfate	96.1	2	9.67	0.20134	13.7	17.7	0.36853	19.6
Total Anions (meq/L)				**1.5**			**1.9**	
Total Ions (meq/L)				**2.9**			**3.8**	
Cation/Anion Ratio				**0.95**			**1.03**	
Percent Difference				**-2.4**			**1.6**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.40			1.94	
Calcium					32.96			28.82
Magnesium					49.82			53.89
Sodium + Potassium					17.22			17.29
sum (SO4, Cl, HCO3+CO3)				1.44			1.87	
Sulfate					13.993			19.657
Chloride					6.234			4.077
Bicarbonate + Carbonate					79.773			76.265

Table 10

Groundwater Within or Adjacent to Channel Cc1

Site ID			**MW-10**			**MW-13**		
Date			11/9/2010			11/10/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.34			7.19		
Conductance			120			160		
TDSobs			94			119		
Calcium	40.1	2	9.24	0.46108	32.4	10.4	0.51896	28.3
Magnesium	24.3	2	8.69	0.71508	50.3	12.1	0.99568	54.2
Potassium	39.1	1	1.48	0.03785	2.7	1.89	0.04834	2.6
Sodium	23.0	1	4.75	0.20661	14.5	6.26	0.2723	14.8
Iron	55.8	2	0.005	0.00018	0.01	0.005	0.00018	0.01
Manganese	54.9	2	0.001	1.8E-05	0.00	0.001	1.8E-05	0.00
Ammonia-N	14.0	1	0.020	0.00143	0.10	0.005	0.00036	0.02
Total Cations (meq/L)				**1.4**			**1.8**	
Anions								
Alkalinity, Total			53.9			74.5		
Carbonate	60.0	2	0.0708	0.00236	0.2	0.06929	0.00231	0.1
Bicarbonate	61.0	1	65.61	1.07548	76.9	90.75	1.48747	75.7
Chloride	35.5	1	3.25	0.09167	6.6	3.14	0.08857	4.5
Nitrate-N	14.0	1	0.385	0.02749	1.97	0.101	0.00721	0.367
Sulfate	96.1	2	9.64	0.20071	14.4	18.2	0.37894	19.3
Total Anions (meq/L)				**1.4**			**2.0**	
Total Ions (meq/L)				**2.8**			**3.8**	
Cation/Anion Ratio				**1.02**			**0.93**	
Percent Difference				**0.9**			**-3.4**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.42			1.84	
Calcium					32.46			28.28
Magnesium					50.34			54.25
Sodium + Potassium					17.21			17.47
sum (SO4, Cl, HCO3+CO3)				1.37			1.96	
Sulfate					14.648			19.360
Chloride					6.690			4.525
Bicarbonate + Carbonate					78.662			76.114

Table 14

Private Wells

Site ID			DW-85			DW-PA		
Date			1/29/2010			1/29/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.6			7.3		
Conductance			166			179		
TDSobs			100			119		
Calcium	40.1	2	14.0	0.6986	43.6	13.2	0.65868	33.5
Magnesium	24.3	2	6.8	0.56202	35.1	12.0	0.98745	50.2
Potassium	39.1	1	2.5	0.06496	4.1	1.6	0.04092	2.1
Sodium	23.0	1	5.9	0.25446	15.9	6.4	0.27795	14.1
Iron	55.8	2	0.1	0.00222	0.1	0.0	0.00018	0.0
Manganese	54.9	2	0.0	0.00172	0.1	0.0	4.7E-05	0.0
Ammonia-N	14.0	1	0.3	0.01835	1.1	0.0	0.00036	0.0
Total Cations (meq/L)				**1.6**			**2.0**	
Anions								
Alkalinity, Total			73.7			75		
Carbonate	60.0	2	0.16407	0.00547	0.3	0.09623	0.00321	0.2
Bicarbonate	61.0	1	89.58	1.46831	91.7	91.30	1.49657	74.5
Chloride	35.5	1	2.8	0.07813	4.9	5.6	0.15683	7.8
Nitrate-N	14.0	1	0.0	0.00036	0.0	0.9	0.0609	3.0
Sulfate	96.1	2	2.3	0.04872	3.0	14.0	0.29149	14.5
Total Anions (meq/L)				**1.6**			**2.0**	
Total Ions (meq/L)				**3.2**			**4.0**	
Cation/Anion Ratio				**1.00**			**0.98**	
Percent Difference				**0.0**			**-1.1**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.58			1.97	
Calcium					44.21			33.52
Magnesium					35.57			50.25
Sodium + Potassium					20.22			16.23
sum (SO_4, Cl, HCO_3+CO_3)				1.60			1.95	
Sulfate					3.044			14.963
Chloride					4.881			8.050
Bicarbonate + Carbonate					92.075			76.987

Table 14

Private Wells

Site ID			DW-85			DW-PA		
Date			4/16/2010			4/16/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.6			6.7		
Conductance			139			173		
TDSobs			67			85		
Calcium	40.1	2	11.7	0.58383	42.4	11.3	0.56387	33.7
Magnesium	24.3	2	5.8	0.48056	34.9	9.9	0.81794	48.9
Potassium	39.1	1	2.2	0.0555	4.0	1.4	0.03581	2.1
Sodium	23.0	1	5.4	0.23576	17.1	5.9	0.2549	15.2
Iron	55.8	2	0.1	0.00228	0.2	0.0	0.00018	0.0
Manganese	54.9	2	0.0	0.00162	0.1	0.0	1.8E-05	0.0
Ammonia-N	14.0	1	0.3	0.01863	1.4	0.0	0.00036	0.0
Total Cations (meq/L)				**1.4**			**1.7**	
Anions								
Alkalinity, Total			70.4			69.2		
Carbonate	60.0	2	0.15317	0.00511	0.3	0.02085	0.00069	0.0
Bicarbonate	61.0	1	85.58	1.40268	90.9	84.38	1.3831	72.8
Chloride	35.5	1	2.8	0.07954	5.2	5.8	0.16219	8.5
Nitrate-N	14.0	1	0.0	0.00036	0.0	0.9	0.06447	3.4
Sulfate	96.1	2	2.7	0.05622	3.6	13.9	0.28941	15.2
Total Anions (meq/L)				**1.5**			**1.9**	
Total Ions (meq/L)				**2.9**			**3.6**	
Cation/Anion Ratio				**0.89**			**0.88**	
Percent Difference				**-5.7**			**-6.3**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.36			1.67	
Calcium					43.07			33.71
Magnesium					35.45			48.90
Sodium + Potassium					21.48			17.38
sum (SO_4, Cl, HCO_3+CO_3)				1.54			1.84	
Sulfate					3.642			15.768
Chloride					5.153			8.837
Bicarbonate + Carbonate					91.205			75.395

Table 14
Private Wells

Site ID			DW-85			DW-PA		
Date			8/20/2010			8/20/2010		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.4			7.22		
Conductance			127.4			163		
TDSobs			99			128		
Calcium	40.1	2	14.1	0.70359	46.3	13.6	0.67864	35.7
Magnesium	24.3	2	5.92	0.48714	32.1	11	0.90516	47.6
Potassium	39.1	1	2.42	0.0619	4.1	1.48	0.03785	2.0
Sodium	23.0	1	5.6	0.24359	16.0	6.4	0.27838	14.6
Iron	55.8	2	0.0553	0.00198	0.1	0.0	0.00018	0.0
Manganese	54.9	2	0.0459	0.00167	0.1	0.0	1.8E-05	0.0
Ammonia-N	14.0	1	0.259	0.01849	1.2	0.0	0.00036	0.0
Total Cations (meq/L)				**1.5**			**1.9**	
Anions								
Alkalinity, Total			70.6			69.8		
Carbonate	60.0	2	0.10639	0.00355	0.2	0.06955	0.00232	0.1
Bicarbonate	61.0	1	85.92	1.40824	91.4	85.01	1.39347	73.3
Chloride	35.5	1	2.61	0.07362	4.8	5.26	0.14837	7.8
Nitrate-N	14.0	1	0.0	0.00036	0.0	0.959	0.06847	3.6
Sulfate	96.1	2	2.68	0.0558	3.6	13.9	0.28941	15.2
Total Anions (meq/L)				**1.5**			**1.9**	
Total Ions (meq/L)				**3.1**			**3.8**	
Cation/Anion Ratio				**0.98**			**1.00**	
Percent Difference				**-0.8**			**0.0**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.50			1.90	
Calcium					47.02			35.72
Magnesium					32.56			47.64
Sodium + Potassium					20.42			16.64
sum (SO_4, Cl, HCO_3+CO_3)				1.54			1.83	
Sulfate					3.621			15.784
Chloride					4.777			8.092
Bicarbonate + Carbonate					91.603			76.124

Table 14
Private Wells

Site ID			DW-85			DW-PA		
Date			1/0/1900			1/0/1900		
Cations	MW	n	mg/L	meq/L	%(meq)	mg/L	meq/L	%(meq)
pH			7.4			7.22		
Conductance			127.4			163		
TDSobs			99			128		
Calcium	40.1	2	14.1	0.70359	46.3	13.6	0.67864	35.7
Magnesium	24.3	2	5.92	0.48714	32.1	11	0.90516	47.6
Potassium	39.1	1	2.42	0.0619	4.1	1.48	0.03785	2.0
Sodium	23.0	1	5.6	0.24359	16.0	6.4	0.27838	14.6
Iron	55.8	2	0.0553	0.00198	0.1	0.0	0.00018	0.0
Manganese	54.9	2	0.0459	0.00167	0.1	0.0	1.8E-05	0.0
Ammonia-N	14.0	1	0.259	0.01849	1.2	0.0	0.00036	0.0
Total Cations (meq/L)				**1.5**			**1.9**	
Anions								
Alkalinity, Total			70.6			69.8		
Carbonate	60.0	2	0.10639	0.00355	0.2	0.06955	0.00232	0.1
Bicarbonate	61.0	1	85.92	1.40824	91.4	85.01	1.39347	73.3
Chloride	35.5	1	2.61	0.07362	4.8	5.26	0.14837	7.8
Nitrate-N	14.0	1	0.0	0.00036	0.0	0.959	0.06847	3.6
Sulfate	96.1	2	2.68	0.0558	3.6	13.9	0.28941	15.2
Total Anions (meq/L)				**1.5**			**1.9**	
Total Ions (meq/L)				**3.1**			**3.8**	
Cation/Anion Ratio				**0.98**			**1.00**	
Percent Difference				**-0.8**			**0.0**	
TRILINEAR DIAGRAM DATA								
sum (Ca, Mg, Na+K)				1.50			1.90	
Calcium					47.02			35.72
Magnesium					32.56			47.64
Sodium + Potassium					20.42			16.64
sum (SO_4, Cl, HCO_3+CO_3)				1.54			1.83	
Sulfate					3.621			15.784
Chloride					4.777			8.092
Bicarbonate + Carbonate					91.603			76.124

Appendix K

Appendix K

Gas Monitoring Data

King County Solid Waste Division
Environmental Monitoring Data
Data Collected February 2010
Vashon Landfill--Gas Testing Results

Sample Location	Sample Date/Time	CH4		CO2	Vol O2	Relative Pressure
		%Vol	%LEL	%Vol	%Vol	in. H2O
AM-1	2/24/2010 13:56	0	0	0.0	20.6	0.02
AM-2	2/24/2010 13:37	0	0	0.0	20.9	-0.02
AM-3	2/24/2010 12:27	0	0	0.0	20.6	0.00
AM-4	2/24/2010 12:43	0	0	0.0	20.6	0.00
AM-5	2/24/2010 12:59	0	0	0.0	20.8	0.00
AM-6	2/24/2010 13:14	0	0	0.0	20.8	0.00
AM-7	2/24/2010 13:41	0	0	0.0	20.9	0.01
AM-8	2/24/2010 14:08	0	0	0.0	20.7	0.02
AM-CB	2/24/2010 13:34	0	0	0.0	20.8	0.00
GP-1	2/24/2010 13:08	0	0	2.4	17.7	-0.09
GP-2	2/24/2010 13:43	0	0	1.8	17.8	-0.10
NP-1 s	2/24/2010 13:22	0	0	0.0	20.7	-0.10
NP-1 i	2/24/2010 12:53	0	0	0.0	20.7	0.01
NP-1 d	2/24/2010 12:55	0	0	2.1	16.6	0.12
NP-2 s	2/24/2010 12:34	0	0	0.0	20.5	0.95
NP-2 i	2/24/2010 12:32	0	0	0.2	19.4	-0.16
NP-2 d	2/24/2010 12:31	0	0	0.6	20.0	-0.84
NP-3 s	2/24/2010 12:41	0	0	0.5	18.1	0.58
NP-3 i	2/24/2010 12:39	0	0	0.2	19.4	0.43
NP-3 d	2/24/2010 12:37	0	0	0.1	20.5	0.00
NP-4 s	2/24/2010 12:51	0	0	2.6	16.2	0.16
NP-4 i	2/24/2010 12:49	0	0	3.2	16.5	0.13
NP-4 d	2/24/2010 12:46	0	0	0.4	20.4	-1.65
NP-5 s	2/24/2010 13:06	0	0	1.3	16.6	0.20
NP-5 i	2/24/2010 13:04	0	0	1.4	18.8	-0.10
NP-5 d	2/24/2010 13:02	0	0	2.6	16.8	0.45
NP-6 s	2/24/2010 13:20	0	0	3.2	15.8	-0.47
NP-6 i	2/24/2010 13:19	0	0	2.9	17.7	-0.23
NP-6 d	2/24/2010 13:16	0	0	3.0	16.6	-0.11
NP-7 s	2/24/2010 13:50	0	0	0.2	20.8	-0.37
NP-7 i	2/24/2010 13:48	0	0	0.2	20.6	-0.14
NP-7 d	2/24/2010 13:47	0	0	2.9	13.0	0.35
NP-8 s	2/24/2010 14:04	0	0	2.3	16.5	-0.29
NP-8 i	2/24/2010 14:02	0	0	0.2	20.4	-0.12
NP-8 d	2/24/2010 14:01	0	0	0.0	20.6	0.06
MW-5	2/24/2010 13:31	0	0	1.1	14.7	0.79
MW-13	2/24/2010 13:30	0	0	0.4	20.2	-0.19
MW-24	2/24/2010 13:28	0	0	3.7	15.1	0.66

King County Solid Waste Division
Environmental Monitoring Data
Data Collected June 2010
Vashon Landfill--Gas Testing Results

Sample Location	Sample Date/Time	CH4		CO2	Vol O2	Relative Pressure
		%Vol	%LEL	%Vol	%Vol	in. H2O
AM-1	6/10/2010 11:37	0	0	0	20.8	29.60
AM-2	6/10/2010 11:16	0	0	0	20.9	29.56
AM-3	6/10/2010 10:07	0	0	0	20.8	29.53
AM-4	6/10/2010 10:25	0	0	0	20.6	29.56
AM-5	6/10/2010 10:37	0	0	0	20.7	29.56
AM-6	6/10/2010 10:50	0	0	0	20.8	29.58
AM-7	6/10/2010 11:19	0	0	0	21	29.56
AM-8	6/10/2010 11:53	0	0	0	20.8	29.57
AM-CB	6/10/2010 11:06	0	0	0	21	29.54
GP-1	6/10/2010 10:46	0	0	0	20.6	29.58
GP-2	6/10/2010 11:24	0	0	2	17.8	29.61
NP-1 s	6/10/2010 10:11	0	0	2.4	17.7	29.53
NP-1 i	6/10/2010 10:13	0	0	0	19.7	29.53
NP-1 d	6/10/2010 10:15	0	0	0	20.7	29.53
NP-2 s	6/10/2010 10:18	0	0	0	20.5	29.53
NP-2 i	6/10/2010 10:21	0	0	0.1	19.2	29.54
NP-2 d	6/10/2010 10:23	0	0	0	20.5	29.54
NP-3 s	6/10/2010 10:27	0	0	2.8	16.6	29.56
NP-3 i	6/10/2010 10:29	0	0	3.5	16.2	29.56
NP-3 d	6/10/2010 10:31	0	0	2.6	16.6	29.56
NP-4 s	6/10/2010 10:40	0	0	3.3	16.4	29.58
NP-4 i	6/10/2010 10:42	0	0	0.9	19.7	29.58
NP-4 d	6/10/2010 10:44	0	0	1.9	16.1	29.58
NP-5 s	6/10/2010 10:53	0	0	3.6	16.1	29.59
NP-5 i	6/10/2010 10:55	0	0	3.4	17.5	29.58
NP-5 d	6/10/2010 10:57	0	0	3	16.6	29.59
NP-6 s	6/10/2010 11:28	0	0	3.6	12.1	29.59
NP-6 i	6/10/2010 11:30	0	0	0	20.7	29.59
NP-6 d	6/10/2010 11:32	0	0	0	20.8	29.59
NP-7 s	6/10/2010 11:42	0	0	0	20.8	29.57
NP-7 i	6/10/2010 11:43	0	0	0.1	20.6	29.58
NP-7 d	6/10/2010 11:45	0	0	2.9	15.3	29.57
NP-8 s	6/10/2010 11:10	0	0	7.3	0.4	29.56
NP-8 i	6/10/2010 11:11	0	0	0.3	20.2	29.55
NP-8 d	6/10/2010 11:13	0	0	0	20.7	29.56
MW-5	6/10/2010 11:00	0	0	0	20.9	29.60
MW-13	6/10/2010 10:33	0	0	0	20.4	29.57
MW-24	6/10/2010 10:34	0	0	2.4	16.5	29.56

King County Solid Waste Division
Environmental Monitoring Data
Data Collected June 2010
Vashon Landfill--Gas Testing Results

	Sample Location	Sample Date/Time	CH4		CO2	Vol O2	Relative Pressure
			%Vol	%LEL	%Vol	%Vol	in. H2O
Vaamb001	AM-1	7/13/2010 12:13	0		0	21	0.00
Vaamb002	AM-2	7/13/2010 10:29	0		0	21	0.00
Vaamb003	AM-3	7/13/2010 10:50	0		0	20.8	0.00
Vaamb004	AM-4	7/13/2010 11:06	0		0	20.7	0.00
Vaamb005	AM-5	7/13/2010 11:21	0		0	20.9	0.00
Vaamb006	AM-6	7/13/2010 11:42	0		0	21	0.00
Vaamb007	AM-7	7/13/2010 12:18	0		0	21	0.00
Vaamb008	AM-8	7/13/2010 12:33	0		0	21	-0.01
Vaamb0CB	AM-CB	7/13/2010 10:37	0		0	20.8	0.00
Vagp0001	GP-1	7/13/2010 11:39	0		0	21	-0.91
Vagp0002	GP-2	7/13/2010 12:20	0		1.5	18.1	-0.06
Vagp0MW5	MW-5	7/13/2010 11:54	0		0	21	-0.08
VagpMW13	MW-13	7/13/2010 11:15	0		0	20.6	0.09
VagpMW24	MW-24	7/13/2010 11:17	0		1.8	16.7	-1.70
VaNP001D	NP-1D	7/13/2010 10:56	0		0	20.9	-2.01
VaNP001I	NP-1I	7/13/2010 10:54	0		0.1	19.6	-0.07
VaNP001S	NP-1S	7/13/2010 10:53	0		1.2	18.5	-5.44
VaNP002D	NP-2D	7/13/2010 11:03	0		0.1	20.8	-1.91
VaNP002I	NP-2I	7/13/2010 11:01	0		0.1	20	-1.85
VaNP002S	NP-2S	7/13/2010 10:59	0		0.1	20.6	0.00
VaNP003D	NP-3D	7/13/2010 11:11	0		2.1	16.5	-1.70
VaNP003I	NP-3I	7/13/2010 11:10	0		1.9	18	-1.67
VaNP003S	NP-3S	7/13/2010 11:08	0		1.9	16.9	-0.09
VaNP004D	NP-4D	7/13/2010 11:36	0		0.3	20.6	-1.70
VaNP004I	NP-4I	7/13/2010 11:34	0		0.8	19.8	-1.05
VaNP004S	NP-4S	7/13/2010 11:33	0		2.8	17.2	-0.40
VaNP005D	NP-5D	7/13/2010 11:51	0		2.5	16.6	-0.43
VaNP005I	NP-5I	7/13/2010 11:49	0		1.8	18.9	-0.24
VaNP005S	NP-5S	7/13/2010 11:47	0		3.3	16.3	-0.06
VaNP006D	NP-6D	7/13/2010 12:01	0		0.1	21	-0.86
VaNP006I	NP-6I	7/13/2010 12:00	0		0.1	21	-0.28
VaNP006S	NP-6S	7/13/2010 11:58	0		3.7	13	0.00
VaNP007D	NP-7D	7/13/2010 12:09	0		2.3	15.5	-0.03
VaNP007I	NP-7I	7/13/2010 12:07	0		0.2	20.8	-1.20
VaNP007S	NP-7S	7/13/2010 12:05	0		0	21	-1.35
VaNP008D	NP-8D	7/13/2010 10:35	0		0	21	-1.86
VaNP008I	NP-8I	7/13/2010 10:34	0		0	21	-0.1
VaNP008S	NP-8S	7/13/2010 10:32	0		0	21	-1.78

VASHON LANDFILL

Bar.Start: 30.32
Bar Stop: 30.26
Amb. Temp: 55F
Tech: Dye

Probe ID	Date/Time	CH_4 %vol	CO_2 %vol	O_2 %vol	Lower Explosive Limit %LEL	Static Pressure in INWC
Vaamb001	10/12/2010 11:48	0.0	0.0	21.0	0	0
Vaamb002	10/12/2010 10:21	0.0	0.1	20.8	0	0
Vaamb003	10/12/2010 10:31	0.0	0.0	21.0	0	0
Vaamb004	10/12/2010 10:49	0.0	0.0	21.0	0	0
Vaamb005	10/12/2010 11:04	0.0	0.0	20.8	0	0
Vaamb006	10/12/2010 11:29	0.0	0.0	20.9	0	0
Vaamb007	10/12/2010 11:35	0.0	0.0	21.0	0	0
Vaamb008	10/12/2010 12:03	0.0	0.0	20.9	0	0
Vaamb0CB	10/12/2010 10:28	0.0	0.0	21.0	0	0
Vagp0001	10/12/2010 11:12	0.0	0.0	20.8	0	-0.05
Vagp0002	10/12/2010 11:37	0.0	1.6	18.4	0	-0.03
Vagp0MW5	10/12/2010 11:24	0.0	0.1	21.0	0	-0.01
VagpMW13	10/12/2010 10:59	0.0	0.1	20.7	0	0.07
VagpMW24	10/12/2010 11:01	0.0	0.5	20.3	0	-0.18
VaNP001D	10/12/2010 10:37	0.0	0.0	21.0	0	-0.91
VaNP001I	10/12/2010 10:35	0.0	0.0	20.8	0	-0.68
VaNP001S	10/12/2010 10:34	0.0	2.5	16.6	0	0.05
VaNP002D	10/12/2010 10:47	0.0	0.1	20.9	0	-0.6
VaNP002I	10/12/2010 10:45	0.0	0.2	20.2	0	-0.62
VaNP002S	10/12/2010 10:43	0.0	1.1	19.5	0	0
VaNP003D	10/12/2010 10:57	0.0	2.8	17.4	0	-0.25
VaNP003I	10/12/2010 10:55	0.0	3.3	16.5	0	-0.25
VaNP003S	10/12/2010 10:53	0.0	2.6	17.6	0	0.06
VaNP004D	10/12/2010 11:10	0.0	1.0	17.8	0	0.04
VaNP004I	10/12/2010 11:08	0.0	0.5	20.1	0	-0.06
VaNP004S	10/12/2010 11:07	0.0	3.1	18.0	0	-0.01
VaNP005D	10/12/2010 11:22	0.0	3.0	16.2	0	-0.02
VaNP005I	10/12/2010 11:20	0.0	2.5	18.2	0	-0.02
VaNP005S	10/12/2010 11:19	0.0	3.7	16.9	0	0
VaNP006D	10/12/2010 11:43	0.0	0.2	21.0	0	-0.13
VaNP006I	10/12/2010 11:41	0.0	0.2	20.9	0	-0.13
VaNP006S	10/12/2010 11:40	0.0	4.9	16.3	0	0
VaNP007D	10/12/2010 11:59	0.0	2.9	16.4	0	0.03
VaNP007I	10/12/2010 11:57	0.0	0.2	21.0	0	-0.61
VaNP007S	10/12/2010 11:56	0.0	0.0	21.0	0	-0.5
VaNP008D	10/12/2010 10:27	0.0	0.2	20.8	0	-0.74
VaNP008I	10/12/2010 10:25	0.0	0.4	20.2	0	-0.83
VaNP008S	10/12/2010 10:23	0.0	11.4	0.0	0	1.06

Appendix L

Appendix L
Inspection Survey Reports

TO KCSW 3/5/10

Inspection Survey Report
Solid Waste Program

King County

Public Health – Seattle & King County
Environmental Hazards Section 206-205-4394
401 Fifth Avenue, Suite 1100 • Seattle, WA 98104

Business Name	Operator	Phone
Vashon Landfill	KCSW - Anne	(206) 463-4328

Address	City	ZIP	Time In
18830 130th Ave. SW.	Vashon	98070	9:45 am

EHS	Date	General Health Record ID	P/E	Activity Time	Travel Time
PON	031210	PR 0071723	1002	60 m	90 m

Violation Number	Violation Description	Correction Date
	No violations observed during site inspection.	

ENTERED 3/12/10

Service
126 ☐ Fld Pl Rvw
127 ☐ Pre-Operat
128 ☒ Routine
129 ☐ Return
130 ☐ Complaint
131 ☐ Comp Rtn
☐

Results
01 ☒ Satisfactory
02 ☐ Unsatisfactory
07 ☐ In Compliance
08 ☐ Not in Compliance
22 ☐ Not Access
☐

Action
00 ☒ Not Applicable
04 ☐ Suspend
07 ☐ Approved
08 ☐ App w/ Cond
26 ☐ Return Visit
27 ☐ Phone Follow
☐

Misc
☐ Photos Taken

Weather
☐ Sunny
☒ Cloudy
☐ Partially Cloudy
☐ Showers
☐ Rain
☐ Wind
☐ Snow

Comments / Observations

Tour of landfill's stormwater ponds and outfall with Greg Stegman, Madeline Wall, (Ecology) Anne Holmes & Bob Keating (KCSW), and Ed Davis.

SVB is the monitoring point at the outfall and should be reported in the quarterly reports.

Person in Charge: [signature]

Health Authority: [signature]

Based on an inspection this day, the above listed violations must be corrected by the next routine inspection or such period of time as may be specified in writing by the health officer. Failure to comply with this notice may result in immediate suspension of your permit and/or assessment of civil penalties. An opportunity for an appeal of the findings of an inspection report will be provided if a written request is filed with the health officer within ten (10) days of the date of the suspension or inspection. The complete list of inspection items is contained on the back of this form.

PH-0002 (Rev. 6/07)

Inspection Survey Report
Solid Waste Program

King County

Public Health – Seattle & King County
Environmental Hazards Section 206-205-4394
401 Fifth Avenue, Suite 1100 • Seattle, WA 98104

Business Name	Operator	Phone
Vashon Landfill	KCSWD - Anne	(206) 463-4328 (T.S.#)

Address	City	ZIP	Time In
18830 130th Ave SW.	Vashon	98070	2:20 p.m.

EHS	Date	General Health Record ID	P/E	Activity Time	Travel Time
PON	061610 PR/SR	00157723	1002	60 m	75 m

Violation Number	Violation Description	Correction Date
	Note: Vegetation cutting needed in fill area to check for leachate weeps or staining.	

ENTERED

Service
126 ☐ Fld Pl Rvw
127 ☐ Pre-Operat
128 ☒ Routine
129 ☐ Return
130 ☐ Complaint
131 ☐ Comp Rtn
☐

Results
01 ☒ Satisfactory
02 ☐ Unsatisfactory
07 ☐ In Compliance
08 ☐ Not in Compliance
22 ☐ Not Access
☐

Action
00 ☒ Not Applicable
04 ☐ Suspend
07 ☐ Approved
08 ☐ App w/ Cond
26 ☐ Return Visit
27 ☐ Phone Follow
☐

Misc
☒ Photos Taken

Weather
☐ Sunny
☒ Cloudy
☐ Partially Cloudy
☐ Showers
☐ Rain
☐ Wind
☐ Snow

Comments / Observations

Aeration on at leachate pond.
Surface water ditches clear with little water.
No landfill gas odor at treatment facility for the landfill gas.
No landfill gas odor at wells checked.
Checked south stormwater ponds – clear and south detention pond had little water.
Walked upper elevation of fill area – unable to see any signs of leachate or staining due to heavy vegetation. (See Note above.)

Note to PH: Bring own lock to daisy-chain with KCSWD's open lock for the main gate entrance into the transfer station and landfill.

Person In Charge	Health Authority
no one on-site to sign.	Yolanda Pon

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PH-0002 (Rev. 3/10)

Inspection Survey Report
Solid Waste Program

King County

Public Health – Seattle & King County
Environmental Hazards Section 206-205-4394
401 Fifth Avenue, Suite 1100 • Seattle, WA 98104

Page 1 of 1

Business Name	Operator	Phone
Vashon Landfill	K.C. Anne	(T.S.#) (206) 463-4328

Address	City	ZIP	Time In
18830 130th Ave. SW.	Vashon	98070	1:40 p.m.

EHS	Date	General Health Record ID	P/E	Activity Time	Travel Time
PON	073010 PR/SR	0015723	1002	50 m	85 m

Violation Number	Violation Description	Correction Date
	No violations observed at time of inspection.	

ENTERED

Service
126 ☐ Fld Pl Rvw
127 ☐ Pre-Operat
128 ☒ Routine
129 ☐ Return
130 ☐ Complaint
131 ☐ Comp Rtn
☐

Results
01 ☒ Satisfactory
02 ☐ Unsatisfactory
07 ☐ In Compliance
08 ☐ Not in Compliance
22 ☐ Not Access
☐

Action
00 ☒ Not Applicable
04 ☐ Suspend
07 ☐ Approved
08 ☐ App w/ Cond
26 ☐ Return Visit
27 ☐ Phone Follow
☐

Misc
☒ Photos Taken

Weather
☒ Sunny
☐ Cloudy
☐ Partially Cloudy
☐ Showers
☐ Rain
☐ Wind
☐ Snow

Comments / Observations

Vegetation recently cut. — Thank you! ☺
No leachate weeps or staining observed.
Drove fill area and site perimeters and upper fill area.
No water in surface water ditches at fill perimeter.
Aeration on at leachate pond.
Checked south stormwater ponds – clear ~~w~~ for those with volumes.
No landfill gas odor noted at wells checked.
No landfill gas odor at gas treatment facility

Person in Charge
No one on-site to sign. np

Health Authority
[signature]

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PH-0002 (Rev. 3/10)

Inspection Survey Report
Solid Waste Program

King County

Public Health – Seattle & King County
Environmental Hazards Section 206-205-4394
401 Fifth Avenue, Suite 1100 • Seattle, WA 98104

Page _____ of _____

Business Name	Operator	Phone
Vashon Landfill	KCSWD - Anne	(206) 463-4328

Address	City	ZIP	Time In
18830 130th Ave SW	Vashon	98070	1:10 - 1:50

EHS	Date	General Health Record ID	P/E	Activity Time	Travel Time
DCH	102110	PR/SR 0015723	1002	40 m	80 m

Violation Number	Violation Description	Correction Date

ENTERED

Service
126 ☐ Fld Pl Rvw
127 ☐ Pre-Operat
128 ☒ Routine
129 ☐ Return
130 ☐ Complaint
131 ☐ Comp Rtn
☐ _____

Results
01 ☒ Satisfactory
02 ☐ Unsatisfactory
07 ☐ In Compliance
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07 ☐ Approved
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26 ☐ Return Visit
27 ☐ Phone Follow
☐ _____

Misc
☒ Photos Taken

Weather
☒ Sunny
☐ Cloudy
☐ Partially Cloudy
☐ Showers
☐ Rain
☐ Wind
☐ Snow

Comments / Observations

1) large puddle at Base of slope - Clear H_2O But Brown Scum Floating - ~~But~~ 1/2 wall Between Public Entrance and T.S. Gate
2) Leachate Lagoon "Sea" Smell
3) All 3 Settling Ponds apear Healthy - Have H_2O
4) Grass on slopes could use a cutting -
5) No odors at Gas stand pipes on Fill area
6) walked Parimeter of Fill area

Person In Charge	Health Authority
No one on site	David Christenson

Based on an inspection this day, the above listed violations must be corrected by the next routine inspection or such period of time as may be specified in writing by the health officer. Failure to comply with this notice may result in immediate suspension of your permit and/or assessment of civil penalties. An opportunity for an appeal of the findings of an inspection report will be provided if a written request is filed with the health officer within ten (10) days of the date of the suspension or inspection. The complete list of inspection items is contained on the back of this form.

PH-0002 (Rev. 3/10)

to KCSW 1-14-11

Inspection Survey Report
Solid Waste Program

King County

Public Health - Seattle & King County
Environmental Hazards Section 206-205-4394
401 Fifth Avenue, Suite 1100 • Seattle, WA 98104

Page _____ of _____

Business Name	Operator	Phone
Vashon Landfill	KCSWD	( )

Address	City	ZIP	Time In
16830 130th Ave SW	Vashon		1:40 - 2:20

EHS	Date	General Health Record ID	P/E	Activity Time	Travel Time
DCM	122210	PR 0015723	1002	40 m	115 m

Violation Number	Violation Description	Correction Date

Service
126 ☐ Fld Pl Rvw
127 ☐ Pre-Operat
128 ☒ Routine
129 ☐ Return
130 ☐ Complaint
131 ☐ Comp Rtn
☐ _____

Results
01 ☒ Satisfactory
02 ☐ Unsatisfactory
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Misc
☒ Photos Taken

Weather
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☐ Cloudy
☐ Partially Cloudy
☐ Showers
☐ Rain
☐ Wind
☐ Snow

Comments / Observations

No odors at standpipes (gas system) on top of Landfill.
water in ditch to the East clear - No odor
Leachate pond not aerating at this time - No odor
East pond and South Siltation pond cloudy.
Pipe placed in Ground to Drain Leachate from last inspection - Partially successful

Person in Charge

Health Authority David Christensen

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