U.S. Army Corps of Engineers
New England District

FINAL
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
FOR AREA OF CONTAMINATION 69W

DEVENS, MASSACHUSETTS

CONTRACT DACA87-02-D-0007
DELIVERY ORDER NO. DB01

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

NOVEMBER 2005

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MACTEC

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Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

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Portland, Maine

NOVEMBER 2005

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OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION FOR AREA OF CONTAMINATION 69W

DEVENS, MASSACHUSETTS

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EXECUTIVE SUMMARY

This Operating Properly and Successful Demonstration for Area of Contamination (AOC) 69W at the former Fort Devens, Massachusetts has been prepared in accordance with the U.S. Environmental Protection Agency "Guidance for Evaluation of Federal Agency Demonstrations that Remedial Actions are Operating Properly and Successfully Under CERCLA Section 120(h)(3)" (USEPA, 1996). Demonstration that current remedial actions are "operating properly and successfully" is a precondition to the pending deed transfer of federally-owned property, as required in Section 120(h)(3) of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA).

AOC 69W is located at the northeast corner of MacArthur Avenue and Antietam Street on the former Fort Devens Main Post. AOC 69W comprises the former Fort Devens Elementary School (Building 215) [now the Parker Charter School] and the associated parking lot and adjacent lawn extending approximately 300 feet northwest to Willow Brook. Contamination at the site is attributed to heating oil, which leaked from underground piping in two separate incidences in 1972 and 1978. It is estimated that approximately 7,000 to 8,000 gallons of fuel oil were released into the soil from each incident, but approximately one-half the second spill was recovered. In 1998, a Time-Critical Removal Action was performed, and approximately 3,500 cubic yards of petroleum-contaminated soil were excavated. In addition, a 10,000-gallon fuel oil underground storage tank and associated piping were removed. The Record of Decision for AOC 69W was signed on June 29, 1999. A Limited Action remedy consisting of long-term monitoring, institutional controls, and five-year reviews was selected for groundwater and subsurface soils.

Based upon the information presented in this report, the Army concludes that the remedial actions selected for AOC 69W, are operating properly and successfully, consistent with the provisions of CERCLA, Section 120(h)(3). This conclusion is based on the following lines of evidence:

- The remedy for AOC 69W has been implemented as designed.
- The remedy will achieve the remedial action objectives delineated in the Record of Decision.
- The remedy is functioning in such a manner that it is expected to adequately protect human health and the environment when completed.
- Institutional controls have been enacted to provide further protection to human health.

The selected remedy will continue to keep risks from exposure to site contaminants at low, acceptable levels and be protective of human health and the environment. In addition, the remedy meets federal and state requirements that are applicable or relevant and appropriate.

1.0 INTRODUCTION

1.1 BACKGROUND

This Operating Properly and Successfully (OPS) Demonstration for Area of Contamination (AOC) 69W at the former Fort Devens, Massachusetts has been prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) for the U. S. Army Corps of Engineers (USACE) New England District. Fort Devens was identified for cessation of operations and closure under Public Law 101-510, the Defense Base Closure and Realignment Act of 1990 (BRAC Act, or BRAC), and was officially closed in September 1996. Portions of the property formerly occupied by Fort Devens were retained by the Army and renamed the Devens Reserve Forces Training Area (RFTA). Areas not retained as part of the Devens RFTA were, or are in the process of being transferred to new owners for reuse and redevelopment. AOC 69W is located in an area designated for transfer to MassDevelopment.

This demonstration has been prepared in accordance with the U.S. Environmental Protection Agency (USEPA) "Guidance for Evaluation of Federal Agency Demonstrations that Remedial Actions are Operating Properly and Successfully Under CERCLA Section 120(h)(3)" (OPS Guidance) (USEPA, 1996) to demonstrate that current remedial actions are "operating properly and successfully" as a precondition to the pending deed transfer of federally-owned property, as required in Section 120(h)(3). Fort Devens was placed on the National Priorities List on December 21, 1989, under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA). The Army is the lead federal agency responsible for the cleanup and funding is from the Department of Defense. The CERCLIS ID for Ft. Devens is MA7210025154.

The Final Remedial Investigation (RI) Report for AOC 69W was issued in 1998. Based on the results of a Removal Action and the RI, the Army, along with the USEPA and Massachusetts Department of Environmental Protection (MADEP), concluded that under current conditions and uses, including re-use as a school, AOC 69W did not present unacceptable risks to human health or the environment and that a feasibility study to evaluate remedial action alternatives was not needed. The Proposed Plan detailing the Army's plan for Limited Action at AOC 69W was issued for public comment, and, subsequently, a Limited Action Record of Decision was signed in 1999. The Limited Action consisted of long-term groundwater monitoring and institutional controls to limit the potential exposure to contaminated soil and groundwater under current and future site conditions. Long-term monitoring was initiated in 2000, and semi-annual groundwater monitoring has been conducted to date.

1.2 OPS DEFINITION

As defined by the USEPA (USEPA, 1996), the phrase "operating properly and successfully" involves two separate concepts. A remedial action is operating "properly" if it is operating as designed. That same system is operating "successfully" if its operation will achieve the cleanup levels or performance goals delineated in the decision document. Additionally, in order to be successful, that remedy must be protective of human health and the environment. For instance, a pump-and-treat system may be operating properly according to its design for pumping and extracting groundwater, but not operating successfully because the level of one or more contaminants has not been reduced in the aquifer. The success of a particular remedial action will be evaluated based on whether it successfully addresses the particular contaminant(s) it was designed to remediate. Where more than one remedial action is required for a parcel, all such actions must operate properly and successfully, and USEPA must evaluate the suite of actions comprehensively prior to property transfer to determine that all necessary remedial actions have been taken. Thus, USEPA interprets the term "operating properly and successfully" to mean that the remedial action is functioning in such a manner that it is expected to adequately protect human health and the environment when completed.

1.3 APPLICABILITY

OPS demonstrations are made to the USEPA Administrator and are applicable when a federal agency is implementing an ongoing remedial action and desires to transfer the property after a remedial action has been completely constructed and installed, but before the remedial objectives are met.

As part of the 1986 amendments to CERCLA under SARA, Congress added Section 120(h), which placed certain requirements on the deed transfer of U.S. Government owned property to other parties. The primary purpose of Section 120(h) was to ensure that property contaminated by the federal government is environmentally restored by the federal government before being conveyed outside the federal government. CERCLA Section 120(h)(3) was included to ensure that end by requiring that deeds transferring property where hazardous substances had been stored, released, or disposed of shall contain a covenant warranting that *"all remedial action necessary to protect human health and the environment with respect to any [hazardous] substance remaining on the property has been taken before the date of such transfer."*

In October, 1992, Congress enacted the Community Environmental Response Facilitation Act (CERFA), which, among other things, amended CERCLA Section 120(h)(3) to clarify when all remedial action is deemed to have been taken. Specifically, the amendment added language stating that all necessary actions have been taken, *"if the construction and installation of an approved remedial design has been completed and the remedy has been demonstrated to the [EPA] Administrator to be operating properly and successfully."*

2.0 SITE DESCRIPTION

2.1 LOCATION AND SETTING

The former Fort Devens is located in the towns of Ayer and Shirley (Middlesex County) and Harvard and Lancaster (Worcester County), approximately 35 miles northwest of Boston, Massachusetts (see Figure 1). It lies within the Ayer, Shirley, and Clinton map quadrangles (7½-minute series). The former Fort Devens occupied approximately 9,260 acres, divided into the Former North Post, Main Post, and South Post.

Over 6,000 acres at Fort Devens were used for training and military maneuvers, and over 3,000 acres were developed for housing, buildings, and other facilities. Prior to closure, the installation was reported as the largest undeveloped land holding under a single owner in north-central Massachusetts (U.S. Fish and Wildlife Service [USFWS], 1992). The South Post is located south of Massachusetts Route 2 and is largely undeveloped. The Main Post and North Post primarily contain developed lands, including recreational areas (e.g., a golf course and Mirror Lake), training areas, and an inactive airfield.

AOC 69W is located on the Main Post at the northeast corner of MacArthur Avenue and Antietam Street (see Figure 2). AOC 69W comprises the former Fort Devens Elementary School (Building 215) [now the Parker Charter School] and the associated parking lot and adjacent lawn extending approximately 300 feet northwest to Willow Brook. Site features and monitoring wells are shown on Figure 3. A typical geologic cross section is presented in Figure 4. AOC 69W is located in an area planned for transfer to MassDevelopment for reuse as educational, cultural, institutional, and office space.

The topography at AOC 69W is, in general, relatively flat, sloping gently towards Willow Brook, which abuts the west and northwest portions of the site. A small, wooded, grassy wetland area is located to the northwest and north. The northern portion of the site is an asphalt parking lot that extends approximately 120 feet before grading into a grassy area. The eastern portion of the site is a combination of asphalt pavement and grass. A small section of the southern portion of AOC 69W is asphalt paved followed by a steep grassy embankment leading up to Antietam Street. The west side of the site is a combination of asphalt pavement and grass leading to Willow Brook.

2.2 HISTORY OF AOC 69W

General events in the site history are presented in Table 1.

TABLE 1
AOC 69W OPERATING HISTORY

Date	Event
1951	The Fort Devens Elementary School was built and consisted of the east/southeast half of the present school. The school was heated by an oil-fired boiler, and the heating oil was stored in a 10,000-gallon underground storage tank (UST) located in what is currently the school courtyard. The school was operated and maintained by the Ayer School Department.
1972	An addition to the school was built which formed the current school structure. Although a new boiler room was constructed, the old boiler room remained operational. The original 10,000-gallon UST was removed, and a new 10,000-gallon UST was installed north of the school in the middle of the current parking lot.
1972	During the UST installation, the underground fuel line leading to the new boiler room was accidentally crimped, causing the pipe to split and leak approximately 7,000 to 8,000 gallons of No. 2 fuel oil to the ground.
1972 - 1973	As a result of the fuel release, an oil recovery system was installed in the vicinity of the 10,000-gallon UST. The system consisted of underground piping connected to a buried 250-gallon concrete vault that acted as an oil/water separator. The vault collected oily water and was pumped out approximately every three months.
1978	Underground fuel piping near the old boiler room failed at a pipe joint. Approximately 7,000 to 8,000 gallons of oil were released into the soil during the incident. Soil was excavated to locate the source of the release. The excavation was used to collect the residual oil for one month before the damaged piping was found and replaced. A minimum of 2,600 gallons of residual oil was pumped from the oil recovery system.
Post 1986	The 250-gallon oil/water separator was filled with crushed rock.
1989	Fort Devens is placed on National Priorities List under CERCLA.
1993	The Ayer School Department closed the school because the facility was excess to its needs. As part of the Base Closure process, the Army conducted a base-wide evaluation of past spill sites and designated the elementary school spill site as Area Requiring Environmental Evaluation (AREE) 69W. Based on document reviews and site visits, the evaluation concluded that residual fuel contamination might have been present in the soil and groundwater at the site.
1994	The Army performed a Site Investigation (SI), which revealed the presence of fuel-related contaminants in soil and groundwater between the school and the existing fuel UST, and in an area extending northwest from the existing fuel UST to near Willow Brook. The Army redesignated the site as AOC 69W and proposed that an RI be performed.

TABLE 1
AOC 69W OPERATING HISTORY

Date	Event
1995 - 1998	An RI was conducted to define the distribution of contaminants previously detected in the soil and groundwater during the AREE 69W SI, and to determine whether remediation was warranted. The RI data showed that fuel-related compounds, primarily total petroleum hydrocarbons (TPH) and semivolatile organic compounds (SVOCs) were present in soils extending from the new (1972) boiler room to approximately 300 feet northwest. The observed groundwater contaminants consisted of fuel-related volatile organic compounds (VOCs), SVOCs, TPH, and inorganics. Soil and groundwater contamination appeared to be largely a result of the 1972 fuel oil release. The underground oil recovery system apparently acted as a conduit for contaminant migration in soil and groundwater. Observed contamination from the 1978 release did not appear to be migrating downgradient and further migration was unlikely.
1996	Fort Devens was officially closed. AOC 69W was slated for future transfer to the Massachusetts Government Land Bank. The existing school building was expected to be re-opened in the near future.
1997 - 1998	Based on a review of the soil and groundwater contaminant data, the Army performed a removal action and excavated approximately 3,500 cubic yards of petroleum-contaminated soil associated with the 1972 fuel oil leak. The 10,000-gallon fuel oil UST, the oil recovery system's 250-gallon vault, and associated piping were also removed. The 10,000-gallon fuel oil UST was confirmed to be intact. Confirmatory soil sampling in excavated areas indicated that extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) concentrations immediately adjacent to the school still exceeded the Massachusetts Contingency Plan (MCP) Method 1 S-1/GW-1 soil standards after the removal action. Because of the proximity of the school, this soil could not be excavated without potential structural damage to the building. Because the area is paved, there is minimal potential for further migration of contaminants and future exposure.
1998	The Final RI Report (HLA, 1998) was issued. Based on the results of the RI and Removal Action, the Army, along with the USEPA and MADEP, concluded that under current conditions and uses, including re-use as a school, AOC 69W did not present unacceptable risks to human health or the environment and that a feasibility study to evaluate remedial action alternatives was not needed.
1999	The Proposed Plan detailing the Army's plan for Limited Action at AOC 69W was issued for public comment.
1999	A Limited Action Record of Decision (HLA, 1999) was signed. The Limited Action consisted of long-term groundwater monitoring and institutional controls to limit the potential exposure to contaminated soil and groundwater under current and future site conditions.

TABLE 1
AOC 69W OPERATING HISTORY

Date	Event
2000	The former Fort Devens Elementary School was reopened as Parker Charter School.
2000	Final Long-term Monitoring Plan (LTMP) for AOC 69W is issued (HLA, 2000a).
May 2000 - Present	Long-term monitoring initiated, semi-annual groundwater monitoring conducted.

3.0 SITE CHARACTERIZATION AND DEVELOPMENT OF REMEDIAL OBJECTIVES

3.1 SITE CHARACTERIZATION

Contamination at the site is attributed to heating oil, which leaked from underground piping in two separate incidences in 1972 and 1978. It is estimated that approximately 7,000 to 8,000 gallons of fuel oil were released into the soil from each incident, but approximately one-half the second spill was recovered. The Army performed an SI in 1994, which revealed the presence of fuel-related contaminants in soil and groundwater between the school and the existing fuel UST, and in an area extending northwest from the existing fuel UST to near Willow Brook. The Army redesignated the site as AOC 69W and, from 1995 to 1998, performed an RI to define the distribution of contaminants previously detected in the soil and groundwater during the SI and to determine whether remediation was warranted.

The RI data showed that fuel-related compounds, TPH and SVOCs, were present in soils extending from the new (1972) boiler room to approximately 300 feet northwest. The observed groundwater contaminants consisted of fuel-related VOCs, SVOCs, TPH, and inorganics. Soil and groundwater contamination appeared to be largely a result of the 1972 fuel oil release. The underground oil recovery system apparently acted as a conduit for contaminant migration in soil and groundwater. Observed contamination from the 1978 release did not appear to be migrating downgradient and further migration was unlikely.

3.2 PRE-RECORD OF DECISION REMOVAL ACTIONS

In 1998, a Time-Critical Removal Action was performed, and approximately 3,500 cubic yards of petroleum-contaminated soil were excavated. In addition, the 10,000-gallon fuel oil UST, the oil recovery system's 250-gallon vault, and associated piping were also removed.

A summary of the details of the site investigation, enforcement and cleanup is presented in Table 2.

TABLE 2
MAJOR INVESTIGATION, ENFORCEMENT, AND CLEANUP MILESTONES AT AOC 69W

Date	Event
1993	A document review of the Elementary School, designated AREE 69W, was performed and focused on the 1978 on spill. The review concluded there was potential for contamination in soil and groundwater.
1994	Further investigation was performed at AREE 69W which included sampling, field screening, and laboratory analysis of surface soil, subsurface soil, groundwater, surface water, and sediment, and a geophysical survey to locate subsurface utilities. It was concluded that TPH and carcinogenic polynuclear aromatic hydrocarbon (cPAH) soil contamination appeared to be concentrated in the area of the existing UST, and may have migrated downgradient towards Willow Brook. Groundwater northwest of the UST was also found to have elevated concentrations of inorganics and TPH, suggesting that contaminants had migrated downgradient of the UST location.
1995 - 1997	An RI field program consisting of several field efforts was initiated. The initial RI field effort was performed in the fall of 1995. As a result of the findings of this field effort, additional work was determined necessary to characterize contaminant distribution at AOC 69W. Additional phases of work were performed in the falls of 1996 and 1997. The RI field program for AOC 69W included a geophysical survey; twenty-nine TerraProbe^{SM} points; three soil borings; eight surface soil samples; nine sediment and three toxicity test samples collected in Willow Brook; installation and development of seven monitoring wells and two piezometers; two rounds of groundwater samples collected from the newly installed and previously existing monitoring wells, and two supplemental rounds of groundwater sampling using low-flow techniques; one test pit; indoor air sampling inside the elementary school; aquifer testing on the new and existing monitoring wells; and horizontal and vertical survey of all RI explorations.
1997 - 1998	Roy F. Weston, Inc. (R.F. Weston) removed approximately 3,500 cubic yards of petroleum-contaminated subsurface soil associated with the 1972 fuel oil leak, and removed the 10,000-gallon UST, the 250-gallon vault, and the associated piping that may have served as a potential conduit to downgradient areas.
May 2000	Long-term monitoring initiated, semi-annual groundwater monitoring conducted.
Nov. 2000	Semi-annual groundwater monitoring is conducted.
April 2001	2000 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued (USACE, 2001).
May 2001	Semi-annual groundwater monitoring is conducted.
Nov. 2001	Semi-annual groundwater monitoring is conducted.

TABLE 2
MAJOR INVESTIGATION, ENFORCEMENT, AND CLEANUP MILESTONES AT AOC 69W

Date	Event
April 2002	2001 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued (USACE, 2002).
May 2002	Semi-annual groundwater monitoring is conducted.
Nov. 2002	Semi-annual groundwater monitoring is conducted.
April 2003	2002 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued (USACE, 2003).
May 2003	Semi-annual groundwater monitoring is conducted.
Nov. 2003	Semi-annual groundwater monitoring is conducted.
April 2004	2003 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued (USACE, 2004).
April 2004	Semi-annual groundwater monitoring is conducted.
Oct. 2004	Semi-annual groundwater monitoring is conducted.
In Review	2004 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued (USACE, 2005).

In December 1997, the MADEP and the USEPA approved the proposed removal of the 10,000-gallon UST, 1,200 cubic yards of petroleum-contaminated soil from a hot-spot adjacent to the UST location, underground piping from the "skimmer system", and the underground vault. The areas affected by excavations are depicted on Figure 5. The scope of the removal actions performed at AOC 69W is described below.

A Time-Critical Removal Action was initiated in January 1998 (R. F. Weston, 1998). The removal action encompassed an area approximately 120 by 180 feet immediately north of the elementary school. A narrow "extension" of the removal action reached as far as Willow Brook to the northwest, past the 250-gallon underground vault. Visual inspection of the 10,000-gallon UST confirmed that it was intact (i.e., no holes or leaks were observed). A summary of removal activities is presented in Table 3.

TABLE 3
REMOVAL ACTION/SITE DETAILS

Action	Description
Underground vault removal	Top of concrete ~1.5 feet below ground surface (bgs). Vault circular ~5 by 5 feet. Filled with stone and soil. Heavy petroleum contamination in bottom 2 feet. Water table ~4 feet bgs. Excavation continued to 7 feet bgs. Sidewall towards Willow Brook showed some staining. Excavation removed 3-4 feet

TABLE 3
REMOVAL ACTION/SITE DETAILS

Action	Description
	of sidewalls until field screens showed soils below 1,000 parts per million (ppm) TPH. Transite pipe found (6-inch diameter) at 2 feet bgs ~15 feet long, ending 5 feet from Willow Brook. At conclusion, slight oily sheen on groundwater adsorbed with pads. Confirmatory soil samples collected from sidewalls and from floor.
Underground pipe and trench excavation	Digging traced pipe from UST area in the parking lot of the school from the concrete vault. Trench then excavated to a depth of 1 foot below pipe bottom extending 4 feet on either side. All pipe sections upstream of vault were clay. Some local contamination from leaks. Pipe was ~5 feet bgs at edge of parking lot. Trench excavation was widened and deepened until all soils showing contamination above 1,000 ppm by non-dispersive infrared detection (NDIR) field screening were removed.
UST removal and disposal	10,000-gallon UST in the parking lot north of the school contained oily water. Contents pumped out ~660 gallons, and UST cleaned and removed. 6-8 inches of pavement removed; no evidence of petroleum contamination except near fill pipe. No evidence of leaks or deterioration in walls. UST top 2 feet bgs; bottom ~9 feet bgs. Groundwater ~8 feet bgs. Feed and return lines removed to edge of excavation adjacent to loading dock and remaining sections crimped. No product emanating. UST was strapped to concrete pad ~15 by 20 feet.
UST area excavation	• Sandy soils with no staining or petroleum odor. No headspace readings registered. East sidewall had some pockets of contamination at 7-9 feet that were removed. Excavation advanced an additional 3-4 feet into sidewall to depth of 10 feet bgs (2 feet below water table) until NDIR screening showed readings well below 1,000 ppm. North, west, and south sidewalls showed pockets with dark staining at 7-10 feet bgs; TPH field screens exceeding 5,000 ppm. Well 69W-94-11 destroyed. • Additional soils removed below the concrete pad. No field screening TPH concentration above 1,000 ppm. Samples from floor and one from east sidewall sent off-site for EPH/VPH. • Two brass pipes found at 7 feet bgs on south side of the excavation. Found terminated on the west side of the UST location. No free product found.

TABLE 3
REMOVAL ACTION/SITE DETAILS

Action	Description
Hot spot excavation	• RI data showed soil contamination hot spot around well 69W-94-10. Planned to remove 1,200 cubic yards soil at UST and hot spot. Excavated 3,500 cubic yards following soils above 1,000 ppm by NDIR field screening. Pavement removed to the planned boundaries. Soils were field screened at one sample per 15-20 cubic yards. Soils above 4 feet bgs did not exhibit staining, odor, or headspace above 10 ppm. Soils generally contaminated from 5-6 feet bgs to 10-11 feet bgs. Field screened by headspace and NDIR. • Excavation of the floor continued to 2-3 feet below water table. At ~11 feet bgs (2-3 feet below water table), silty soils did not show staining or odor. Confirmed by field screens. Excavation stopped at maximum safe depth of excavation. • South sidewall TPH exceeded 5,000 ppm. Excavation could not be advanced advance because of the building. Contamination appeared concentrated at 7-11 feet bgs, heaviest at 8-11feet bgs. • West side excavation continued beyond the pipe trench until TPH less than 1,000 ppm by NDIR. Confirmatory sidewall samples taken at 5-8 feet bgs for off-site EPH /VPH analyses. In first round, one sample exceeded MCP S1/GW1 standard for C9-C19 aliphatics at 2,200 ppm and for C11-C22 aromatics at 520 ppm. Additional soils excavated; results were below standards for EPH/VPH.
Hot spot excavation	• East side excavation did not advance beyond the loading dock as determined by NDIR field screening. • Excavation on the north side removed visible petroleum contamination on the sidewall to approximately 50 feet northward of wells 69W-94-12 and 69W-94-13. • During excavation, oily sheen developed on groundwater. Sorbent pads and booms were used. Approximately 1,900 gallons of oily water were pumped from the excavation.
Underground pipe investigation	At the conclusion of excavation, the section of pipe remaining under the school building was ~6 inches above the water table (~8 feet bgs). Pipe not discharging anything. The length and direction of the pipe under the building was investigated. Smoke test showed no smoke entering the building. Other tests included introducing soapy water and foam, a video inspection during high water table (very poor visibility), and a high-pressure wash test (no evidence in drains and sumps). Pipe was filled with 5 cubic yards of tremie concrete.
March 1998 Backfilling operations	Samples sent to off-site lab for VOCs, SVOCs, polychlorinated biphenyls, total Resource Conservation and Recovery Act (RCRA) Metals, and TPH. Passed standards. The concrete vault excavation and the underground pipe trench upstream of the vault were backfilled with imported gravel. The remaining excavation backfilled with on-site material.

3.3 REMEDIAL ACTION COMPONENTS / REQUIREMENTS OF THE RECORD OF DECISION

Based on the results from supplemental sampling, the soil removal action, and the RI risk evaluation, no Feasibility Study was performed. The Record of Decision recommended long-term monitoring of groundwater quality with no additional investigation or remedial action.

The Record of Decision for AOC 69W was signed on June 29, 1999. A Limited Action alternative was the selected remedy for groundwater and subsurface soils. It specified the following key components:

- Development of a LTMP to monitor for any potential off-site migration of contaminants and to verify that elevated concentrations decrease over time. Anticipated monitored analytes were arsenic and MADEP EPH/VPH.

- Establishment and enforcement of institutional controls, including deed and/or use restrictions, to restrict or prevent potential human exposure to site soil and groundwater contaminants left in place.

- Performance of five-year reviews to review the data collected and to assess the effectiveness of the remedy.

No remedy design or construction activities were required in the Record of Decision.

3.3.1 Remedial Action Objectives

The remedial action objectives (RAOs) as stated in the Record of Decision are:

- Restore the aquifer to drinking water standards within a reasonable timeframe.
- Monitor potential future migration of groundwater contamination.
- Eliminate risk from potential consumption of groundwater.
- Reduce or eliminate the direct contact threat of contaminated soils.

The RAOs are based on potential health risks to individuals in current and future use scenarios (i.e., maintenance worker and elementary school children scenarios) at the site. Site risk was attributed to arsenic in groundwater used as a potable water source. The rationale for the limited action alternative is:

- The groundwater will not be used as a drinking water source. Because the Town of Devens has a municipal water supply, groundwater poses no threat to human health or the environment.

- The Army will monitor arsenic and EPH/VPH levels in groundwater and will place institutional controls on the property to ensure current and future protectiveness.

4.0 REAL ESTATE ISSUES

4.1 PROPERTY PROPOSED FOR TRANSFER

This OPS document for AOC 69W at the former Fort Devens will be used as part of the transfer documents for the site which is described in Subsection 2.1. The Parker Charter School currently occupies the former Fort Devens Elementary School building at AOC 69W. The property also includes an associated parking lot and adjacent lawn extending approximately 300 feet northwest to Willow Brook.

4.2 DEED RESTRICTIONS AND COVENANTS

CERCLA, Section 120(h)(3) requires that deeds which transfer federally-owned property where hazardous substances were known to have been stored, released, or disposed of, shall contain a covenant warranting that "all remedial action necessary to protect human health and the environment with respect to any [hazardous] substance remaining on the property has been taken before the date of such transfer." CERCLA, Section 120(h)(3) was amended in October 1992 to add language stating that all such action has been taken "*if the construction and installation of an approved remedial design has been completed and the remedy demonstrated to the [EPA] Administrator to be operating properly and successfully.*"

The Army, upon compliance with the requirements of Section 120 of CERCLA, intends to make final disposition of AOC 69W to MassDevelopment. The conveyance document(s) will contain land use controls and restrictions necessary for protection of human health and the environment and to ensure continuation of the Army's remedial activities. These controls and restrictions will be monitored by the Army as part of continuing CERCLA activities. Specifically, the conveyance documents will include language that:

1. restricts the extraction and use of groundwater at AOC 69W for industrial and/or potable use by any current or future landowner;
2. restricts or prevents exposure to soil contaminants within an Excavated Soil Management Area (ESMA);
3. ensures that any grantee, successor and/or assignee shall comply with the institutional controls established in the conveyance documents;
4. requires that any grantee, successor, and/or assignee obtain prior approval from the USEPA, MADEP, and MassDevelopment of any modification to or release of an institutional control;
5. requires proper recording of the institutional controls and any future modifications or release of any institutional controls; and

6. requires annual monitoring and inspection to ensure that the institutional controls are being followed.

The language will be incorporated in full or by reference into any deeds, easements, mortgages, leases, or any other instrument of property transfer as appropriate that transfers any interest in the real property at AOC 69W. Imposition of such controls is a specific requirement of the AOC 69W Record of Decision.

Deeds and other conveyance documents transferring any of the real property comprising AOC 69W will contain access provisions to permit the Army rights of entry to the transferred property for conducting the required long-term monitoring activities. During the execution of long-term monitoring activities, the Army will make note of compliance with, or violations of, land use controls implemented at AOC 69W. Additionally, the 5-year review process under CERCLA will evaluate the effectiveness of and compliance with these controls.

As necessary to comply with CERCLA Section 120(h) and the specific requirements of the AOC 69W Record of Decision, the Army will incorporate the above-described land use controls into draft deeds and other conveyance documents transferring real property comprising AOC 69W. To ensure Army compliance with the Record of Decision, USEPA and MADEP will review these draft deeds and other conveyance documents to verify that the necessary land use controls are incorporated into them. USEPA and MADEP involvement in the conveyance preparation by the Army, including deeds, is guaranteed through the following process:

- The Fort Devens Federal Facility Agreement (FFA), Section 37, which requires that a copy of the proposed deed or other conveyance document used in any real property transaction relating to Fort Devens will be provided to USEPA and the Commonwealth for review and comment so that USEPA and the Commonwealth can verify that the provisions of FFA Section 37 have been included in the transfer document.

- Massachusetts General Law (M.G.L.) 21E.

4.2.1 Institutional Control Inspection

Existing land use and site conditions will be evaluated as part of the long term monitoring program to ensure that the institutional control requirements are being met. If the future proposed land use at AOC 69W is inconsistent with these institutional controls, then the site exposure scenarios for human health and environmental risk will be re-evaluated to ensure that this response action is appropriate. Inspections will be performed at the same frequency as the groundwater monitoring, but in no instances less than once every year. Institutional control inspections will include the checklist components described in the following paragraphs.

Institutional Control Inspection Interview.

The monitoring crew will contact the property owner of the site, its manager, or other designee with knowledge of the day-to-day activities of the property to make arrangements for groundwater sampling and to review compliance with the institutional controls. As part of the review, the monitoring crew will inquire regarding:

1. The owner's familiarity regarding institutional controls imposed upon the property and documentation of these controls.
2. Excavations (planned or emergency) that may have extended to soils below 2 feet in depth north of the school within the ESMA, and if excavations did occur, were they performed in accordance with an Excavated Soils Management Plan that defines the precautionary measures to be taken to minimize risk to human health and the environment.
3. Source of public drinking water for the property.
4. Proposed plans for property sale, future redevelopment, construction or demolition activities at the site.

Institutional Control On-Site Inspection.

After the monitoring crew has contacted the property owner, groundwater monitoring will be performed as well as a physical on-site inspection of the property to determine compliance with the institutional controls. The physical on-site inspection shall include examination for evidence that:

1. No groundwater extraction wells have been installed on the premises.
2. No penetrations are evident through the pavement within the ESMA.
3. No repaved cut marks exist in the pavement within the ESMA that have not otherwise been identified and properly documented by the property owner.

After the inspection is complete, the Army will provide a copy of the annotated inspection checklist, a written summary of the findings and all supporting documentation to the Devens Enterprise Commission, USEPA, MADEP, and Mass Development. This inspection report will be transmitted with the annual report. The inspection report shall explain the basis of any known or suspected violation identified during the inspection.

4.3 ADJACENT PROPERTIES

The Zoning Map maintained by the Devens Enterprise Commission identifies AOC 69W within the Gateway II Verbeck Zoning district (DEC, 2003). The primary goal of this zoning district is to provide for a range of cultural, educational, institutional, and open space/recreational uses that will serve as a distinct entryway and point of arrival for Devens. Permitted uses in this zoning district include the following:

- Office, small-scale (less than 40,000 square feet);
- Cultural;
- Conference;
- Academic/Institutional/Civic;
- Municipal Uses; and
- Dormitories (Group Residence).

This zoning district is also designated for the following accessory usage:

- Small-scale Retail: Accessory Use; and
- Single or Two Family Dwelling.

Currently, the Shriver Job Corps Center is located within the Gateway II Zone, north of AOC 69W.

The Gateway II district is bounded on the north by West Main Street in Ayer, on the east by Shepley's Hill, on the south by Antietam Street, and on the west by MacArthur Avenue. Bordering land use to the east, southeast and west is designated as "open space and recreation" on the Zoning Map. The Zoning Map identifies Zoning District 11 southwest of AOC 69W (south of Antietam Street). Zoning District 11 is designated for Residential II use. The Residential II uses include residential and municipal use and small-scale office and home office accessory use. Property immediately north of West Main Street is not owned/controlled by the Army.

5.0 DEMONSTRATION OF OPERATING PROPERLY AND SUCCESSFULLY

The objective of this OPS demonstration is to document that construction and implementation of the Limited Action remedy is complete, and that it is operating "properly" (i.e., operating or being performed as designed) and "successfully" (i.e., its operation will achieve the cleanup levels or performance goals delineated in the Record of Decision).

5.1 CONSTRUCTION AND IMPLEMENTATION OF REMEDY IS COMPLETE

The USEPA OPS Guidance identifies criteria to consider when evaluating the proper and successful operation of groundwater remedies. The remedy for AOC 69W consists of the implementation of long-term monitoring, institutional controls, and five-year reviews. Therefore, the remedy was compared to the requirements for natural attenuation groundwater remedies, presented in Appendix A.2 - Natural Attenuation Groundwater Remedies, of the USEPA OPS Guidance (USEPA, 1996), as presented in the following subsections.

5.1.1 Source Control is Complete

The Record of Decision required no remedy design and construction, but rather required a LTMP that includes the evaluation of the institutional controls. A Time-Critical Removal Action was performed in 1998, prior to drafting of the Record of Decision, to address source area contamination (refer to subsection 3.2). The removal action included the excavation of approximately 3,500 cubic yards of petroleum-contaminated soil, and the removal of a 10,000-gallon fuel oil UST, the oil recovery system's 250-gallon vault, and associated piping.

At the conclusion of excavation, a section of pipe associated with the source area remained under the on-site school building. The length and direction of the pipe under the building was investigated. Smoke test showed no smoke entering the building. Other tests included introducing soapy water and foam, a video inspection during high water table (very poor visibility), and a high-pressure wash test (no evidence in drains and sumps). The pipe was then filled with five cubic yards of tremie concrete.

Confirmation samples sent were sent off-site for VOC, SVOC, polychlorinated biphenyl, total RCRA metals, and TPH analysis. All samples passed applicable standards. The concrete vault excavation and the underground pipe trench upstream of the vault were

backfilled with imported gravel. The remaining excavation area was backfilled with clean on-site material.

5.1.2 Natural Attenuation is Occurring

The USEPA OPS Guidance identifies the following three categories of evidence for supporting natural attenuation:

- Contaminant levels have been reduced as expected, the estimated rate of contaminant loss has been established, and the plume is stable or retreating;
- Intermediate degradation products and associated toxicity changes are present; and
- Geochemical factors associated with contaminant degradation indicate remediation.

The contaminants of concern (COCs) for this site are VPH, EPH, arsenic, and manganese. Iron is no longer a COC, as recommended in the first Five-year Review Report (HLA, 2000b). Although SVOCs were not COCs for the site, the SVOC bis(2-ethylhexyl)phthalate was initially analyzed for in wells ZWM-95-17X and ZWM-99-22X. This compound was detected in some of the 1996 RI samples, and additional analyses for this analyte were performed to determine if its presence was site related. Initial results suggested its presence was not site related, and it was eventually dropped from future testing rounds. Table 4 presents the groundwater sample analyses and procedures for the long-term monitoring program.

TABLE 4
GROUNDWATER SAMPLE ANALYSIS AND PROCEDURE

ANALYSIS	METHOD NO
EPH	MADEP [1]
VPH	MADEP [2]
Manganese	USEPA Method 200.7
Arsenic	USEPA Method 206.2

TABLE 4
GROUNDWATER SAMPLE ANALYSIS AND PROCEDURE

ANALYSIS	METHOD NO
Field Parameters	
pH	Field Measured
Temperature	Field Measured
Specific Conductance	Field Measured
Dissolved Oxygen	Field Measured
Oxidation Reduction Potential	Field Measured
Turbidity	Field Measured

[1] MADEP Method for the Determination of Extractable Petroleum Hydrocarbons. Only carbon fractions are to be reported.

[2] MADEP Method for the Determination of Volatile Petroleum Hydrocarbons. Only carbon fractions are to be reported.

Note: Analyses for bis(2-ethylhexyl)phthalate initially conducted to assess if previous detections were site-related or a sampling/laboratory artifact. Analyses performed in monitoring wells ZWM-99-22X and ZWM-95-17X. Analyte dropped from COC list after initial results were reviewed.

Nine monitoring wells, including a background well, four source-area wells, and four sentry wells, were initially incorporated in the long-term groundwater monitoring program. In the May 2000 sampling round, results for well ZWM-96-19X (boiler room) continued to be below cleanup goals and the well was dropped from further monitoring in accordance with the LTMP. Two new sentry wells (ZWM-01-25X and ZWM-01-26X) were installed in October 2001, after results from sentry well ZWM-99-23X showed exceedences that negated its function as a sentry well. The monitoring wells which have been incorporated in the long-term monitoring program are presented in Table 5.

TABLE 5
LONG-TERM MONITORING WELLS

MONITORING WELL	LOCATION	RATIONALE	COMMENTS
XWM-95-17X (4" I.D.)	Southeast of school	Background well.	
ZWM-99-22X (2" I.D.)	Paved source area	Source area well. Replacement well for former source area well 69W-94-10. Monitor for decrease in COC concentrations.	
69W—94-13 (2" I.D.)	North of paved area near source area	Source area well. Monitor for decrease in COC concentrations.	
69W-94-14 (2" I.D.)	Approximately 30 feet upgradient of Willow Brook wetlands	Source area well. Monitor for decrease in COC concentrations and decrease in the potential for off-site migration.	
ZWM-96-19X (2" I.D.)	Located within "new" boiler room	Source area well. Monitor for decrease in COC concentration and decrease in the potential for off-site migration.	Results below COC MCLs, well dropped from program after May 2000
ZWM-95-15X (4" I.D.)	Near former underground concrete vault	Sentry well. Monitor for decrease in COC concentration and decrease in the potential for off-site migration.	
ZWM-95-18X (4" I.D.)	Approximately 120 feet downgradient of the concrete vault	Sentry well. Monitor for off-site migration.	
ZWM-99-23X (2" I.D.)	Downgradient well northeast of 69W-94-14	Sentry well. Monitor for decrease in COC concentration and decrease in the potential for off-site migration.	Exceedences of COC detected throughout LTMP, no longer a valid sentry well

TABLE 5
LONG-TERM MONITORING WELLS

MONITORING WELL	LOCATION	RATIONALE	COMMENTS
ZWM-99-24X (2" I.D.)	Downgradient well east of Willow Brook and southwest of 69W-94-14	Sentry well. Monitor for potential for off-site migration.	
ZWM-01-25X	Downgradient well northeast of 69W-94-14	Sentry well. Monitor for potential for off-site migration.	Installed in October 2001 after COC exceedences detected in ZWM-99-23X
ZWM-01-26X	Downgradient well northeast of 69W-94-14	Sentry well. Monitor for potential for off-site migration.	Installed in October 2001 after COC exceedences detected in ZWM-99-23X

The results of long-term groundwater monitoring are presented numerically in Table C-1 and graphically in Graphs C-1 through C-12. Those wells that exhibited only nondetects or estimated values near the detection limit are not presented graphically. Additionally, Table D-1 and Graphs D-1 through D-6 present the results field parameter measurements from the long-term groundwater monitoring program.

The Mann-Kendall test for trend (Kendall, 1975) has been applied to the data for the principal COCs presented in Graphs C-1 through C-12 (see Table E-1) and to dissolved oxygen and oxidation-reduction potential data for the monitoring wells presented in Graphs C-1 through C-12 (see Table E-2).

A minimum of four data points are required for conducting a Mann-Kendall test for trend and be statistically significant at the 95-percent confidence level. For each set of data ordered in time, the Mann-Kendall statistic (S) is calculated by comparing each data value to subsequent data values. Starting with the first data point, each subsequent data point is compared to the baseline value, and each comparison is assigned a value of 1 (greater than the baseline point), 0 (equal to the baseline point), or -1 (less than the baseline data point), whereby a set of values is calculated for each individual data point. This evaluation is completed for each data point in turn, with the maximum possible contribution to the total S-value consequently decreasing with each subsequent comparison. All calculated values are then summed, and the resulting value is the S value. The S value is either negative,

positive, or possibly zero, and indicates the potential for a decreasing trend (negative S value) or increasing trend (positive S value). The Mann-Kendall test probability (p) is then obtained from published tables for the unique number of data points and the unique calculated S value. This p-value is the probability that the S value was calculated in the absence of a true trend (the null hypothesis of the test is no trend). For the S-statistic to indicate a statistically significant trend, some level of confidence must be selected, and the value of S must be sufficiently high that the null hypothesis of no trend is rejected.

For purposes of this evaluation, a confidence level of 90 percent or greater (p-value <0.1) is considered indicative of a high confidence level for trend. The probability of no trend, p, has been determined for the available data. Results of the statistical trend analysis do not result in rejection of the null hypothesis of no statistically significant trend (i.e., eleven of fifteen tests not statistically significant at the 90 percent confidence level [see Table E-1]); see following discussion. Of the four tests showing statistically significant trends, three were downward.

Evidence of Contaminant Level Reduction

The monitoring wells incorporated in the LTMP, with the exception of source wells 69W-94-13 and ZWM-99-22X, are currently attaining cleanup goals for EPH and VPH. EPH concentrations in well ZWM-99-22X exceed the EPH aromatic C11 - C22 cleanup goal of 200 micrograms per liter (µg/L), but have decreased substantially (2,500 down to 400 µg/L) and show a decreasing trend with a high level of confidence (probability of 97 percent).

VPH concentrations in 69W-94-13 and ZWM-99-22X currently exceed the VPH aromatic C9-C10 cleanup goal of 200 µg/L, though concentrations of VPH aromatic C9-10 have historically been below criteria at times in both of these wells. The concentration of VPH aromatic C9-C10 in 69W-94-13 is currently only slightly above the cleanup goal of 200 µg/L (230 µg/L), and well within the concentration fluctuation range that has been historically evident at this well. The concentration of VPH aromatic C9-C10 in ZWM-99-22X increased from 150 to 840 µg/L in May 2003 after three consecutive monitoring events below the cleanup goal, but has been decreasing in subsequent monitoring events.

Four monitoring wells, 69W-94-13, ZWM-99-22X, ZWM-95-15, and ZWM-99-23X exceed the 10 µg/L cleanup goal for arsenic. Statistical trend analysis for arsenic data did not result in rejecting the hypothesis of no trend.

Four monitoring wells continue to show exceedences of the manganese cleanup goal. These monitoring wells are the same four wells that show arsenic exceedences. Additionally, the current concentration of manganese in monitoring well ZWM-01-25X is equivalent to the health advisory value of 300 µg/L. Manganese data for one of these wells, ZWM-95-15X, exhibits a decreasing trend with a high level of confidence (probability of 92 percent).

The presence of arsenic and manganese in groundwater at AOC 69W is caused by reductive dissolution from overburden soils as a result of the aerobic biodegradation of hydrocarbons, and concentrations should decrease after fuel degradation is complete.

Intermediate Degradation Products and Associated Toxicity Changes

Hydrocarbons degrade through a series of steps to methane, and eventually carbon dioxide and water. These associated intermediate and final degradation products do not exhibit any increases in toxicity or mobility which would present a risk to human health and the environment and are not monitored in the long-term monitoring program. The elements arsenic and manganese do not degrade. Dissolved arsenic and manganese will return to the soil matrix following the return and establishment of aerobic conditions to the source area groundwater which reduces the solubility of these metals.

Geochemical Indicators of Degradation

The presence of arsenic and manganese in groundwater at AOC 69W is attributed to the mobility characteristics of these elements, which are strongly affected by compound solubility, pH, soil cation exchange capacity, soil type, oxidation-reduction potential, adsorption processes, major ion concentrations, and salinity. Relative to other inorganic elements, arsenic and manganese are considered moderately mobile under reducing conditions (low dissolved oxygen and oxidation-reduction potential).

As discussed above, the presence of arsenic and manganese in groundwater at AOC 69W results from by reductive dissolution from overburden soils as a result of the aerobic biodegradation of hydrocarbons, resulting in the consumption of dissolved oxygen and other electron acceptors. This interpretation is supported by the low in-situ measurements of dissolved oxygen and low or negative oxidation-reduction potential readings in source area groundwater. Monitoring data show the on-going cleanup of fuel at AOC 69W, and arsenic and manganese concentrations should decrease after fuel degradation is complete.

Processes that will control the fate of the fuel-related COCs at AOC 69W include volatilization, advection/dispersion, and biodegradation. Naturally occurring soil microorganisms capable of degrading hydrocarbons in groundwater rely on dissolved oxygen and other electron acceptors, the later of which can facilitate degradation under anaerobic conditions once dissolved oxygen is depleted. As the hydrocarbons are mobilized by dissolution from the soil, they are likely to be rapidly degraded as long as dissolved oxygen and sufficient microorganisms are available. As indicated in the previous paragraph, EPH and VPH concentrations generally show a decreasing trend. Dissolved oxygen concentrations in the source area have been generally low, on average less than 1 milligram per liter (mg/L), but have exhibited upward fluctuations during the course of the long-term groundwater monitoring. The upgradient monitoring well

(ZWM-95-17) has exhibited an average dissolved oxygen concentration of greater than 7 mg/L, and is considered representative of upgradient groundwater which provides dissolved oxygen recharge to the source area. The average oxidation-reduction potential value taken from source area wells is 48 millivolts (mV), compared to 265 and 247 mV, respectively, from sentry and upgradient monitoring wells.

The continued degradation of fuel-related COCs in monitoring wells 69W-94-13 and ZWM-99-22X is dependent on the continued transport of dissolved oxygen from upgradient locations. Evidence of a return to aerobic conditions is supported by a high level of confidence for an upward trend for oxidation-reduction potential at source area monitoring wells 69W-94-13and 69W-94-14, at 95 and 99 percent, respectively (refer to Table E-2). Dissolved oxygen values average over 7.2 mg/L in sentry and upgradient monitoring wells.

5.1.3 Institutional Controls / Deed Covenants Are In-Place

Institutional controls have been enacted to ensure that the remaining contaminated soils beneath and adjacent to the building are controlled and the extraction of groundwater from the site for industrial and/or potable water supply is not permitted. They are to be incorporated either in full or by reference into all deeds, easements, mortgages, leases or any other instruments of transfer prior to the transfer of the property to MassDevelopment. In the CERCLA five-year review process, existing land use is evaluated to ensure control requirements are being met.

The Parker Charter School currently occupies the property. MassDevelopment supplies potable water to the school. USACE long-term monitoring staff has observed no excavations within the ESMA (Figure 6) during any long-term sampling event. In addition, no penetrations through the pavement or re-paved pavement cut marks have been observed within the ESMA. No groundwater extraction wells have been installed on the site.

5.1.4 LTMP Has Been Implemented

The required LTMP was approved and semi-annual long-term monitoring initiated in May 2000. The monitoring is conducted on a semi-annual basis, in November and April of each year. Annual reports are submitted in May of each year. The USACE sampling team reports institutional control results in each semi-annual and annual report. The first review was performed in September 2000. The LTMP specified sampling of nine groundwater monitoring wells (four source-area wells, four sentry wells, and one background well) to monitor for off-site migration of COCs and to verify that COCs decrease over time (refer to Table C-1). In addition, source-area monitoring well ZWM-96-19X, located within the new boiler room, was included in the first round of

monitoring. One monitoring well has been removed from the LTMP since it was initiated, and two have been added.

5.1.5 Other Criteria Considered

The USEPA OPS Guidance (USEPA, 1996) requires that possible impacts to surface water, if applicable, be incorporated in this evaluation. Willow Brook is located approximately 300 feet northwest of the Parker Charter School at AOC 69W, and groundwater flow is generally in this direction. A narrow "extension" of the 1998 Time-Critical Removal Action reached as far as Willow Brook, extending past the 250-gallon underground vault. The monitoring wells ZWM-95-15X and ZWM-95-18X, a subset of monitoring wells designated as sentry wells in the LTMP, are located in this area, upgradient of Willow Brook. Results of the long-term groundwater monitoring indicate that with the exception of manganese in ZWM-95-15X, no COCs exceed cleanup goals in these wells.

5.2 REMEDY IS OPERATING PROPERLY AND SUCCESSFULLY

Subsection 5.1 provides evidence that the Limited Action remedy is operating "properly and successfully", including that the monitoring data provide evidence that natural attenuation is occurring, sampling procedures are being followed as described in the LTMP such that natural attenuation is reliably monitored, and that appropriate institutional controls are in place. Additionally, USEPA interprets the term "operating properly and successfully" to mean that the remedy is functioning in such a manner that it is expected to adequately protect human health and the environment when completed. This subsection provides discussion of the remedies protectiveness of human health and the environment, the enforceability and reliability of the components of the remedy, and the adequateness of the current site characterization.

5.2.1 Risk to Public Health and Environment

The results of the Human-Health Risk Assessment (HLA, 1998), completed after the 1998 removal action, show that under current land use conditions the estimated excess carcinogenic risks for exposure of a child trespasser and site maintenance worker to soil, sediment, and groundwater were within the USEPA acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. Similarly, potential non-cancer risks do not exceed the USEPA hazard index (HI) threshold value of 1. Estimated excess carcinogenic risks under future land use conditions were evaluated for a pupil (exposure to surface soil, sediment, groundwater, and indoor air) and utility worker (exposure to surface soil and subsurface soil). The excess carcinogenic risk for a pupil is within the USEPA acceptable risk range while the utility worker risk was less than the USEPA threshold level of $1x10^{-6}$. Again, potential non-cancer risks do not exceed the USEPA HI threshold value of 1.

The risk assessment evaluated the indoor air exposure pathway to identify areas of the building where the presence of constituents detected in indoor air could be attributable to migration from subsurface soil and/or groundwater beneath the school. The analysis provided evidence that the presence of the constituents detected in air throughout the building is likely attributable to ambient and anthropogenic sources inside and outside the building, and is not attributable to subsurface fuel oil contamination beneath the building. The risk assessment attributed detections of 2-methylheptane, xylenes, and ethylbenzene in air samples collected from the library and an adjacent classroom to sources within the building (e.g., carpeting, paint, adhesives, and fuel oil leaks in the new boiler room); however, a possible association between the presence of these constituents in air samples from these rooms and the soil in the vicinity of that area of the building could not be ruled out. Although these three analytes may be the only indoor air contaminants potentially associated with subsurface fuel oil contamination, all analytes detected in indoor air samples were evaluated in the risk assessment in order to provide a conservative assessment of potential exposures.

The USEPA performed independent indoor air sampling in April 1998, and, in general, identified a similar profile of chemicals in indoor air. However, analytes were generally detected at concentrations considerably lower than those detected in the RI sampling effort. Most notably, toluene was detected at only 2 micrograms per cubic meter ($\mu g/m^3$) in the USEPA samples compared to 1000 $\mu g/m^3$ in the RI samples, ethylbenzene at only 0.5 $\mu g/m^3$ in the USEPA samples compared to 470 $\mu g/m^3$ in the RI samples; nonane and octane were not detected in the USEPA samples, whereas other fuel-related constituents (e.g., decane, dodecane, and trimethylbenzene) were detected at concentrations below 1 $\mu g/m^3$. Methylpentane was detected at 170 $\mu g/m^3$ in the USEPA samples, but was not detected in the RI samples. Methylnaphthalene and naphthalene, which were associated with rejected data in the RI samples, were detected at concentration up to 1.4 $\mu g/m^3$ in the USEPA samples.

Given this information, it appears that the RI sampling effort provided a conservative assessment of the potential concentrations of indoor air constituents. Evaluation of the maximum detected concentrations in indoor air samples collected during the RI sampling effort as the Exposure Point Concentrations in the risk assessment provided a conservative assessment that is unlikely to underestimate potential risks to future pupils that may use the school.

Historical groundwater data from the time of the risk assessment was compared to groundwater data collected during long-term monitoring. The long-term monitoring program does not include collection of groundwater samples from beneath the building. However, comparison of VPH data from ZWM-99-22X to the October 1996 data (refer to Table 4 of Appendix O-1, the Vapor Migration Pathway Analysis of the Human Health Risk Assessment [HLA, 1998]) from former monitoring well 69W-94-10 during the time of the indoor air evaluation (69W-94-10 was located in the vicinity of existing well ZWM-99-22X, the closest well to the building of wells monitored under the current

program) indicates a concentration of 790 µg/L during the time of the indoor air sampling compared to a concentration of 600 µg/L in October of 2004. The concentrations of groundwater contaminants near the building have decreased since the risk assessment, indicating that the risk assessment's indoor air evaluation results remain valid.

There is and was no current use of groundwater at AOC 69W; therefore, the risk assessment evaluated potential risks associated with future residential potable use. Estimated cancer and non-cancer risks associated with this hypothetical future exposure exceeded levels generally considered acceptable by the USEPA, primarily as a result of the presence of arsenic in groundwater. The arsenic concentrations that contributed the greatest to excess risk were from monitoring wells 69W-94-10 and 69W-94-13. Monitoring well 69W-94-10 was excavated during the 1997-1998 soil removal action along with contaminated soils surrounding it and immediately upgradient of 69W-94-13. Review of historical groundwater data for 69W-94-13 from September 1994 and November 1995 (see Tables 7-7 and 7-15 of the RI report [HLA, 1998]) shows arsenic concentrations of 400 µg/L and 250 µg/L (filtered), respectively, substantially greater than subsequent concentrations to date. Although a statistically significant trend was not identified for 69W-94-13 based on data collected during the long-term monitoring program (see Subsection 5.1.2), arsenic concentrations are anticipated to further decrease from historical levels because of the contaminated soil removal. The historical arsenic levels used in the risk assessment are, therefore, believed to represent a conservative evaluation of potential risk.

There was no Feasibility Study, and the Record of Decision did not specify a timeframe for groundwater restoration (i.e., attaining cleanup goals). The components of the selected Limited Action remedy are institutional controls, long-term groundwater monitoring, and five-year reviews. The stated expected outcome of this alternative is restoration of the aquifer to drinking water standards within a "reasonable time frame."

The RAOs presented in the Record of Decision were based on potential health risks to individuals in current and future use scenarios (i.e., maintenance worker and elementary school children scenarios) at the site. Site risk was attributed to arsenic in groundwater used as a potable water source. The rationale for the limited action alternative was:

- The groundwater will not be used as a drinking water source. Because the Town of Devens has a municipal water supply, groundwater poses no threat to human health or the environment.

- The Army will monitor arsenic and EPH/VPH levels in groundwater and will place institutional controls on the property to ensure current and future protectiveness.

Based on the conclusions of the ecological risk assessment, there are no unacceptable risks associated with site-related fuel oil contamination at AOC 69W.

5.2.2 Enforceability

In the event the Devens Enterprise Commission, USEPA, MADEP, Mass Development, and/or the Army determines that any owner of, and/or tenant at, is not complying with the institutional controls, then such party shall provide written notice to the owner and the other parties of such alleged violation. Upon such determination or notification the Devens Enterprise Commission, USEPA, MADEP, Mass Development, and/or the Army may take independent enforcement action against such owner and/or tenant pursuant to any federal, state, or local law, regulation, rule, permit, policy, and/or Record of Decision. Failure by the Devens Enterprise Commission, USEPA, MADEP, and/or Mass Development to provide such notification to the Army shall not give rise to any defense either in law or in equity in any cost recovery action or other action arising out of such noncompliance.

5.2.3 Technology Reliability

The Record of Decision required no remedy design and construction, and therefore does not rely upon remedial technologies. Rather, the remedy consists of long-term monitoring and institutional controls.

The USACE sampling team inspects the monitoring wells and the physical features of AOC 69W during each round and states any significant observations in each annual report. No discrepancies or concerns have been noted.

The Army has provided documentation verifying the institutional control and long-term monitoring remedy components are established in the annual reports, and USEPA/MADEP has concurred.

The Army evaluates the quality of performance data for each sampling event and provides data quality evaluations in the annual reports. There are checks on field quality control (QC) procedures, and chemists review the primary laboratory's data and evaluate quality assurance (QA) sample results. All VPH and metals comparisons have been in good overall quantitative agreement to date. A discrepancy was detected between the primary and QA laboratories' EPH results because of different methodologies. The primary laboratory's method appears to be more sensitive and the resulting concentrations may be biased high. The methods were investigated and both were considered valid. However, to be consistent with the QA laboratory's method, beginning in the November 2002 sampling round, the EPH analyses were subcontracted to Woods Hole Group (Raynham, MA), and the analyses were done using the standard gas chromatograph/flame ionization detector (GC/FID) method. Since that time, the EPH results shown in the data tables are those derived using the GC/FID method.

The Army's sampling team leader observes site conditions around the school during each semi-annual event ensuring that the institutional controls are being met. Observations were included in the annual reports. No excavations were observed within the ESMA, confirming continued protection against exposure to remaining contaminated soils. The school is served by a public water supply system. Existing land use is evaluated in the five-year review process to ensure institutional control requirements are being met. The current tenant is abiding by the institutional controls imposed on the property.

5.2.4 Site Characterization

Numerous investigations conducted between 1993 and 1998, including document reviews, site visits, an SI, an RI, and an extensive removal action, have provided thorough characterization of AOC 69W. Furthermore, long-term groundwater monitoring initiated in 2000 as a component of the Limited Action remedy, enters its sixth year of semi-annual monitoring, consisting of sampling and analysis for COCs in ten monitoring wells. No further information is required to characterize AOC 69W.

6.0 CONCLUSIONS / CERTIFICATION

Based upon the information presented in this report, the Army concludes that the remedial actions selected for AOC 69W at Fort Devens, Devens, Massachusetts, are operating properly and successfully, consistent with the provisions of CERCLA, Section 120(h)(3). This conclusion is based on the following lines of evidence:

- The remedy for AOC 69W has been implemented as designed.
- The remedy will achieve the RAOs listed in the Record of Decision.
- The remedy is functioning in such a manner that it is expected to adequately protect human health and the environment when completed.
- Institutional controls have been enacted to provide further protection to human health.

In summary, the selected remedy of Limited Action, consisting of long-term monitoring, institutional controls, and five-year reviews, will continue to keep risks from exposure to arsenic and petroleum hydrocarbons at low, acceptable levels, protective of human health and the environment. In addition, this remedy meets federal and state requirements that are applicable or relevant and appropriate.

FIGURES

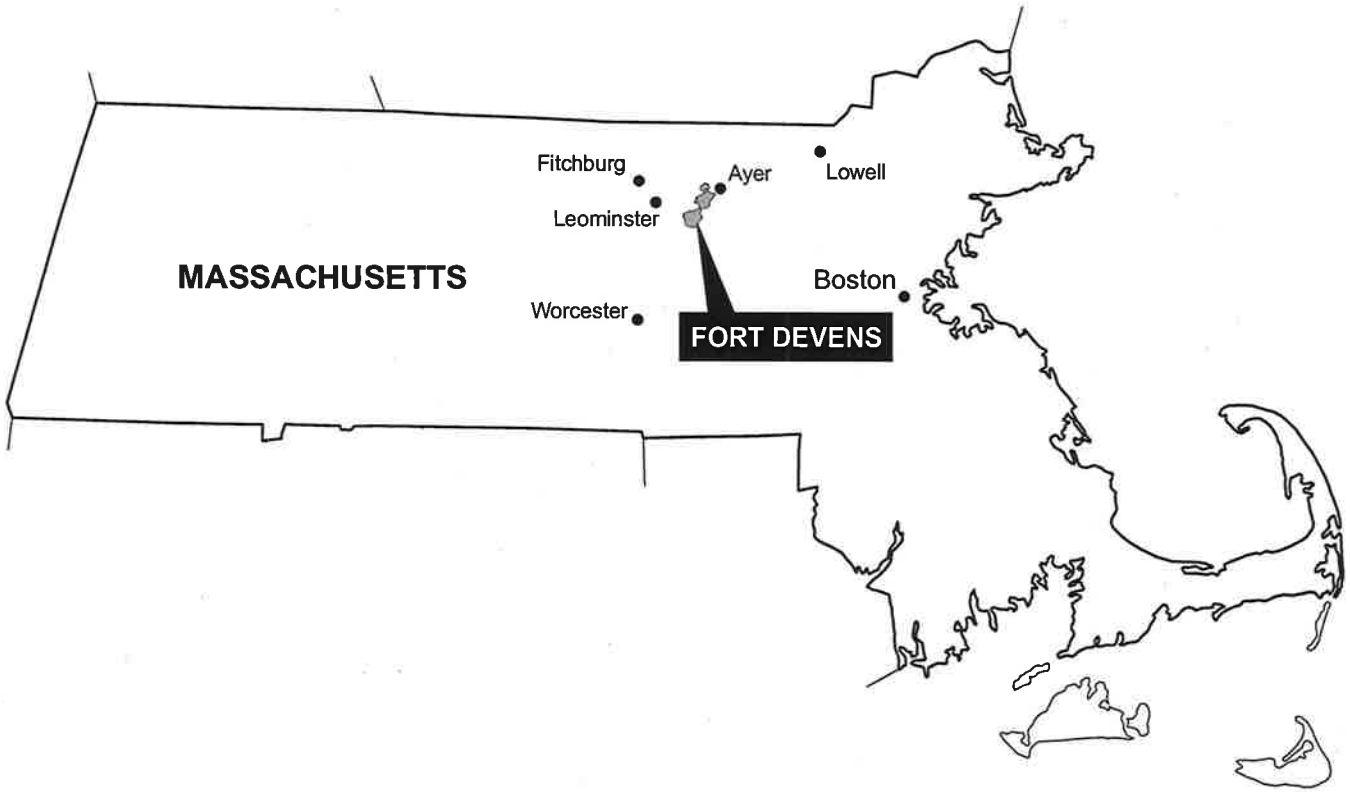

FIGURE 1
LOCATION OF FORMER FORT DEVENS
AOC 69W OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
DEVENS, MA

PREPARED/DATE:	PL 05/26/04
CHECKED/DATE:	SR 05/26/04

MACTEC

W2004018b.cdr

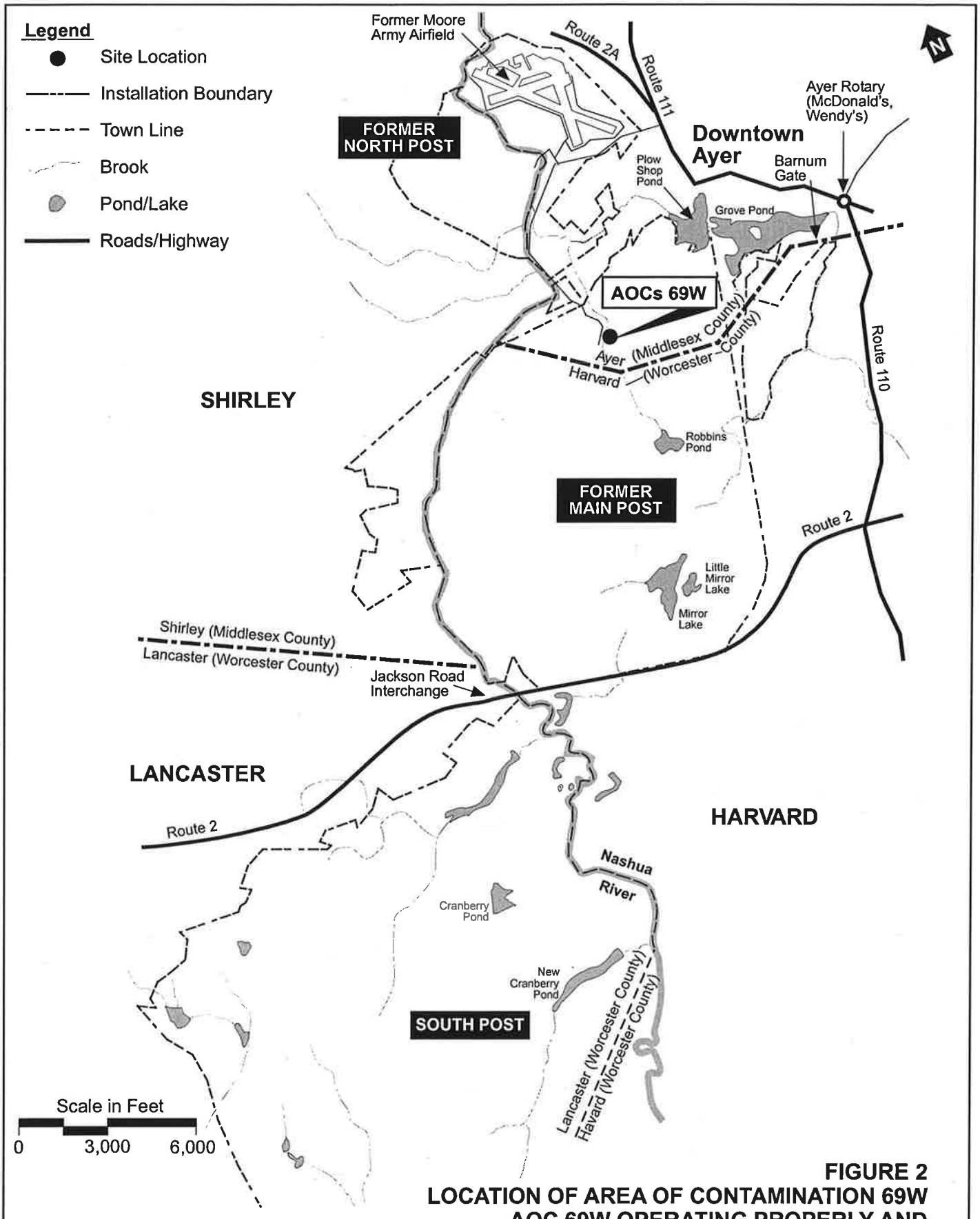

FIGURE 2
LOCATION OF AREA OF CONTAMINATION 69W
AOC 69W OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
DEVENS, MA

PREPARED BY/DATE	PL 05/26/04
CHECKED BY/DATE	SR 05/26/04

MACTEC

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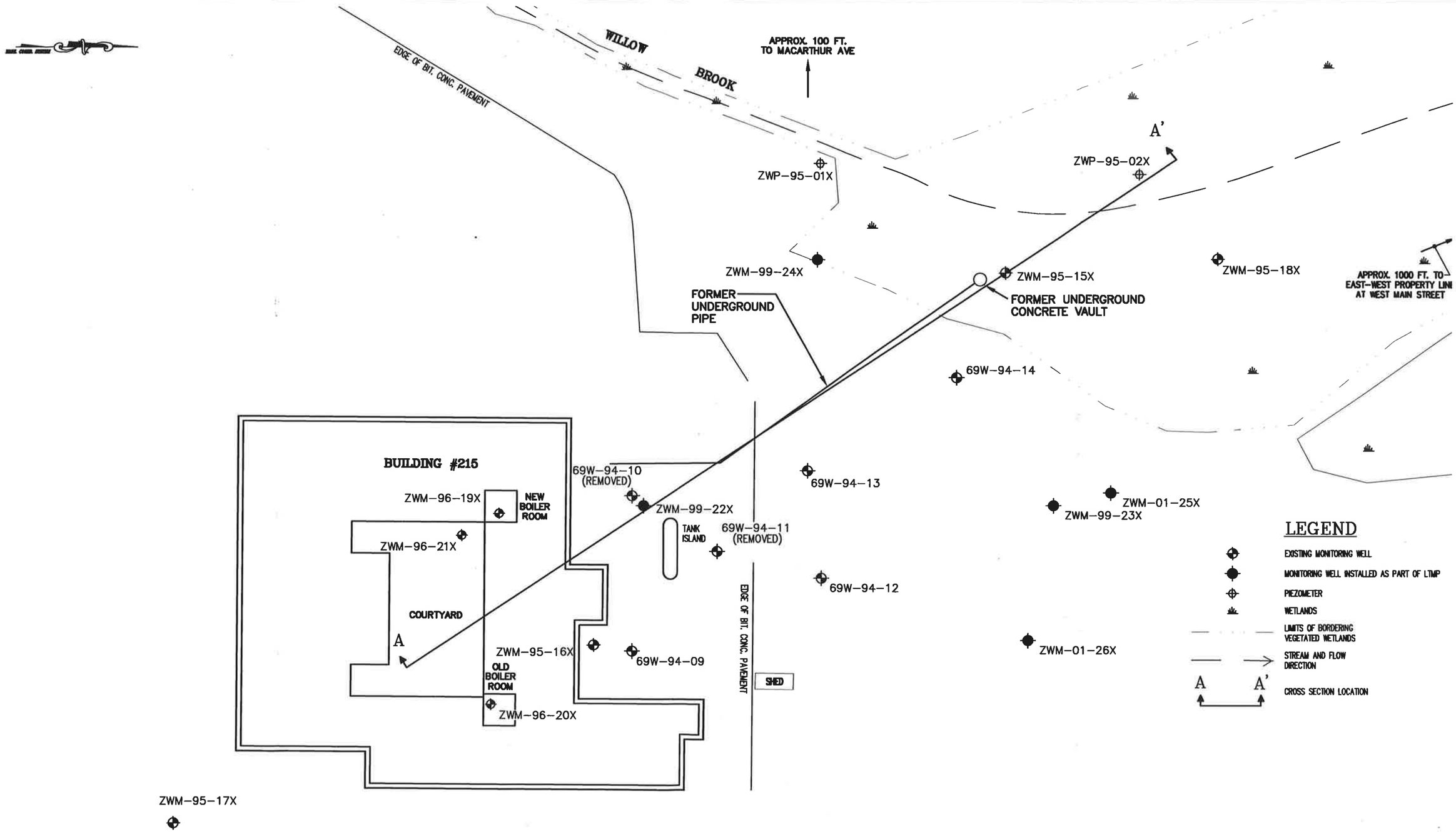

PREPARED/DATE:	RHH/05-31-05
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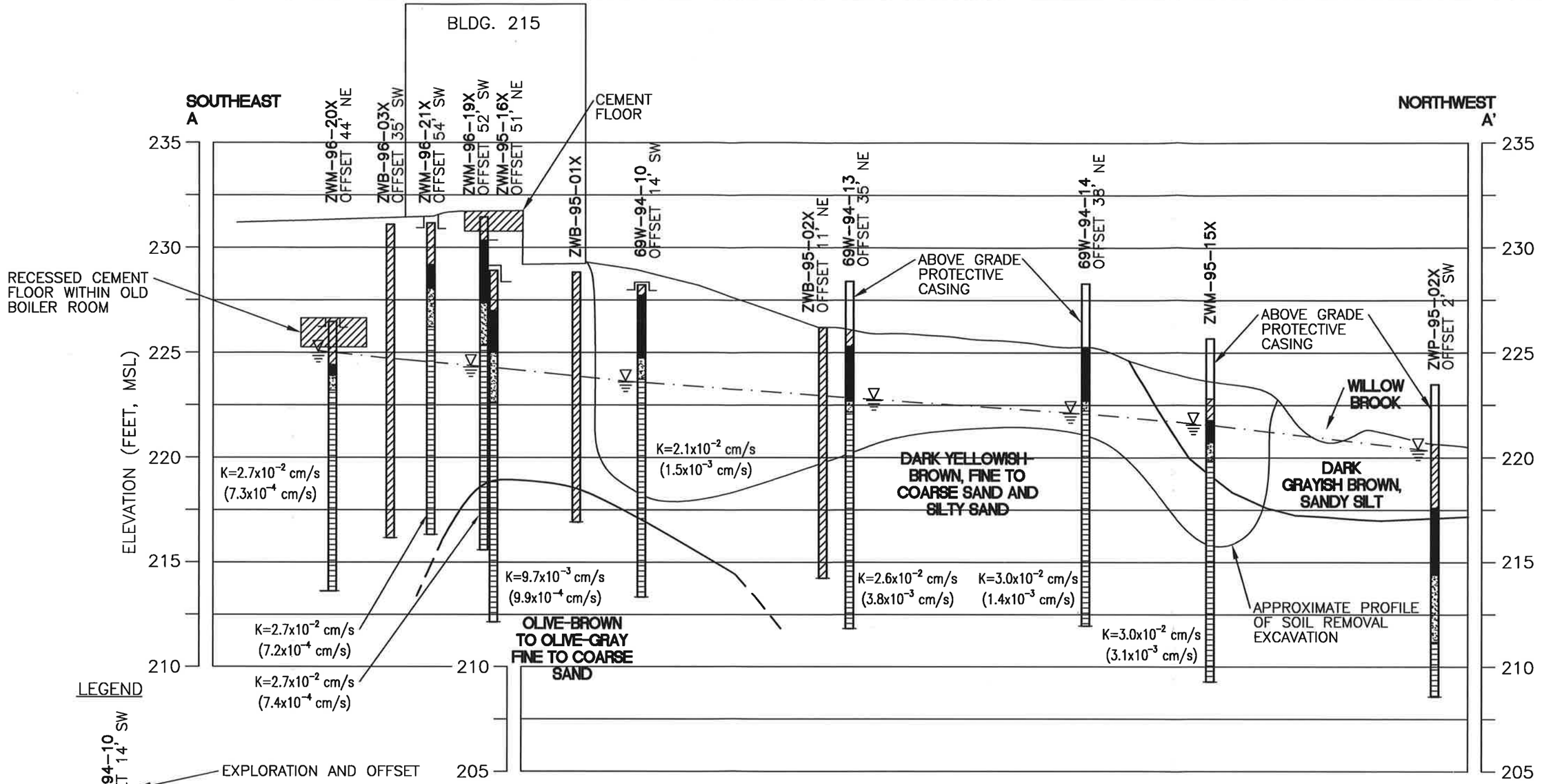
FIGURE 3
AOC 69W SITE MAP
AOC 69W OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
DEVENS, MA
MACTEC



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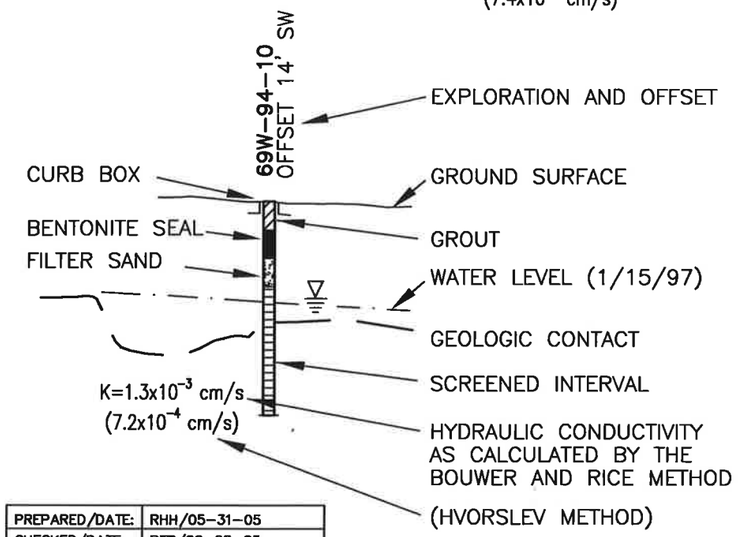

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CROSS SECTION A - A'

NOTES:

1. FOR ORIENTATION OF CROSS SECTION, SEE FIGURE 3.
2. GEOLOGIC CONDITIONS BETWEEN WELLS ARE AN INTERPRETATION OF AVAILABLE DATA. ACTUAL CONDITIONS MAY VARY.
3. MSL = MEAN SEA LEVEL

0 50 100

HORIZONTAL SCALE: 1"=50'
VERTICAL SCALE: 1"=5'
VERTICAL EXAGGERATION: 10:1

FIGURE 4
INTERPRETIVE GEOLOGIC CROSS SECTION A-A'
AOC 69W OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
DEVENS, MA
MACTEC

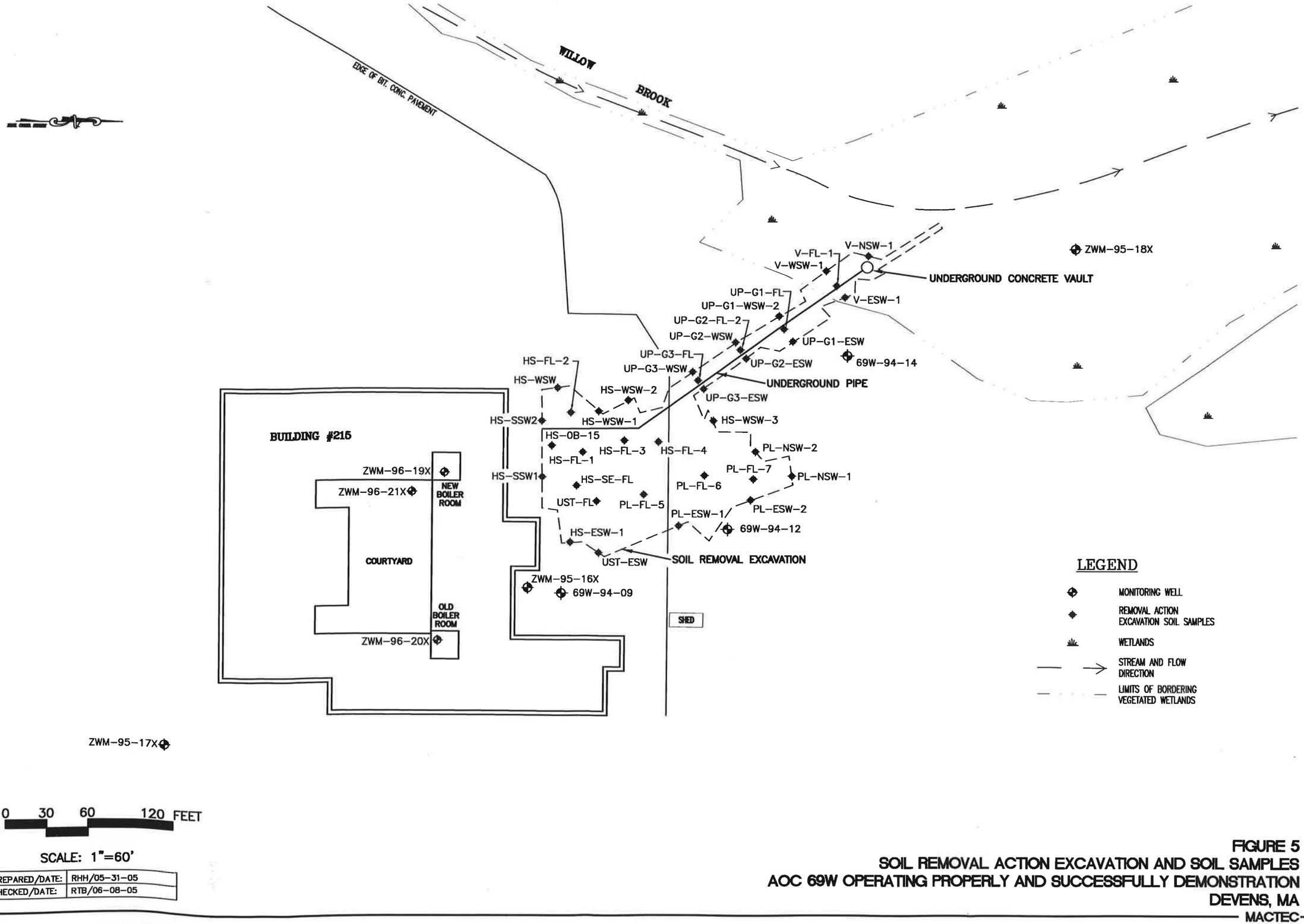

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FIGURE 5
SOIL REMOVAL ACTION EXCAVATION AND SOIL SAMPLES
AOC 69W OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
DEVENS, MA

MACTEC

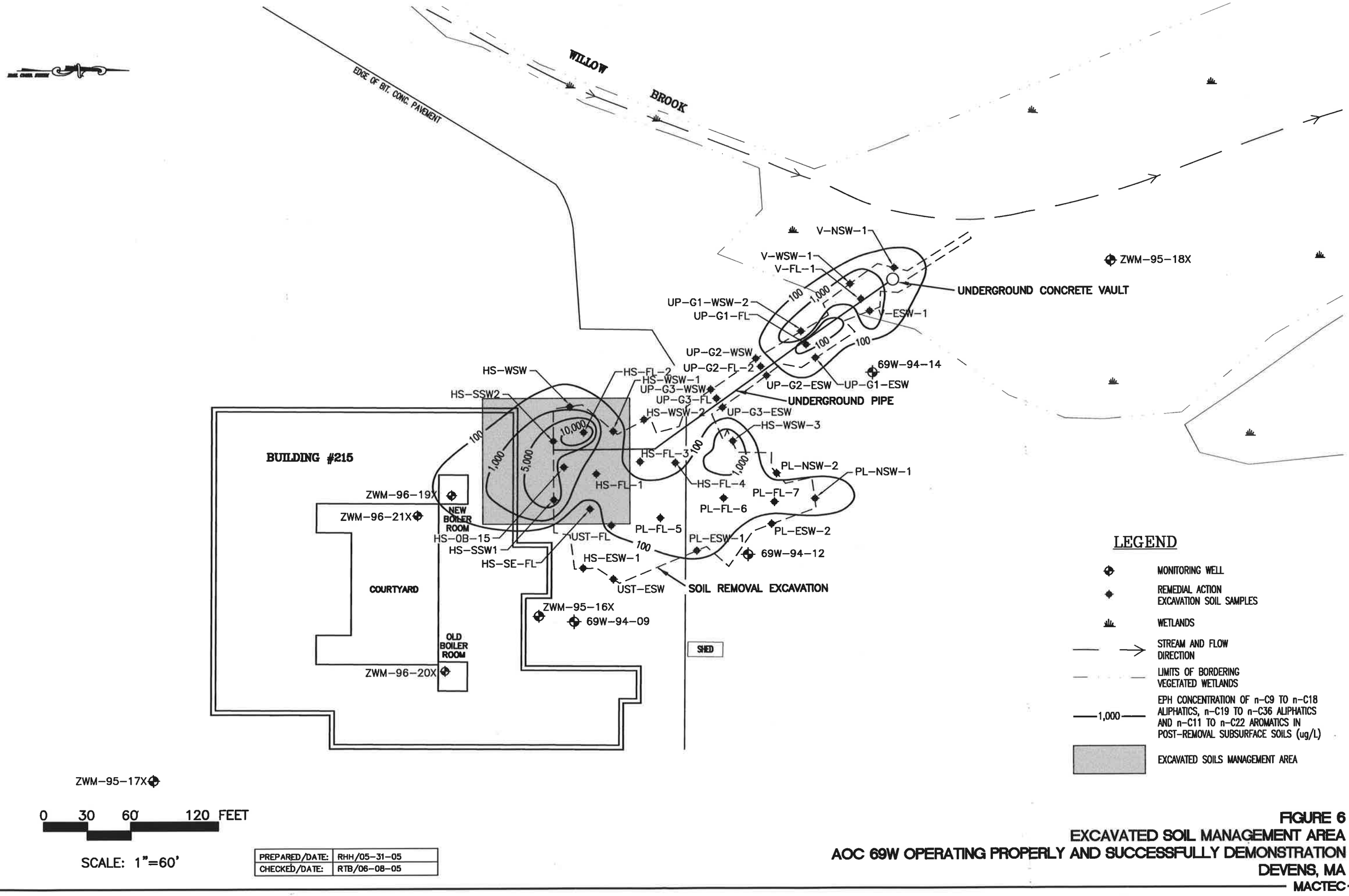

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FIGURE 6
EXCAVATED SOIL MANAGEMENT AREA
AOC 69W OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION
DEVENS, MA
MACTEC

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APPENDIX A

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Contamination
AREE	Area Requiring Environmental Evaluation
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
COC	contaminant of concern
cPAH	carcinogenic polynuclear aromatic hydrocarbons
EPH	extractable petroleum hydrocarbons
ESMA	excavated soil management area
FFA	Federal Facility Agreement
FID	flame ionization detector
GC	gas chromatograph
HI	hazard index
LTMP	Long-term Monitoring Plan
MACTEC	MACTEC Engineering and Consulting, Inc.
MADEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
mg/L	milligrams per liter
mV	millivolts
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
NDIR	non-dispersive infrared detection
OPS	Operating Properly and Successfully
p	Mann-Kendall probability
ppm	parts per million
QA	Quality assurance
QC	Quality control

RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
R.F. Weston	Roy F. Weston, Inc.
RI	Remedial Investigation
RFTA	Reserved Forces Training Area
S	Mann-Kendall statistic
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons

APPENDIX B

REFERENCES

REFERENCES

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APPENDIX C

HISTORICAL GROUNDWATER ANALYTICAL DATA SUMMARY (2000-2004)

TABLE C-1
AOC 69W HISTORICAL GROUNDWATER ANALYTICAL DATA (2000 - 2004)
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

MONITORING WELL	ANALYTE AND CLEANUP GOALS (µg/L) (1)	CONCENTRATION (µg/L) SAMPLING ROUND 1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
SOURCE WELLS											
69W-94-13											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	180	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	180	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	690	1400	720	790	1900	290	ND	160	ND	110
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	130	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	120	270	160	320	150	200	62	140	130	230
Metals											
	Arsenic (10 µg/L)	54	110	85	150	52	130	35	69	27	88
	Iron *	9800	9400	7700	12000	11000	20000	12000	8500	10000	7400
	Manganese (300 µg/L)	2300	1700	1500	1600	2100	2400	2800	4100	2500	1300
69W-94-14											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals											
	Arsenic (10 µg/L)	8.3	12	ND	5.9	4.5	4.3	2.2	1.9	ND	2.4
	Iron *	1300	2000	520	1400	1100	1300	550	500	660	200
	Manganese (300 µg/L)	300	340	5.1	340	320	350	200	250	360	78
ZWM-99-22X											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	250	ND	210	ND	ND	ND	ND	ND	ND	310
	C19 - C36 (5,000 µg/L)	180	150	130	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	2500	1400	2100	370	620	210	380	330	420	400
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	630	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	620	150	550	83	88	150	840	450	650	600
Metals											
	Arsenic (10 µg/L)	150	130	230	140	86	140	150	160	150	180
	Iron *	21000	14000	25000	16000	13000	21000	31000	18000	22000	16000
	Manganese (300 µg/L)	2000	1800	2300	2400	2000	1500	2700	2300	3100	2000

Notes:
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-- = Well not installed at the time of the sampling round.
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1) Cleanup value as identified in the Record of Decision using the more conservative of MCP GW-1/GW-2 Groundwater Standards.
* As of the May 2001 sampling event, iron was no longer considered a Contaminant of Concern but will be compared to the background concentration of 9,100 ug/L.
Iron concentrations will be used as an indicator of remediation efficacy,

TABLE C-1 Continued
AOC 69W HISTORICAL GROUNDWATER ANALYTICAL DATA (2000 - 2004)
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

MONITORING WELL	ANALYTE AND CLEANUP GOALS (µg/L) (1)	CONCENTRATION (µg/L) SAMPLING ROUND 1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
SENTRY WELLS											
ZWM-95-15X											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	430	160	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	280	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	ND	ND	ND	ND	1400	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals											
	Arsenic (10 µg/L)	ND	7.9	ND	22	36	40	ND	16	7.7	30
	Iron *	ND	5100	ND	4300	11000	12000	470	3700	20000	6800
	Manganese (300 µg/L)	28	1300	25	100	1500	2200	1600	970	4600	980
ZWM-95-18X											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals											
	Arsenic (10 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Iron *	49 B	ND	ND	ND	ND	ND	ND	ND	35	17
	Manganese (300 µg/L)	9.2	ND	ND	4.4	4.4	ND	15	5.5	7.4	6.3
ZWM-99-23X											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	170	520	200	140	140	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	46	62	40	34	ND	ND	53	59	ND	ND
Metals											
	Arsenic (10 µg/L)	23	70	67	55	15	40	27	60	44	61
	Iron *	8000	11000	13000	8000	2000	6500	11000	7900	9000	7400
	Manganese (300 µg/L)	4200	3600	5800	1500	550	1700	5300	4300	2500	2300

Notes:
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= Well not installed at the time of the sampling round.
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TABLE C-1 Continued
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AOC 69W
DEVENS, MASSACHUSETTS

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SENTRY WELLS											
ZWM-99-24X											
EPH - Aliphatic Hydrocarbons	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons	C11 - C22 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons	C9 - C10 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals	Arsenic (10 µg/L)	2.3	ND	ND	ND	ND	ND	ND	ND	ND	1.7
	Iron *	340	ND	ND	ND	ND	ND	ND	ND	24	ND
	Manganese (300 µg/L)	27	12	ND	14	ND	ND	6.0	31	31	8.7
ZWM-01-25X											
EPH - Aliphatic Hydrocarbons	C9 - C18 (1,000 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons	C11 - C22 (200 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons	C5 - C8 (400 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons	C9 - C10 (200 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
Metals	Arsenic (10 µg/L)	--	--	--	4.1	ND	ND	2.3	ND	ND	3.4
	Iron *	--	--	--	170	ND	240	59	ND	19	ND
	Manganese (300 µg/L)	--	--	--	280	61	1000	89	230	140	300
ZWM-01-26X											
EPH - Aliphatic Hydrocarbons	C9 - C18 (1,000 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons	C11 - C22 (200 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons	C5 - C8 (400 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons	C9 - C10 (200 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
Metals	Arsenic (10 µg/L)	--	--	--	ND	ND	ND	ND	ND	ND	ND
	Iron *	--	--	--	ND	ND	ND	ND	ND	16	ND
	Manganese (300 µg/L)	--	--	--	58	8.6	ND	11	85	55	25

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TABLE C-1 Continued
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AOC 69W
DEVENS, MASSACHUSETTS

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BACKGROUND WELL											
ZWM-95-17X											
EPH - Aliphatic Hydrocarbons											
	C9 - C18 (1,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C19 - C36 (5,000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C11 - C22 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VPH - Aliphatic Hydrocarbons											
	C5 - C8 (400 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	C9 - C12 (1000 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Hydrocarbons											
	C9 - C10 (200 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals											
	Arsenic (10 µg/L)	ND	ND	ND	ND	ND	ND	2	ND	ND	2
	Iron *	220	ND	ND	ND	ND	ND	ND	ND	20	ND
	Manganese (300 µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	1.9	3.6

Notes:

LTM = Long Term Monitoring

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ND = Non detect above methos detection limit

25 = concentrations that exceed the cleanup goal for the respective contaminant

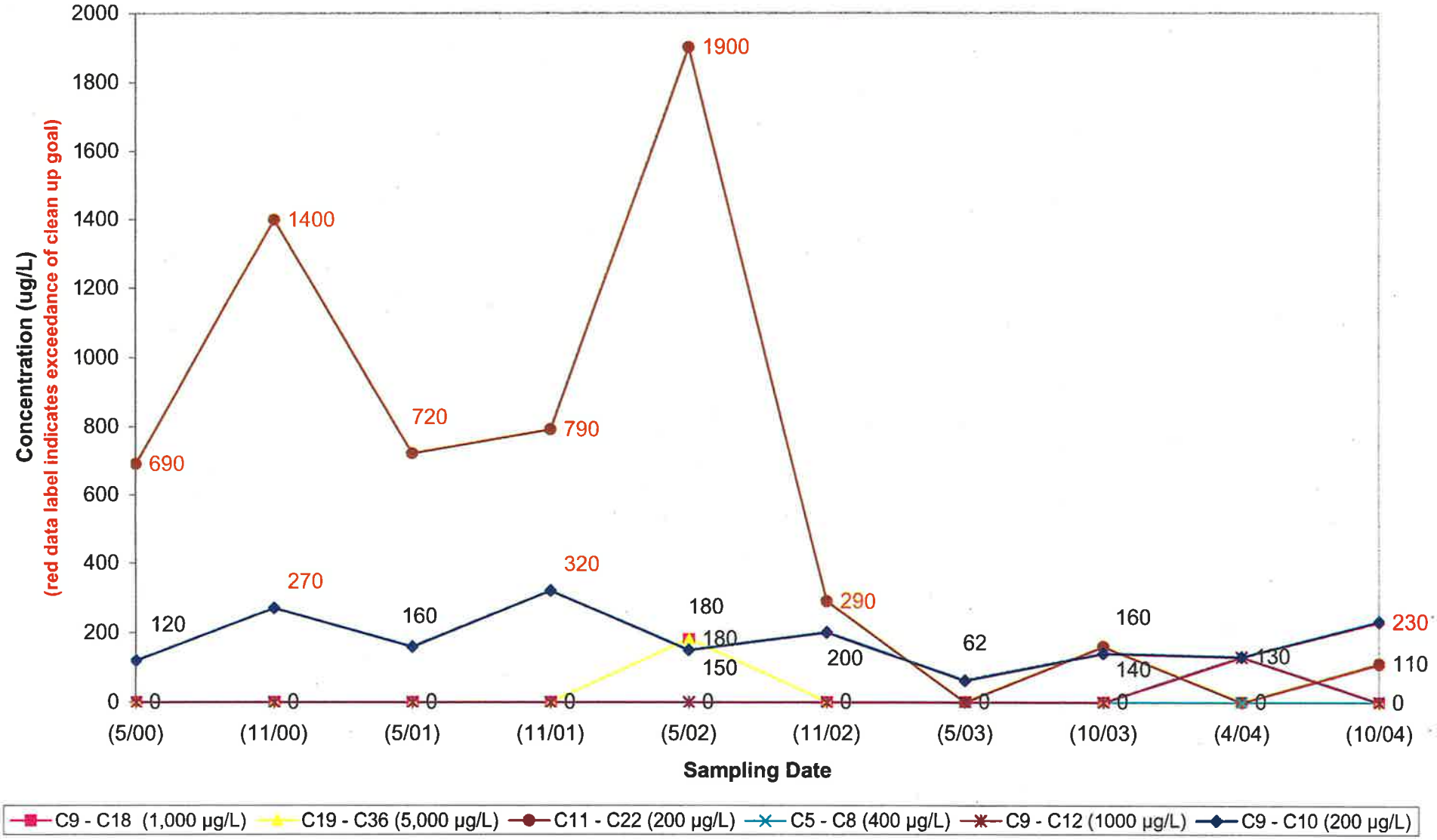
(1) Cleanup value as identified in the Record of Decision using the more conservative of MCP GW-1/GW-2 Groundwater Standards.

* As of the May 2001 sampling event, iron was no longer considered a Contaminant of Concern but will be compared to the background concentration of 9,100 ug/L. Iron concentrations will be used as an indicator of remediation efficacy,

Prepare By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-1
SOURCE WELL
69W-94-13 Hydrocarbons



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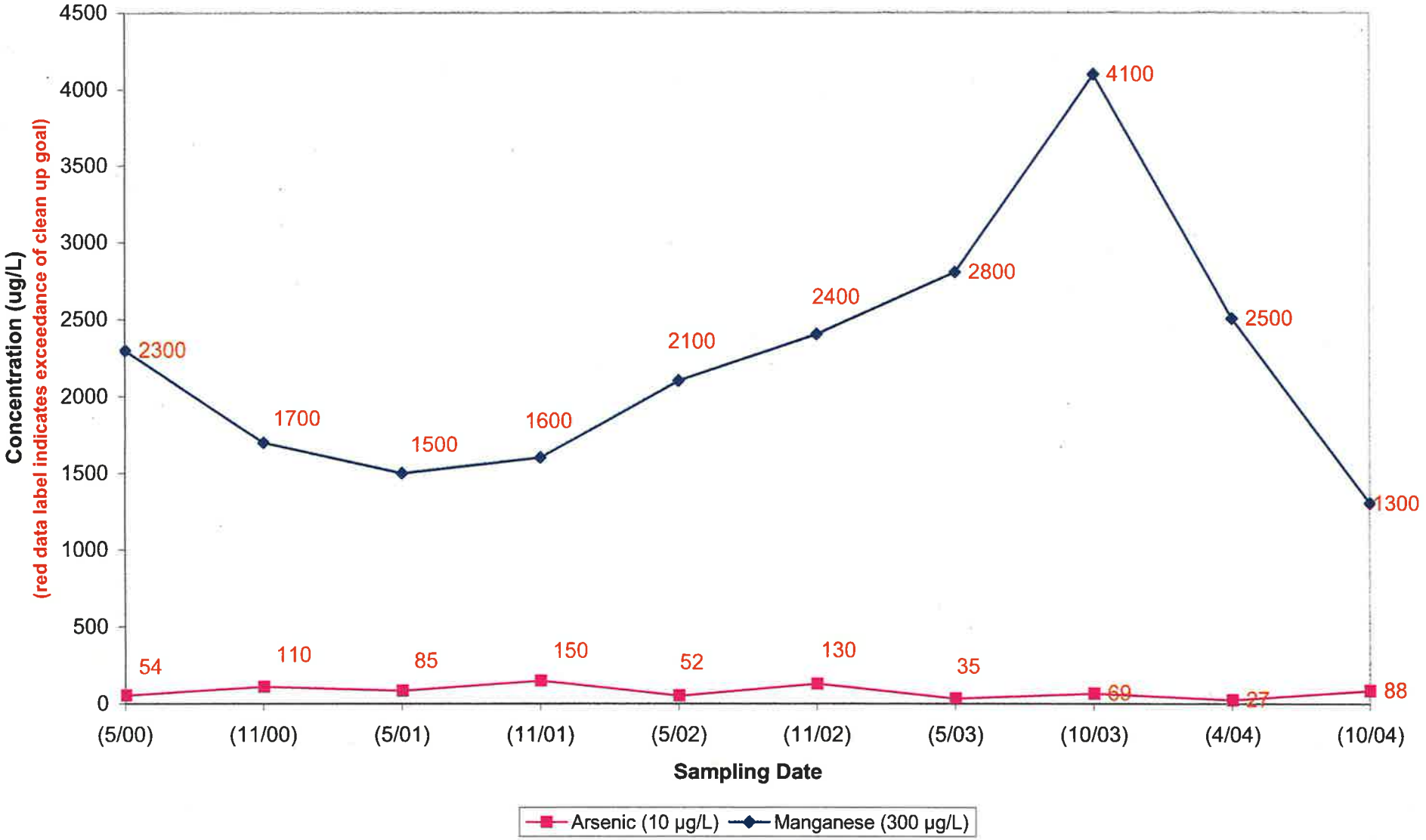
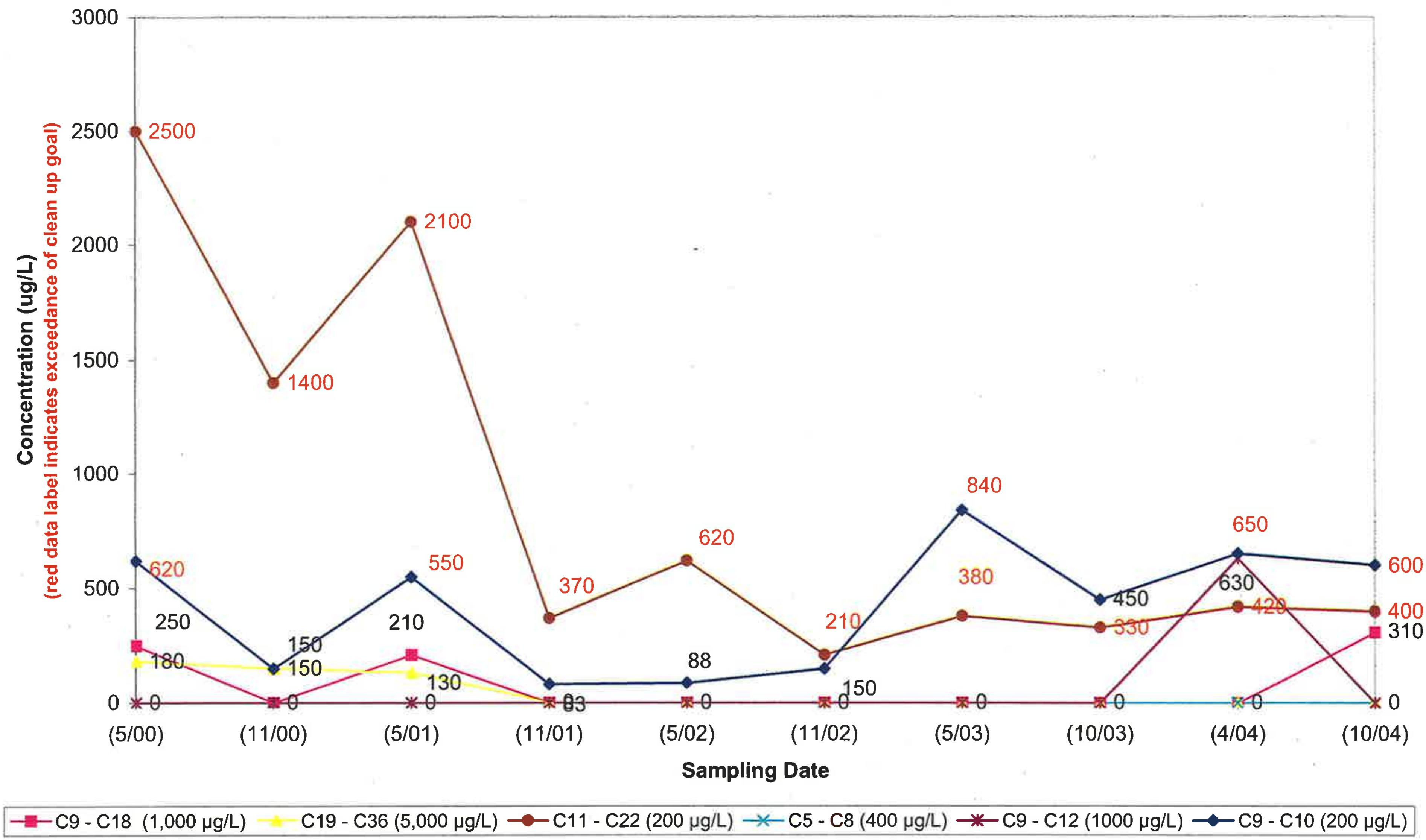
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-2
SOURCE WELL
69W-94-13 Metals



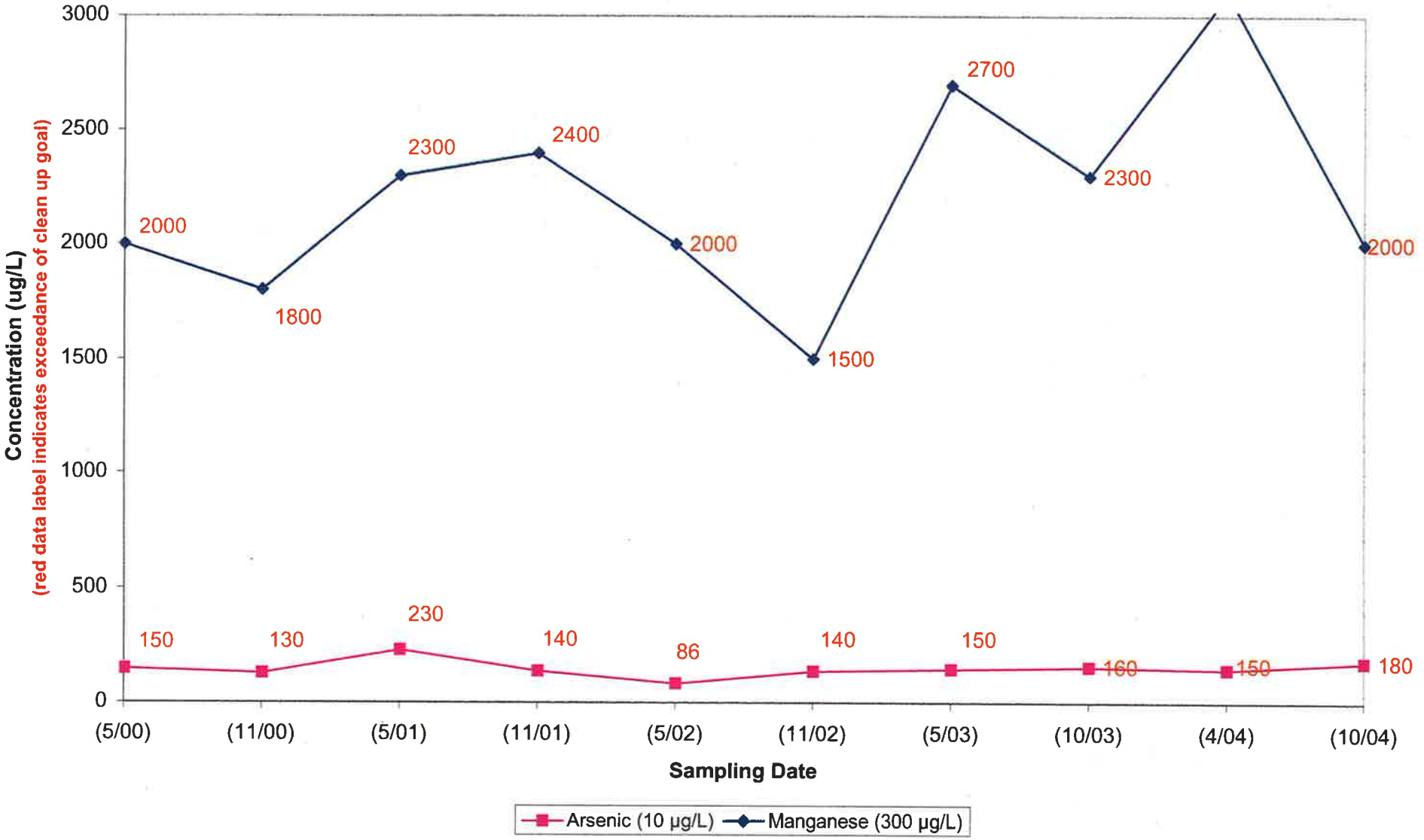
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-4
SOURCE WELL
ZWM-99-22X Hydrocarbons



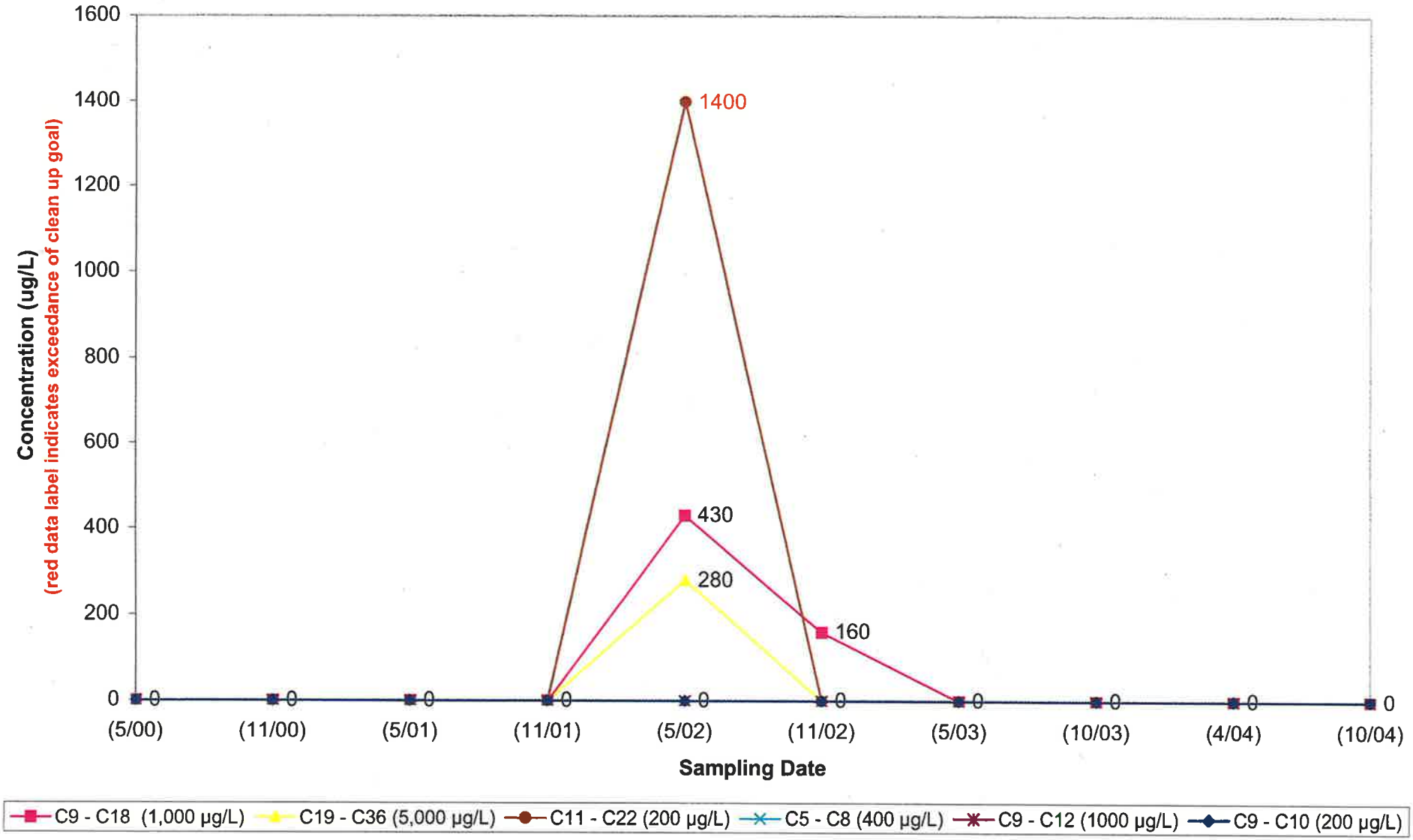
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-5
SOURCE WELL
ZWM-99-22X Metals



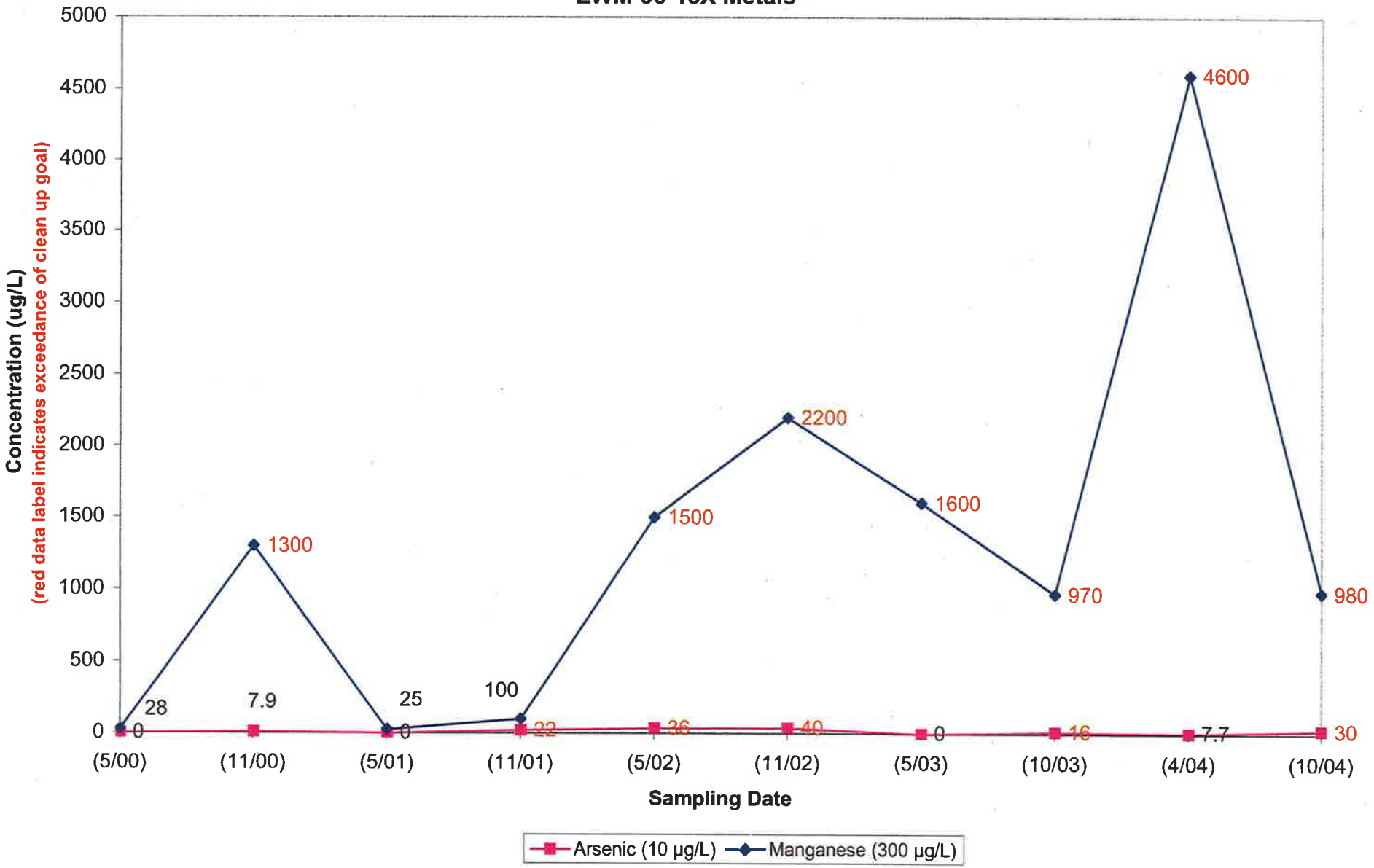
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-6
SENTRY WELL
ZWM-95-15X Hydrocarbons



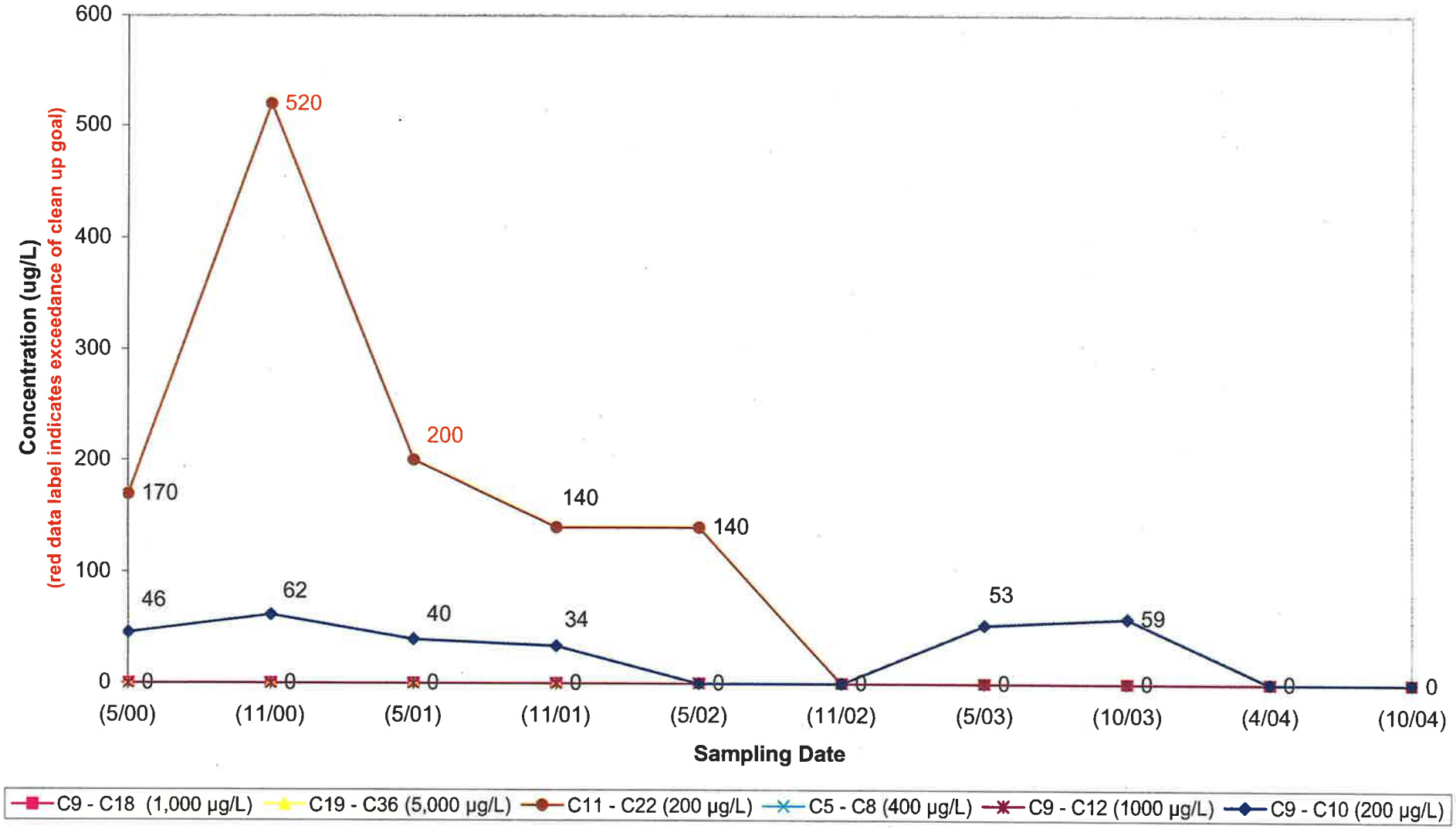
GRAPH C-7
SENTRY WELL
ZWM-95-15X Metals

Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05



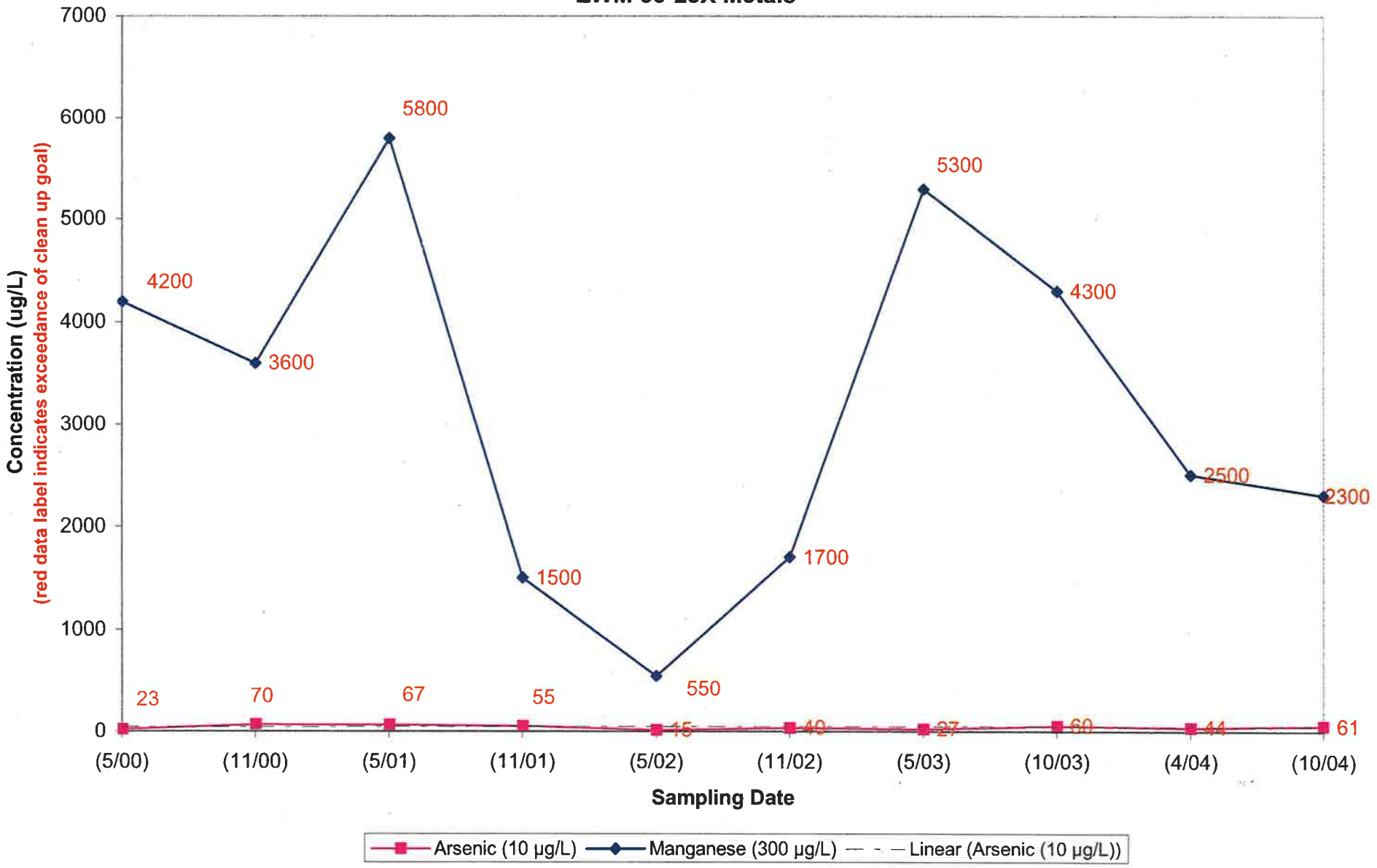
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-8
SENTRY WELL
ZWM-99-23X Hydrocarbons



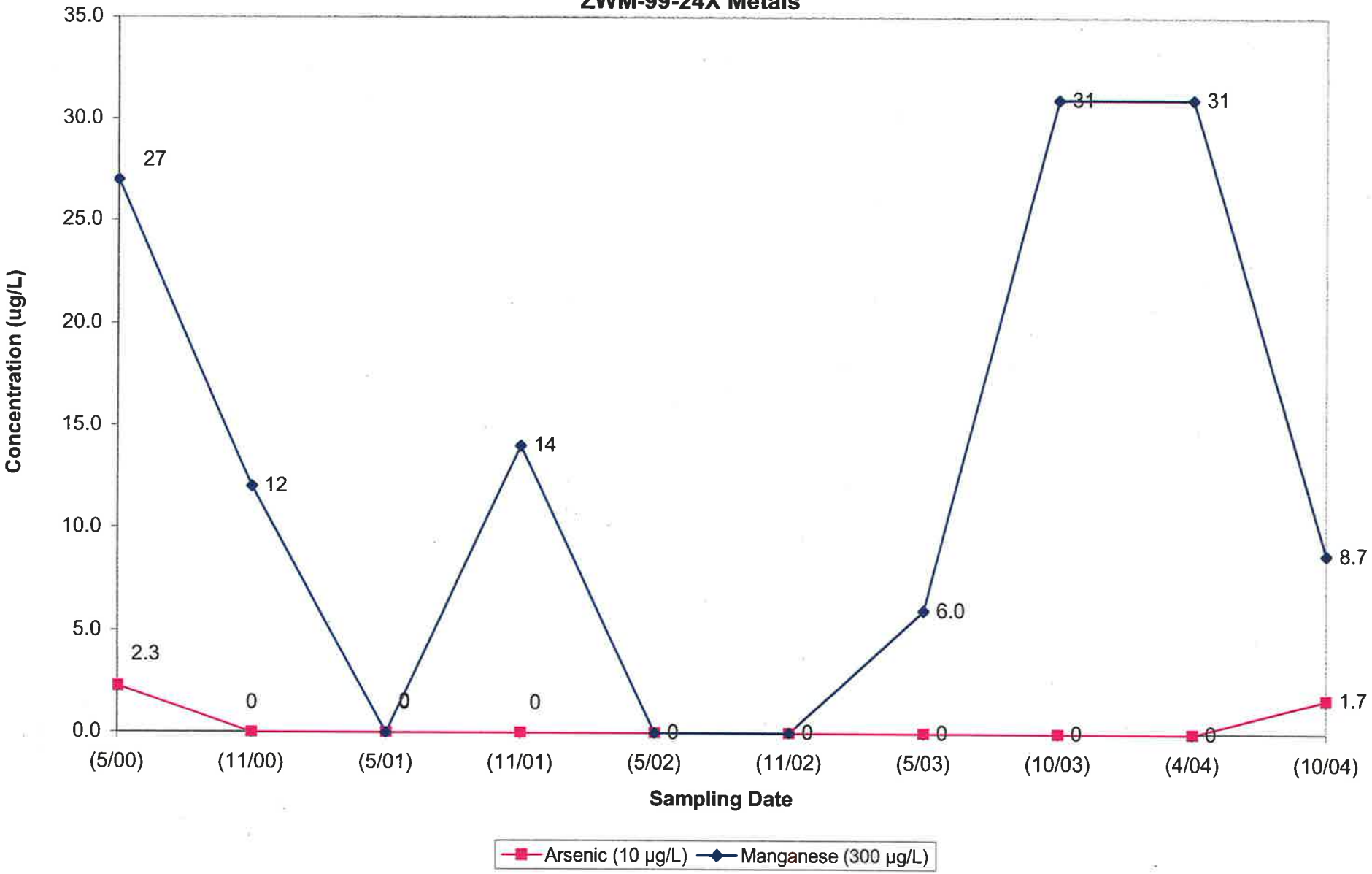
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-9
SENTRY WELL
ZWM-99-23X Metals



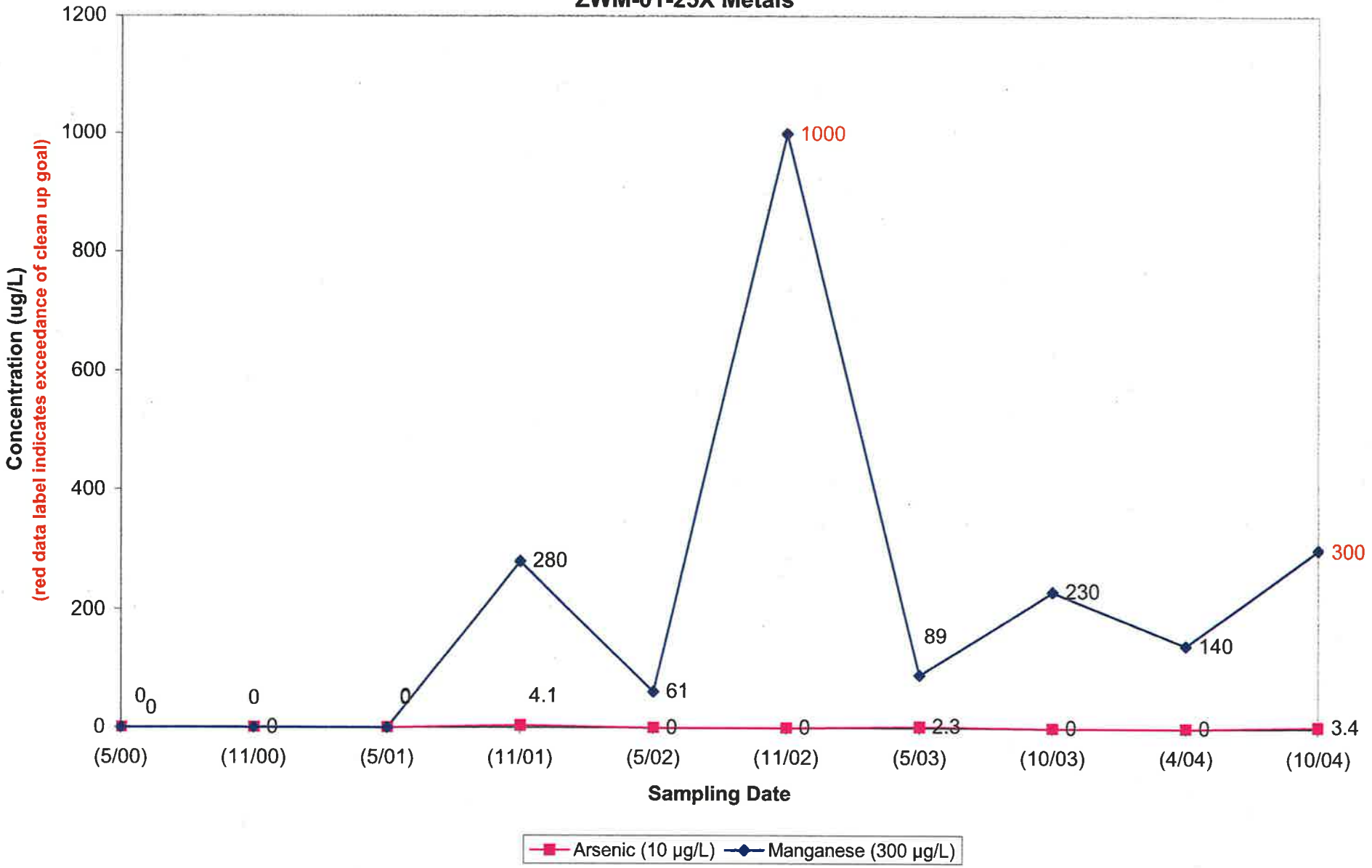
GRAPH C-10
SENTRY WELL
ZWM-99-24X Metals

Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05



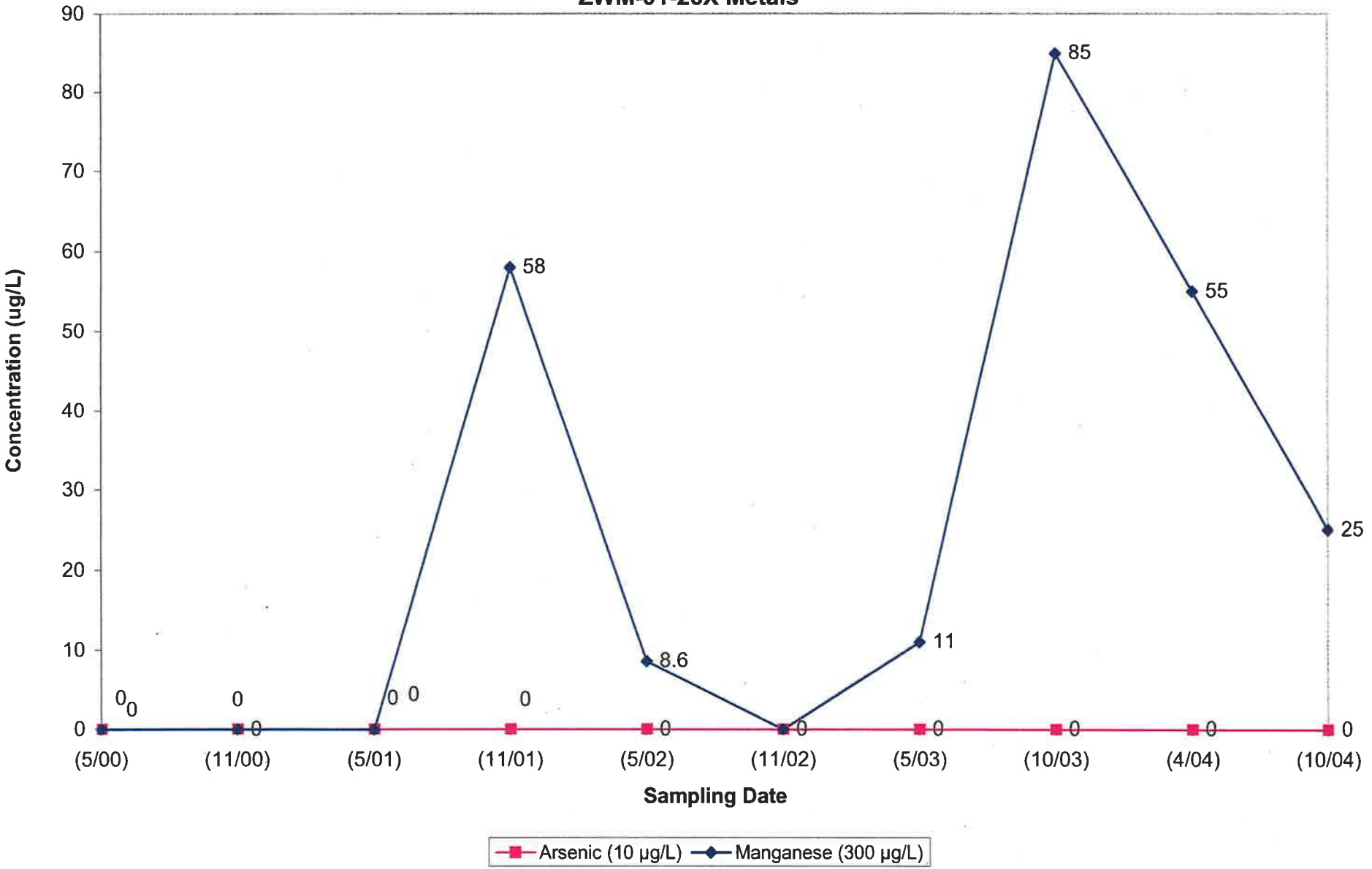
GRAPH C-11
SENTRY WELL
ZWM-01-25X Metals

Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05



Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date: 6/8/05

GRAPH C-12
SENTRY WELL
ZWM-01-26X Metals



APPENDIX D

HISTORICAL FIELD PARAMETER DATA SUMMARY (2000-2004)

TABLE D-1
AOC 69W HISTORICAL FIELD PARAMETER DATA (2000 - 2004)
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

Monitoring Well Location Designation	Monitoring Well ID	Parameter	Semi-annual Round No:	1	2	3	4	5	6	7	8	9	10
			Date (MM/YY):	(5/00)	(11/00)	(5/01)	(11/01)	(5/02)	(11/02)	(5/03)	(10/03)	(4/04)	(10/04)
			Units										
Source Wells	69W-94-13	pH	s.u.	6.26	6.55	6.43	6.53	6.3	6.35	5.79	6.35	NA	NA
		Temperature	degrees Celsius	13.77	16.44	13.1	17.4	14.94	17.02	12.42	18.9	NA	NA
		Specific Conductance	uS/cm	352	405	383	414	421	490	753	895	NA	NA
		Dissolved Oxygen	mg/L	0.03	0.79	0.3	0.24	2.9	1.96	0.25	0.48	0.25	0.32
		Oxidation Reduction Potential	mv	12.1	-29.4	-24.2	-49.7	7	0.3	40.7	-23	142.4	124.3
		Turbidity	NTUs	2.5	2.3	0.4	1.37	1.35	10.11	1.37	27	NA	NA
	69W-94-14	pH	s.u.	5.99	5.85	5.79	5.93	5.86	6	5.87	5.83	NA	NA
		Temperature	degrees Celsius	12.21	16.34	12.42	18.04	12.74	16.99	12.34	19.51	NA	NA
		Specific Conductance	uS/cm	222	254	543	381	674	439	826	793	NA	NA
		Dissolved Oxygen	mg/L	0.64	2.59	6.05	2.42	28.7	4.11	5.11	1.87	0.64	1.18
		Oxidation Reduction Potential	mv	117.5	91	113.8	177.7	134.2	240.2	181	192.9	243.4	156.4
		Turbidity	NTUs	3	2.2	4.27	3.19	1.03	1.24	1.1	1.66	0.64	NA
	ZWM-96-19X	pH	s.u.	6.08	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Temperature	degrees Celsius	13.99	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Specific Conductance	uS/cm	291	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Dissolved Oxygen	mg/L	0.39	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Oxidation Reduction Potential	mv	64.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Turbidity	NTUs	2.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
	ZWM-99-22X	pH	s.u.	6.42	6.47	6.75	6.45	5.82	6.69	6.26	6.39	NA	NA
		Temperature	degrees Celsius	15.66	17.62	15.44	20.15	15.71	19.03	15	21	NA	NA
		Specific Conductance	uS/cm	334	299	380	366	317	343	563	498	NA	NA
		Dissolved Oxygen	mg/L	-0.03	0.52	0.37	0.52	0.58	0.98	0.84	0.14	0.2	0.53
		Oxidation Reduction Potential	mv	-45.9	-30.1	-64.1	-25.8	31	-56.7	-50.5	-92.2	13.3	-111
		Turbidity	NTUs	3.3	4.72	0.6	1.63	1.12	1.47	2.33	1	NA	NA
Sentry Wells	ZWM-95-15X	pH	s.u.	6.01	6.04	5.88	6.43	6.27	6.31	5.69	6.56	NA	NA
		Temperature	degrees Celsius	11.96	15.42	11.29	15.02	11.73	14.2	10.8	17.19	NA	NA
		Specific Conductance	uS/cm	195	290	340	293	340	301	578	325	NA	NA
		Dissolved Oxygen	mg/L	1.2	1.7	5.1	0.47	2.9	1.41	2.84	0.37	0.47	0.19
		Oxidation Reduction Potential	mv	258	38.2	292.3	29	-23.4	138.3	167.2	29.4	132.2	30.9
		Turbidity	NTUs	1.2	1.79	0.8	16.2	2.13	3.75	2.07	NA	NA	NA

TABLE D-1
AOC 69W HISTORICAL FIELD PARAMETER DATA (2000 - 2004)
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

Monitoring Well Location Designation	Monitoring Well ID	Parameter	Semi-annual Round No: / Date (MM/YY): / Units	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
Sentry Wells - cont.	ZWM-95-18X	pH	s.u.	6.12	6.09	6.01	6.19	6.03	6.07	5.95	6.2	NA	NA
		Temperature	degrees Celsius	11.19	14.42	10.39	14.71	11.37	14.88	9.85	15.47	NA	NA
		Specific Conductance	uS/cm	265	278	305	429	385	438	456	535	NA	NA
		Dissolved Oxygen	mg/L	3.2	7.64	6.47	5.36	27.4	7.2	6.39	7.97	5.96	5.49
		Oxidation Reduction Potential	mv	255.6	236.8	217.7	313.8	221	275.1	316	206.2	628.5	392
		Turbidity	NTUs	0.5	0.14	0.15	0.32	0.06	1.93	0.08	-0.31	NA	NA
	ZWM-99-23X	pH	s.u.	6.04	6.34	6.03	6.42	5.89	6.65	6.02	6.43	NA	NA
		Temperature	degrees Celsius	14.73	15.9	12.41	16.78	12.61	16.3	11.89	18.37	NA	NA
		Specific Conductance	uS/cm	293	319	440	318	207	492	576	545	NA	NA
		Dissolved Oxygen	mg/L	0.39	0.84	0.44	1.5	3.78	2.73	0.74	0.26	1.37	0.23
		Oxidation Reduction Potential	mv	67.4	22	14.7	-22.2	107	17.8	66	18.6	673	7.6
		Turbidity	NTUs	0.5	1.1	0.71	1	1.09	1.48	0.75	1.56	NA	NA
	ZWM-99-24X	pH	s.u.	5.55	5.91	5.36	5.86	4.68	5.73	5.54	5.71	NA	NA
		Temperature	degrees Celsius	12.62	16.75	11.65	16.21	12.21	15.34	9.57	17.71	NA	NA
		Specific Conductance	uS/cm	361	144	1024	289	197	416	413	463	NA	NA
		Dissolved Oxygen	mg/L	1.8	1.7	4.1	2.93	8.32	4.74	5.35	0.37	1.66	0.65
		Oxidation Reduction Potential	mv	277.2	194.9	326.8	275.7	607	226.4	204.6	191.3	380.8	411.6
		Turbidity	NTUs	4.8	2.27	0.4	2.23	1.28	2.68	0.35	0.97	NA	NA
	ZWM-01-25X	pH	s.u.	NS	NS	NS	6.4	6.27	6.31	6.27	NS	NA	NA
		Temperature	degrees Celsius	NS	NS	NS	18.31	13.48	17.51	11.12	NS	NA	NA
		Specific Conductance	uS/cm	NS	NS	NS	282	256	397	286	NS	NA	NA
		Dissolved Oxygen	mg/L	NS	NS	NS	4.82	68	6.85	6.49	NS	4.15	4.79
		Oxidation Reduction Potential	mv	NS	NS	NS	233.9	148.7	195.5	219	NS	601.2	468.8
		Turbidity	NTUs	NS	NS	NS	2.35	0.47	3.78	1.63	NS	NA	NA
	ZWM-01-26X	pH	s.u.	NS	NS	NS	5.83	4.89	5.97	5.92	NS	NA	NA
		Temperature	degrees Celsius	NS	NS	NS	16.87	14.86	15.23	10.74	NS	NA	NA
		Specific Conductance	uS/cm	NS	NS	NS	298	321	167	86	NS	NA	NA
		Dissolved Oxygen	mg/L	NS	NS	NS	47.6	10.06	6.03	8.28	NS	7.38	2.98
		Oxidation Reduction Potential	mv	NS	NS	NS	252.3	625	289.9	190	NS	547.3	206.9
		Turbidity	NTUs	NS	NS	NS	1.07	3.41	1.69	1.53	NS	NA	NA

TABLE D-1
AOC 69W HISTORICAL FIELD PARAMETER DATA (2000 - 2004)
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

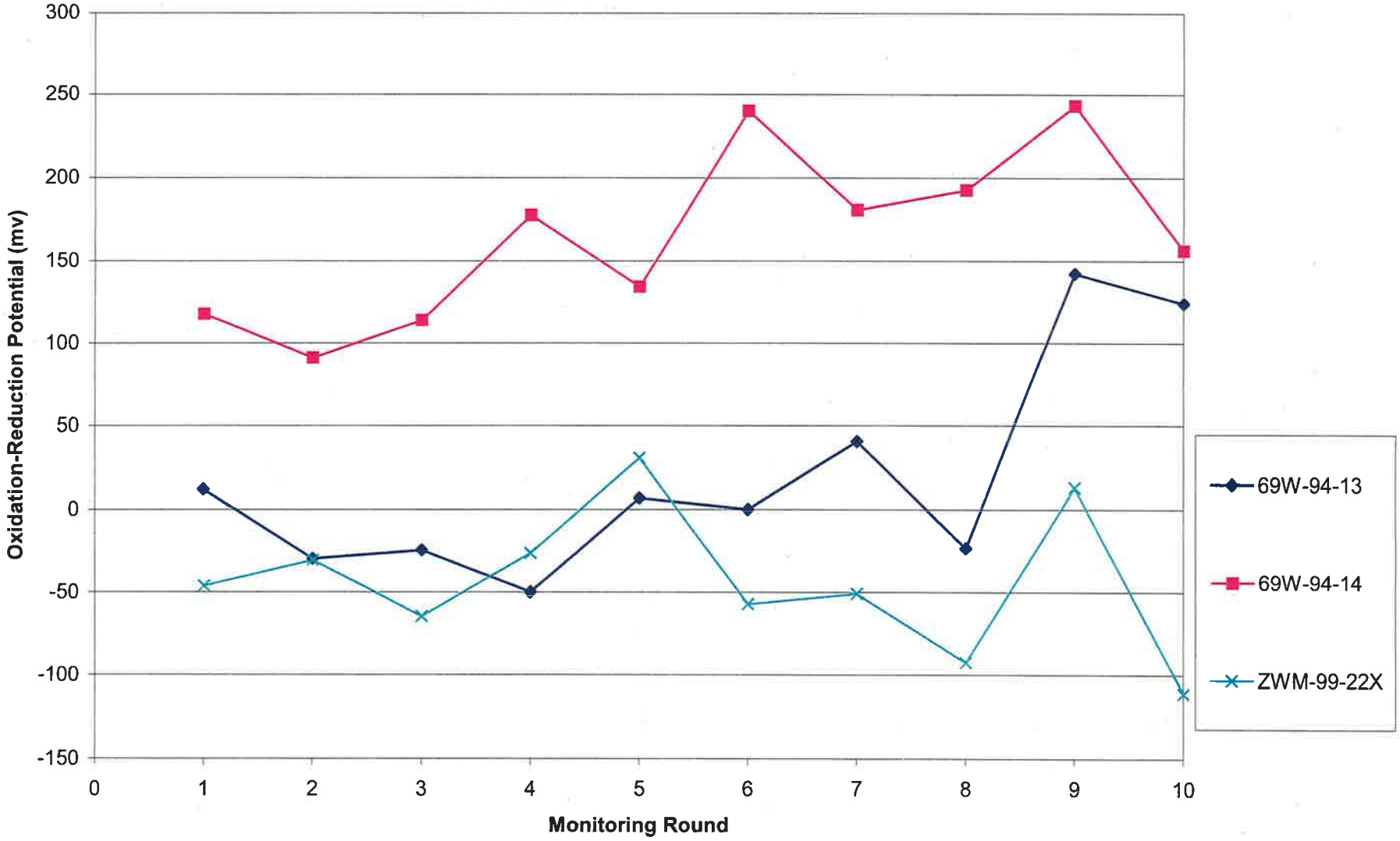
Monitoring Well Location Designation	Monitoring Well ID	Parameter	Semi-annual Round No:	1	2	3	4	5	6	7	8	9	10
			Date (MM/YY):	(5/00)	(11/00)	(5/01)	(11/01)	(5/02)	(11/02)	(5/03)	(10/03)	(4/04)	(10/04)
			Units										
Background Well	ZWM-95-17X	pH	s.u.	6.41	6.32	6.41	6.6	5.89	6.43	6.39	6.47	NA	NA
		Temperature	degrees Celsius	15.58	15.48	13	14.79	14.43	15.81	12.97	12.79	NA	NA
		Specific Conductance	uS/cm	223	231	251	247	232	262	198	281	NA	NA
		Dissolved Oxygen	mg/L	4.79	6.5	7.52	5.67	6.74	7.77	8.26	7.68	8.49	8.57
		Oxidation Reduction Potential	mv	244.2	200.8	252.7	197.8	538.2	169.7	163.6	172.5	350	181.3
		Turbidity	NTUs	0.3	0.38	0.3	0.44	0.15	0.29	0.18	NA	NA	NA

Notes:
NS = not sampled
NA = not available
mv = millivolts
mg/L = milligrams per liter
uS/cm = microsiemens per cm
NTUs = standard turbidity units
s.u.. = standard units

Prepare By: RTB
Date: 6/8/2005
Checked By: SWR
Date: 6/8/2005

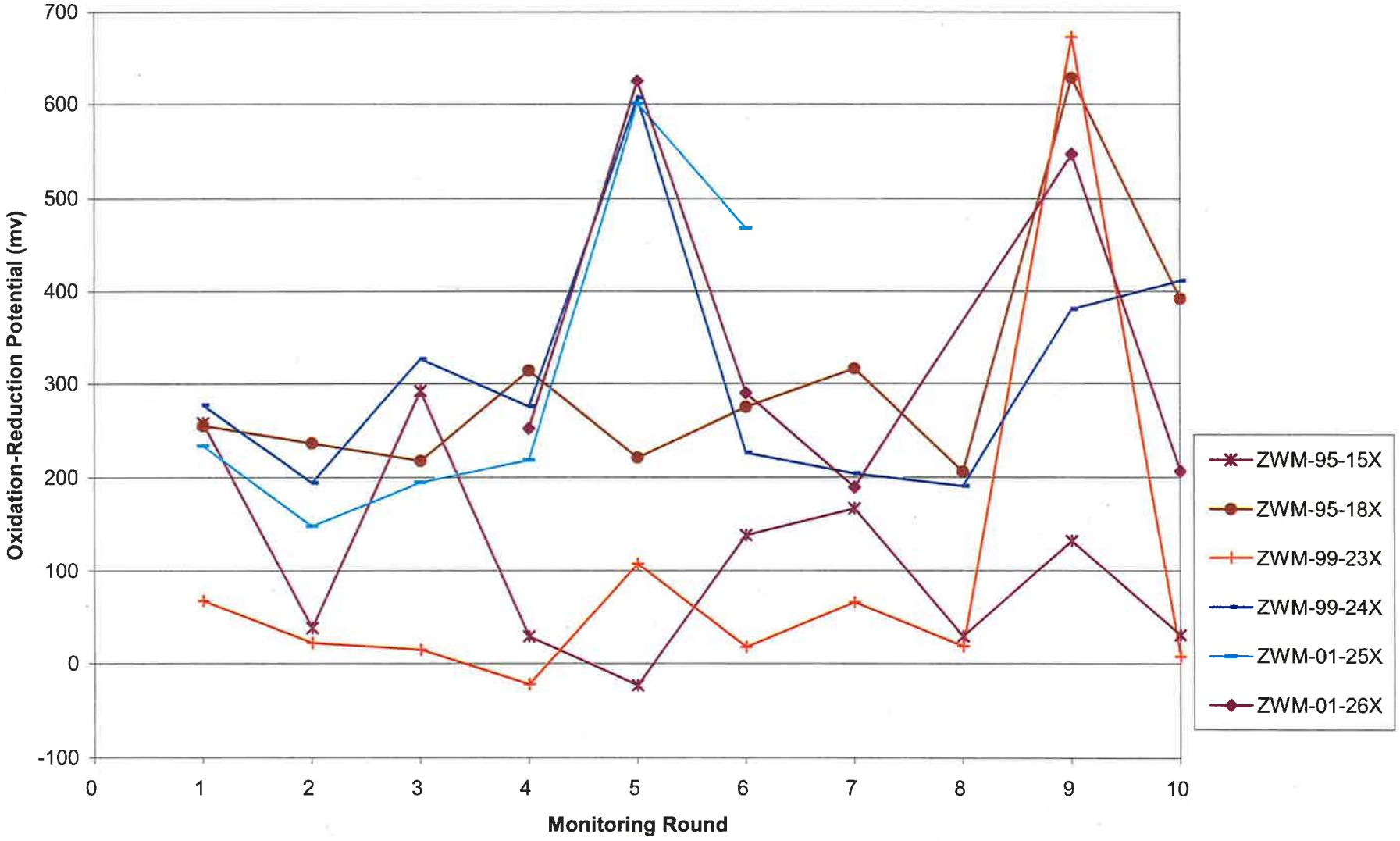
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date:6/8/05

GRAPH D-1
SOURCE WELL ORP MEASUREMENTS



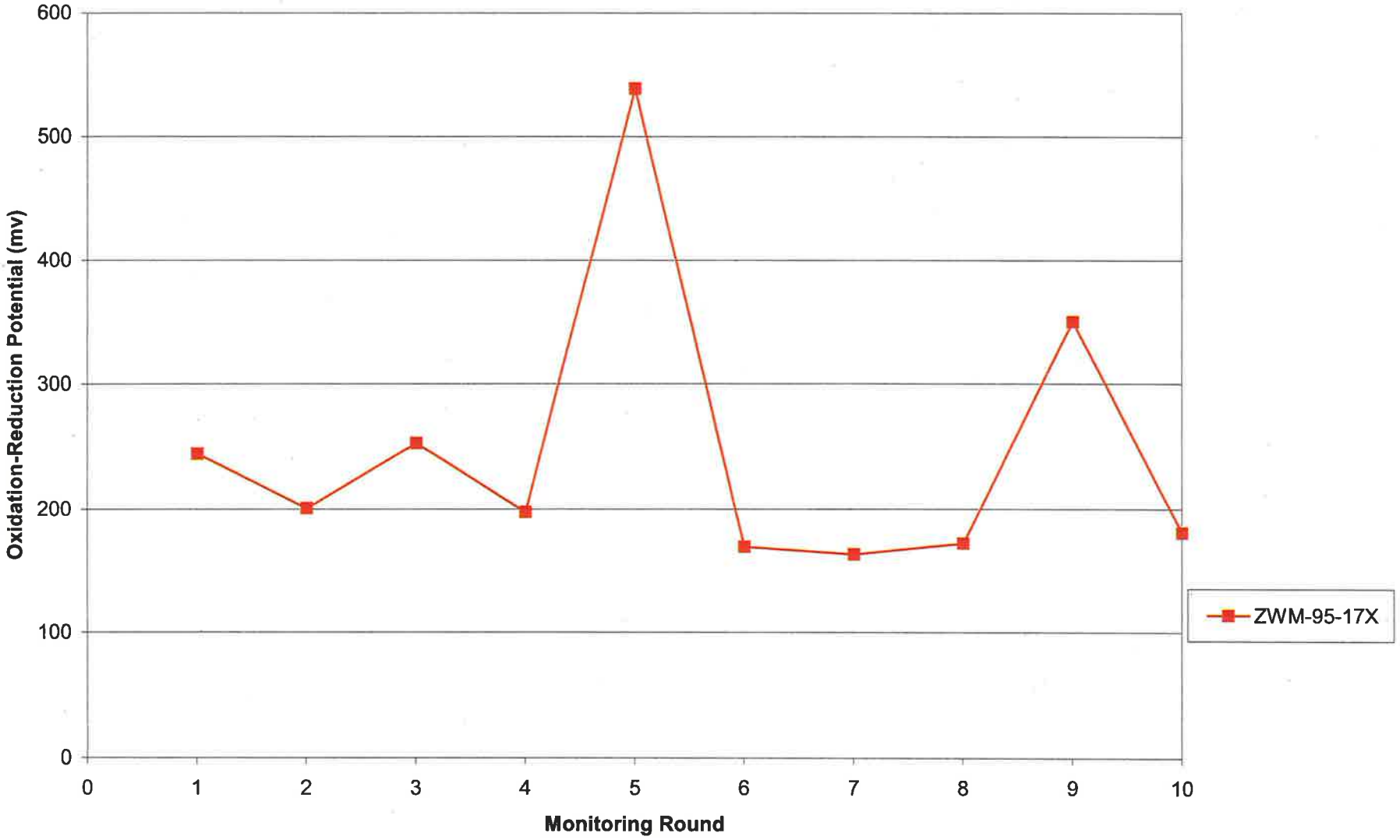
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date:6/8/05

GRAPH D-2
SENTRY WELL ORP MEASUREMENTS



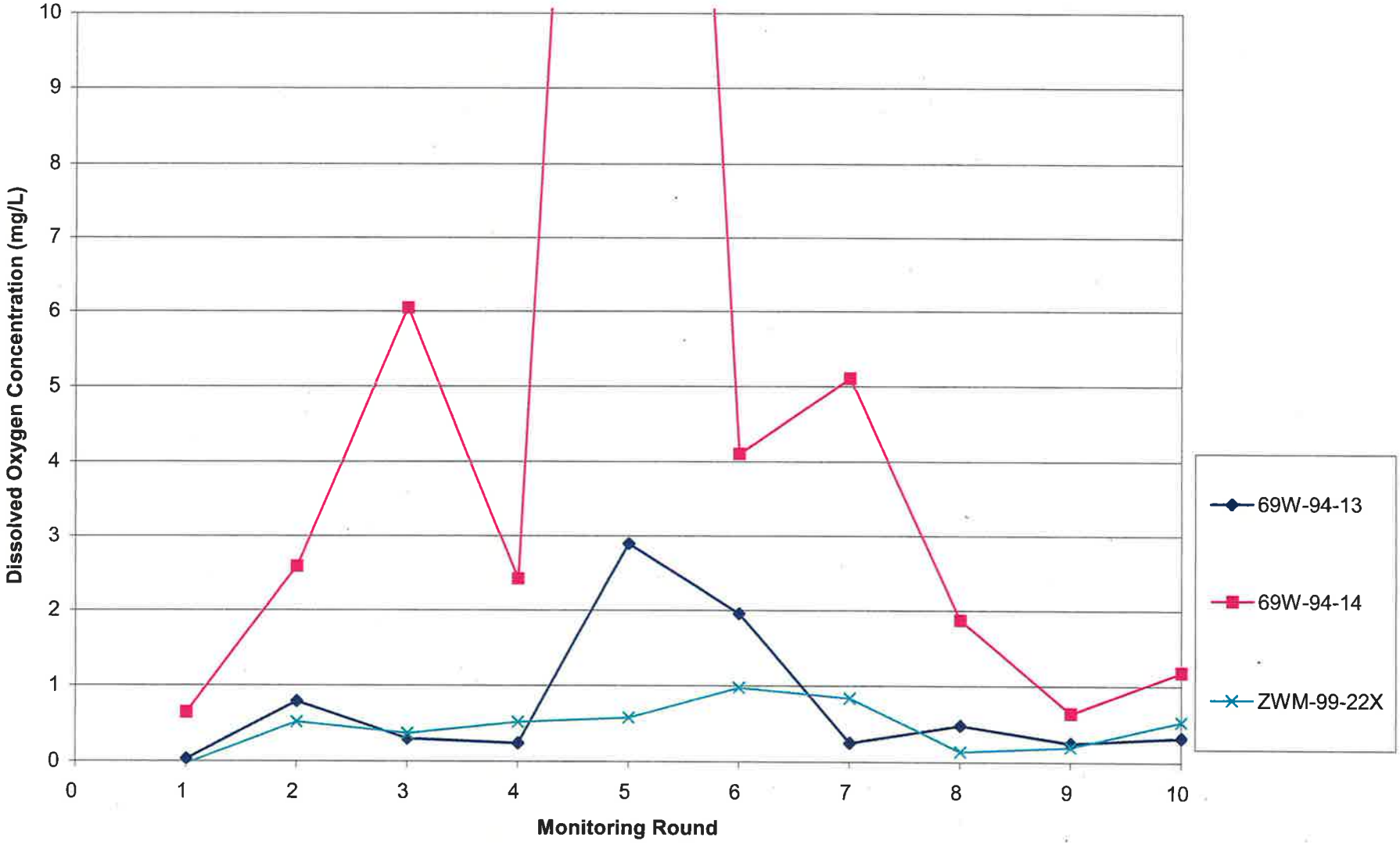
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date:6/8/05

GRAPH D-3
BACKGROUND WELL ORP MEASUREMENTS



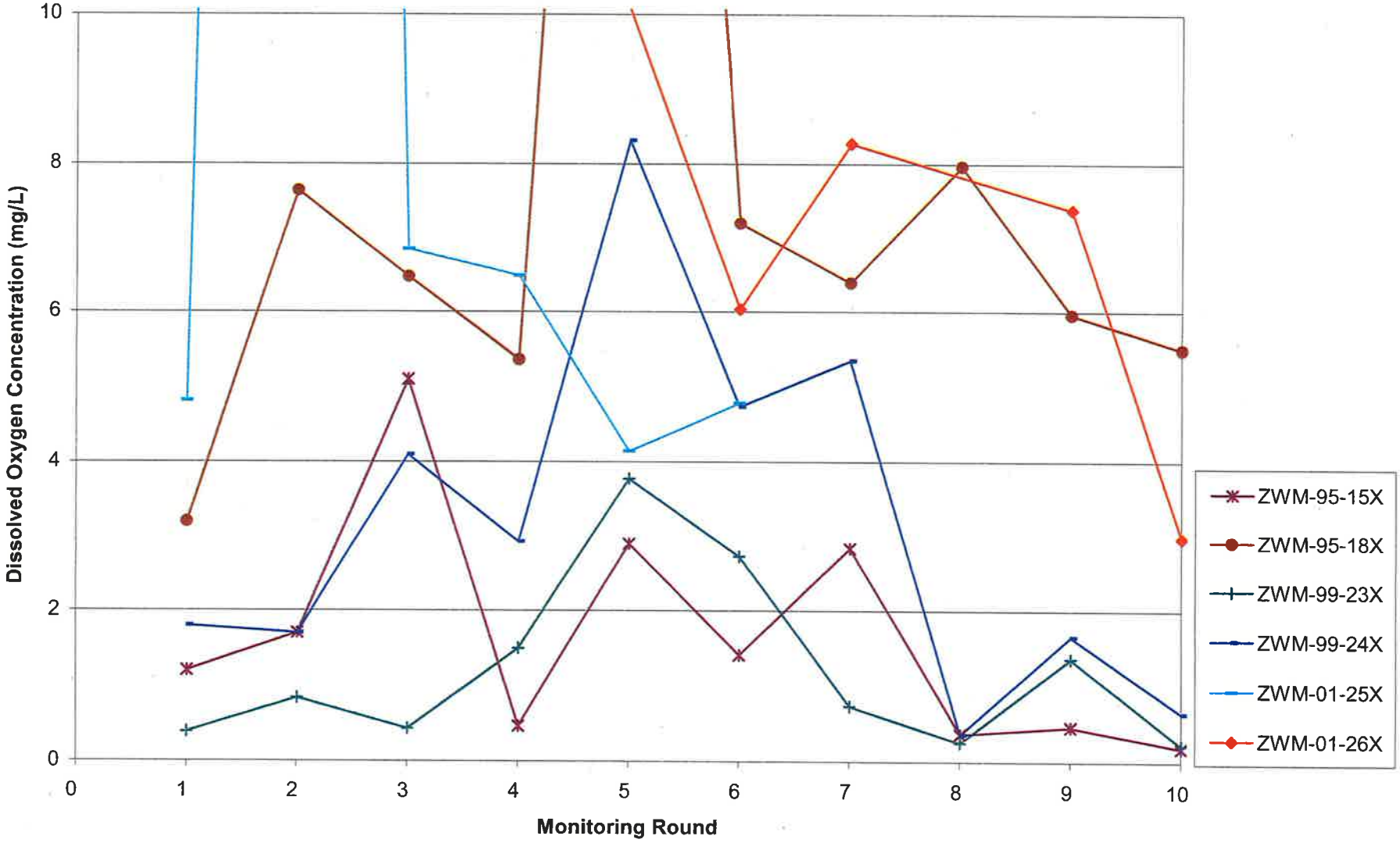
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date:6/8/05

GRAPH D-4
SOURCE WELL DO MEASUREMENTS



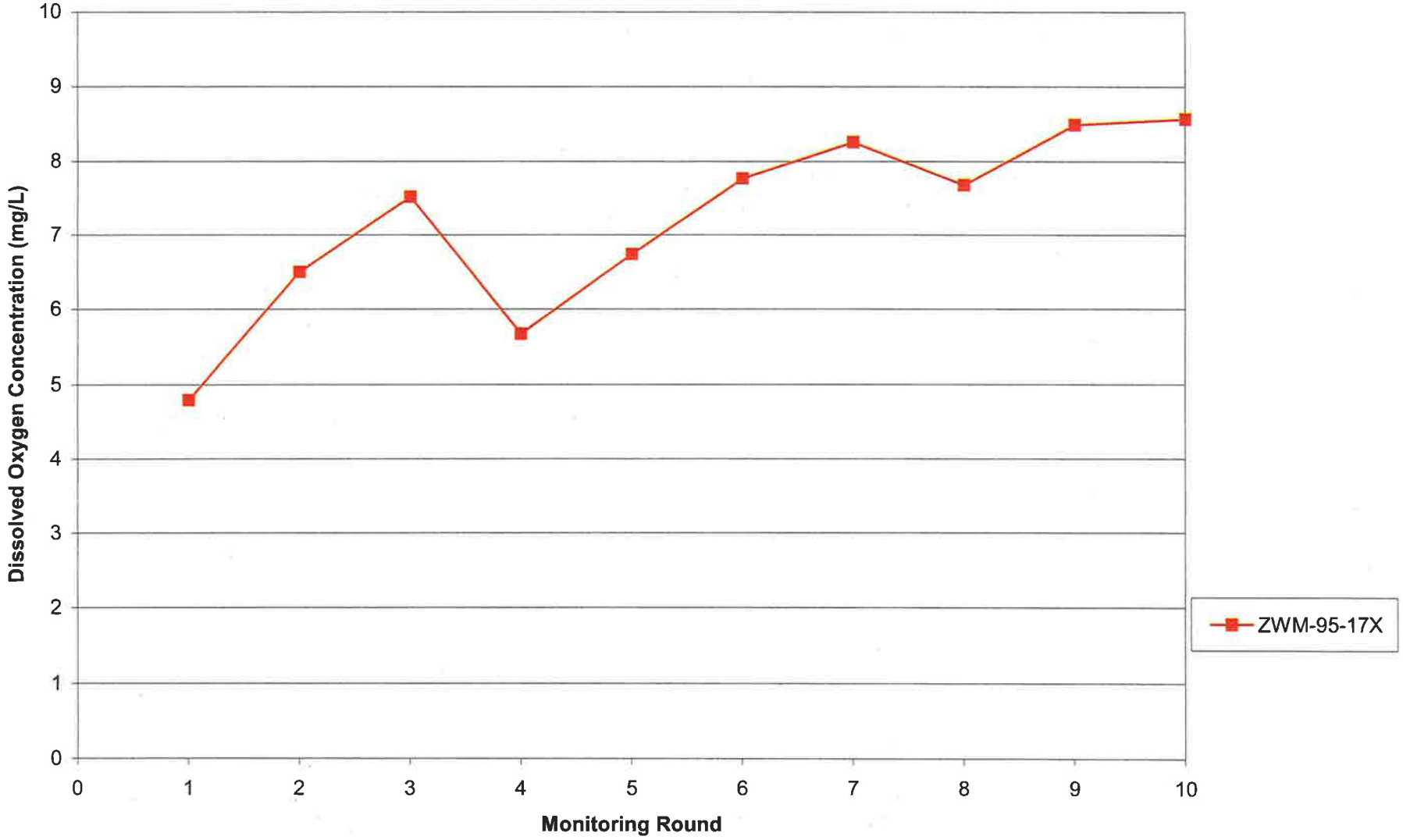
Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date:6/8/05

GRAPH D-5
SENTRY WELL DO MEASUREMENTS



Prepared By: RTB
Date: 6/8/05
Checked By: SWR
Date:6/8/05

GRAPH D-6
BACKGROUND WELL DO MEASUREMENTS



APPENDIX E

MANN-KENDALL STATISTICAL TREND ANALYSIS

TABLE E-1
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

	Monitoring Round and Date 69W-94-13 C11-C22									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	1	-1	-1	1	-1	1	
	1	-1	1	-1	-1	-1	0	-1		
	1	1	-1	-1	-1	-1	1			
	1	-1	-1	-1	-1	-1				
	-1	-1	-1	-1	-1					
	-1	-1	-1	-1						
	-1	-1	-1							
	-1	-1								
	-1									
um	**-1**	**-6**	**-3**	**-4**	**-5**	**-4**	**2**	**-2**	**1**	

Total -22 =S

p= 0.0295 Conclusion: significant downward trend

	Monitoring Round and Date 69W-94-13 C9-C10									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	-1	1	-1	1	-1	1	
	1	1	-1	-1	-1	-1	1	1		
	1	-1	1	-1	-1	-1	1			
	1	-1	-1	-1	-1	1				
	1	-1	-1	-1	1					
	-1	-1	-1	-1						
	1	-1	1							
	1	-1								
	1									
Sum	**7**	**-6**	**-1**	**-6**	**-1**	**-2**	**3**	**0**	**1**	

otal -5 =S

p= 0.364 Conclusion: not significant at 90%

	Monitoring Round and Date 69W-94-13 arsenic									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	-1	1	-1	1	-1	1	
	1	1	-1	-1	-1	-1	-1	1		
	1	-1	1	-1	1	-1	1			
	-1	1	-1	-1	-1	-1				
	1	-1	-1	-1	1					
	-1	-1	-1	-1						
	1	-1	1							
	-1	-1								
	1									
um	**3**	**-4**	**-1**	**-6**	**1**	**-4**	**1**	**0**	**1**	

Total -9 =S

p= 0.242 Conclusion: not significant at 90%

TABLE E-1
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

	Monitoring Round and Date 69W-94-13 manganese									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	-1	-1	1	1	1	1	1	-1	-1	
	-1	-1	1	1	1	1	-1	-1		
	-1	1	1	1	1	1	-1			
	-1	1	1	1	1	-1				
	1	1	1	1	-1					
	1	1	1	-1						
	1	1	-1							
	1	-1								
	-1									
um	**-1**	**2**	**5**	**4**	**3**	**2**	**-1**	**-2**	**-1**	

otal 11 =S

p= 0.19 Conclusion: not significant at 90%

	Monitoring Round and Date 69W-94-14 arsenic									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	-1	-1	-1	-1	-1	1	
	-1	-1	1	-1	-1	-1	-1	1		
	-1	-1	1	-1	-1	-1	1			
	-1	-1	1	-1	-1	-1				
	-1	-1	1	-1	-1					
	-1	-1	-1	-1						
	-1	-1	1							
	-1	-1								
	-1									
Sum	**-7**	**-8**	**5**	**-6**	**-5**	**-4**	**-1**	**0**	**1**	

otal -25 =S

p= 0.014 Conclusion: significant downward trend

	Monitoring Round and Date 69W-94-14 manganese									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	-1	1	-1	1	1	-1	
	-1	0	1	1	-1	-1	1	-1		
	1	-1	1	-1	-1	1	-1			
	1	1	1	-1	1	-1				
	1	-1	1	1	-1					
	-1	-1	1	-1						
	-1	1	1							
	1	-1								
	-1									
um	**1**	**-3**	**7**	**-2**	**-1**	**-2**	**1**	**0**	**-1**	

otal 0 =S

p= 0.5 Conclusion: not significant at 90%

TABLE E-1
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

Monitoring Round and Date
ZWM-99-22X C11-C22

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
-1	1	-1	1	-1	1	-1	1	-1	
-1	-1	-1	-1	-1	1	1	1		
-1	-1	-1	1	-1	1	1			
-1	-1	-1	-1	-1	1				
-1	-1	-1	1	-1					
-1	-1	-1	1						
-1	-1	-1							
-1	-1								
-1									
um **-9**	**-6**	**-7**	**2**	**-5**	**4**	**1**	**2**	**-1**	

Total -19 =S

p= 0.054 Conclusion: significant downward trend

Monitoring Round and Date
ZWM-99-22X C9-C10

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
-1	1	-1	1	1	1	-1	1	-1	
-1	-1	-1	1	1	1	-1	1		
-1	-1	-1	1	1	1	-1			
-1	0	1	1	1	1				
-1	1	-1	1	1					
1	1	1	1						
-1	1	1							
1	1								
-1									
Sum **-5**	**3**	**-1**	**6**	**5**	**4**	**-3**	**2**	**-1**	

Total 10 =S

p= 0.216 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-99-22X arsenic

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
-1	1	-1	-1	1	1	1	-1	1	
1	1	-1	0	1	1	0	1		
-1	-1	-1	1	1	1	1			
-1	1	-1	1	1	1				
-1	1	-1	1	1					
0	1	-1	1						
1	1	-1							
0	1								
1									
um **-1**	**6**	**-7**	**3**	**5**	**4**	**2**	**0**	**1**	

Total 13 =S

p= 0.146 Conclusion: not significant at 90%

TABLE E-1
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

Monitoring Round and Date
ZWM-99-22X manganese

	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	-1	1	1	-1	-1	1	-1	1	-1	
	1	1	-1	-1	1	1	1	-1		
	1	1	-1	1	1	1	-1			
	0	-1	1	-1	1	1				
	-1	1	0	1	0					
	1	1	1	-1						
	1	1	-1							
	1	1								
	0									
um	**3**	**6**	**0**	**-2**	**2**	**4**	**-1**	**0**	**-1**	

Total 11 =S

p= 0.19 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-95-15X arsenic

	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	1	1	-1	1	-1	1	
	0	1	1	1	-1	-1	1	1		
	1	1	1	-1	-1	-1	1			
	1	1	0	-1	-1	-1				
	1	-1	1	-1	-1					
	0	1	1	1						
	1	-1	1							
	1	1								
	1									
Sum	**7**	**2**	**6**	**0**	**-3**	**-4**	**3**	**0**	**1**	

Total 12 =S

p= 0.168 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-95-15X manganese

	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	1	1	-1	-1	1	-1	
	-1	-1	1	1	1	-1	1	-1		
	1	1	1	1	-1	1	-1			
	1	1	1	1	1	-1				
	1	1	1	1	-1					
	1	-1	1	1						
	1	1	1							
	1	-1								
	1									
um	**7**	**0**	**7**	**6**	**1**	**-2**	**-1**	**0**	**-1**	

Total 17 =S

p= 0.078 Conclusion: significant upward trend

TABLE E-1
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

Monitoring Round and Date
ZWM-99-23X arsenic

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
1	-1	-1	-1	1	-1	1	-1	1	
1	-1	-1	-1	1	1	1	1		
1	-1	-1	-1	1	1	1			
-1	-1	-1	1	1	1				
1	-1	-1	-1	1					
1	-1	-1	1						
1	-1	-1							
1	-1								
1									
Sum **7**	**-8**	**-7**	**-2**	**5**	**2**	**3**	**0**	**1**	

Total 1 =S

p= 0.5 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-99-23X manganese

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
-1	1	-1	-1	1	1	-1	-1	-1	
1	-1	-1	1	1	1	-1	-1		
-1	-1	-1	1	1	1	-1			
-1	-1	-1	1	1	1				
-1	1	-1	1	1					
1	1	-1	1						
1	-1	-1							
-1	-1								
-1									
Sum **-3**	**-2**	**-7**	**4**	**5**	**4**	**-3**	**-2**	**-1**	

Total -5 =S

p= 0.364 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-01-25X manganese

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
			-1	1	-1	1	-1	1	
			1	1	-1	1	1		
			-1	1	-1	1			
			-1	1	-1				
			-1	1					
			1						
um **0**	**0**	**0**	**-2**	**5**	**-4**	**3**	**0**	**1**	

Total 3 =S

p= 0.386 Conclusion: not significant at 90%

TABLE E-2
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

	Monitoring Round and Date 69W-94-13 ORP									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	-1	1	-1	1	-1	1	-1	1	-1	
	-1	-1	1	1	1	-1	1	1		
	-1	1	1	1	-1	1	1			
	-1	1	1	1	1	1				
	-1	1	1	1	1					
	1	1	1	1						
	-1	1	1							
	1	1								
	1									
um	**-3**	**6**	**5**	**6**	**1**	**2**	**1**	**2**	**-1**	

Total 19 =S

p= 0.054 Conclusion: significant upward trend

	Monitoring Round and Date 69W-94-13 DO									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	-1	1	-1	-1	1	-1	1	
	1	-1	1	1	-1	-1	0	-1		
	1	1	1	1	-1	-1	1			
	1	1	-1	1	-1	-1				
	1	-1	1	1	-1					
	1	-1	-1	1						
	1	-1	1							
	1	-1								
	1									
Sum	**9**	**-4**	**1**	**6**	**-5**	**-4**	**2**	**-2**	**1**	

otal 4 =S

p= 0.3975 Conclusion: not significant at 90%

	Monitoring Round and Date 69W-94-14 ORP									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	-1	1	1	-1	1	-1	1	1	-1	
	-1	1	1	1	1	-1	1	-1		
	1	1	1	1	1	1	-1			
	1	1	1	1	1	-1				
	1	1	1	1	1					
	1	1	1	1						
	1	1	1							
	1	1								
	1									
um	**5**	**8**	**7**	**4**	**5**	**-2**	**1**	**0**	**-1**	

Total 27 =S

p= 0.008 Conclusion: significant upward trend

TABLE E-2
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

	Monitoring Round and Date 69W-94-14 DO									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	1	-1	1	-1	1	-1	-1	1	
	1	-1	1	1	-1	-1	-1	-1		
	1	1	-1	1	-1	-1	-1			
	1	1	-1	-1	-1	-1				
	1	1	-1	-1	-1					
	1	-1	-1	-1						
	1	-1	-1							
	0	-1								
	1									
um	**8**	**0**	**-5**	**0**	**-5**	**-2**	**-3**	**-2**	**1**	

Total -8 =S

p= 0.271 Conclusion: not significant at 90%

	Monitoring Round and Date ZWM-99-22X ORP									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	1	-1	1	-1	1	-1	
	-1	1	1	-1	-1	-1	1	-1		
	1	1	1	-1	-1	1	-1			
	1	-1	1	-1	-1	-1				
	-1	-1	-1	1	-1					
	-1	-1	1	-1						
	-1	1	-1							
	1	-1								
	-1									
Sum	**-1**	**-2**	**3**	**-2**	**-5**	**0**	**-1**	**0**	**-1**	

otal -9 =S

p= 0.242 Conclusion: not significant at 90%

	Monitoring Round and Date ZWM-99-22X DO									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	-1	1	1	1	-1	-1	1	1	
	1	0	1	1	1	-1	-1	1		
	1	1	1	1	-1	-1	-1			
	1	1	1	-1	-1	-1				
	1	1	-1	-1	-1					
	1	-1	-1	1						
	1	-1	1							
	1	1								
	1									
um	**9**	**1**	**3**	**2**	**-1**	**-4**	**-3**	**2**	**1**	

Total 10 =S

p= 0.216 Conclusion: not significant at 90%

TABLE E-2
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

	Monitoring Round and Date ZWM-95-15X ORP									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	-1	1	-1	-1	1	1	-1	1	-1	
	1	-1	-1	1	1	-1	-1	1		
	-1	-1	-1	1	1	-1	-1			
	-1	1	-1	1	1	-1				
	-1	1	-1	1	1					
	-1	-1	-1	1						
	-1	1	-1							
	-1	-1								
	-1									
Sum	**-7**	**0**	**-7**	**4**	**5**	**-2**	**-3**	**2**	**-1**	
Total	-9 =S									
	p=	0.242		Conclusion:		not significant at 90%				

	Monitoring Round and Date ZWM-95-15X DO									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	1	1	-1	1	-1	1	-1	1	-1	
	1	-1	-1	1	-1	-1	-1	-1		
	-1	1	-1	1	-1	-1	-1			
	1	-1	-1	-1	-1	-1				
	1	1	-1	0	-1					
	1	-1	-1	-1						
	-1	-1	-1							
	-1	-1								
	-1									
Sum	**1**	**-2**	**-7**	**1**	**-5**	**-2**	**-3**	**0**	**-1**	
Total	-18 =S									
	p=	0.066		Conclusion:		significant downward trend				

	Monitoring Round and Date ZWM-99-23X ORP									
	1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
	-1	-1	-1	1	-1	1	-1	1	-1	
	-1	-1	1	1	-1	1	1	-1		
	-1	1	1	1	-1	1	-1			
	1	-1	1	1	1	-1				
	-1	1	1	1	-1					
	-1	-1	1	1						
	-1	1	-1							
	1	-1								
	-1									
Sum	**-5**	**-2**	**3**	**6**	**-3**	**2**	**-1**	**0**	**-1**	
Total	-1 =S									
	p=	0.5		Conclusion:		not significant at 90%				

TABLE E-2
AOC 69W STATISTICAL TREND ANALYSIS
OPERATING PROPERLY AND SUCCESSFULLY DEMONSTRATION REPORT
AOC 69W
DEVENS, MASSACHUSETTS

Monitoring Round and Date
ZWM-99-23X DO

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
1	-1	1	1	-1	-1	-1	1	-1	
1	1	1	1	-1	-1	1	-1		
1	1	1	-1	-1	-1	-1			
1	1	1	-1	-1	-1				
1	-1	-1	-1	-1					
1	-1	1	-1						
-1	1	-1							
1	-1								
-1									
Sum	**5**	**0**	**3**	**-2**	**-5**	**-4**	**-1**	**0**	**-1**

Total -5 =S

p= 0.364 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-01-25X ORP

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
			-1	1	1	1		-1	
			-1	1	1	1			
			-1	1	1				
			1	1					
			1						
Sum	**0**	**0**	**0**	**-1**	**4**	**3**	**2**	**0**	**-1**

otal 7 =S X= 6

p= 0.136 Conclusion: not significant at 90%

Monitoring Round and Date
ZWM-01-25X DO

1 (5/00)	2 (11/00)	3 (5/01)	4 (11/01)	5 (5/02)	6 (11/02)	7 (5/03)	8 (10/03)	9 (4/04)	10 (10/04)
			1	-1	-1	-1		1	
			1	-1	-1	-1			
			1	-1	-1				
			-1	-1					
			-1						
um	**0**	**0**	**0**	**1**	**-4**	**-3**	**-2**	**0**	**1**

Total -7 =S

p= 0.136 Conclusion: not significant at 90%