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ANNUAL GROUNDWATER QUALITY AND CAPTURE REPORT FOR 1998

ONALASKA MUNICIPAL LANDFILL
Onalaska, Wisconsin

Remedial Action

WA No. 003-RALR-05L5 / Contract No. 68-W6-0025
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Annual Groundwater Quality and Capture Report for 1998

Introduction

Purpose

The primary objectives of the semiannual groundwater monitoring program at the Onalaska Municipal Landfill are to:

- Provide data to determine if groundwater contaminant concentrations in the aquifer between the landfill and the Black River are being reduced by the extraction system
- Provide data to determine if groundwater contaminant concentrations in the aquifer have been reduced to below the cleanup criteria
- Provide data to verify that a hydraulic gradient is being maintained by the extraction system in order to contain and collect contaminated groundwater
- Monitor the impact on water levels in the wetlands adjacent to the site to make sure that the extraction system is not lowering water levels to such a level as to affect the wetlands adversely

The groundwater monitoring program can also be used to identify any seasonal fluctuations in groundwater quality and provide information on background water quality.

Cleanup Criteria

Under the remedy selected in the ROD, the following cleanup standards were adopted:

- Groundwater contaminant plume located at any point beyond the property boundary or design management zone (DMZ):
  - Preventive Action Limits (PALs) from Wisconsin Administrative Code Chapter NR 140
- Groundwater contaminant plume located at landfill waste boundary:
  - Maximum Contaminant Level (MCLs) from the Safe Drinking Water Act, 40 CFR 141.61 and 40 CFR 143
  - Maximum Contaminant Level Goals (MCLGs) above zero from the Safe Drinking Water Act, 40 CFR 141.50

Groundwater Monitoring Program

Groundwater samples are collected from the monitoring wells, extraction wells, and two residential wells. Baseline sampling was conducted in November 1993 before startup of the groundwater extraction and treatment system in the spring of 1994. Quarterly sampling was

begun in March 1995. Sampling frequency was reduced from quarterly to semiannually because quarterly data collected from March 1995 through March 1997 demonstrated that semiannual sampling was sufficient to achieve the objectives noted above. Table 1 summarizes the rationale for selection of each well and piezometer. The residential wells are located at the Hubley and Ackerman homes.

Existing monitoring well MW-4S was added to the groundwater sampling program in March 1996. This well was replaced in the summer of 1997 because something was obstructing the passage of a bailer. Existing monitoring well MW-5S was added to the groundwater sampling program in July 1996. Existing monitoring wells MW-2S, MW-2M, and MW-2D (located in the landfill) were added to the groundwater sampling program in June 1997 under the RAC contract. These monitoring wells were added to assess volatile organic compound (VOC) contamination in and close to the landfill since the concentration of VOCs in the outer wells has generally decreased to below preventive action limits (PALs). Metals analyses were also conducted on these wells for comparison to outer wells, which continue to show metals contamination above PALs.

Sampling and Observations

Semiannual groundwater samples and groundwater elevation measurements were collected on July 7 to 10 and October 26 to 29, 1998. Figure 1 shows the monitoring points locations.

VOC samples from the residential wells were sent by overnight courier to Northern Lake Service laboratory in Crandon, Wisconsin. Northern Lake Service Laboratory is a subcontract laboratory to Specialized Assays Environmental laboratory in Nashville, Tennessee. The remaining samples were sent by overnight courier to Specialized Assays Environmental for testing of select VOCs, metals, and wet chemistry parameters.

The monitoring wells were sampled in accordance with the procedures described in the Field Sampling Plan. The following observations were made and actions taken during the sampling events:

- Groundwater from monitoring wells MW-4S and MW-5S appeared to be cloudy or colored.
- A hydrocarbon odor was noted in MW-4S and MW-14S.
- OVM readings of 600 ppm and 120 ppm were measured at MW-4S.
- Extraction well EW-5 could not be sampled in October because the extraction well pump failed and had to be replaced.

TABLE 1
Monitoring Well Network Rationale

Well Designation	Rationale
PZ-01	Monitor groundwater level west of westernmost extraction well to determine if necessary capture zone is being attained
PZ-02	Monitor groundwater level between wetlands and extraction system to determine if wetlands water levels are being lowered
PZ-03	Monitor groundwater level between wetlands and extraction system to determine if wetlands water levels are being lowered
PZ-04	Monitor groundwater level between wetlands and extraction system to determine if wetlands water levels are being lowered
PZ-05	Monitor groundwater level east of easternmost extraction well to determine if necessary capture zone is being attained
PZ-06	Monitor groundwater level east of easternmost extraction well to determine if necessary capture zone is being attained
MW-1S	Monitor shallow background groundwater quality upgradient of the landfill and the extraction system to allow statistical evaluation of background groundwater characteristics
MW-2S	Monitor shallow groundwater quality in the center of the landfill to determine if reduction in groundwater contaminants occurs over time
MW-2M	Monitor intermediate groundwater quality in the center of the landfill to determine if reduction in groundwater contaminants occurs over time
MW-2D	Monitor deep groundwater quality in the center of the landfill to determine if reduction in groundwater contaminants occurs over time
MW-4S	Monitor shallow groundwater quality immediately downgradient of landfill to determine if reduction in groundwater contaminants occurs over time (compliance point for Wisconsin PALs)
MW-5S	Monitor shallow groundwater quality immediately downgradient of landfill to determine if reduction in groundwater contaminants occurs over time (compliance point for MCLs)
MW-6S	Monitor shallow groundwater quality downgradient of the landfill and extraction system to determine if reduction in groundwater contaminants occurs over time (compliance point for Wisconsin PALs)
MW-6M	Monitor intermediate groundwater quality downgradient of landfill and extraction system to determine if reduction in groundwater contaminants occurs over time (compliance point for Wisconsin PALs)
MW-8S	Monitor shallow groundwater quality downgradient of the landfill and extraction system to determine if contaminated groundwater had been captured (compliance point for Wisconsin PALs)
MW-8M	Monitor intermediate groundwater quality downgradient of landfill and extraction system to determine if contaminated groundwater has been captured (compliance point for Wisconsin PALs)
MW-12S	Monitor shallow groundwater quality east of easternmost extraction well to determine if necessary capture zone is being attained and whether contaminated groundwater has been captured (compliance point for Wisconsin PALs)
MW-14S	Monitor shallow groundwater quality west of westernmost extraction well to determine if necessary capture zone is being attained and whether contaminated groundwater has been captured (compliance point for Wisconsin PALs). The Bly Rendering Works was located near this well. The RI report notes that contamination at MW-14S may be related to that facility rather than the landfill.

TABLE 1
Monitoring Well Network Rationale

Well Designation	Rationale
EW-1	Groundwater extraction well—water quality monitored to determine if reduction in groundwater contaminants occurs over time (compliance point for Wisconsin PALs)
EW-2	Groundwater extraction well—water quality monitored to determine if reduction in groundwater contaminants occurs over time (compliance point for MCLs)
EW-3	Groundwater extraction well—water quality monitored to determine if reduction in groundwater contaminants occurs over time (compliance point for MCLs)
EW-4	Groundwater extraction well—water quality monitored to determine if reduction in groundwater contaminants occurs over time (compliance point for MCLs)
EW-5	Groundwater extraction well—water quality monitored to determine if reduction in groundwater contaminants occurs over time (compliance point for Wisconsin PALs)

Presentation of Results

Analytical Results

The analytical results are presented in tabular format in Appendix A and graphically in Appendix B. Laboratory results were sent to the USEPA Region 5 for data validation. Validation results were not received for the following data.

- MW-5S volatiles (July 1998)
- MW-6M odor and color (July 1998)
- MW-8S odor and color (July 1998)
- Field Blank number 1 volatiles (October 1998)
- All metals (October 1998)

U.S. EPA granted permission for the unvalidated results to be validated by CH2M HILL. The U.S. EPA and CH2M HILL validation included a comparison of the data packages and QA/QC results to the requirements described in the Special Analytical Service (SAS) methods. QA/QC qualifiers resulting from the validation have been added to the tables in Appendix A. Table 2 summarizes the results of the validation.

Appendix B provides graphs of the VOCs, metals, and wet chemistry results for the baseline sampling and each sampling event to date. Results qualified as rejected (R) during validation were not plotted. All undetected parameters were plotted at the detection limit.

Discussion of the results is grouped by VOCs, metals, and wet chemistry. Comparisons are made to the PALs and MCLs for each parameter with a standard. Comparisons are also made to the value calculated using the procedures to establish a Wisconsin alternative concentration limit (ACL) for parameters with background concentrations that may prevent compliance with PALs (Table 3). ACLs may replace PALs for these parameters.

TABLE 2
Summary of USEPA Region 5 Validation Groundwater Monitoring Analyses 1998
Onalaska Municipal Landfill

Parameter	Well	Quarter	SAS No.	USEPA Qualifier	EPA Validation Comments
Iron	Ackerman, Hubley	3	98ZR03-28 and 29	J	Contaminated preparation blank
Iron	EW-01 to EW-05, MW-01S, MW-02S, M, D, MW-04S, MW-05S, MW-06S, M, MW-08S, M, MW-12S, MW-14S	3	98ZR03-30-39, 40-43, 44-45, 53	J	Poor LCS recovery and performance
Lead	EW-01 to EW-05, MW-01S, MW-02S, M, D, MW-04S, MW-05S, MW-12S, MW-14S	3	98ZR03-30-39, 44-45, 53	UJ	Poor LCS recovery
Lead	MW-06S, M, MW-08S, M	3	98ZR03-40-43	UJ	Possible elevation of the detection limit
Lead	Ackerman, Hubley	3	98ZR03-28, 29	UJ	Bad LCS sample
Manganese	EW-01 to EW-05, MW-01S, MW-02S, M, D, MW-04S, MW-05S, MW-06S, M, MW-08S, M MW-14S	3	98ZR03-30-39, 40-43, 45, 53	J	Poor LCS recovery
Manganese	MW-12S	3	98ZR03-44	UJ	Poor LCS recovery
Oil and Grease	EW-01 to EW-05, MW-01S, MW-02S, M, D, MW-04S, MW-05S, MW-12S, MW-14S	3	98ZR03-30-39, 44-45, 53	J	Blank contamination of 0.14 µg/l
Color	EW-01 to EW-05, MW-01S, MW-02S, M, D, MW-04S, MW-05S, MW-12S, MW-14S	3	98ZR03-30-39, 44-45, 53	J	Poor field duplicate reproducibility
Turbidity	EW-01 to EW-05, MW-01S, MW-02S, M, D, MW-04S, MW-05S, MW-12S, MW-14S	3	98ZR03-30-39, 44-45, 53	J	Poor field duplicate reproducibility
Turbidity	Ackerman, Hubley	3	98ZR03-28,29	R	LCS, calibration verification standard, and lab blank were all missing from the QC section
TDS	MW-06S, M, MW-08S, M	3	98ZR03-40-43	J	Poor field duplicate reproducibility

Groundwater Elevation and Capture Analysis

Semiannual groundwater elevation data are summarized in Table 5. The data were used to plot groundwater elevations on Figures 2 and 3. The plotted data were used to evaluate whether a hydraulic gradient is being maintained in order to contain and collect contaminated groundwater and to evaluate effects on the wetlands.

TABLE 3

Statistical Evaluation of Select Parameters from Background Monitoring Well MW-1S (Using Data To Date)

Preliminary Background Based ACLs For Select Parameters

Parameter	Average	Standard Deviation	No. of Results	Avg. + 2 Std. Dev.	Original PAL	Preliminary ACL
Iron (µg/L)	208	252	12	712	150	720
Manganese (µg/L)	767	655	12	2077	25	2100
Color C.U.	42.5	56.8	11	156.1	7.5	160

Preliminary Background Based PALs For Select Parameters Where PALs Have Not Been Set

Parameter	Average	Standard Deviation	No. of Results	Avg. + 3 Std. Dev.[1]	Avg. + NR140.20 Table 3 Incr.	Greater of 2 Prev. Col.
Indicator Parameters						
Alkalinity, Total as $CaCO_3$ (mg/L)	125	23	7	194	225	225
Chemical Oxygen Demand (mg/L)	9	5	6	24	34	34
Hardness (As $CaCO_3$) mg/L	206	88	9	471	306	471
pH	6.80	N.A.	12	N.A.	N.A.	N.A.
Specific Conductance (µmho/cm)	200	40	9	319	400	400
Total Dissolved Solids (Residue, Filterable) (mg/L)	295	444	12	1,627	495	1,627
Total Organic Carbon (mg/L)	5	1	9	9	6	9
Other Parameters Requiring Monitoring						
Oil & Grease, Total Rec (mg/L)	1.0	1.4	9.0	5.1	NA	5.1
Turbidity (NTU)	94	75	11	319	NA	319

E140811.CV.05.02.03 Fig 1 MW, EX, Piez NW 3-25-98 TLL/lmh/mjl

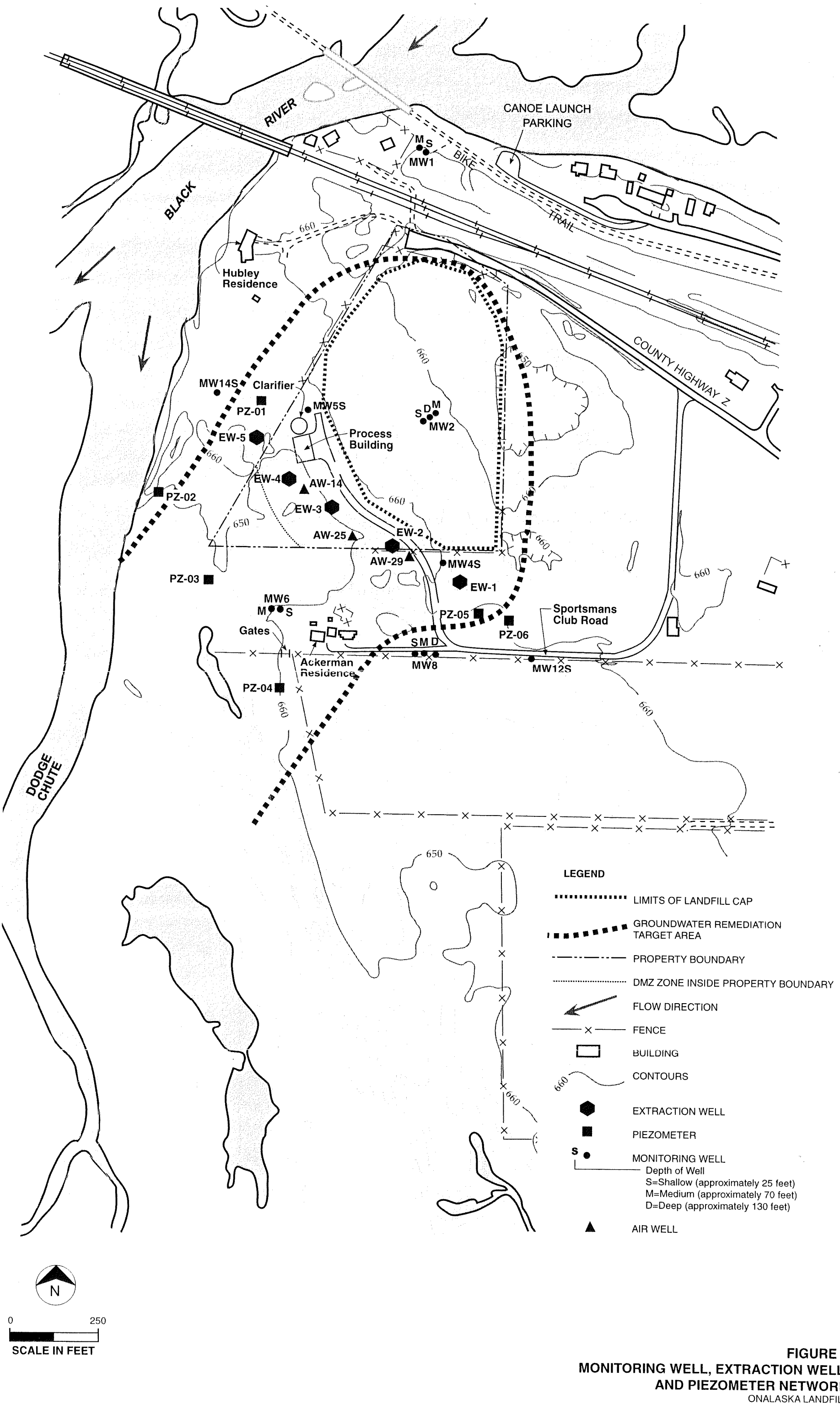


FIGURE 1
MONITORING WELL, EXTRACTION WELL, AND PIEZOMETER NETWORK
ONALASKA LANDFILL

Analytical Summary of Results

VOCs

No chlorinated VOCs were detected in any of the wells in 1998. The concentrations of one or more of the BTEX compounds were greater than the PALs at least once during the year in monitoring wells MW-02M, MW-04S and MW-05S, and extraction well EW-04. MW-04S was the only well with VOCs that exceeded groundwater standards since it was the only well exceeding a PAL that is beyond the property boundary. MW-02M, MW-05S, and EW-04 were in compliance with the less stringent standards applicable within the property boundary.

BTEX compounds were detected in extraction wells EW-01 through EW-05 and monitoring wells MW-01S through MW-12S in 1998. However, the only detected BTEX compound in MW-1S, MW-2D, MW-6S, MW-6M, MW-8S, MW-8M, and MW-12S was toluene, which was reported at or just above the detection limit in the July 1998 event. The low level toluene results may be questionable since they are at or just above the detection limit. The October 1998 MW-04S sample was diluted 20 times by the laboratory for BTEX analyses due to a high concentration of xylene. This raised the detection limit for benzene, toluene, and ethylbenzene to above the PAL, but the compounds were not detected at the elevated detection limit. The benzene, toluene, and ethylbenzene results for MW-04S are not shown on the graphs since they would appear misleading if plotted at the elevated detection limits.

VOC concentrations are significantly less than those measured during the remedial investigation (RI). The sum of chlorinated VOCs in the shallow groundwater to the southwest of the landfill was in the range of 500 to 1,000 µg/L during the RI. Using the detection limits for undetected contaminants to estimate the sum concentration of these contaminants, the sum of measured chlorinated VOCs during 1998 was 2 to 4.5 µg/L or less. During the RI, the sum of benzene, toluene, ethylbenzene, and xylene compounds in the shallow groundwater southwest of the landfill was generally in the range of 100 to 1,000 µg/L, with localized concentrations as high as 40,000 µg/L. In 1998, the sum of BTEX compounds was less than 4.5 µg/L in monitoring well MW-06S, and ranged from less than 1.6 µg/L to 66 µg/L in the extraction wells.

The concentration of VOCs in MW-04S and MW-05S during the RI ranged from 10,000 to 17,500 µg/L. The 1998 VOC concentrations ranged from 60 µg/L to 231 µg/L. During the RI, the total VOC concentration was comprised of mainly BTEX compounds. In 1998, all the detected VOCs were BTEX compounds.

The lower concentrations are thought to be attributable to the successful removal of more highly contaminated groundwater, reduced leaching of contaminants into the groundwater due to the landfill cap, and dilution of contaminated water with less contaminated water. The dilution occurs as less contaminated water is drawn toward the extraction system. Some of the more contaminated shallow groundwater may also be diluted in the extraction wells, which draw from both the shallow groundwater and less contaminated intermediate depth groundwater. Although concentrations measured in 1998 were less than those measured during the RI, concentrations would be expected to increase somewhat if the system were turned off. This increase would likely occur as contaminants leach from the landfill and soil without the dilution noted above.

The VOC results are discussed in more detail below.

Benzene

Wells exceeding PAL in 1998	MW-2M, EW-04
Wells exceeding PAL in 1998 outside property boundary	None
Wells exceeding MCL within property boundary in 1998	None

The PAL for benzene is 0.5 µg/L; the MCL is 5 µg/L. The detection limit used for benzene was 1 µg/L (0.2 µg/L residential) for the July sampling event and 0.4 µg/L (0.24 µg/L residential) for the October sampling event. Benzene was reported as being detected at the detection limit of 1 µg/L in MW-2M during the July 1998 sampling event and also in EW-04 during the October 1998 sampling event. The benzene concentrations have been below detection limits at most wells since the start of the sampling program. Most of the variations on the graphs are due to detection limit variations. In general it appears that the benzene concentrations are below the PAL at most wells. The laboratory results indicate the benzene concentration has been above the PAL at times in EW-03, EW-04, MW-2M, MW-4S, and MW-5S. The benzene concentration is not consistently above the PAL in these wells.

Ethylbenzene

Wells exceeding PAL in 1998	None

The PAL for ethylbenzene is 140 µg/L; the MCL is 700 µg/L. A detection limit of 1 µg/L (0.2 µg/L residential) was used during the July sampling event and of 0.2 µg/L (0.18 µg/L residential) for the October 1998 sampling event. Ethylbenzene has consistently been below the PAL at all of the wells with the exception of baseline monitoring in 1993 in MW-5S, when it slightly exceeded the PAL. Although below the PAL, ethylbenzene contamination is apparent in MW-4S and MW-5S and to a lesser extent in the extraction wells.

Toluene

Wells exceeding PAL in 1998	MW-5S
Wells exceeding PAL in 1998 outside property boundary	None
Wells exceeding MCL within property boundary in 1998	None

The PAL for toluene is 68.6 µg/L; the MCL is 1,000 mg/L. A detection limit of 1 µg/L (0.2 µg/L residential) was used for the July sampling event and of 0.3 µg/L (0.21 µg/L residential) for the October sampling event. The toluene concentration has been below the PAL at most wells since the start of the sampling program. The toluene concentration has been above the PAL at times in EW-03, EW-04, and MW-5S. The toluene concentration was below the PAL in EW-03 and EW-04 in 1997 and 1998. The toluene concentration in MW-5S has generally decreased since a peak in the third quarter of 1996 and was below the PAL in the October 1998 sample.

Total Xylenes

Wells exceeding PAL in 1998	MW-4S, MW-5S
Wells exceeding PAL in 1998 outside property boundary	MW-4S
Wells exceeding MCL within property boundary in 1998	None

The PAL for total xylenes is 124 µg/L; the MCL is 10,000 µg/L. A detection limit of 1 µg/L (0.4 µg/L residential) was used for the July sampling event and of 0.8 µg/L (0.36 µg/L residential) for the October sampling event. The total xylenes concentration has been below the PAL at most wells since the start of the sampling program. The total xylenes concentration has been above the PAL in MW-4S and MW-5S. The total xylenes concentration in MW-4S has decreased since a peak in the fall of 1997; it has been close to the PAL for many of the sampling events. The total xylenes concentration in both MW-4S and MW-5S decreased below the PAL in October 1998. Although below the PAL, total xylenes contamination has been apparent in all the extraction wells except in the October samples where it was only detected in EW-03 and EW-04.

Chlorinated VOCs

Wells exceeding PAL in 1997	None

None of the chlorinated VOCs were detected at any of the wells. The detection limit was less than or equal to the PAL for the chlorinated VOCs. The chlorinated VOC concentrations have generally been below the PALs, or below the detection limits in cases where the detection limit used was above the PAL, at all sampling locations since the start of the sampling program. Most of the variations (including the apparent peaks at MW-5S in the fall of 1996) that can be seen on the graphs are due to detection limit variations.

Metals

In 1998, metals were detected at concentrations above PALs in all monitoring wells, residential wells, and extraction wells. The graphs indicate that the arsenic, barium, iron, and manganese concentrations in some of the wells will likely remain above the PAL (or preliminary ACL) for years.

The manganese and iron concentrations in some wells appear to be due to background concentrations. Manganese and iron were reported at concentrations above PALs (and the Enforcement Standard [ES] for manganese) in MW-1S upgradient of the landfill. Because manganese and iron are present upgradient of the landfill at concentrations above PALs, their presence in other wells is thought to be partially attributable to background concentrations. The statistical evaluation in Table 3 indicates what alternative concentration limits (ACLs) may be appropriate for iron and manganese, which have been present at concentrations above the PALs in background monitoring well MW-1S. It is recommended that ACLs be requested of WDNR at some future date when it appears that the only parameters exceeding PALs are exceeding the PALs due to background concentrations. The statistical evaluation would be similar to that provided in Table 3, but it would include the additional results that will be accumulated up to the time of the request.

Manganese was present at concentrations above the PAL and ES in both the residential wells. The manganese concentrations in the residential wells appear to be completely

attributable to background levels. Iron was present at concentrations above the PAL in the Ackerman residential well. The iron concentrations in the Ackerman well appear greater than background. However, the background concentration of shallow well MW-1S may not be indicative of the background concentration at deeper wells such as the Ackerman well. Therefore, the iron concentration in the Ackerman well may be unrelated to the landfill. There is no MCL drinking water standard for iron or manganese.

A definite decreasing concentration gradient is apparent to either side of the center of the groundwater remediation target area. EW-03, located in the center of the contaminated groundwater plume, had metals concentrations that were almost always higher than the other extraction wells. Extraction wells EW-02 and EW-04 typically had the next highest metals concentrations, and the outer extraction wells EW-01 and EW-05 typically had the lowest metals concentrations of the extraction wells.

The metals results are discussed in more detail below.

Arsenic

Wells exceeding PAL in 1998	EW-01, EW-02, EW-03, EW-04, EW-05, MW-2M, MW-2D, MW-4S, MW-5S
Wells exceeding PAL in 1998 outside property boundary	EW-01, EW-05, MW-4S
Wells exceeding MCL within property boundary in 1998	None

The PAL for arsenic is 5 µg/L; the MCL is 50 µg/L. A detection limit of 5 µg/L was used for the July 1998 sampling event, and a detection limit of 2.5 µg/L was used for the October 1998 sampling event. Arsenic concentrations in the extraction wells ranged from 7 µg/L to 19 µg/L. The highest arsenic concentration, 19 µg/L, occurred in EW-03. No noticeable trends are apparent for arsenic in the wells where concentrations were detected above the PAL. Based on the graphs it appears that the arsenic concentrations in some of the wells will remain above the PAL for years. Based on the locations of the wells where arsenic has been detected versus the location of wells where arsenic concentrations are below the detection limit, the arsenic present above the detection limit appears to be attributable to the landfill. This is also apparent from the fact that arsenic has not been detected in background monitoring well MW-1S (except at a lower detection limit during the baseline monitoring in 1993).

Barium

Wells exceeding PAL in 1998	EW-01, EW-02, EW-03, EW-04, MW-2D, MW-6M, MW-8M
Wells exceeding PAL in 1998 outside property boundary	EW-01, MW-6M, MW-8M
Wells exceeding MCL within property boundary in 1998	None

The PAL for barium is 400 µg/L; the MCL is 2000 µg/L. Barium concentrations in the extraction wells ranged from 290 µg/L to 825 µg/L. The concentrations were highest in MW-06M (1,110 µg/L), EW-03 (825 µg/L), and EW-02 (727 µg/L). The barium in the wells is likely a result of typical wastes disposed of in municipal landfills. The barium may have

been more mobile because of reducing conditions caused by organics in the leachate. As seen on the graphs, the concentrations of barium are decreasing slightly in the wells with the highest concentrations and are remaining relatively constant in the other wells. Based on the graphs it appears that the barium concentrations in some of these wells will remain above the PAL for years. Based on the locations of the shallow wells where barium was reported above the PAL versus the location of shallow wells where barium was below the PAL, the barium present in the shallow wells above the PAL appears to be attributable to the landfill. This is also apparent from the fact that barium is below the PAL in background monitoring well MW-1S. It is not known whether the above PAL barium concentrations in the medium depth and deep well are due to the landfill. Sampling for barium in background monitoring well MW-1M (not currently sampled) may be appropriate in the future to better establish background barium concentrations at medium depths.

Iron

Wells exceeding PAL in 1998	EW-01, EW-02, EW-03, EW-04, EW-05, Ackerman Residential, Hubley Residential, MW-1S, MW-2S, MW-2M, MW-2D, MW-4S, MW-5S, MW-6M, MW-12S, MW-14S
Wells exceeding PAL in 1998 outside property boundary	EW-01, EW-05, Ackerman Residential, Hubley Residential, MW-1S, MW-4S, MW-6M, MW-12S, MW-14S
Wells exceeding preliminary ACL in 1998	EW-01, EW-02, EW-03, EW-04, EW-05, Ackerman Residential, MW-2S, MW-2M, MW-2D, MW-4S, MW-5S, MW-14S
Wells exceeding preliminary ACL in 1998 outside property boundary	EW-01, EW-05, Ackerman Residential, MW-4S, MW-14S

The PAL for iron is 150 µg/L. Iron was present at values above the PAL in all wells except MW-6S, MW-8S, and MW-8M. Iron in background well MW-1S, located upgradient of the landfill, was also above the PAL. Thus, the presence of iron in other wells is likely at least partially attributable to background rather than contamination from the landfill. However, the iron concentration in some of the wells indicates that the landfill has significantly contributed to elevated iron concentrations. Based on background data to date, the average background iron has been 208 µg/L (See Table 3). Evaluation of background data to date using the procedures to establish an ACL yields a value of 720 µg/L (See Table 3). Iron concentrations in the extraction wells ranged from 915 µg/L to 6,290 µg/L. The highest iron concentration occurred in MW-2M which was 31,000 µg/L. There appears to be a decreasing iron concentration trend in most of the extraction and monitoring wells. However, the iron concentration in certain monitoring wells such as MW-14S does not appear to have a decreasing trend. Insufficient data exists to determine any trends for wells closest to the landfill that were only recently added to the sampling program. The iron concentration has decreased for the last two Ackerman residential well samples from the spike in November 1997. There is no MCL drinking water standard for iron. Based on the graphs it appears that the iron concentrations in some of these wells will remain above the background concentration for years.

Lead

Wells exceeding PAL in 1998: None

The PAL for lead is 1.5 µg/L. Detection limits of 1.5 µg/L and 3 µg /L were used during the July 1998 sampling event (varied between wells), and a detection limit of 1.5 µg/L was used during the October 1998 sampling event. The variations apparent on the graphs are due to the different detection limits used by the lab. Lead was not detected in any wells in 1998.

Manganese

Wells exceeding PAL in 1998	EW-01, EW-02, EW-03, EW-04, EW-05 Ackerman and Hubley Residential, MW-1S, MW-2S, MW-2M, MW-2D, MW-4S, MW-5S, MW-6S, MW-6M, MW-8S, MW-8M, MW-14S
Wells exceeding PAL in 1998 outside property boundary	EW-01, EW-05, Ackerman and Hubley Residential, MW-1S, MW-4S, MW-6S, MW-6M, MW-8S, MW-8M, MW-14S
Wells exceeding preliminary ACL	EW-02, EW-03, EW-04, MW-1S, MW-2M, MW-4S, MW-6M, MW-14S
Wells exceeding preliminary ACL in 1998 outside property boundary	MW-1S, MW-4S, MW-6M, MW-14S

The PAL for Manganese is 25 µg/L. Manganese was detected at concentrations greater than the PAL in all the wells except monitoring well MW-12S. Manganese in background well MW-1S, located upgradient of the landfill, was also above the PAL. Thus, the presence of manganese in other wells is at least partially attributable to the background manganese, rather than contamination from the landfill. However, the manganese concentration in some of the wells indicates that the landfill has significantly contributed to elevated manganese concentrations. Based on background data to date, the average background manganese has been 767 µg/L (See Table 3). Evaluation of background data to date using the procedures to establish an ACL yields a value of 2,100 µg/L (See Table 3). It should be noted that the October 1998 result from MW-1S (included in the ACL calculation) would exceed this preliminary ACL. The October 1998 MW-1S manganese concentration was 2240 µg/L. This was the highest result to date in MW-1S. The manganese concentrations in the Hubley and Ackerman wells appear to be completely attributable to background concentration. There is no MCL drinking water standard for manganese.

Manganese concentrations in the extraction wells ranged from 1260 µg/L to 2660 µg/L. The highest manganese concentrations occurred in MW-14S (5430 µg/L), MW-2M (2750 µg/L), EW-03 (2660 µg/L), MW-1S (2,240), and EW-02 (727µg/L).

Wet Chemistry

PALs exist for color and odor. Color was present at values above the PAL in all wells monitored except MW-8M and MW-8S. (MW-12S was below the PAL in July but above in October.) Odor was above the PAL in monitoring well MW-14S in October. The tests for odor and color are highly dependent on the analyst's judgment. The results of these tests are not precise and will vary between analysts. Color was present in monitoring well MW-

1S upgradient of the landfill at varying concentrations in both 1998 sampling events. Thus, the presence of color in other wells may be partially attributed to the background color of the groundwater rather than contamination from the landfill.

A statistical evaluation using the procedures to establish an ACL is presented in Table 3 to provide an indication of what ACL may be appropriate for color. Values for other wet chemistry parameters were also calculated using the procedures to establish PALs as shown in Table 3 for comparison to data collected in other wells. It is recommended that ACLs be requested of WDNR at some future date when it appears that the only parameters exceeding PALs are due to background concentrations. The statistical evaluation would be similar to that provided in Table 3, but it would include the additional results that will be accumulated up to the time of the request.

Wet chemistry parameters are not monitored in wells in or close to the landfill (MW-2S, MW-2M, MW-2D, MW-4S, MW-5S). These wells were added to the VOC monitoring plan because VOC concentrations had dropped to below PALs in the wells beyond the extraction wells. These wells are also sampled for metals to provide a better understanding of metals concentrations which are above PALs in the outer wells. Monitoring of wet chemistry parameters in these wells is being deferred because there is no significant value in monitoring these parameters at this time.

The wet chemistry results are discussed in more detail below.

pH

Values for pH generally ranged from 6.4 to 8.2. There is no PAL for pH but the measured values are relatively neutral and do not indicate any significant pH concerns related to the landfill.

Color

Wells exceeding PAL in 1998	EW-01, EW-02, EW-03, EW-04, EW-05, MW-1S, MW-06S, MW-06M, MW-12S, MW-14S, Hubley Residential, Ackerman Residential
Wells exceeding PAL in 1998 outside property boundary	EW-01, EW-05, MW-1S, MW-06S, MW-06M, MW-12S, MW-14S, Hubley Residential, Ackerman Residential
Wells exceeding preliminary ACL	None

The PAL for color is 7.5 color units (CU). Color was present at values above the PAL in all wells monitored except MW-08M and MW-08S. Color in background well MW-01S, located upgradient of the landfill, was also above the PAL. Thus, the presence of color in other wells is likely at least partially attributable to the background color of the groundwater rather than contamination from the landfill. Based on background data to date, the average background color has been 42.6 CU (See Table 3). Evaluation of background data to date using the procedures to establish an ACL yields a value of 160 CU (See Table 3). None of the wells monitored exceeded this criterion.

Color has been lower at all wells since December 1996 versus March 1995 through October 1996. However, the color results were generally higher in 1998 then in 1997. The tests for color are highly dependent on the analyst's judgment; therefore, the results of these tests are

not precise and will vary between analysts. This may be the cause of some of the variation in results between sampling rounds. The wells with a high color value tended to have a high iron concentration. One potential source of the color is oxidized iron which causes the water to have a red tint.

Odor

Wells exceeding PAL in 1998	MW-14S
Wells exceeding PAL in 1998 outside property boundary	MW-14S

The PAL for odor is 1.5 t.o.n. As in 1996 and 1997, the greatest 1998 laboratory-measured odor values occurred in MW-14S. The water in this well typically contains a field observable hydrocarbon odor and sheen, thereby explaining the odor results in the lab. As stated in the RI report, the odor and sheen at MW-14S may be attributed to an old diesel fuel spill at the former Bly Rendering Works. During the RI, 15 tentatively identified compounds (TICs) totaling 176 µg/L were found at MW-14S. MW-4S, which was not analyzed for odor, also has a strong field observable hydrocarbon odor.

Oil and Grease

Oil and grease in background well MW-01S varied from undetected at 0.11 mg/L to estimated at 0.23 mg/L. Evaluation of background data to date using the procedures to establish a PAL yields a value of 5.1 mg/L (See Table 3). None of the wells monitored exceeded this criterion. Oil and grease was detected above the detection limit at EW-1, EW-2, MW-1S, MW-6S, MW-8S, MW-8M, MW-12S, MW-14S, and the Hubley residential well during 1998. The highest reported oil and grease was the Hubley residential well in October 1998. The reported concentration was 1.11 mg/L. Oil and grease was not detected in the Hubley residential well at a detection limit of 0.12 mg/L in the July 1998 sample. There are no groundwater or drinking water standards for oil and grease. The concentrations of oil and grease have been noticeably lower at most wells since 1996.

TDS

Total dissolved solids (TDS) results are used to indicate if the landfill leachate is impacting the monitoring wells. The TDS concentrations in the background well MW-01S ranged from 131 to 169 mg/L for the 1998 sampling events. Evaluation of background data to date using the procedures to establish a PAL yields a value of 1,700 mg/L (See Table 3). None of the wells monitored exceeded this criterion. The TDS concentrations for the other monitoring, extraction, and residential wells were typically close to the background range, though generally slightly higher. The highest TDS concentration of 325 mg/L occurred in MW-08S. The second highest TDS concentration of 293 occurred at MW-12S which had similar concentrations for the last several rounds of sampling. MW-12S and MW-8S are both south of the landfill. Since MW-12S is not believed to be downstream of the landfill, it is possible that the TDS concentration in MW-12S and MW-8S are at least partially due to sources other than the landfill. It is possible that MW-1S (located at the north end of the site) is not completely representative of all background constituents in the groundwater. The average TDS concentrations have not changed noticeably; however, there were fewer excursions from 1996 to 1998 than in 1995. The TDS concentrations have been below the aesthetic- and taste-based recommended concentration limit of 500 mg/L since 1996.

Turbidity

Turbidity in background well MW-1S was 28.6 nephelometric turbidity unit (NTU) for the July 1998 sampling event, and 18.3 for the October 1998 sampling event. Turbidity in MW-1S has ranged from 18 to 240 NTU during the 1995, 1996, and 1997 sample events. Evaluation of background data to date using the procedures to establish a PAL yields a value of 320 NTU (See Table 3). None of the wells monitored exceeded this criterion. However, turbidity appeared to be noticeably above background in EW-02, EW-03, EW-04, MW-14S, and the Ackerman residential well. There is no turbidity limit applicable to groundwater because of the lower risk of microorganisms in groundwater. For comparison, the U.S. EPA's MCL for turbidity applicable to water systems using surface water is 1 TU or 5 TU if disinfection and microbiological determinations are not an issue.

Other Wet Chemistry Parameters No Longer Monitored

After 1997, the following wet chemistry parameters were deferred from the sampling program to reduce sampling, analysis, data management, validation, and evaluation cost: alkalinity, chemical oxygen demand (COD), hardness, specific conductance, and total organic carbon (TOC). These parameters were not significantly contributing to the evaluation of groundwater contamination due to the landfill. These parameters could be sampled at a future date at WDNR's request, or if required to verify compliance with groundwater criteria when it appears that all other parameters are below groundwater PALs or ACLs.

Table 3 shows the statistical evaluation for these parameters in background monitoring well MW-1S. The number of valid results for alkalinity and COD are less than the eight required to establish a PAL. However, values were calculated using the procedures to establish PALs for all the parameters shown in Table 3 for comparison to data collected in other wells from 1995 to 1997. Additional sampling would be required to establish a PAL for alkalinity and COD if a PAL will be required by WDNR. A discussion of these parameters versus the values calculated using the procedures to establish PALs is presented below.

Alkalinity. Value calculated using the procedures to establish a PAL is 230. The following wells had at least one value above this value: MW-4S, MW-6S, MW-6M, and the Ackerman and Hubley residential wells. MW-4S has not been sampled for alkalinity since prestartup testing in 1993. MW-6S and MW-6M were below 230 in the last five sampling events, and the Hubley residential well has been below 230 in the last seven sampling events. The Ackerman well was in the 220 to 240 range for the four samples taken at that well. It is possible that the shallow background monitoring well MW-1S is not representative of the deeper Ackerman residential well.

COD. Value calculated using the procedures to establish a PAL is 34. The following wells had at least one value above this value: MW-5S, MW-4S, and MW-14S. MW-4S and MW-5S have not been sampled for COD since prestartup testing in 1993. MW-4S and MW-5S are the two closest monitoring wells to the landfill (excluding MW-2 wells which are in the landfill) and are known to have a higher organic concentration than the wells farther away from the landfill. Sampling for specific VOC contaminants is being used to monitor organic contamination in these wells. The COD in MW-14S is likely unrelated to the landfill (see Odor discussion).

Field Conductivity. Value calculated using the procedures to establish a PAL is 400. The following wells had at least one value above this value: EW-02, EW-03, MW-4S, and MW-6S. EW-02 and EW-03 were below 400 in 1996 and 1997.

Hardness. Value calculated using the procedures to establish a PAL is 480. None of the wells have had a result above this value.

TOC. Value calculated using the procedures to establish a PAL is 9. The following wells had at least one value above this value: EW-03, MW-5S, and the Hubley residential well. MW-5S has not been sampled for TOC since prestartup testing in 1993. EW-03 and the Hubley residential well were below 9 in the last 7 sampling events.

Groundwater Elevation and Capture Analysis: Summary of Results

Objectives

The objectives of the Groundwater Elevation and Capture Analysis include the following:

- Evaluate the effectiveness of the Onalaska groundwater extraction system's hydraulic gradient control and collection of contaminated groundwater within the aquifer during pumping in 1998
- Monitor the impact on water levels in the wetlands adjacent to the site to ensure that the extraction system is not lowering water levels to such a level as to adversely affect the wetlands.

Extraction Wells

The groundwater extraction system at the Onalaska site consists of five extraction wells located south of the landfill in a line that extends roughly from the northwest to the southeast (Figure 1). The objective of the groundwater extraction system is to capture groundwater flowing south and southwest of the landfill in the area defined by the groundwater remediation target area, shown as a dashed line on Figures 1, 2, and 3.

The groundwater pumping rates are summarized by year in Table 4. During the Feasibility Study (FS), the amount of groundwater flowing through the sand and gravel aquifer beneath the site was estimated at 350,000 gallons per day (gpd). The groundwater extraction and treatment system removed and treated a total of 257,877,450 gallons in 1998. This is an average removal of 706,514 gallons per day during 1998. The high extraction rates are necessary to create a hydraulic gradient toward the extraction wells in order to capture and contain the plume of contaminated groundwater. This results in a high rate of flushing and dilution.

TABLE 4
Groundwater Pumping Rates

Year	Total Volume Extracted and Treated (gal)	Average Daily Extraction Rate (gal/day)	Average Pumping Rate (gpm)
1994	176,247,120	855,568	594
1995	261,374,480	716,094	497
1996	247,556,080	678,236	471
1997	279,514,300	765,793	532
1998	257,877,450	706,514	491

Available Water Level Data

Available data consists of water elevation data for two semiannual monitoring events in 1998. Water level data were collected at 22 monitoring locations:

- River level at bike bridge near MW-1S
- Shallow wells: MW-1S, MW-2S, MW-4S, MW-5S, MW-6S, MW-8S, MW-12S, and MW-14S
- Intermediate wells: MW-2M, MW-6M, and MW-8M
- Deep wells: MW-2D
- Piezometers: PZ-01 through PZ-06
- Air sparging wells: AW-14, AW-25, and AW-29

Water elevation data are summarized in Table 5. Previous data indicate that groundwater at the Onalaska site flows from the north toward the south-southwest, except during high river stages when groundwater flows to the south-southeast.

Groundwater Capture Evaluation

Approach

Groundwater elevations were calculated by subtracting the depth to water measurements from the well casing elevation. The depth to water is measured from the top of each well casing. Similarly, river elevation is measured based on the depth to water from a surveyed elevation on the bicycle bridge. The groundwater and river water elevation data were plotted for the July and October sampling events (Figures 2 and 3). The directions of groundwater flow were plotted based on the plotted groundwater elevations. Estimated groundwater elevation contours were also plotted based on the groundwater elevations at the monitored locations. Groundwater flow toward the extraction system at the monitoring locations indicates that the extraction system is effectively capturing groundwater in the groundwater remediation target area.

Monitoring wells MW-2S and AW-14 were dry in October. The groundwater elevations for these wells represent the bottom of the well and are shown with a less-than symbol on Figure 3.

TABLE 5
Groundwater Elevation Results For Capture Analysis
Onalaska Municipal Landfill

Well	Well Rim Elevation (ft)	Jul-98		Oct-98	
		Depth to Water (ft)	Water Elevation (ft)	Depth to Water (ft)	Water Elevation (ft)
Black River[1]	655.77	12.30	643.47	13.8	641.97
MW-1S	663.22	19.11	644.11	20.38	642.84
MW-2S[2]	672.39	29.10	643.29	29.5 (bot. of well)	< 642.89
MW-2M	671.34	27.91	643.43	30.45	640.89
MW-2D	672.07	28.70	643.37	31.22	640.85
MW-4S	664.11	21.27	642.84	24.14	639.97
MW-5S	655.56	12.55	643.01	14.94	640.62
MW-6S	646.25	3.34	642.91	5.76	640.49
MW-6M	648.20	5.20	643.00	7.59	640.61
MW-8S	659.11	16.05	643.06	18.62	640.49
MW-8M	659.07	16.14	642.93	18.45	640.62
MW-12S	662.95	19.19	643.76	21.92	641.03
MW-14S	654.32	11.41	642.91	13.71	640.61
AW-14[2]	655.90	12.86	643.04	14.53 (bot. of well)	< 641.37
AW-25	655.57	12.80	642.77	15.34	640.23
AW-29	661.20	18.29	642.91	19.97	641.23
PZ-01	654.73	11.95	642.78	14.33	640.40
PZ-02	649.76	6.02	643.74	9.02	640.74
PZ-03	647.10	4.23	642.87	6.61	640.49
PZ-04	647.43	4.50	642.93	6.9	640.53
PZ-05	660.23	17.05	643.18	19.79	640.44
PZ-06	659.08	15.84	643.24	18.55	640.53

1. The depth to water for the Black River is measured from a surveyed point on the bicycle trail bridge near MW-1S (top of 3rd I-beam from SE end of bridge on the downstream side).
2. Wells MW-2S and AW-14 were dry during the October sampling event. Therefore, depth to water was recorded as the depth to the bottom of the well and the water elevation is reported as less than the elevation of the bottom of the well.

Medium-depth and deep wells (MW-2M, MW-6M, MW-8M, and MW-2D) were used to determine the vertical groundwater flow; they were not used during the horizontal flow direction assessment.

Conclusions

Groundwater flow was toward the extraction system as illustrated by Figures 2 and 3. Higher groundwater elevations occurred in the monitoring wells and piezometers located along the remediation area perimeter (MW-14S, PZ-02, PZ-03, PZ-04, MW-12S, PZ-06, and MW-01S) versus the monitoring wells and piezometers located within the interior of the remediation area. The groundwater flow patterns indicate that groundwater flow is toward the extraction wells in the remediation area and groundwater capture is occurring.

Comparison of groundwater elevations at MW-6S and MW-6M indicates a small upward gradient from the medium depth aquifer to the shallow depth aquifer for both 1998 sampling events. Comparison of groundwater elevations at MW-8S and MW-8M indicates a small downward gradient from the shallow depth aquifer to the medium depth aquifer for the July measurements, but a small upward gradient for the October measurements. Comparison of groundwater elevations at MW-2S and MW-2M indicates a small upward gradient from the medium depth aquifer to the shallow depth aquifer for the July 1998 sampling event. Comparison of groundwater elevations at MW-2M and MW-2D indicates minimal gradient (very slight downward gradient) from the medium depth aquifer to the deep aquifer for both 1998 sampling events. No conclusion can be made regarding vertical gradient between MW-2S and MW-2M in October since MW-2S was dry.

The groundwater elevation for AW-29 indicates the groundwater was 0.8 to 1 ft higher than the groundwater in the surrounding area (see Figure 3). Given this large difference, it is suspected that an instrument or recording error occurred during the depth to water measurement for this well. Therefore, this well was not considered in the groundwater capture analysis.

Pumping Effects on Wetlands

Piezometers PZ-02, PZ-03, and PZ-04 are located in the vicinity of the wetlands to the southwest of the Onalaska Landfill site. One of the objectives of collecting water levels at these locations was to quantify the effects of groundwater extraction on water levels in the wetlands. Based on the proximity of PZ-02 to the Dodge Chute of the Black River, it is likely that PZ-02 is primarily influenced by the water elevation in Dodge Chute and not by the extraction wells.

Groundwater elevations at PZ-03 and PZ-04 were 9.7 to10.4 inches less than at PZ-02 in July and 2.5 to 3 inches less than at PZ-02 in November. Assuming PZ-02 is representative of groundwater level beyond the influence of the extraction wells, the elevation differences provide an indication that PZ-03 and PZ-04 may be within the cone of depression caused by the extraction wells. However, if the river is controlling groundwater elevation in the vicinity of these three piezometers, it would be expected that the groundwater elevation at PZ-02 would be higher than at PZ-03 and PZ-04 because it is further upstream on Dodge Chute. Therefore, it is difficult to determine the actual influence of the extraction wells on the wetlands. The larger differential occurred in July when the river level was 1.5 ft higher and groundwater levels were up to 3 ft higher in locations versus water levels in October. It

would be expected that the extraction wells would have the least impact during periods with higher groundwater and river levels. This would indicate the extraction wells may not have been significantly affecting the wetlands. Furthermore, a draw down of 10.4 inches in July would be less detrimental to the wetlands because the groundwater level was 2.4 feet higher than in October at PZ-03 and PZ-04.

The gradient was nearly flat between PZ-03 and PZ-04 relative to MW-6S. This indicates that the wetlands are either beyond the zone of influence or at the outer edge of the zone of influence (i.e., there is not a steep cone of depression in the area of the wetlands). As discussed in the Annual Groundwater Quality and Capture Report for 1996, comparison of groundwater elevations in PZ-02, PZ-03, and PZ-04 with and without the extraction wells operating would be necessary to evaluate the exact effect of the extraction wells on groundwater elevation at these piezometers.

Recommended Adjustments to the Monitoring Program

Per discussion with Tim Prendiville/U.S. EPA Work Assignment Manager, a single annual report (this document) presenting the results from both 1998 sampling events was issued without issuing a separate report for the spring 1998 sampling event. This reduced cost and is recommended for all future groundwater sampling events.

Metals sampling is recommended from MW-1M to establish background water quality at medium depth wells. This is recommended because of the high barium, iron, and manganese concentrations in medium depth wells MW-2M, MW-6M, and MW-8M. Establishing background concentrations from eight sampling events will be necessary in order to request ACLs for the medium depth wells.

It is recommended that alkalinity and COD analyses be added to the analyses performed on MW-1S in order to have eight usable results for determining background values as required by WDNR. To date, seven usable results are available for alkalinity and six are available for COD. Sampling and analysis for these parameters would be discontinued as soon as there were eight usable results for them.

As called for in the Field Sampling Plan, a priority pollutant scan will be conducted in the fall of 1999 to determine if other parameters should be added to the monitoring program.

It is recommended that sampling of MW-2D be deferred until a reason for sampling the well is identified. The well was added per a recommendation in the 1996 annual report to provide a more thorough picture of contaminant concentrations at the site. The three subsequent sampling rounds from the well provide a sufficient indication at this time of deep groundwater quality below the landfill.

It is recommended that sampling of MW-12S be deferred until a reason for sampling the well is identified. The well is consistently in compliance with PALs except for occasional iron and color exceedances, both of which appear to be attributable to background. Groundwater level would continue to be measured from MW-12S for capture evaluation.

Appendix A
1998 Groundwater Monitoring Results

Onalaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		ACKERMAN	EW-01	EW-02	EW-03	EW-04	EW-05	HUBLEY
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Not Determined	Water	Water	Water	Water	Water	Not Determined
Sample Collection Date:		7/8/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/8/98
Field Sample Identification:		98ZR03-28	98ZR03-30	98ZR03-31	98ZR03-32	98ZR03-33	98ZR03-34	98ZR03-29
Laboratory Sample Identification:		98-A82042	98-A80037	98-A80038	98-A80035	98-A80036	98-A80043	98-A82041
Volatiles	**Units**							
1,1,1-Trichloroethane	ug/L	0.3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-Dichloroethane	ug/L	0.3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-Dichloroethene	ug/L	0.3 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.3 U
Benzene	ug/L	0.2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U
Ethylbenzene	ug/L	0.2 U	7 =	4 =	2 =	3 =	1 =	0.2 U
Tetrachloroethene	ug/L	0.2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U
Toluene	ug/L	0.2 U	7 =	1 =	2 =	4 =	3 =	0.2 U
Trichloroethene	ug/L	0.3 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.3 U
Xylenes, Total	ug/L	0.4 U	51 =	50 =	60 =	35 =	6 =	0.4 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-06S	MW-08M	MW-08M	MW-08S	MW-12S	MW-14S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water, Duplicate	Water	Water	Water	Water, Duplicate
Sample Collection Date:		7/8/98	7/8/98	7/8/98	7/8/98	7/9/98	7/9/98	7/9/98
Field Sample Identification:		98ZR03-40	98ZR03-43	98ZR03-46	98ZR03-42	98ZR03-44	98ZR03-45	98ZR03-47
Laboratory Sample Identification:		98-A79193	98-A79196	98-A79197	98-A79195	98-A80041	98-A80042	98-A80045
Volatiles	**Units**							
1,1,1-Trichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	ug/L	1 =	1 =	1 U	2 =	1 =	1 U	1 U
Trichloroethene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, Total	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Omaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		ACKERMAN	EW-01	EW-02	EW-03	EW-04	EW-05	HUBLEY
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Not Determined	Water	Water	Water	Water	Water	Not Determined
Sample Collection Date:		7/8/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/8/98
Field Sample Identification:		98ZR03-28	98ZR03-30	98ZR03-31	98ZR03-32	98ZR03-33	98ZR03-34	98ZR03-29
Laboratory Sample Identification:		98-A82042	98-A80037	98-A80038	98-A80035	98-A80036	98-A80043	98-A82041
Total Metals	**Units**							
Arsenic	ug/L	5 U	7 =	11 =	19 =	13 =	10 =	5 U
Barium	ug/L	23 =	463 =	669 =	771 =	554 =	290 =	66 =
Iron	ug/L	2440 =	1530 J	5320 J	6920 J	3400 J	915 J	168 J
Lead	ug/L	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ
Manganese	ug/L	81 =	1420 J	1980 J	2420 J	1990 J	1260 J	259 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Omaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-01S	MW-02D	MW-02M	MW-02S	MW-04S	MW-05S	MW-06M
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/8/98	7/8/98
Field Sample Identification:		98ZR03-35	98ZR03-37	98ZR03-36	98ZR03-53	98ZR03-38	98ZR03-39	98ZR03-41
Laboratory Sample Identification:		98-A80039	98-A80049	98-A80048	98-A80047	98-A80050	98-A80051	98-A79194
Total Metals	**Units**							
Arsenic	ug/L	5 U	9 =	11 =	5 U	10 =	6 =	5 U
Barium	ug/L	22 =	513 =	135 =	102 =	303 =	213 =	847 =
Iron	ug/L	128 J	3720 J	31000 J	16100 J	12000 J	6820 J	91 J
Lead	ug/L	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	3 UJ
Manganese	ug/L	137 J	530 J	1450 J	758 J	2160 J	1330 J	1700 J

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-06S	MW-08M	MW-08M	MW-08S	MW-12S	MW-14S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water, Duplicate	Water	Water	Water	Water, Duplicate
Sample Collection Date:		7/8/98	7/8/98	7/8/98	7/8/98	7/9/98	7/9/98	7/9/98
Field Sample Identification:		98ZR03-40	98ZR03-43	98ZR03-46	98ZR03-42	98ZR03-44	98ZR03-45	98ZR03-47
Laboratory Sample Identification:		98-A79193	98-A79196	98-A79197	98-A79195	98-A80041	98-A80042	98-A80045
Total Metals	**Units**							
Arsenic	ug/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Barium	ug/L	95 =	406 =	405 =	87 =	19 =	60 =	53 =
Iron	ug/L	143 J	113 J	144 J	141 J	161 J	1370 J	702 J
Lead	ug/L	3 UJ	3 UJ	3 UJ	3 UJ	1.5 UJ	1.5 UJ	1.5 UJ
Manganese	ug/L	1420 J	1680 J	1600 J	521 J	10 UJ	1100 J	597 J

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		ACKERMAN	ACKERMAN	EW-01	EW-02	EW-03	EW-04	EW-05
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Not Determined	Not Determined	Water	Water	Water	Water	Water
Sample Collection Date:		7/8/98	7/20/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98
Field Sample Identification:		98ZR03-28	98ZR03-55	98ZR03-30	98ZR03-31	98ZR03-32	98ZR03-33	98ZR03-34
Laboratory Sample Identification:		98-A82042	98-A84742	98-A80037	98-A80038	98-A80035	98-A80036	98-A80043
General Chem	**Units**							
pH	ph units	7.24 =	7.4 =	7.3 =	7.1 =	6.9 =	7 =	8.1 =
Color	color unit	NR	34 =	25 J	20 J	30 J	60 J	10 J
Odor	t.o.n.	NR	0 =	0 =	0 =	0 =	0 =	0 =
Oil & Grease, Total Rec	mg/L	0.11 U	NR	0.15 J	0.21 J	0.11 J	0.11 J	0.11 J
Total Dissolved Solids (Residue, Filterable)	mg/L	263 =	NR	242 =	218 =	210 =	187 =	162 =
Turbidity	ntu	0.33 R	NR	26.7 J	82.5 J	85 J	39.1 J	1 J

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:	OML	OML	OML	OML	OML	OML	OML
Field Sample Location:	HUBLEY	HUBLEY	MW-01S	MW-06M	MW-06S	MW-08M	MW-08M
Sample Interval:	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:	Not Determined	Not Determined	Water	Water	Water	Water	Water, Duplicate
Sample Collection Date:	7/8/98	7/20/98	7/9/98	7/8/98	7/8/98	7/8/98	7/8/98
Field Sample Identification:	98ZR03-29	98ZR03-56	98ZR03-35	98ZR03-41	98ZR03-40	98ZR03-43	98ZR03-46
Laboratory Sample Identification:	98-A82041	98-A84743	98-A80039	98-A79194	98-A79193	98-A79196	98-A79197
General Chem	**Units**						
pH	ph units	7.94 =	7.7 =	7.2 =	6.67 =	7.7 =	7.2 =	7.5 =
Color	color unit	NR	18 =	10 J	12 =	17 =	7 =	7 =
Odor	t.o.n.	NR	0 =	0 =	0 =	0 =	0 =	0 =
Oil & Grease, Total Rec	mg/L	0.12 U	NR	0.23 J	0.11 U	0.17 =	0.19 =	0.23 =
Total Dissolved Solids (Residue, Filterable)	mg/L	124 =	NR	169 =	167 J	176 J	196 J	192 J
Turbidity	ntu	10.6 R	NR	28.6 J	1.7 =	2.7 =	2.3 =	2.1 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Oniaska Municipal Landfill
Groundwater Monitoring Results
July, 1998

Field Site Identifier:		OML	OML	OML	OML
Field Sample Location:		MW-08S	MW-12S	MW-14S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water, Duplicate
Sample Collection Date:		7/8/98	7/9/98	7/9/98	7/9/98
Field Sample Identification:		98ZR03-42	98ZR03-44	98ZR03-45	98ZR03-47
Laboratory Sample Identification:		98-A79195	98-A80041	98-A80042	98-A80045
General Chem	**Units**				
pH	ph units	7.63 =	7.39 =	6.56 =	6.3 =
Color	color unit	2 =	5 J	20 J	10 J
Odor	t.o.n.	0 =	0 =	0 =	0 =
Oil & Grease, Total Rec	mg/L	0.15 =	0.59 J	0.54 J	0.44 J
Total Dissolved Solids (Residue, Filterable)	mg/L	247 J	282 =	130 =	129 =
Turbidity	ntu	7.2 =	17.3 J	22.4 J	6.4 J

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Oriaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		ACKERMAN	EW-01	EW-02	EW-03	EW-04	HUBLEY	MW-01S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/27/98	10/28/98	10/28/98	10/28/98	10/28/98	10/27/98	10/27/98
Field Sample Identification:		99ZR01-01	99ZR01-03	99ZR01-04	99ZR01-05	99ZR01-06	99ZR01-02	99ZR01-08
Laboratory Sample Identification:			98-A133007	98-A133008	98-A133009	98-A133010		98-A132240
Volatiles	**Units**							
1,1,1-Trichloroethane	ug/L	0.259 U	0.4 U	0.4 U	0.4 U	0.4 U	0.259 U	0.4 U
1,1-Dichloroethane	ug/L	0.275 U	0.4 U	0.4 U	0.4 U	0.4 U	0.275 U	0.4 U
1,1-Dichloroethene	ug/L	0.271 U	0.4 U	0.4 U	0.4 U	0.4 U	0.271 U	0.4 U
Benzene	ug/L	0.236 U	0.4 U	0.4 U	0.4 U	1.7 =	0.236 U	0.4 U
Ethylbenzene	ug/L	0.184 U	0.4 U	0.4 U	0.4 U	3 =	0.184 U	0.4 U
Tetrachloroethene	ug/L	0.327 U	0.4 U	0.4 U	0.4 U	0.4 U	0.327 U	0.4 U
Toluene	ug/L	0.213 U	0.4 U	0.4 U	0.4 U	20 =	0.213 U	0.4 U
Trichloroethene	ug/L	0.29 U	0.4 U	0.4 U	0.4 U	0.4 U	0.29 U	0.4 U
Xylenes, Total	ug/L	0.359 U	0.4 U	2.2 =	4.1 =	18.6 =	0.359 U	0.4 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Oneida Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-02D	MW-02M	MW-04S	MW-05S	MW-06M	MW-06S	MW-08M
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/28/98	10/28/98	10/26/98	10/26/98	10/27/98	10/27/98	10/27/98
Field Sample Identification:		99ZR01-10	99ZR01-09	99ZR01-11	99ZR01-12	99ZR01-14	99ZR01-13	99ZR01-16
Laboratory Sample Identification:		98-A133004	98-A133003	98-A132251	98-A132252	98-A132242	98-A132243	98-A132244
Volatiles	**Units**							
1,1,1-Trichloroethane	ug/L	0.4 U	0.4 U	8 U	0.4 U	0.4 U	0.4 U	0.4 U
1,1-Dichloroethane	ug/L	0.4 U	0.4 U	8 U	0.4 U	0.4 U	0.4 U	0.4 U
1,1-Dichloroethene	ug/L	0.4 U	0.4 U	8 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzene	ug/L	0.4 U	0.4 U	8 U	0.4 U	0.4 U	0.4 U	0.4 U
Ethylbenzene	ug/L	0.4 U	0.4 U	10 U	4.2 =	0.4 U	0.4 U	0.4 U
Tetrachloroethene	ug/L	0.4 U	0.4 U	8 U	0.4 U	0.4 U	0.4 U	0.4 U
Toluene	ug/L	0.4 U	0.4 U	8 U	28 =	0.4 U	0.4 U	0.4 U
Trichloroethene	ug/L	0.4 U	0.4 U	8 U	0.4 U	0.4 U	0.4 U	0.4 U
Xylenes, Total	ug/L	0.4 U	0.4 U	86 =	27 =	0.4 U	0.4 U	0.4 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Omaha Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML
Field Sample Location:		MW-08M	MW-08S	MW-12S	MW-14S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A
Matrix:		Water, Duplicate	Water	Water	Water	Water, Duplicate
Sample Collection Date:		10/27/98	10/27/98	10/27/98	10/28/98	10/28/98
Field Sample Identification:		99ZR01-19	99ZR01-15	99ZR01-17	99ZR01-18	99ZR01-20
Laboratory Sample Identification:		98-A132245	98-A132246	98-A132241	98-A133005	98-A133006
Volatiles	**Units**					
1,1,1-Trichloroethane	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,1-Dichloroethane	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,1-Dichloroethene	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Benzene	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Ethylbenzene	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Tetrachloroethene	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Toluene	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Trichloroethene	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Xylenes, Total	ug/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		ACKERMAN	EW-01	EW-02	EW-03	EW-04	HUBLEY	MW-01S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/27/98	10/28/98	10/28/98	10/28/98	10/28/98	10/27/98	10/27/98
Field Sample Identification:		99ZR01-01	99ZR01-03	99ZR01-04	99ZR01-05	99ZR01-06	99ZR01-02	99ZR01-08
Laboratory Sample Identification:		98-A132248	98-A133007	98-A133008	98-A133009	98-A133010	98-A132249	98-A132240
Total Metals	**Units**							
Arsenic	ug/L	2.5 U	8 =	11 =	14 =	12 =	2.5 U	5 =
Barium	ug/L	18 =	433 =	727 =	825 =	606 =	54 =	16 =
Iron	ug/L	559 =	921 =	4670 =	4090 =	2830 =	110 =	388 =
Lead	ug/L	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Manganese	ug/L	84 =	1480 =	2180 =	2660 =	2200 =	129 =	2240 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-02D	MW-02M	MW-04S	MW-05S	MW-06M	MW-06S	MW-08M
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/28/98	10/28/98	10/26/98	10/26/98	10/27/98	10/27/98	10/27/98
Field Sample Identification:		99ZR01-10	99ZR01-09	99ZR01-11	99ZR01-12	99ZR01-14	99ZR01-13	99ZR01-16
Laboratory Sample Identification:		98-A133004	98-A133003	98-A132251	98-A132252	98-A132242	98-A132243	98-A132244
Total Metals	**Units**							
Arsenic	ug/L	14 =	15 =	11 =	15 =	2.5 U	2.5 U	2.5 U
Barium	ug/L	484 =	133 =	228 =	364 =	1110 =	73 =	370 =
Iron	ug/L	5360 =	30400 =	9570 =	20900 =	164 =	100 =	105 =
Lead	ug/L	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Manganese	ug/L	580 =	2750 =	802 =	2020 =	2350 =	1140 =	1690 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Oralaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML
Field Sample Location:		MW-08M	MW-08S	MW-12S	MW-14S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A
Matrix:		Water, Duplicate	Water	Water	Water	Water, Duplicate
Sample Collection Date:		10/27/98	10/27/98	10/27/98	10/28/98	10/28/98
Field Sample Identification:		99ZR01-19	99ZR01-15	99ZR01-17	99ZR01-18	99ZR01-20
Laboratory Sample Identification:		98-A132245	98-A132246	98-A132241	98-A133005	98-A133006
Total Metals	**Units**					
Arsenic	ug/L	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Barium	ug/L	360 =	147 =	22 =	130 =	126 =
Iron	ug/L	100 =	147 =	311 =	13000 =	13200 =
Lead	ug/L	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Manganese	ug/L	1640 =	1300 =	4 U	5430 =	5120 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Oriaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		ACKERMAN	EW-01	EW-02	EW-03	EW-04	HUBLEY	MW-01S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/27/98	10/28/98	10/28/98	10/28/98	10/28/98	10/27/98	10/27/98
Field Sample Identification:		99ZR01-01	99ZR01-03	99ZR01-04	99ZR01-05	99ZR01-06	99ZR01-02	99ZR01-08
Laboratory Sample Identification:		98-A132248	98-A133007	98-A133008	98-A133009	98-A133010	98-A132249	98-A132240
General Chem	**Units**							
pH	ph units	6.11 =	6.94 =	6.58 =	6.66 =	6.7 =	7.25 =	6.14 =
Color	color unit	30 =	40 =	100 =	70 =	30 =	17 =	30 =
Odor	none	1 =	1 =	1 =	1 =	1 =	1 =	1 =
Oil & Grease, Total Rec	mg/L	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	1.11 =	0.11 U
Total Dissolved Solids (Residue, Filterable)	mg/L	266 =	252 =	228 =	221 =	204 =	127 =	131 =
Turbidity	ntu	59 =	33.3 =	116 =	109 =	56.4 =	0.15 U	18.3 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Oriaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-02D	MW-02M	MW-04S	MW-05S	MW-06M	MW-06S	MW-08M
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/28/98	10/28/98	10/26/98	10/26/98	10/27/98	10/27/98	10/27/98
Field Sample Identification:		99ZR01-10	99ZR01-09	99ZR01-11	99ZR01-12	99ZR01-14	99ZR01-13	99ZR01-16
Laboratory Sample Identification:						98-A132242	98-A132243	98-A132244
General Chem	**Units**							
pH	ph units	6.5 =	6.04 =	6.2 =	6.36 =	7.6 =	6.4 =	6.4 =
Color	color unit	NR	NR	NR	NR	15 =	24 =	7 =
Odor	none	NR	NR	NR	NR	1 =	1 =	1 =
Oil & Grease, Total Rec	mg/L	NR	NR	NR	NR	0.11 U	0.11 U	0.13 =
Total Dissolved Solids (Residue, Filterable)	mg/L	NR	NR	NR	NR	215 =	167 =	189 =
Turbidity	ntu	NR	NR	NR	NR	2.4 =	6.9 =	3.2 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
October, 1998

Field Site Identifier:		OML	OML	OML	OML	OML
Field Sample Location:		MW-08M	MW-08S	MW-12S	MW-14S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A
Matrix:		Water, Duplicate	Water	Water	Water	Water, Duplicate
Sample Collection Date:		10/27/98	10/27/98	10/27/98	10/28/98	10/28/98
Field Sample Identification:		99ZR01-19	99ZR01-15	99ZR01-17	99ZR01-18	99ZR01-20
Laboratory Sample Identification:		98-A132245	98-A132246	98-A132241	98-A133005	98-A133006
General Chem	**Units**					
pH	ph units	7.3 =	6.18 =	6.41 =	6.01 =	6.6 =
Color	color unit	7 =	5 =	10 =	75 =	50 =
Odor	none	1 =	1 =	1 =	8 =	8 =
Oil & Grease, Total Rec	mg/L	0.11 U	0.11 U	0.15 =	0.47 =	0.56 =
Total Dissolved Solids (Residue, Filterable)	mg/L	197 =	325 =	293 =	188 =	185 =
Turbidity	ntu	3.6 =	13.6 =	20.1 =	52.6 =	71 =

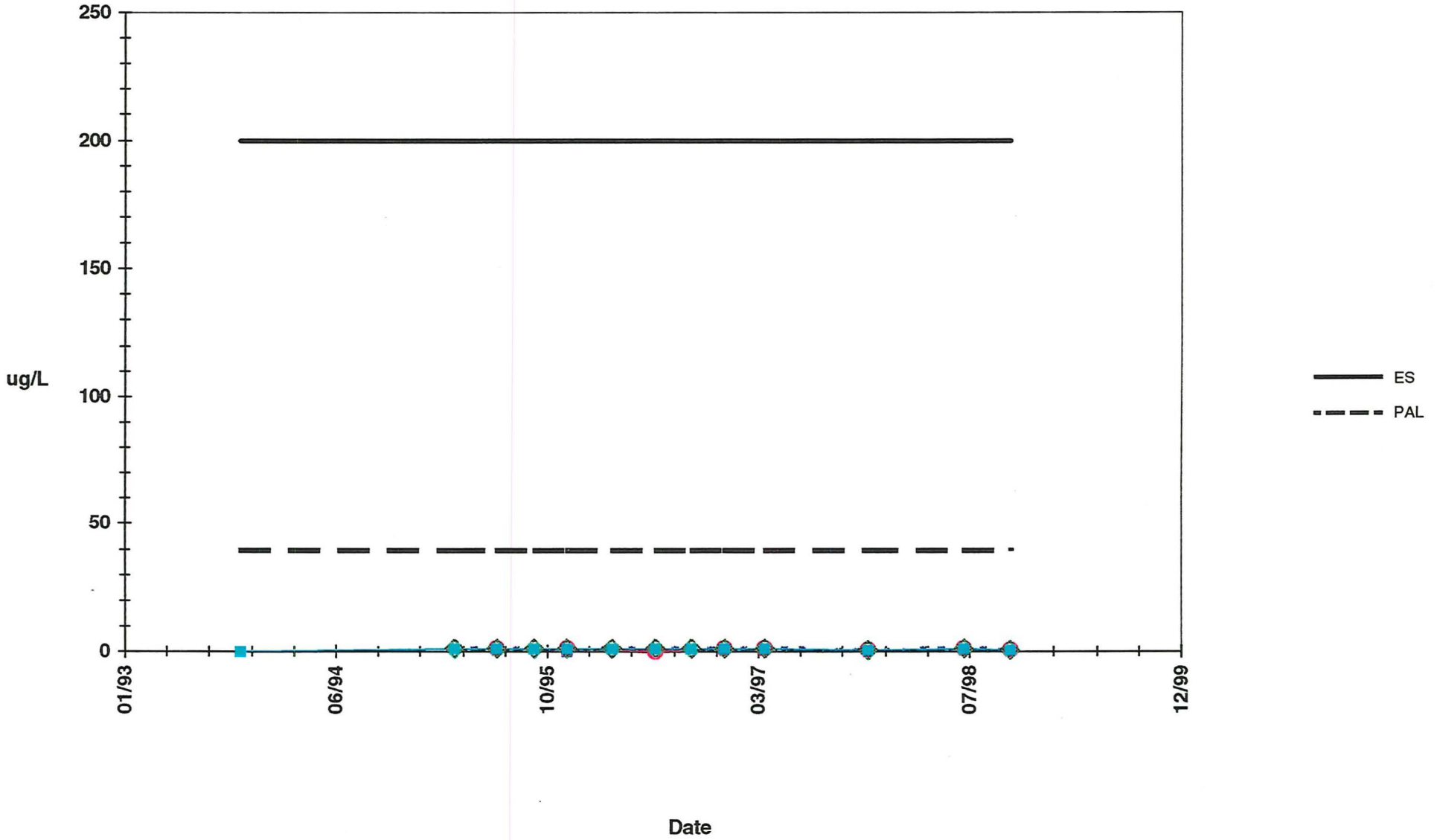
QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Appendix B
Graphed Groundwater Monitoring Results to Date

Onalaska Municipal Landfill

Extraction Wells

1,1,1-Trichloroethane

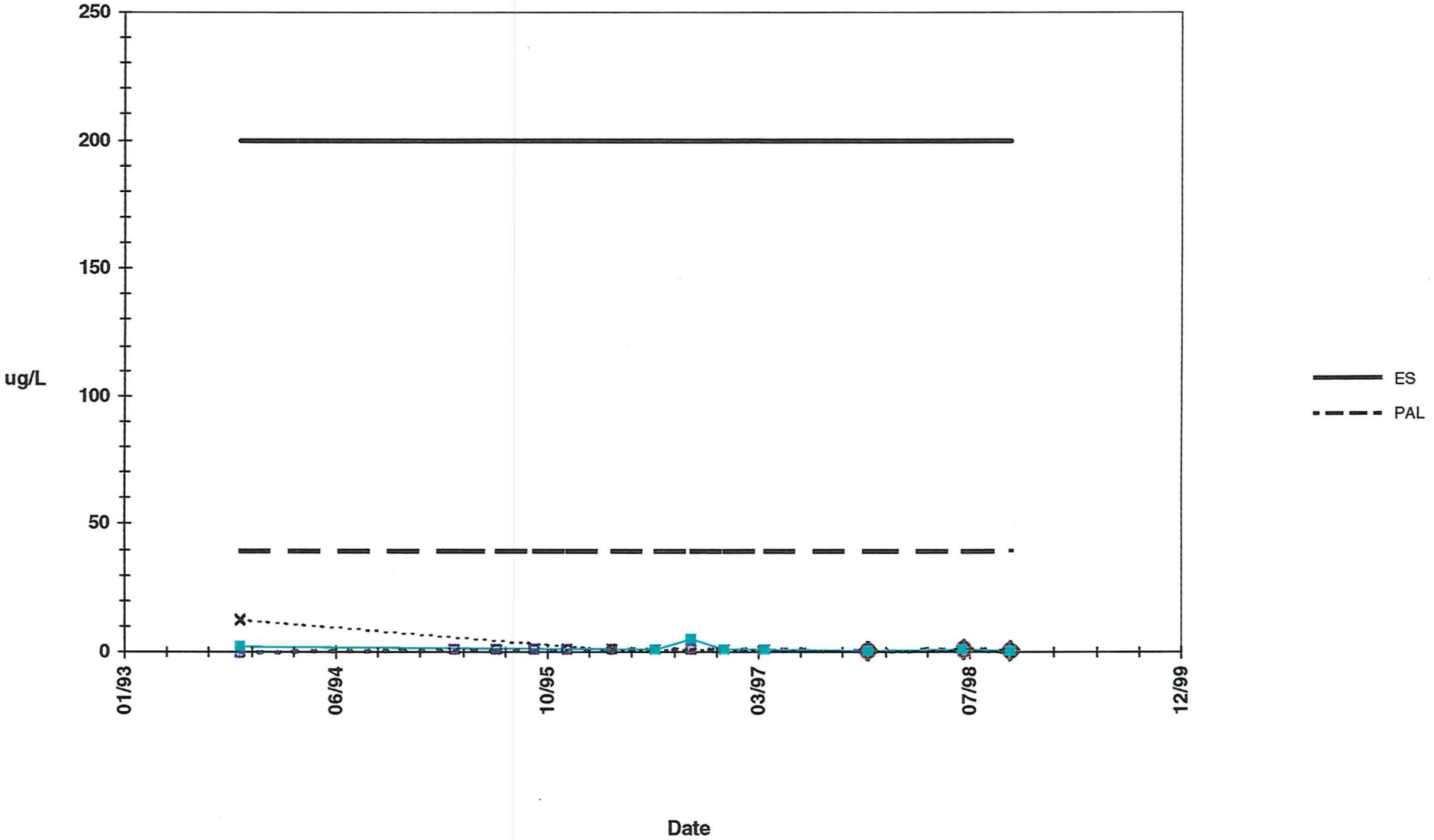


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

1,1,1-Trichloroethane

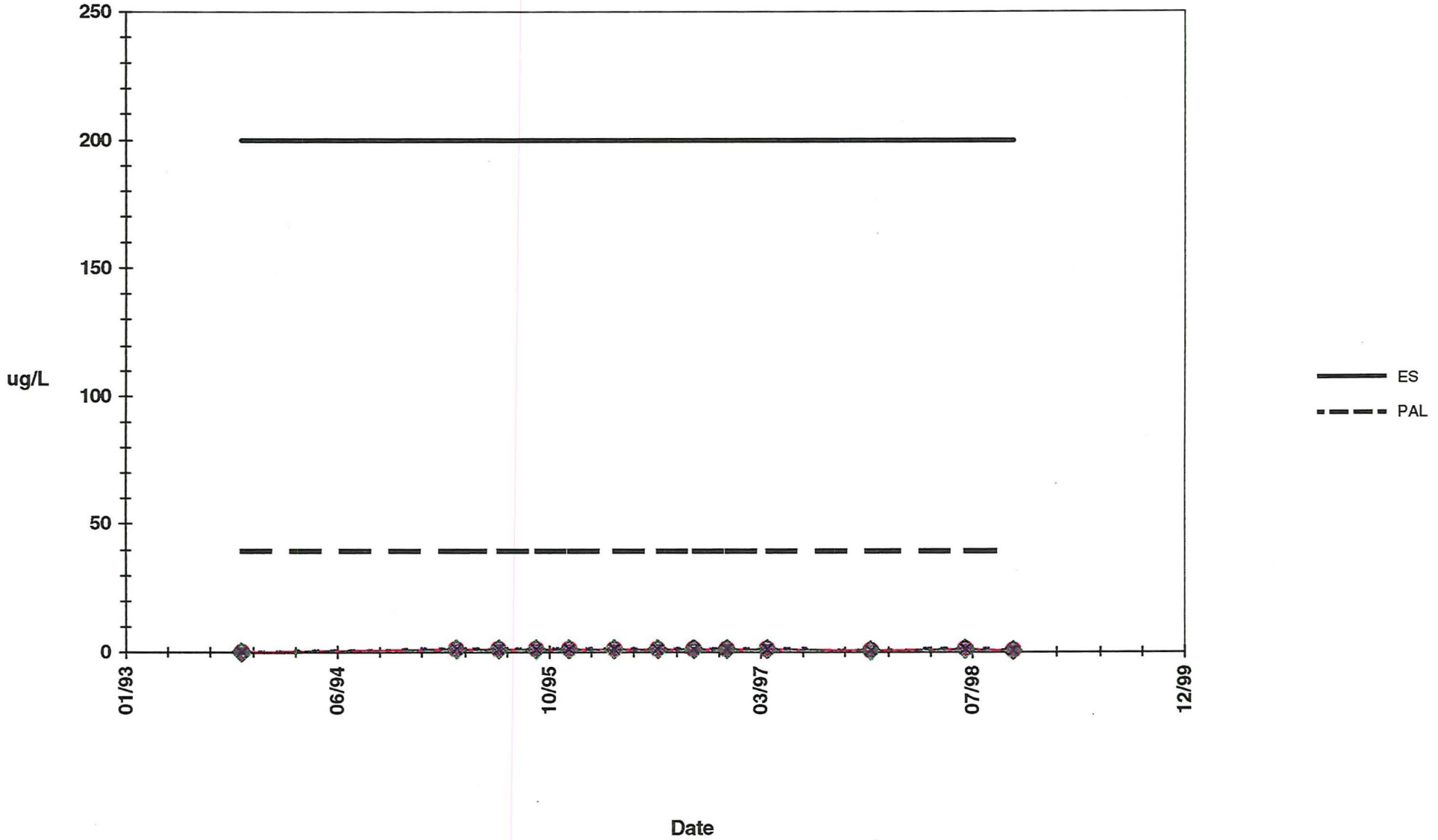


Prepared by CH2M HILL 26-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

1,1,1-Trichloroethane

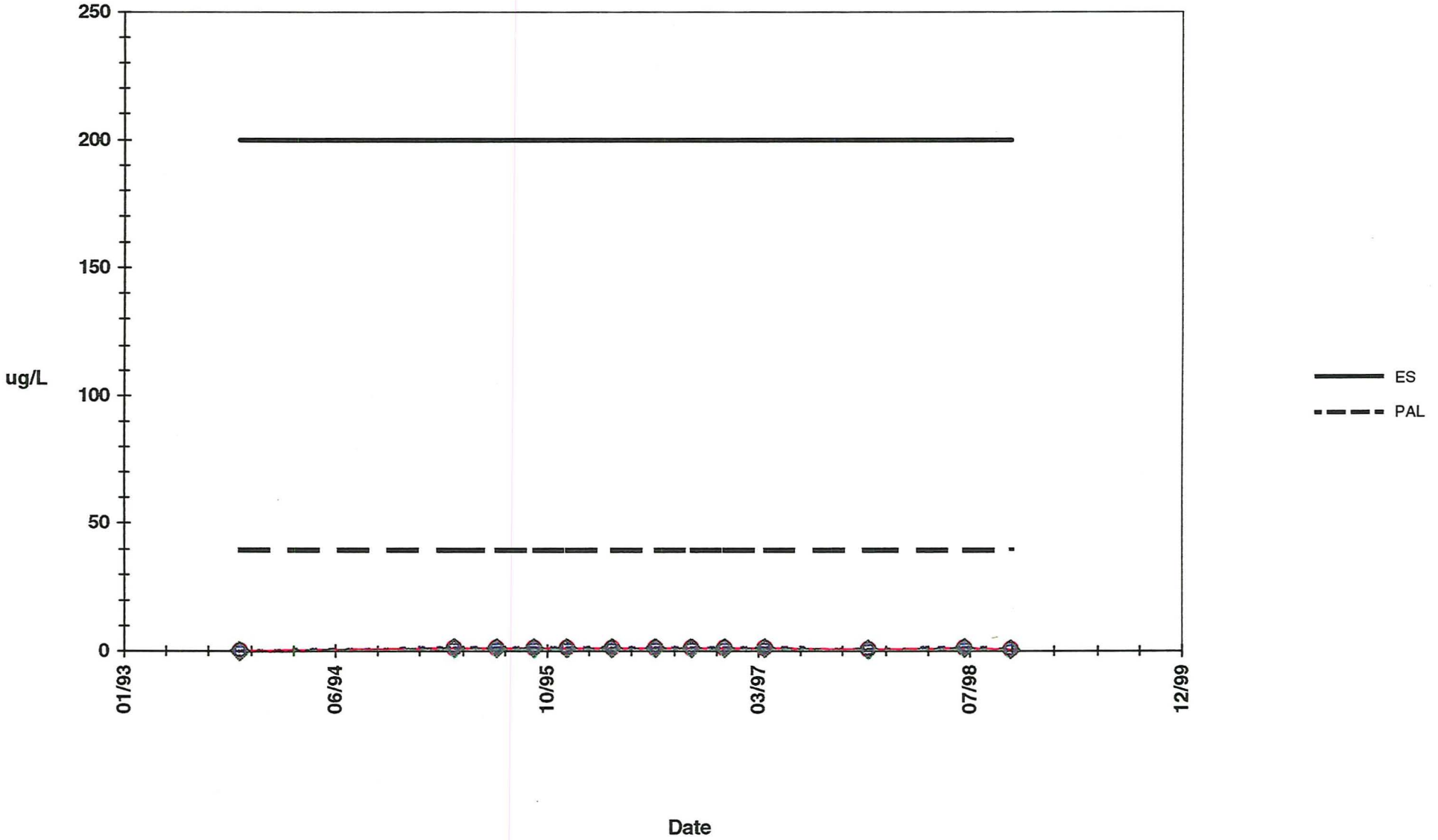


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

MW-12 and MW-14

1,1,1-Trichloroethane

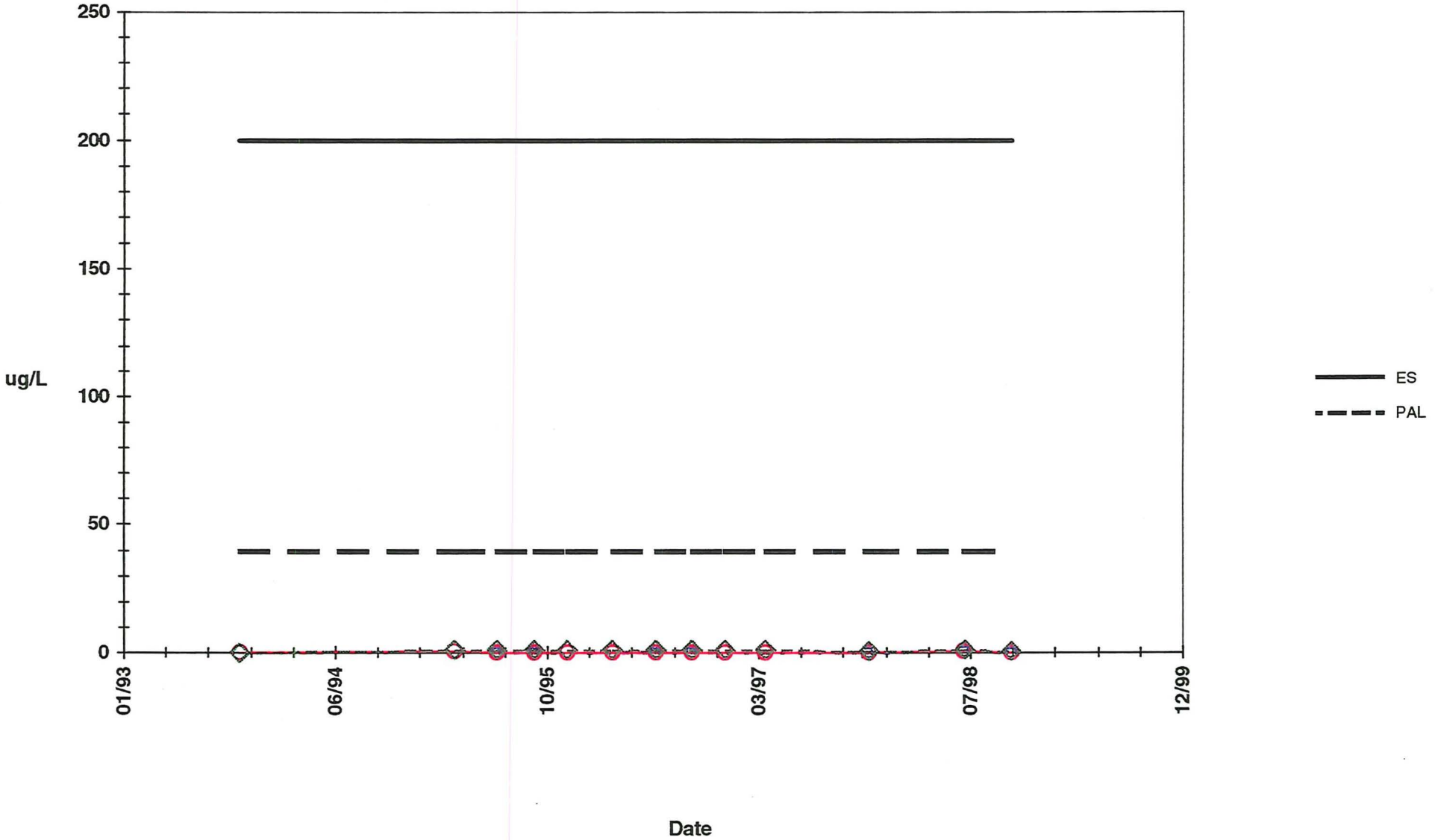


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

1,1,1-Trichloroethane



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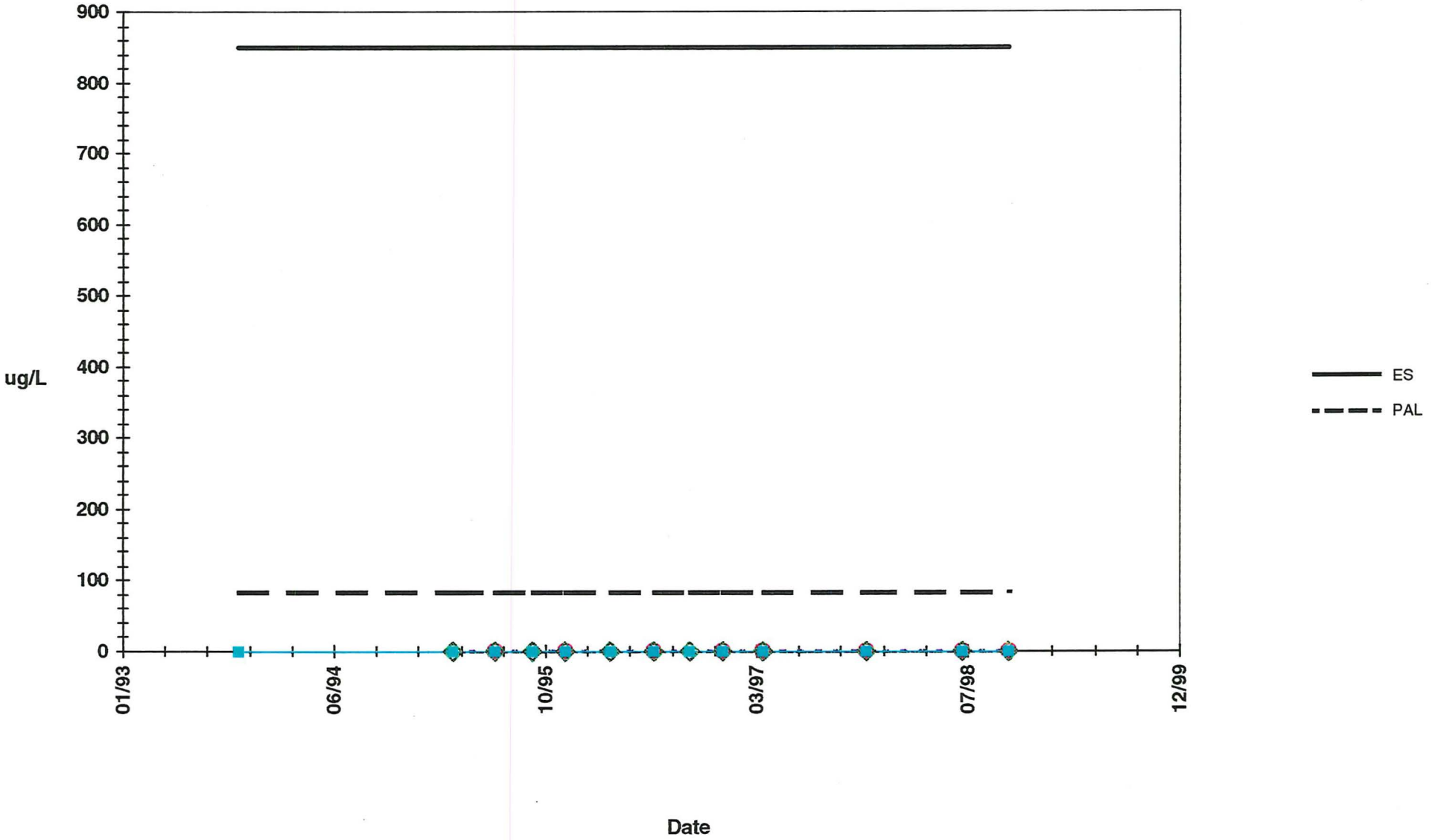
Onalaska Municipal Landfill

Extraction Wells

1,1-Dichloroethane

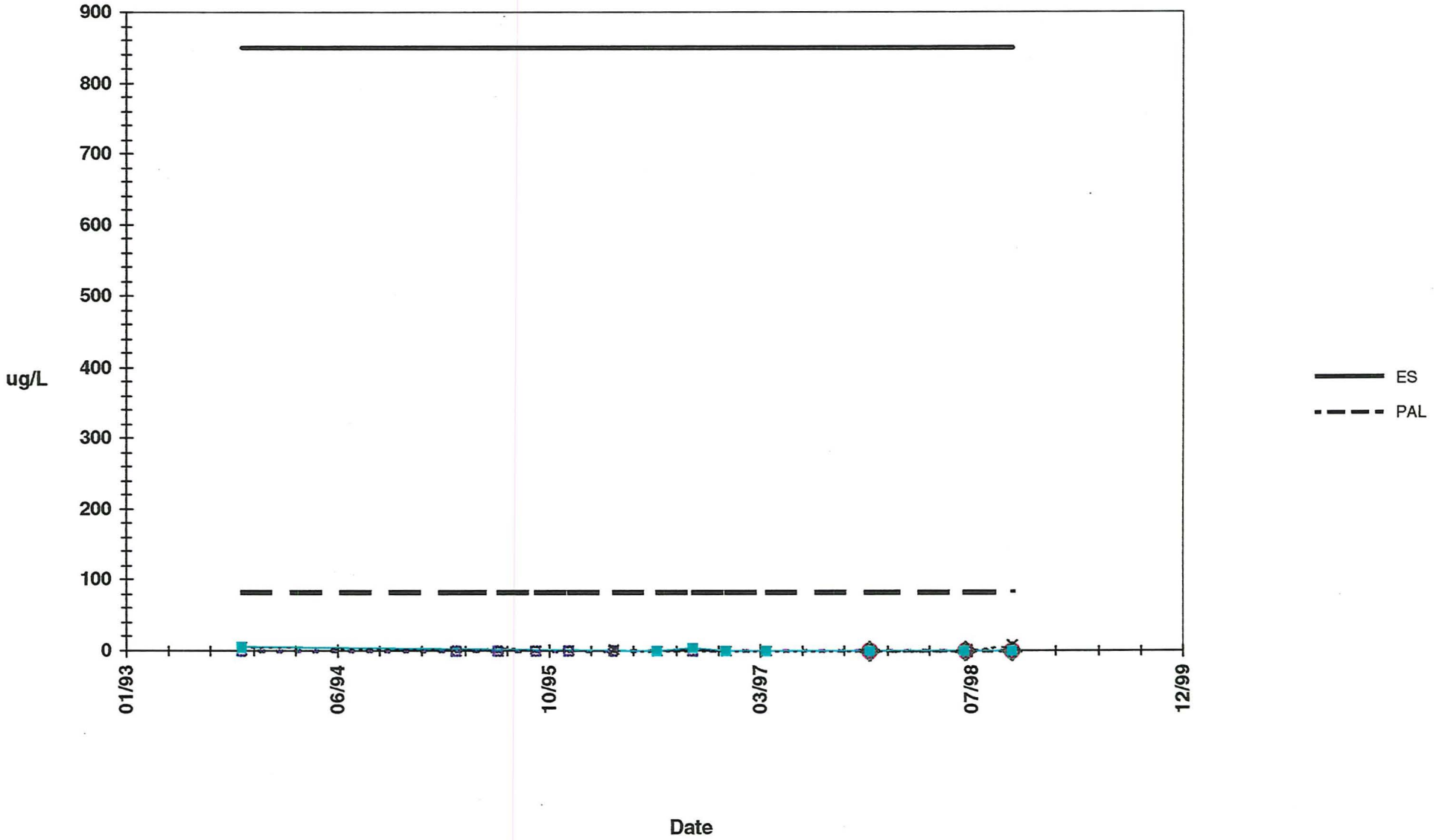


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

1,1-Dichloroethane

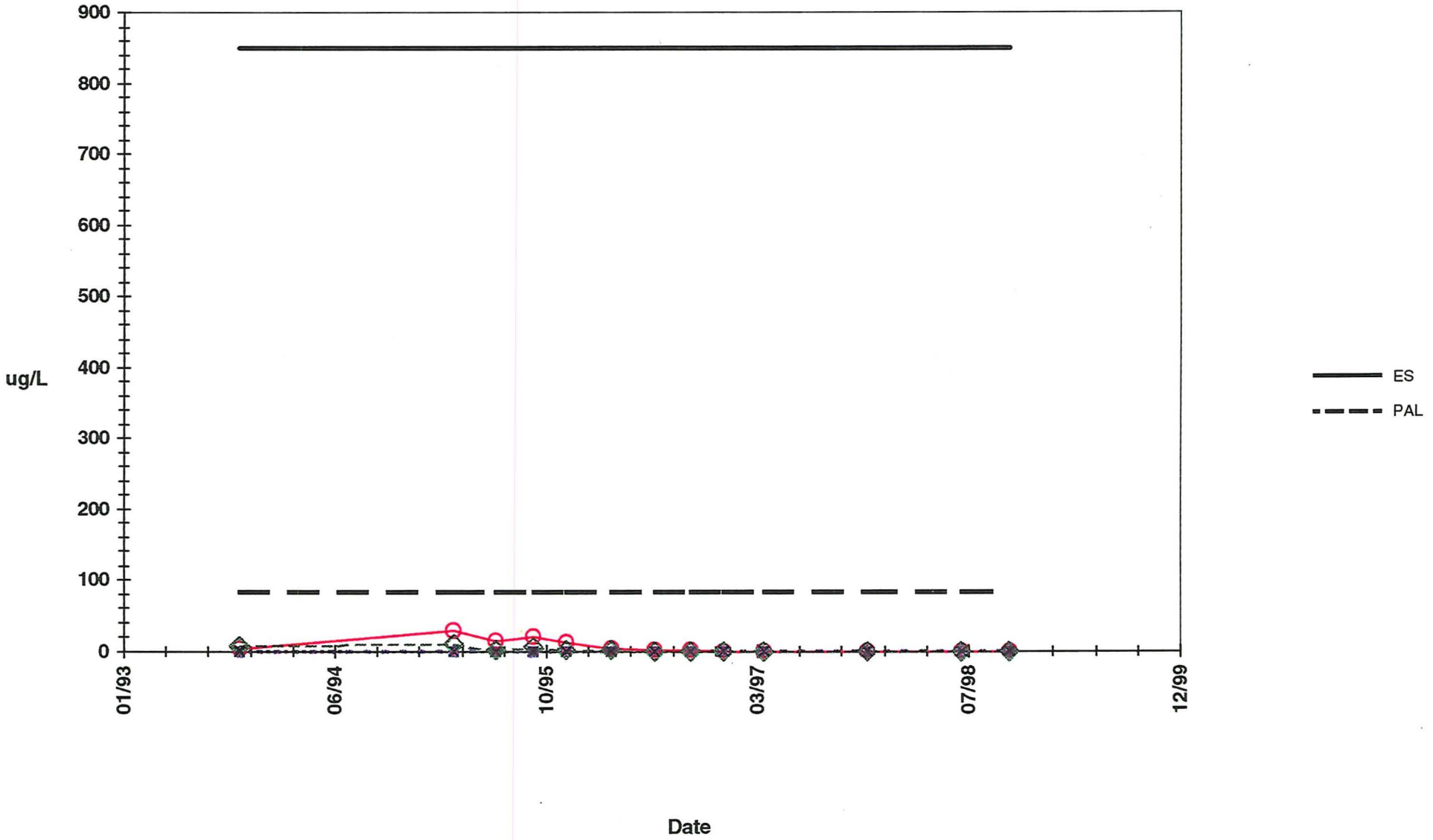


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

1,1-Dichloroethane

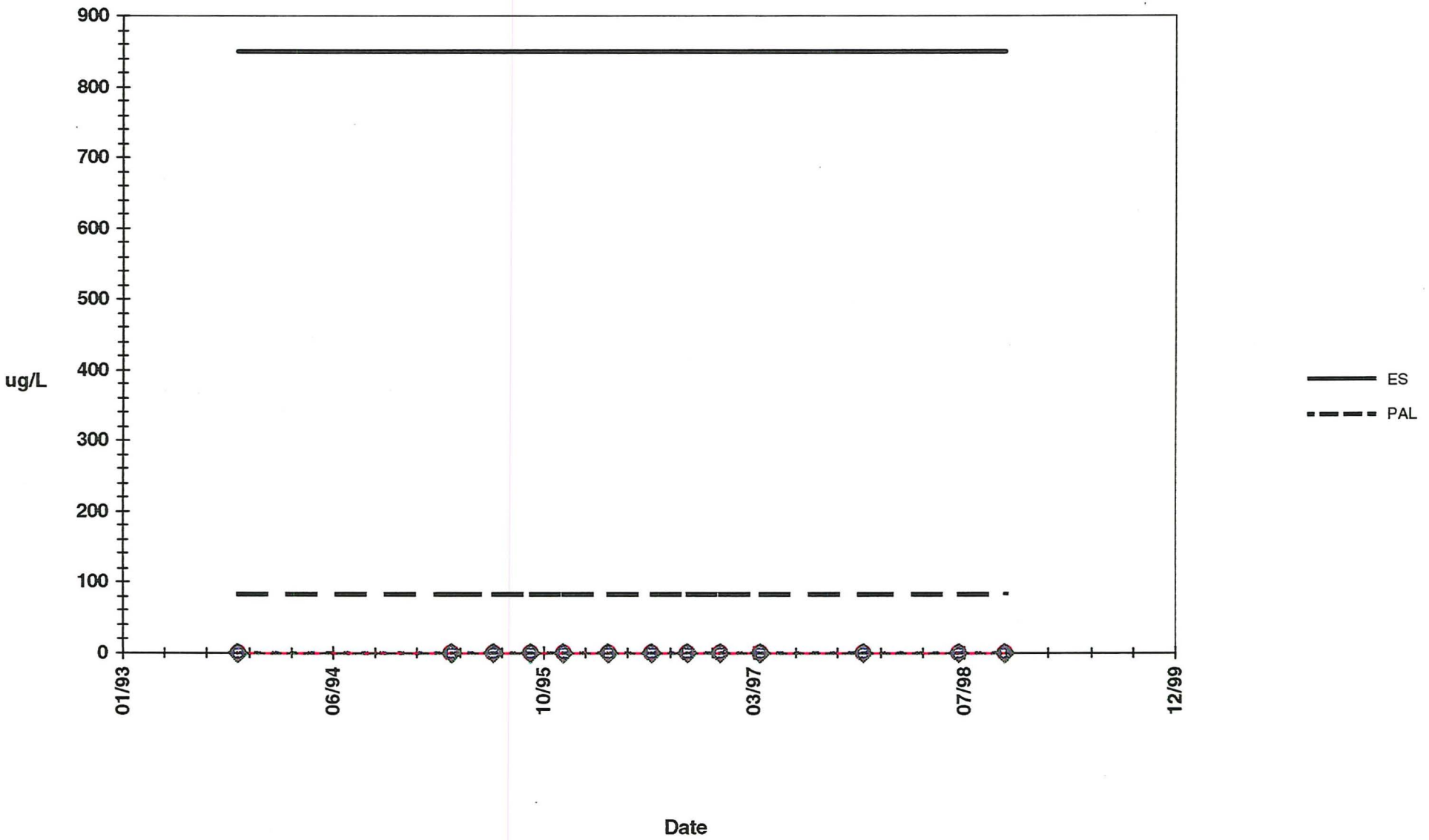


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

MW-12 and MW-14

1,1-Dichloroethane



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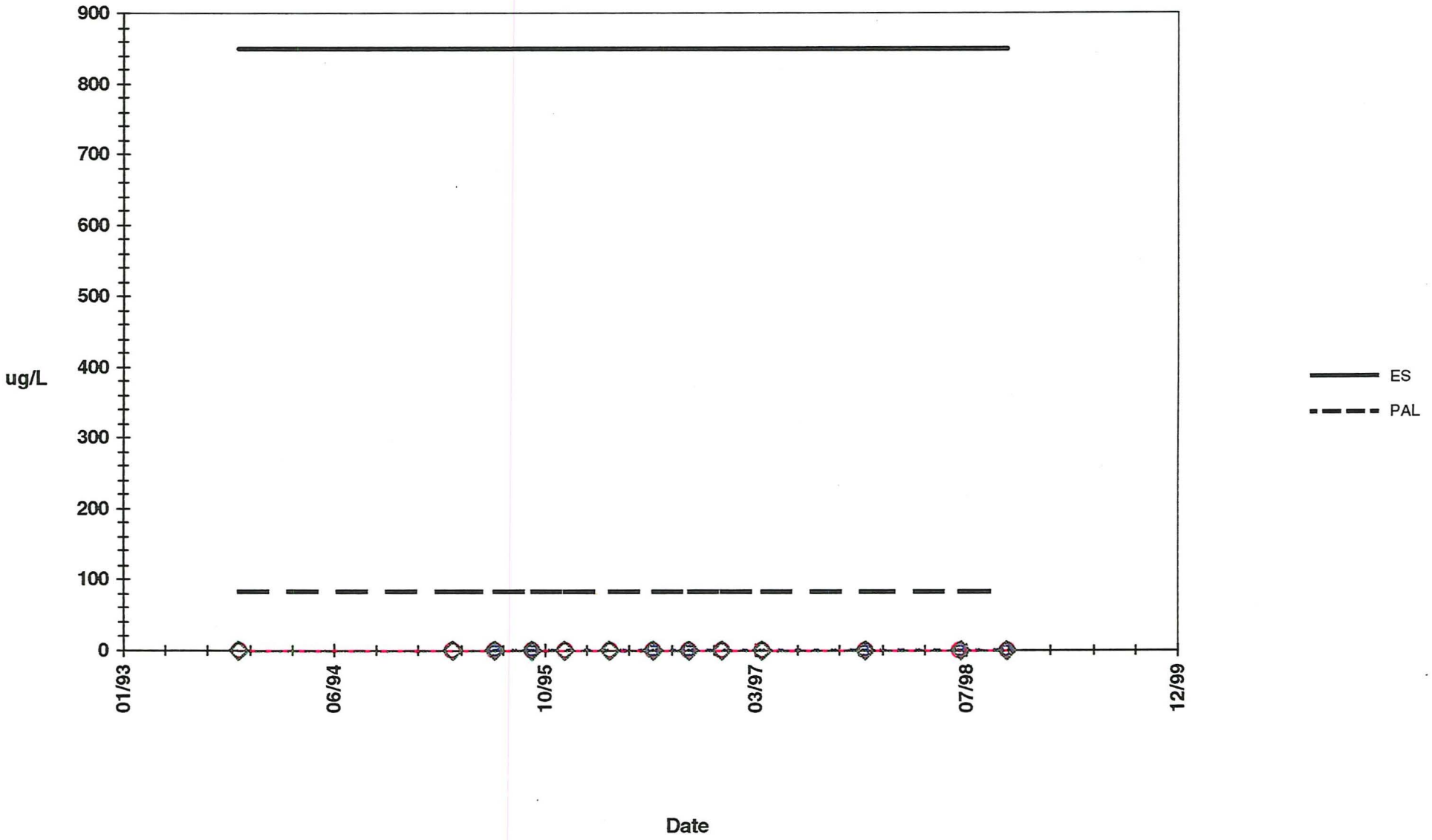
Onalaska Municipal Landfill

Residential Wells

1,1-Dichloroethane

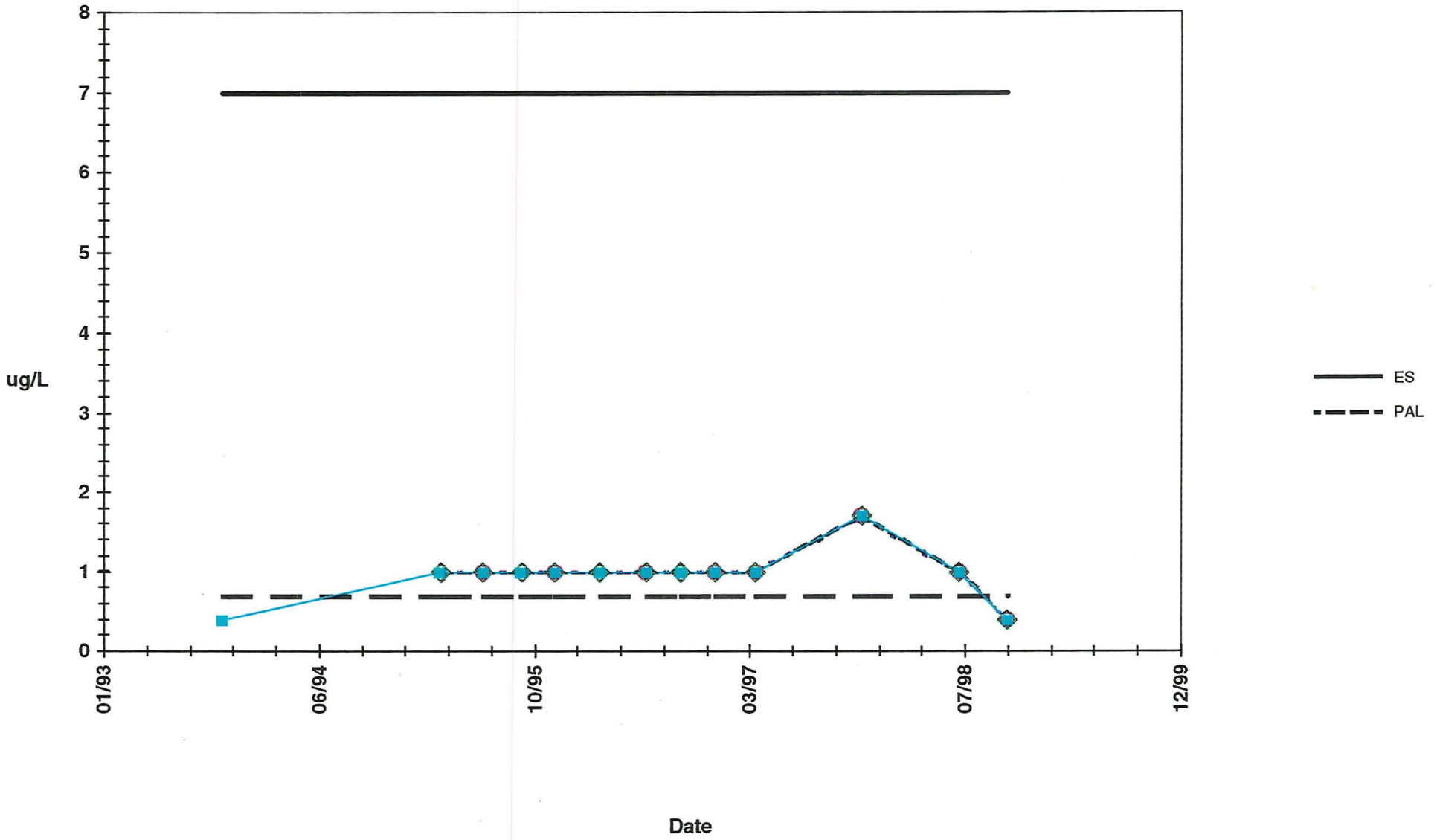


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Extraction Wells

1,1-Dichloroethene

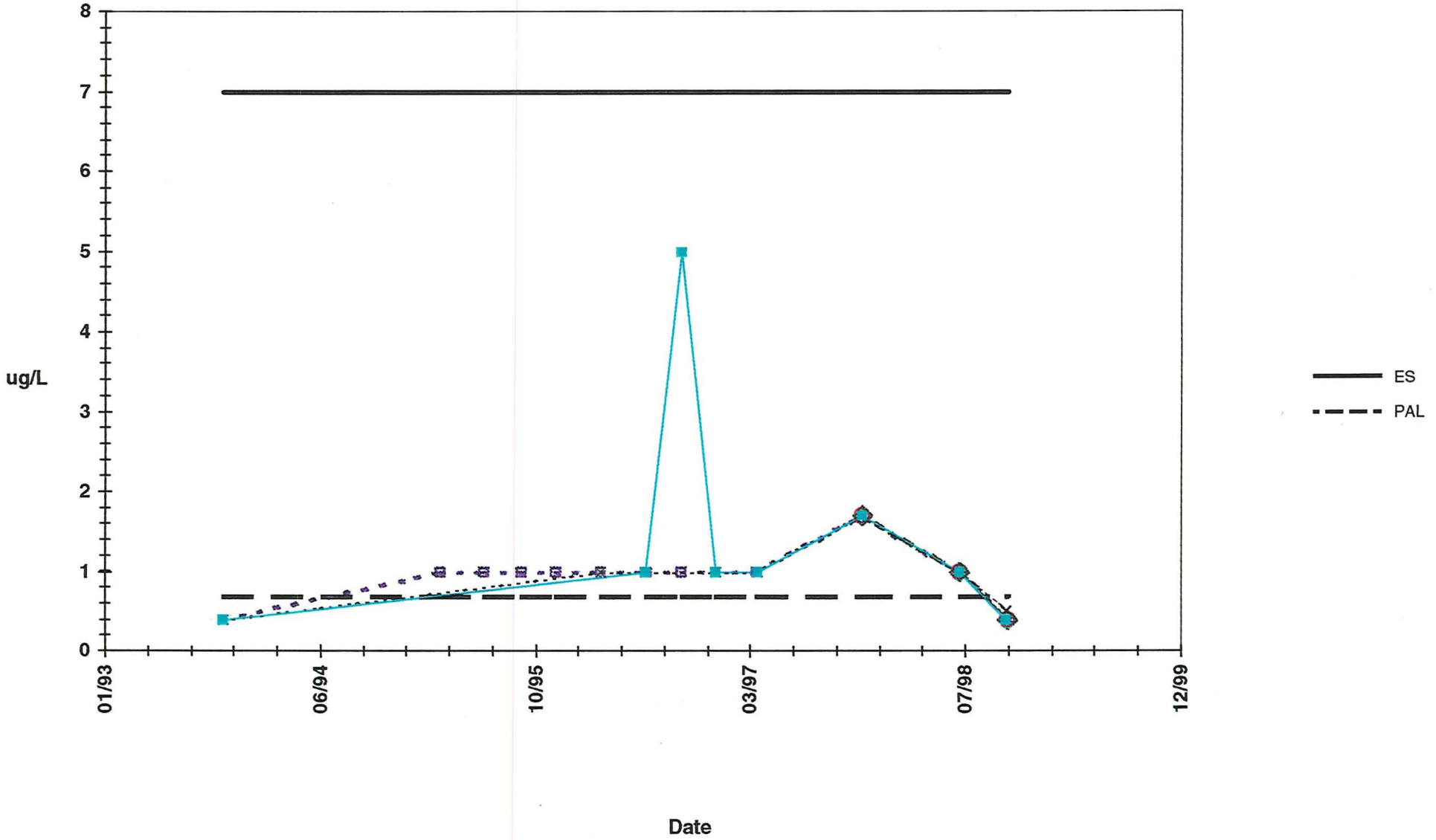


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

1,1-Dichloroethene

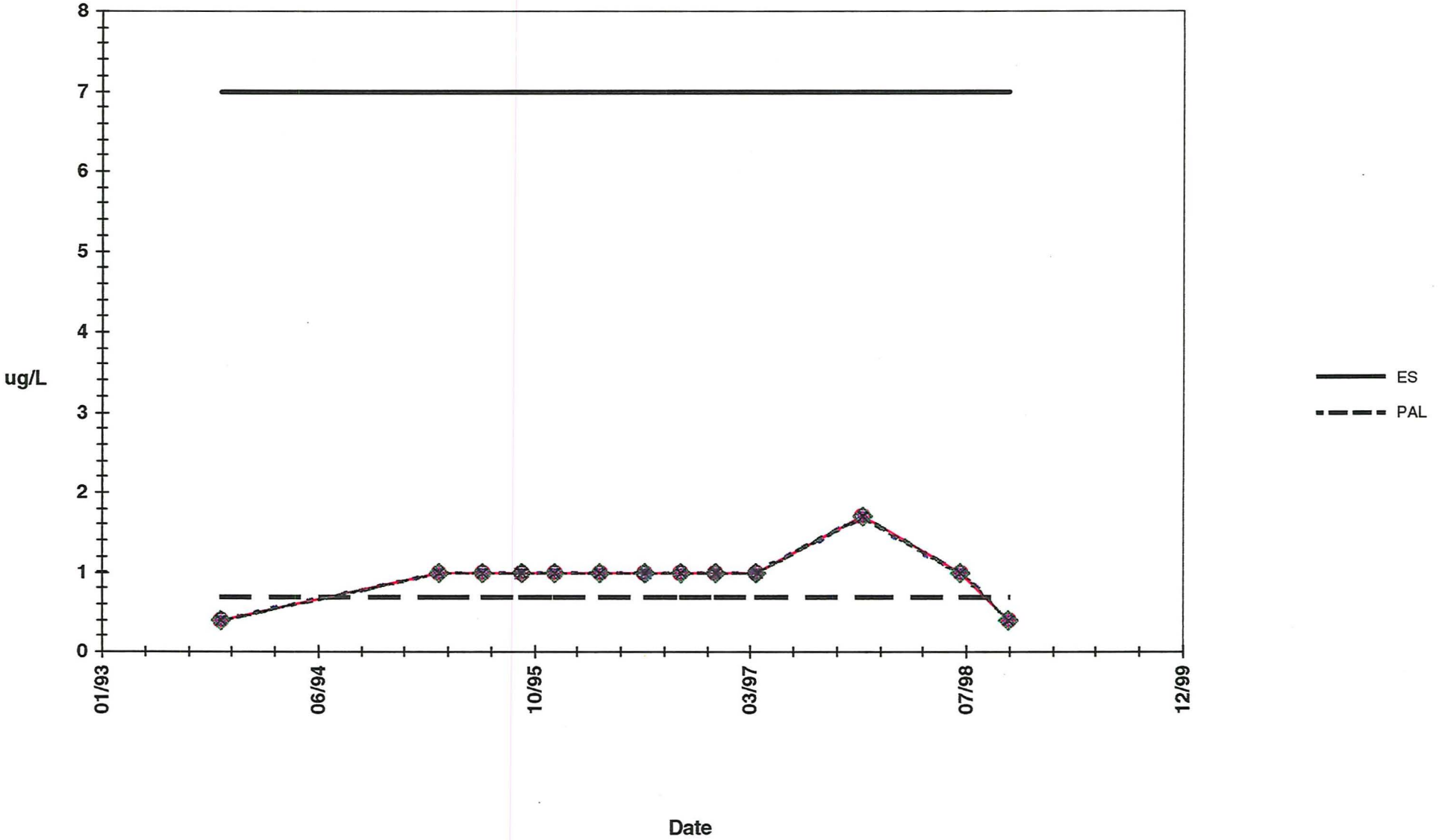


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

1,1-Dichloroethene



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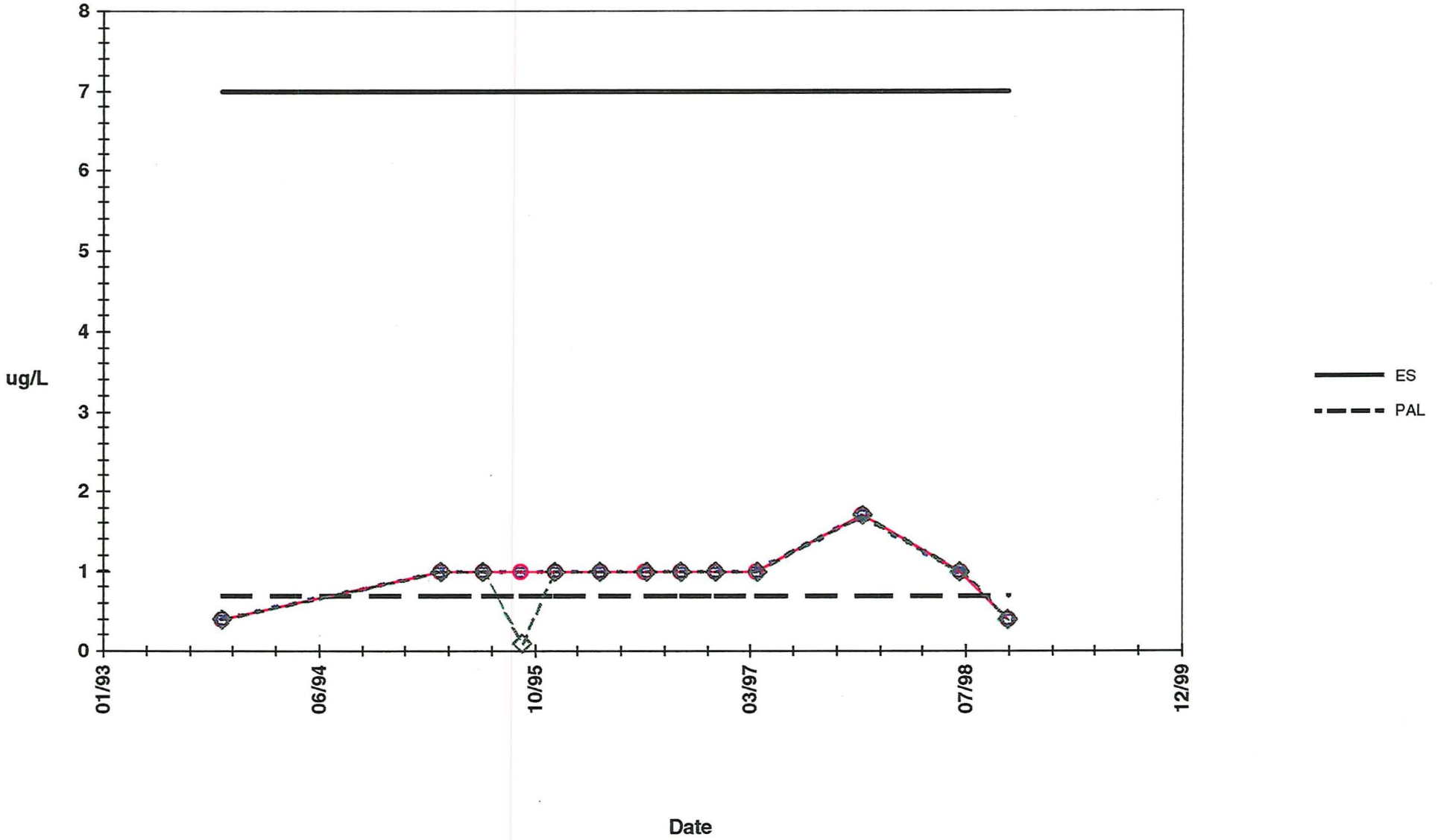
Onalaska Municipal Landfill

MW-12 and MW-14

1,1-Dichloroethene

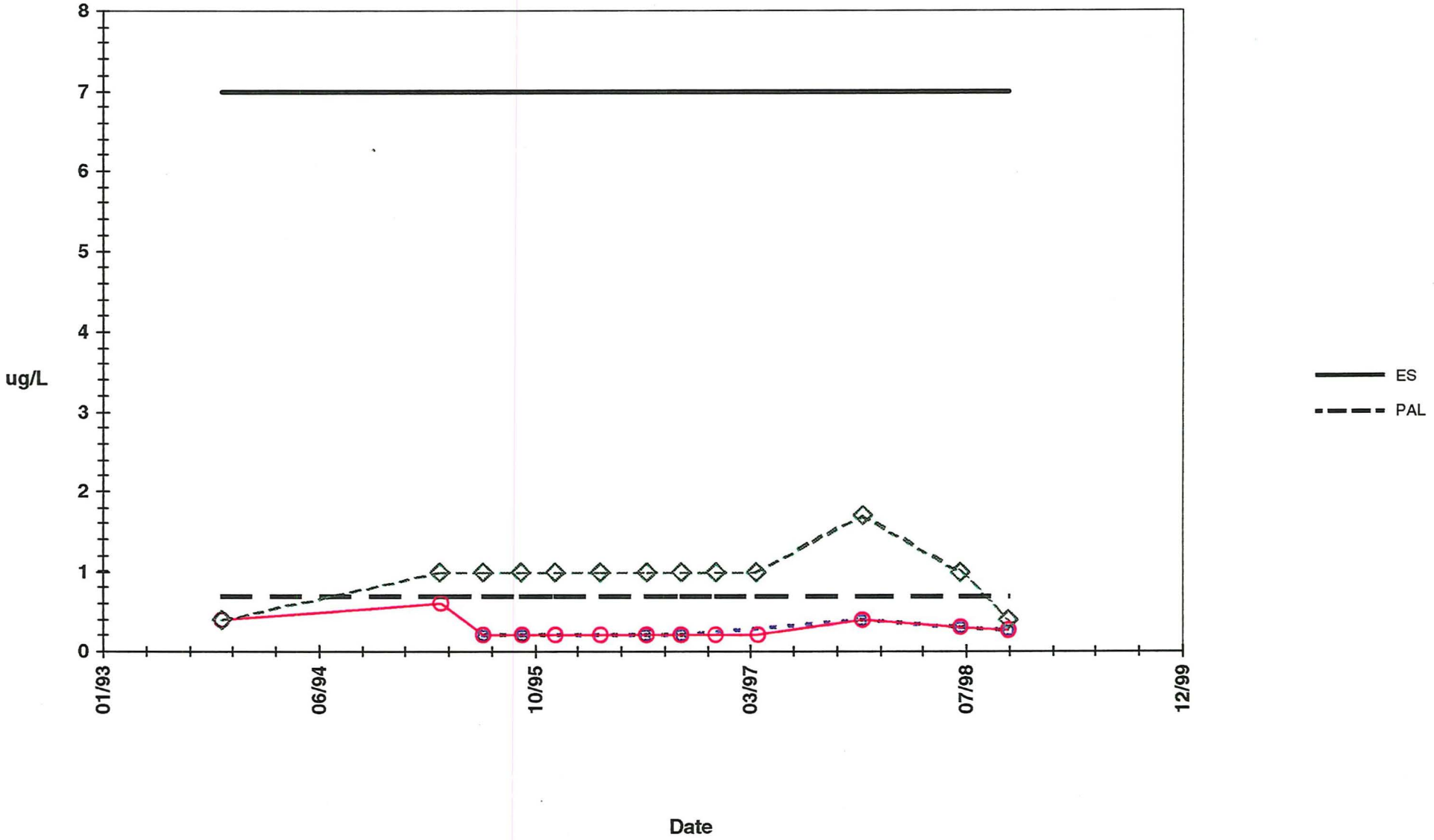


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

1,1-Dichloroethene



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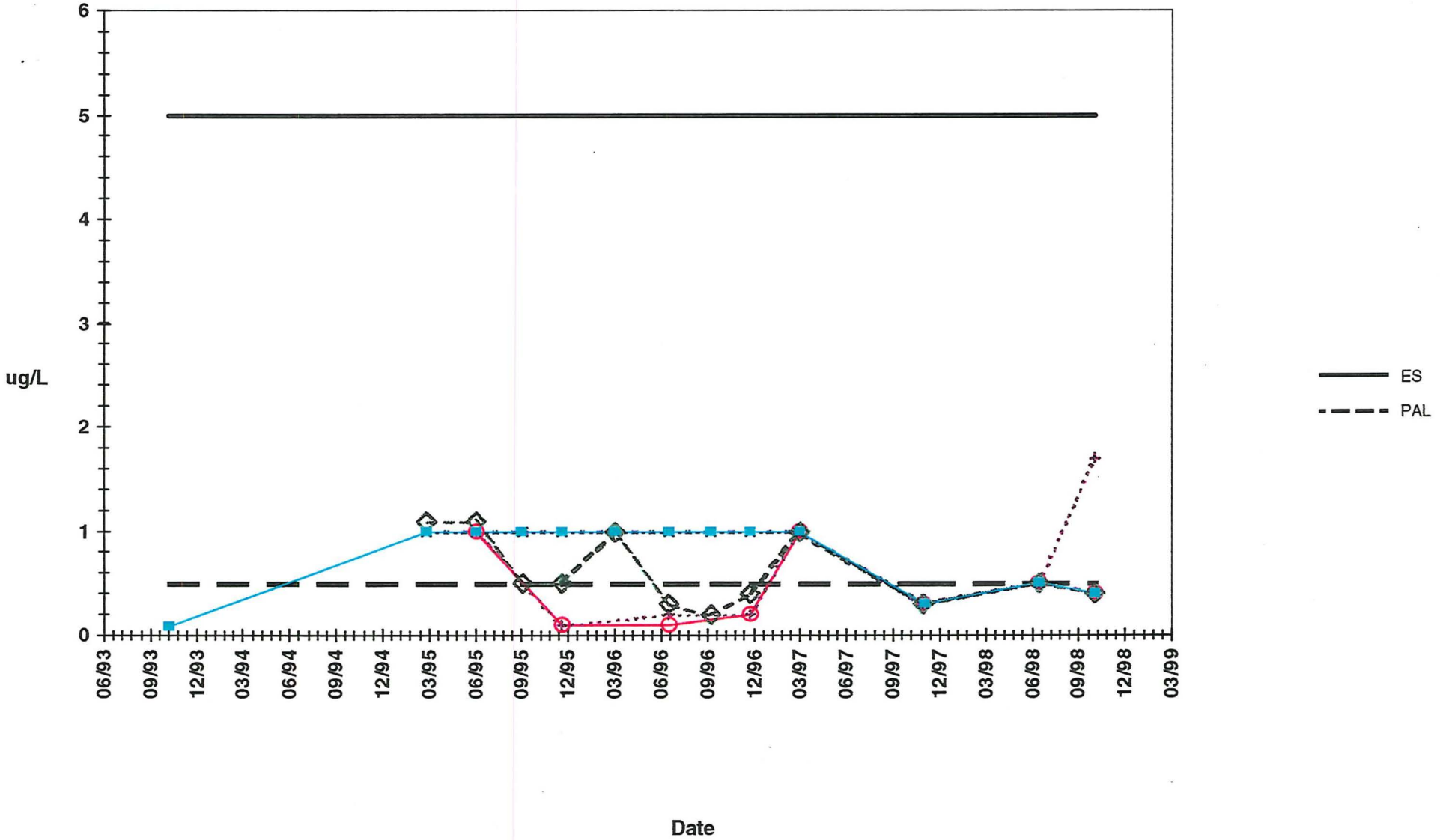
Onalaska Municipal Landfill

Extraction Wells

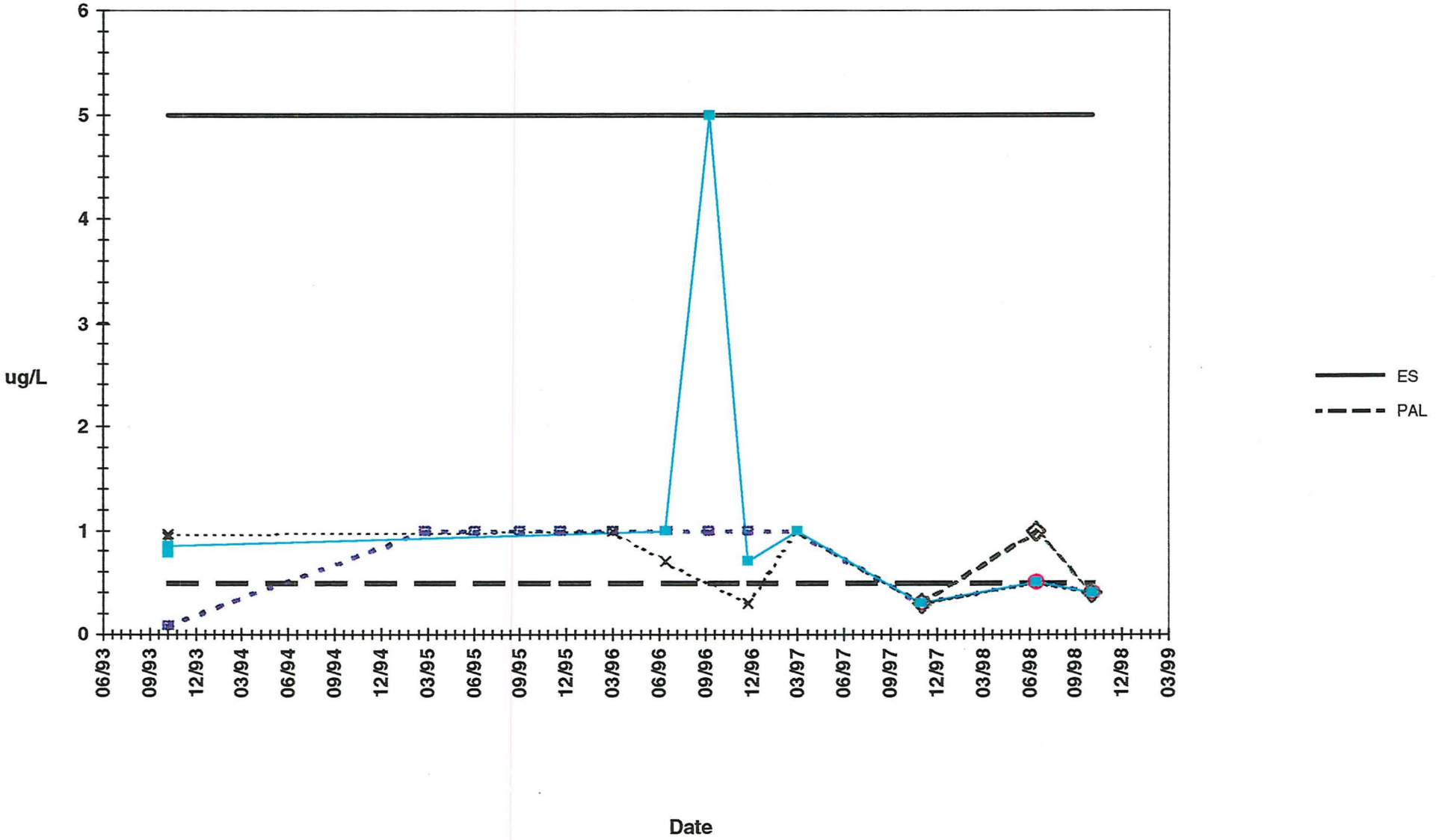
Benzene



Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

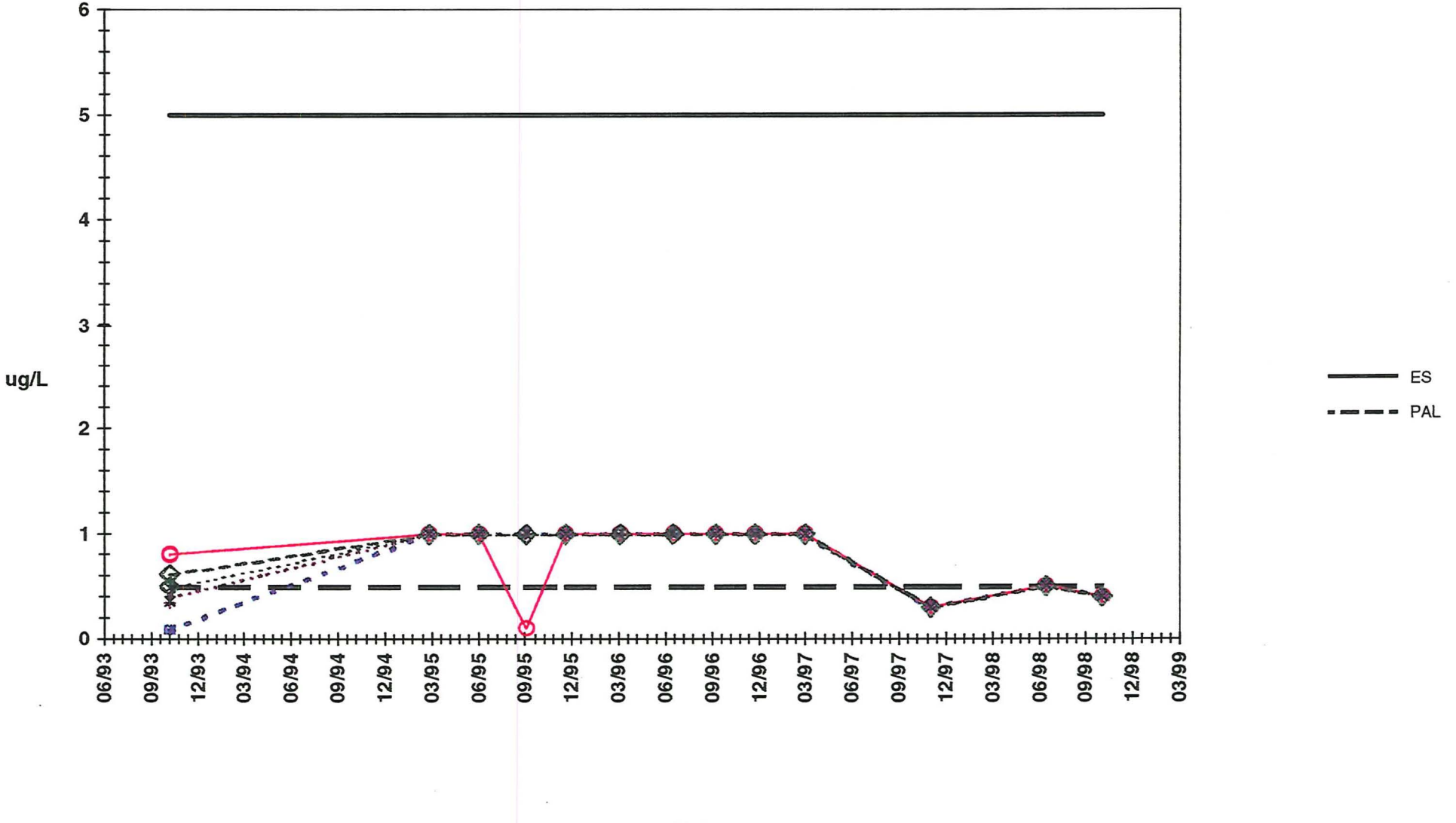
Benzene



Onalaska Municipal Landfill

MW-06 and MW-08

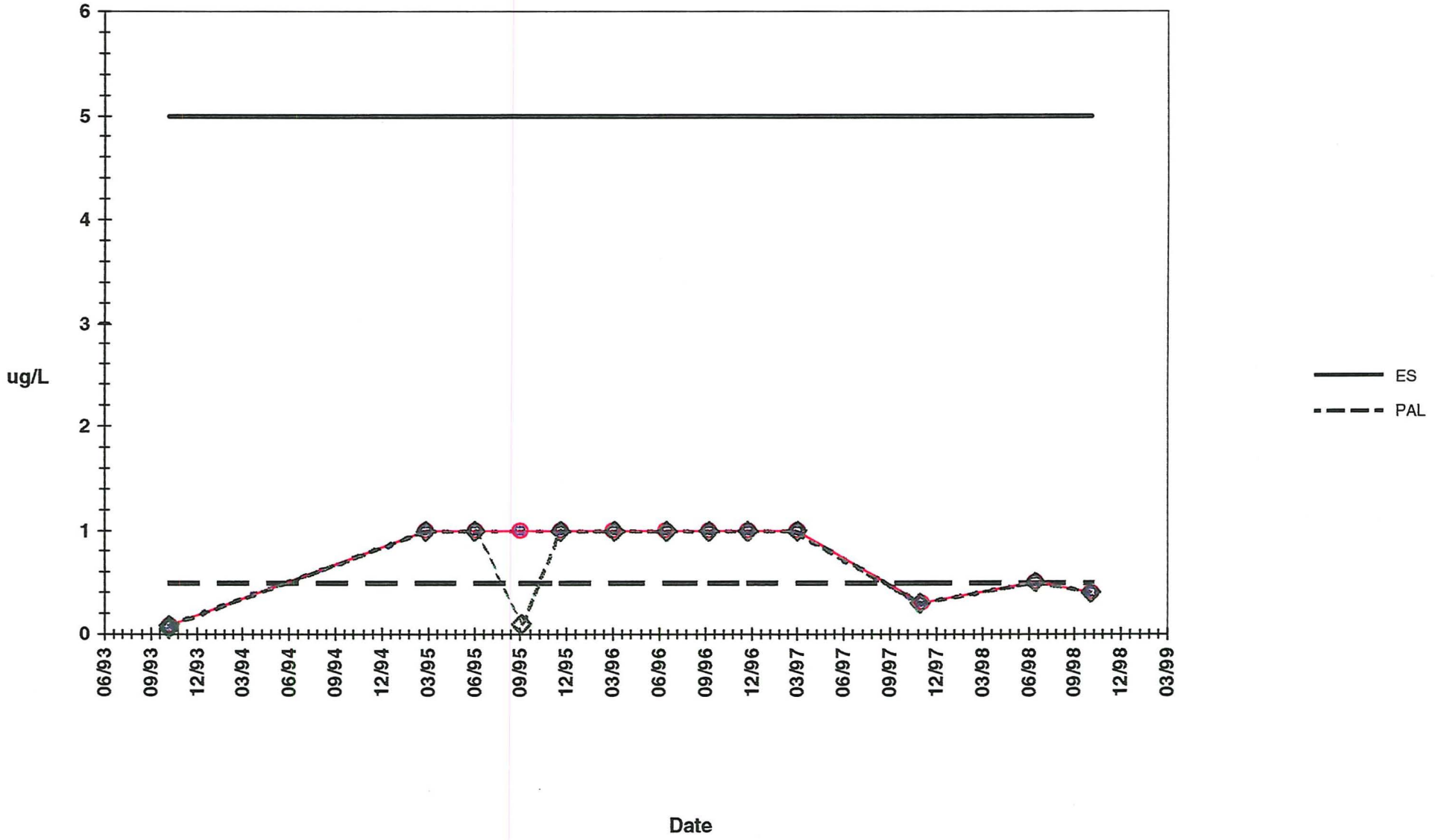
Benzene



Onalaska Municipal Landfill

MW-12 and MW-14

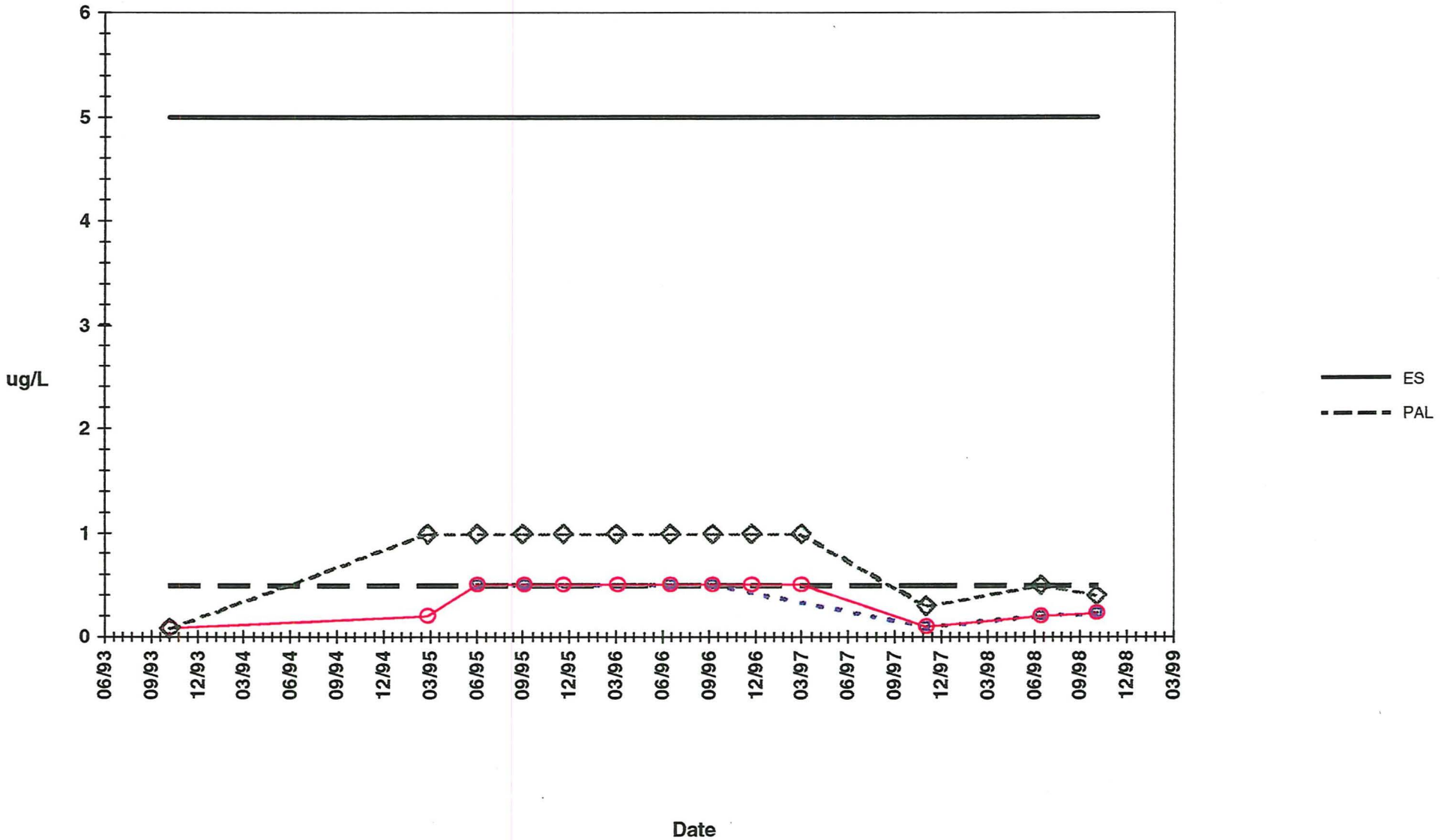
Benzene



Onalaska Municipal Landfill

Residential Wells

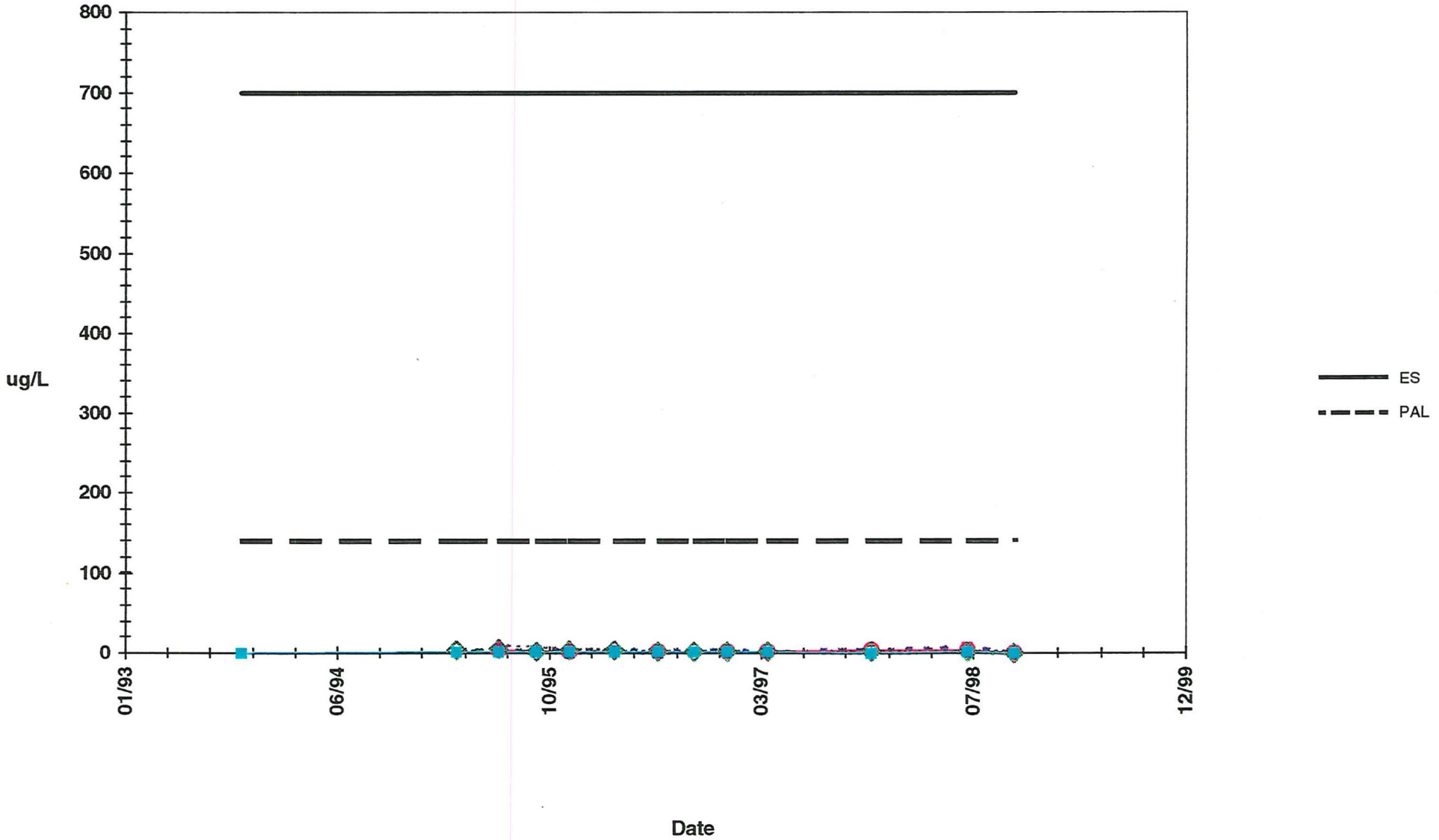
Benzene



Onalaska Municipal Landfill

Extraction Wells

Ethylbenzene



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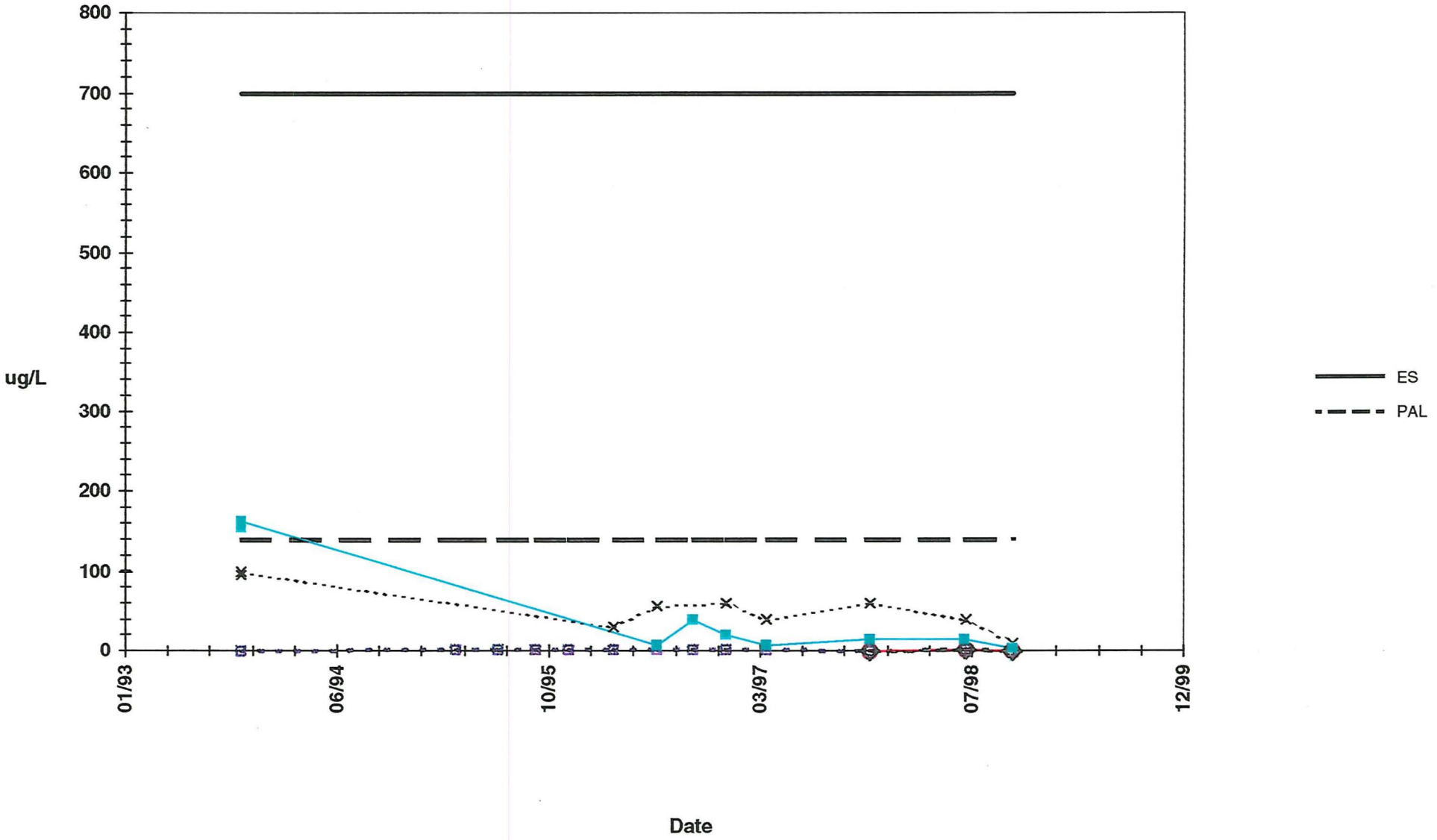
Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Ethylbenzene



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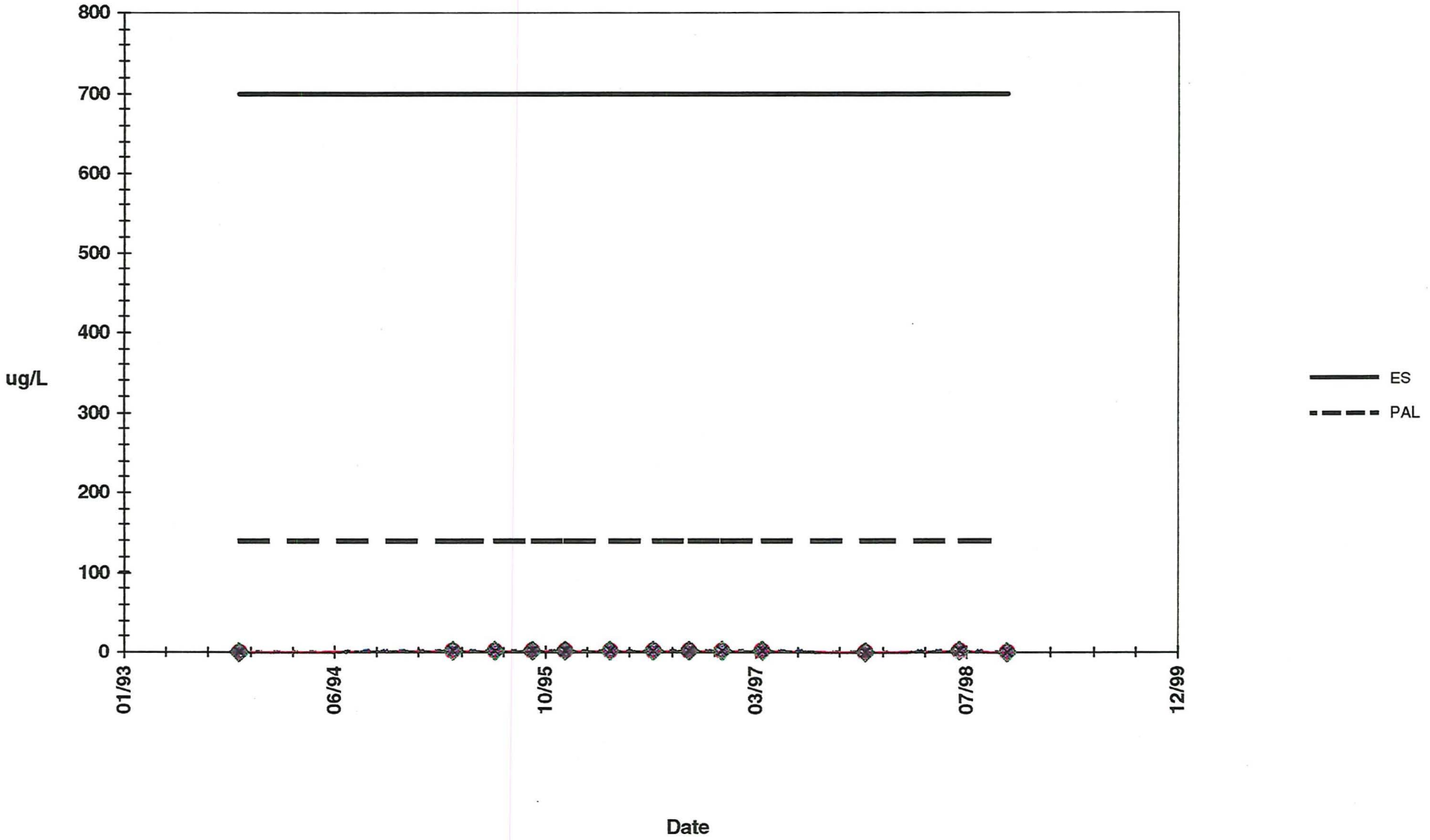
Onalaska Municipal Landfill

MW-06 and MW-08

Ethylbenzene



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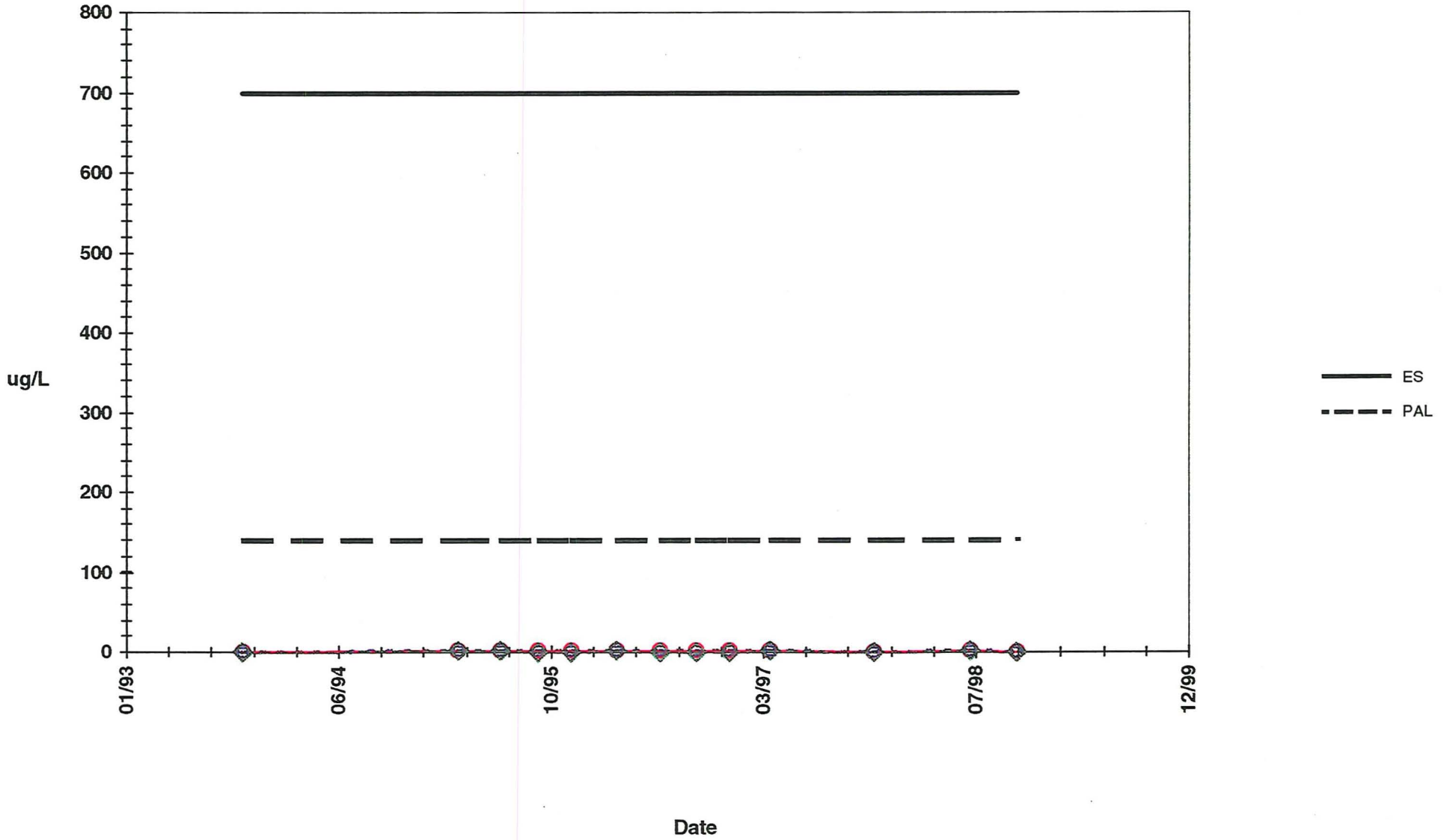
Onalaska Municipal Landfill

MW-12 and MW-14

Ethylbenzene



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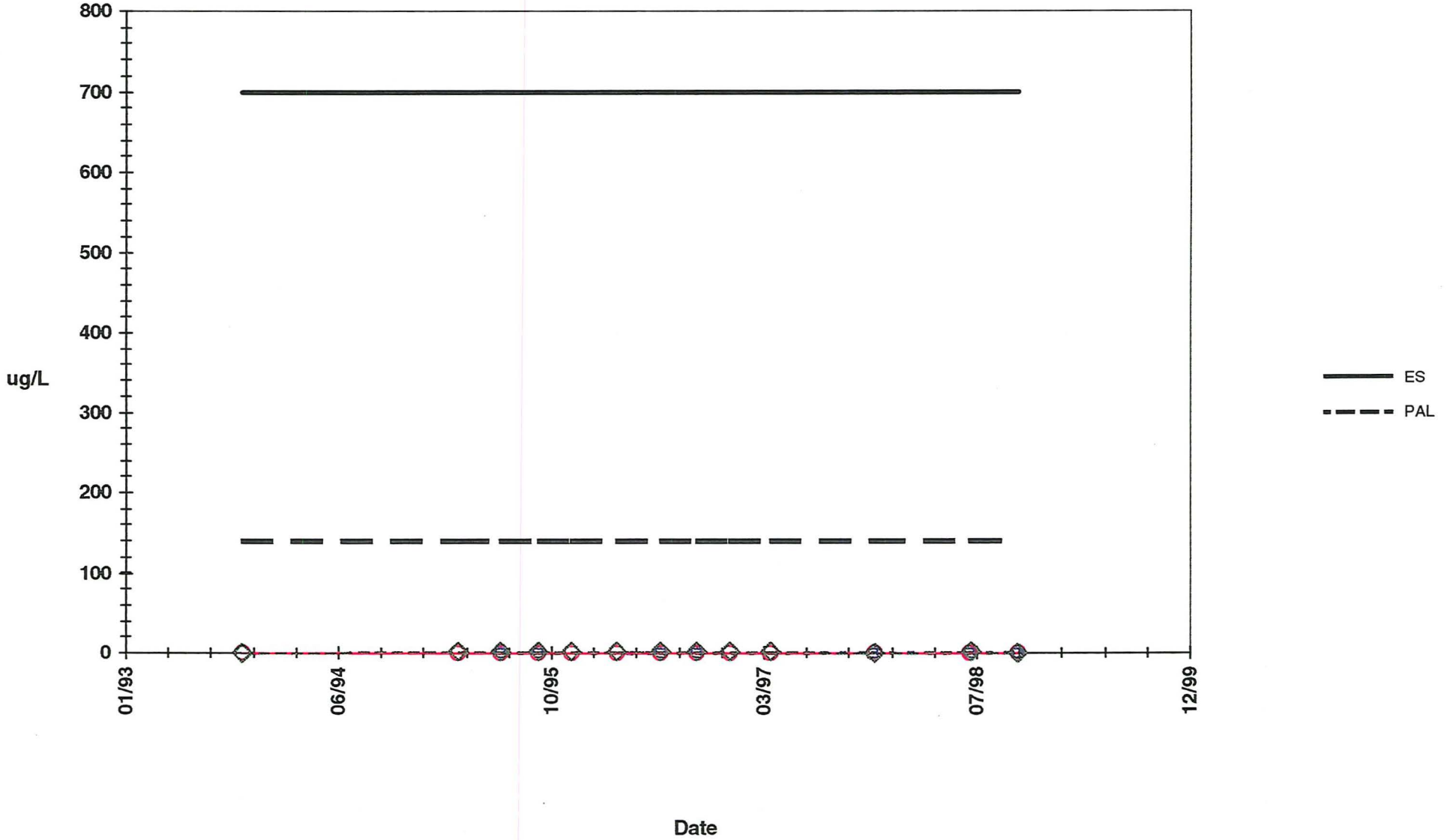
Onalaska Municipal Landfill

Residential Wells

Ethylbenzene



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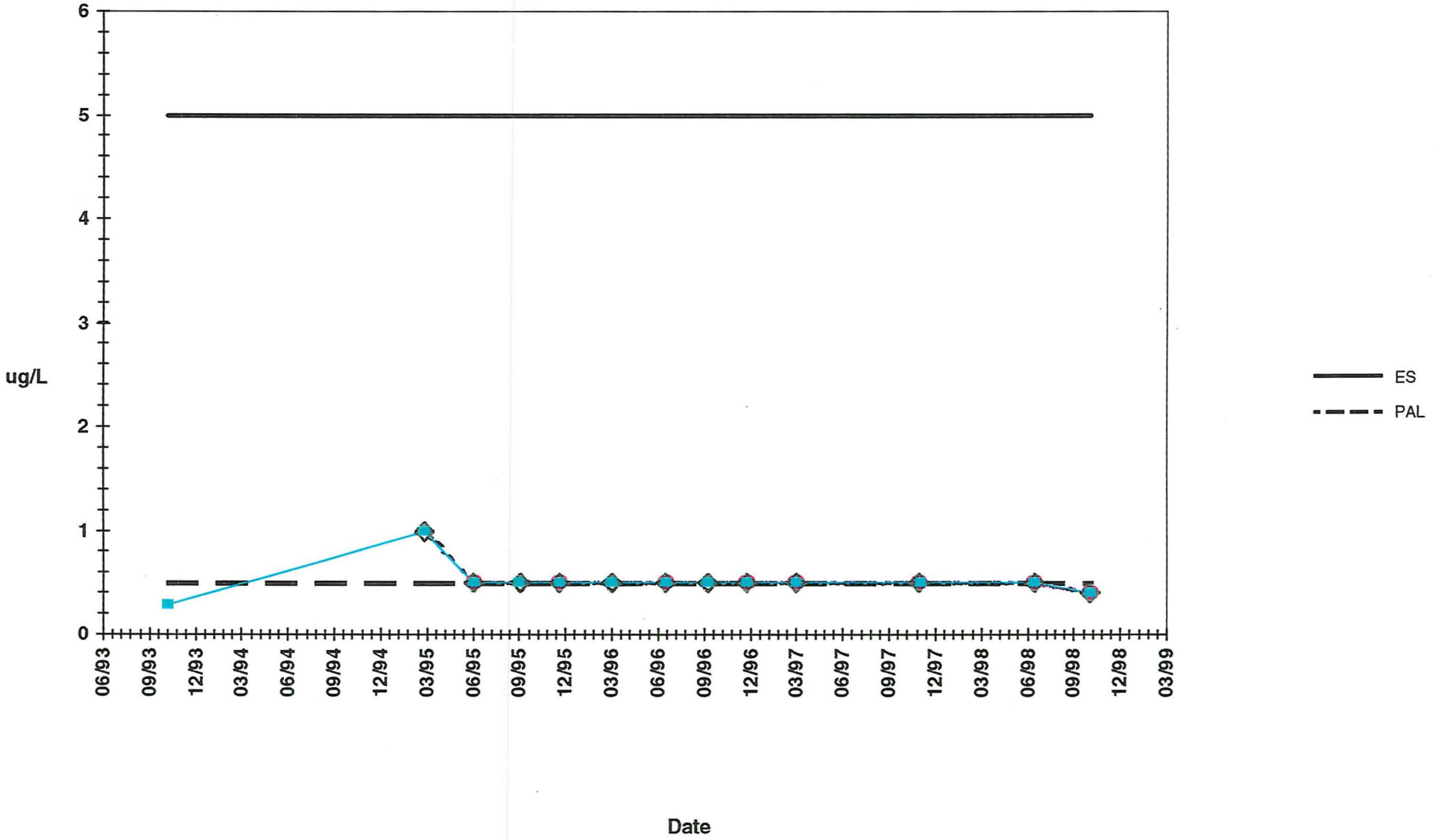
Onalaska Municipal Landfill

Extraction Wells

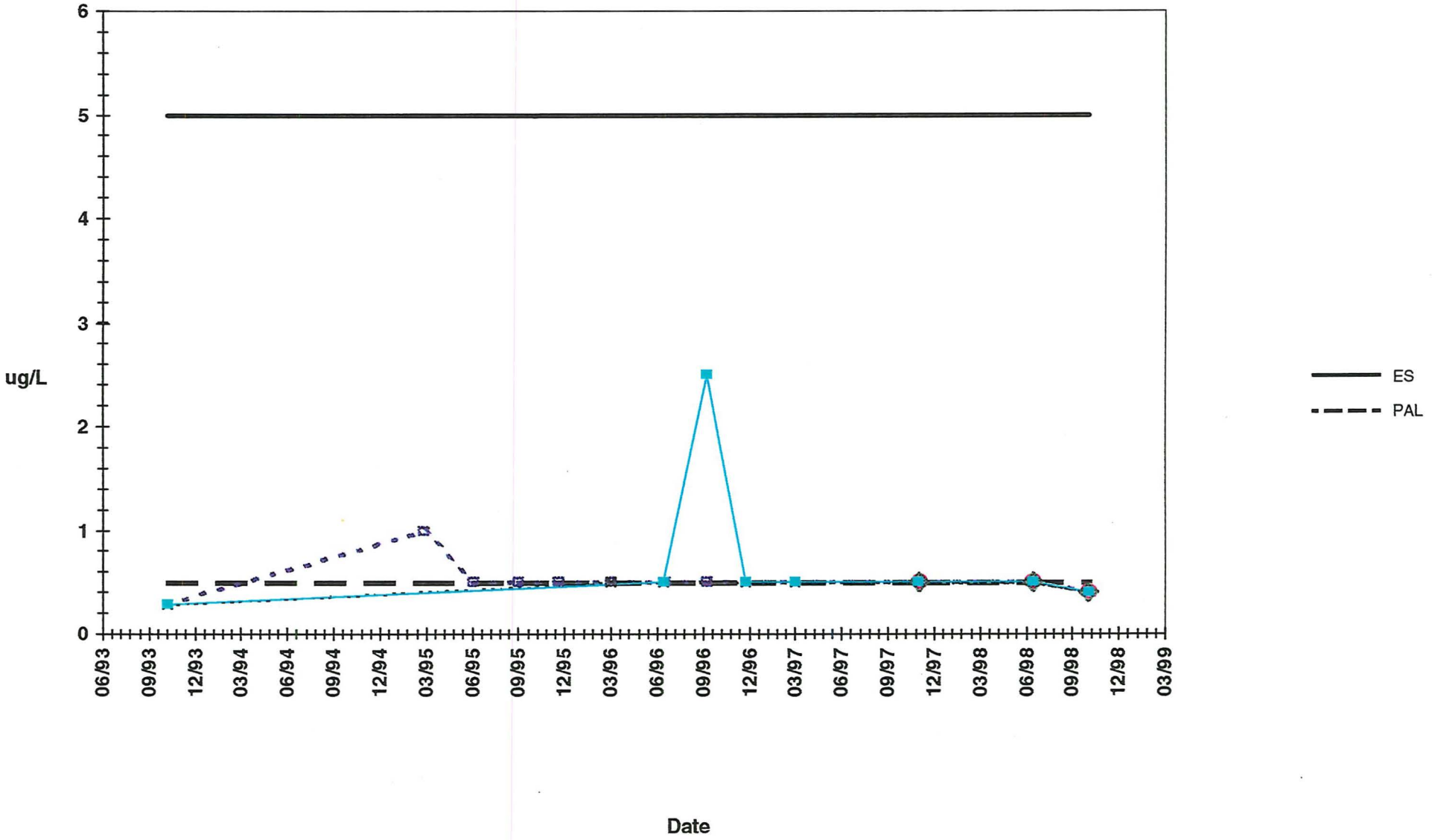
Tetrachloroethene



Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

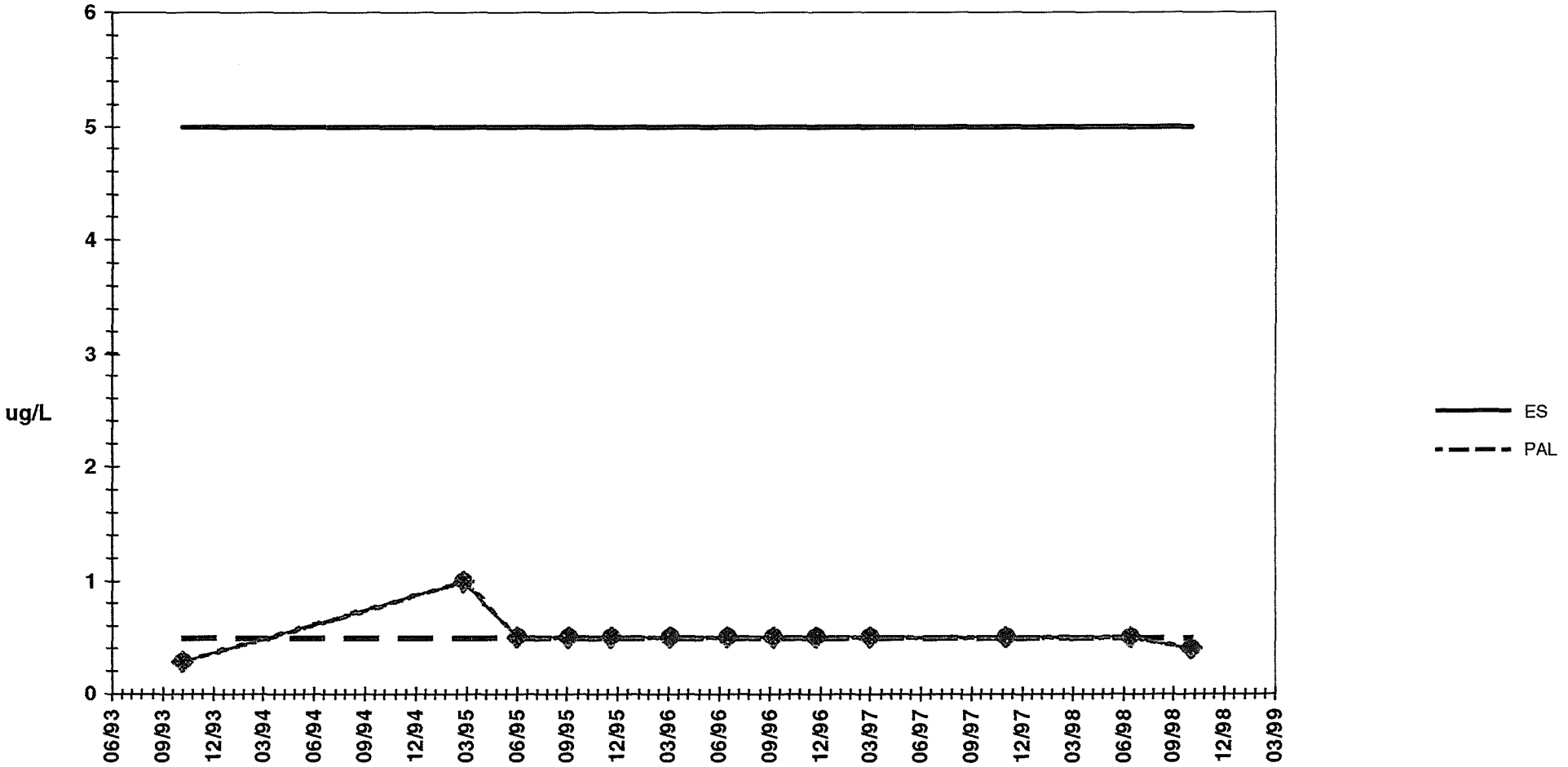
Tetrachloroethene



Onalaska Municipal Landfill

MW-06 and MW-08

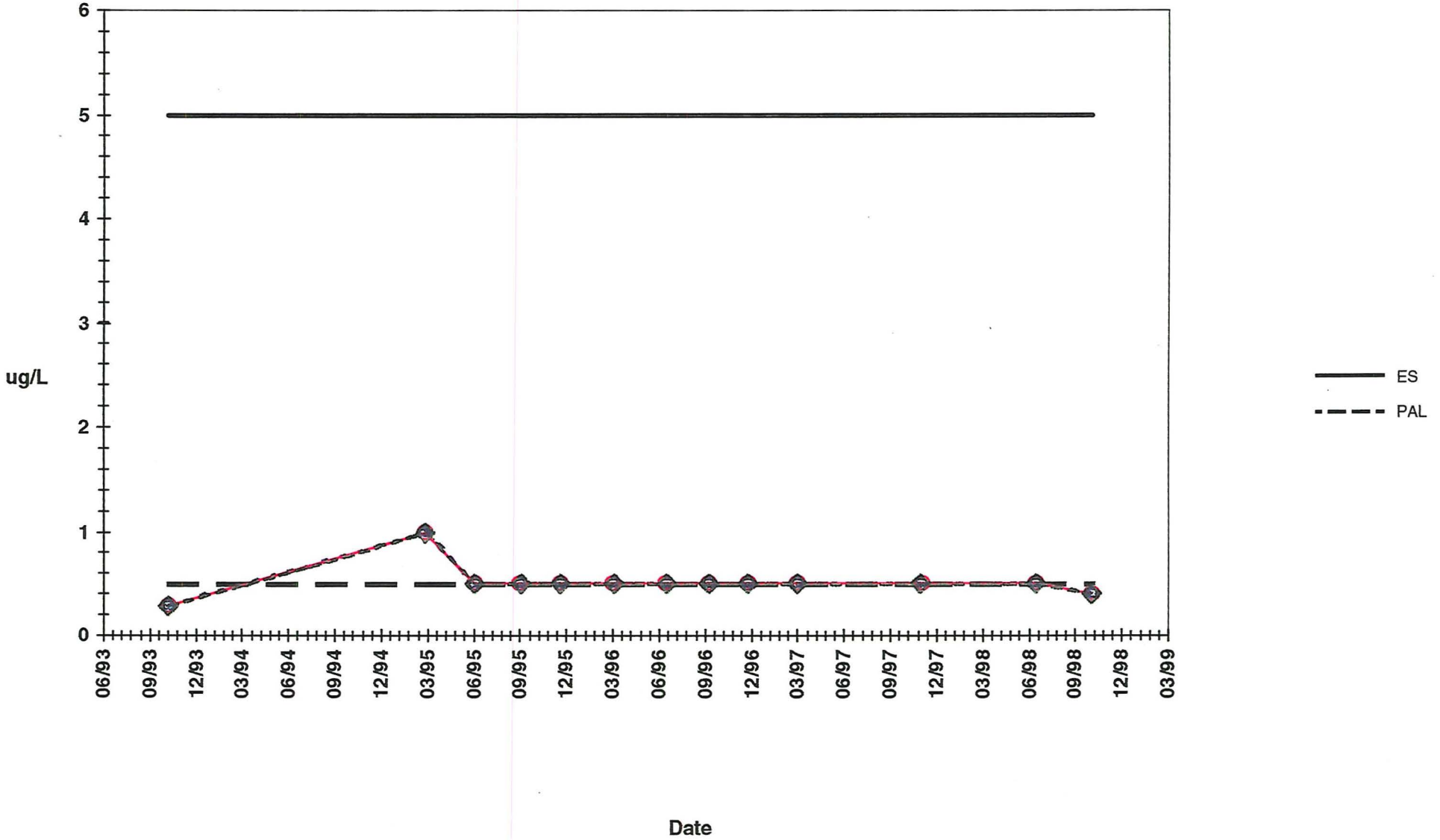
Tetrachloroethene



Onalaska Municipal Landfill

MW-12 and MW-14

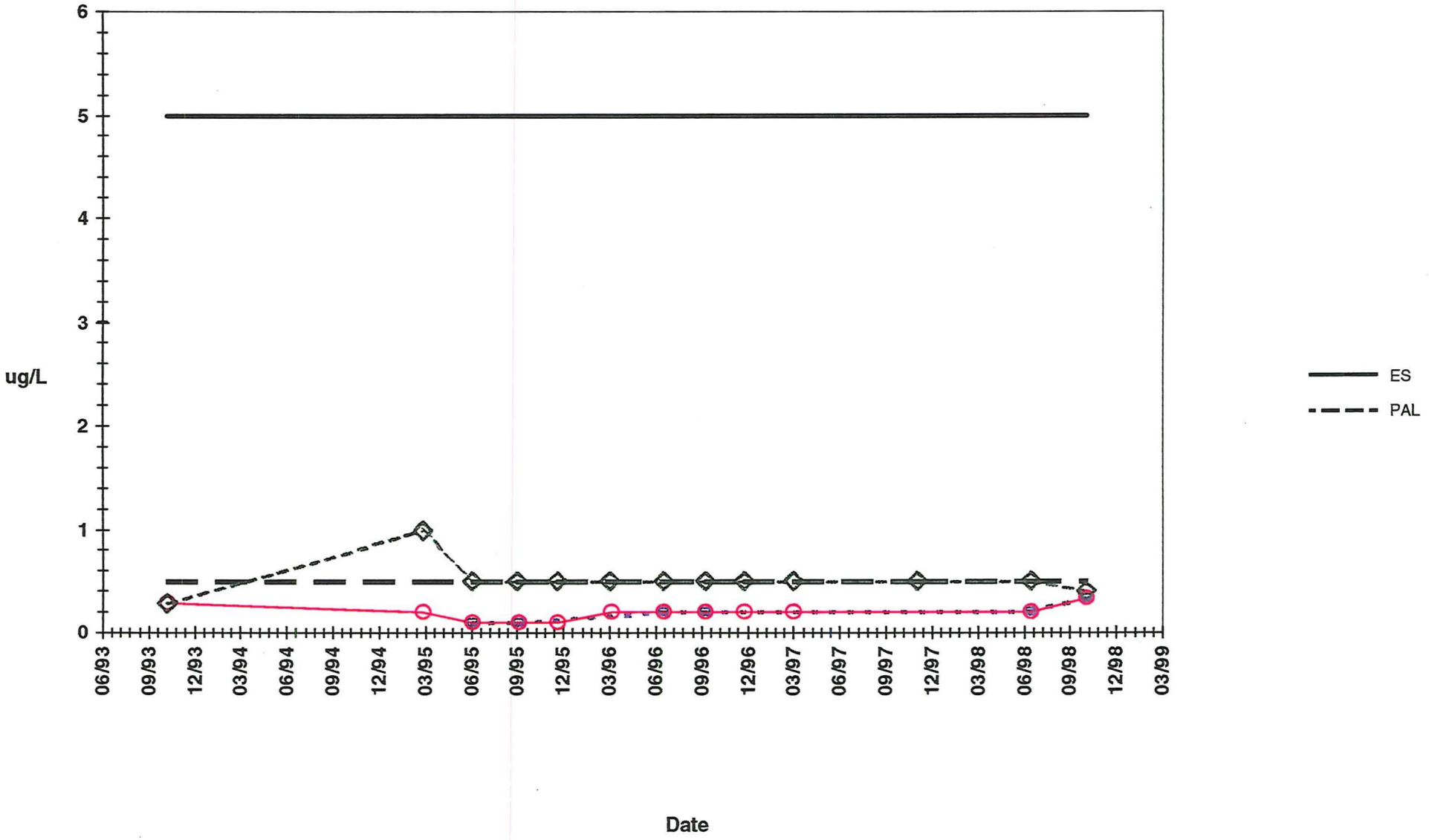
Tetrachloroethene



Onalaska Municipal Landfill

Residential Wells

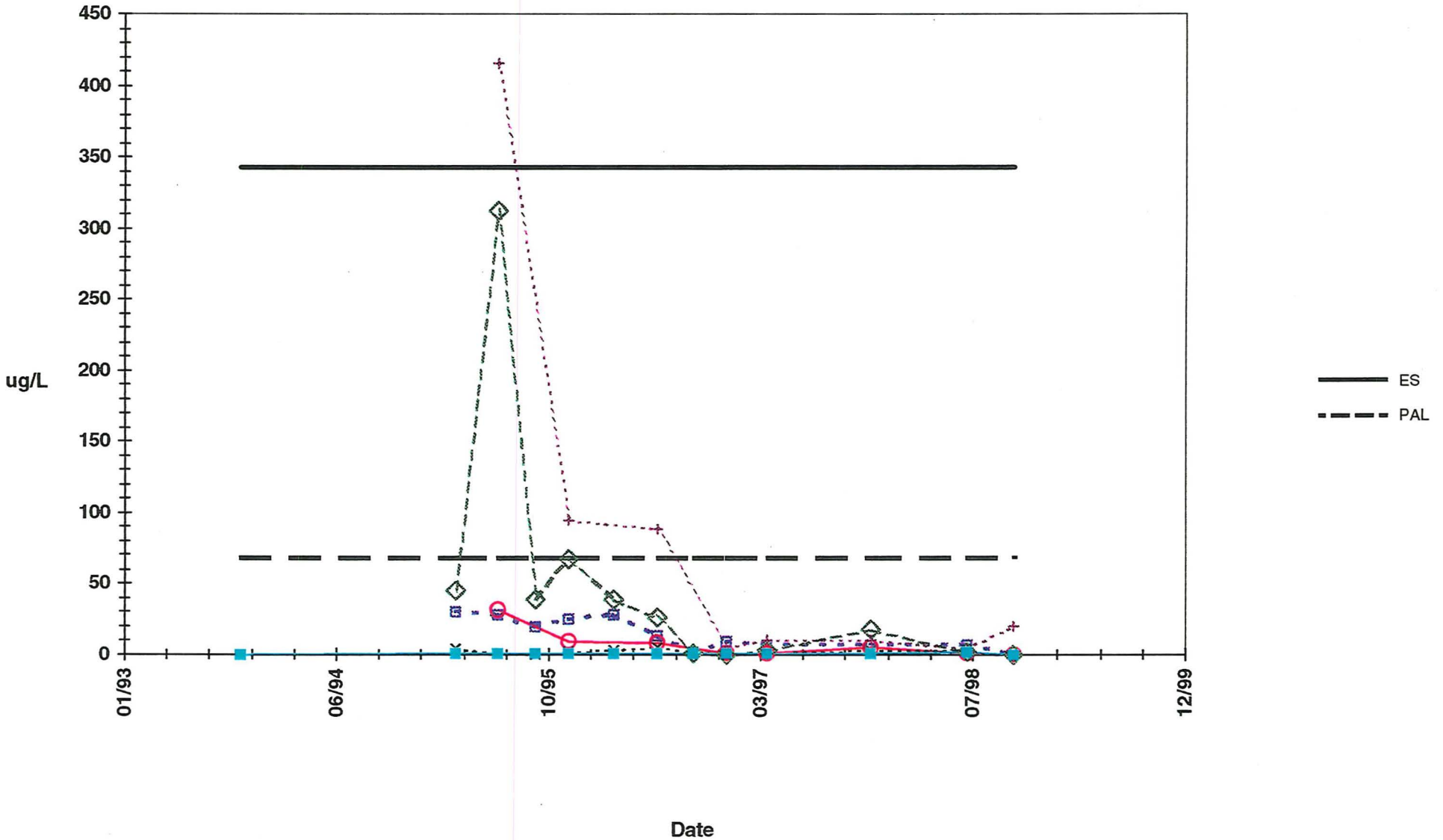
Tetrachloroethene



Onalaska Municipal Landfill

Extraction Wells

Toluene



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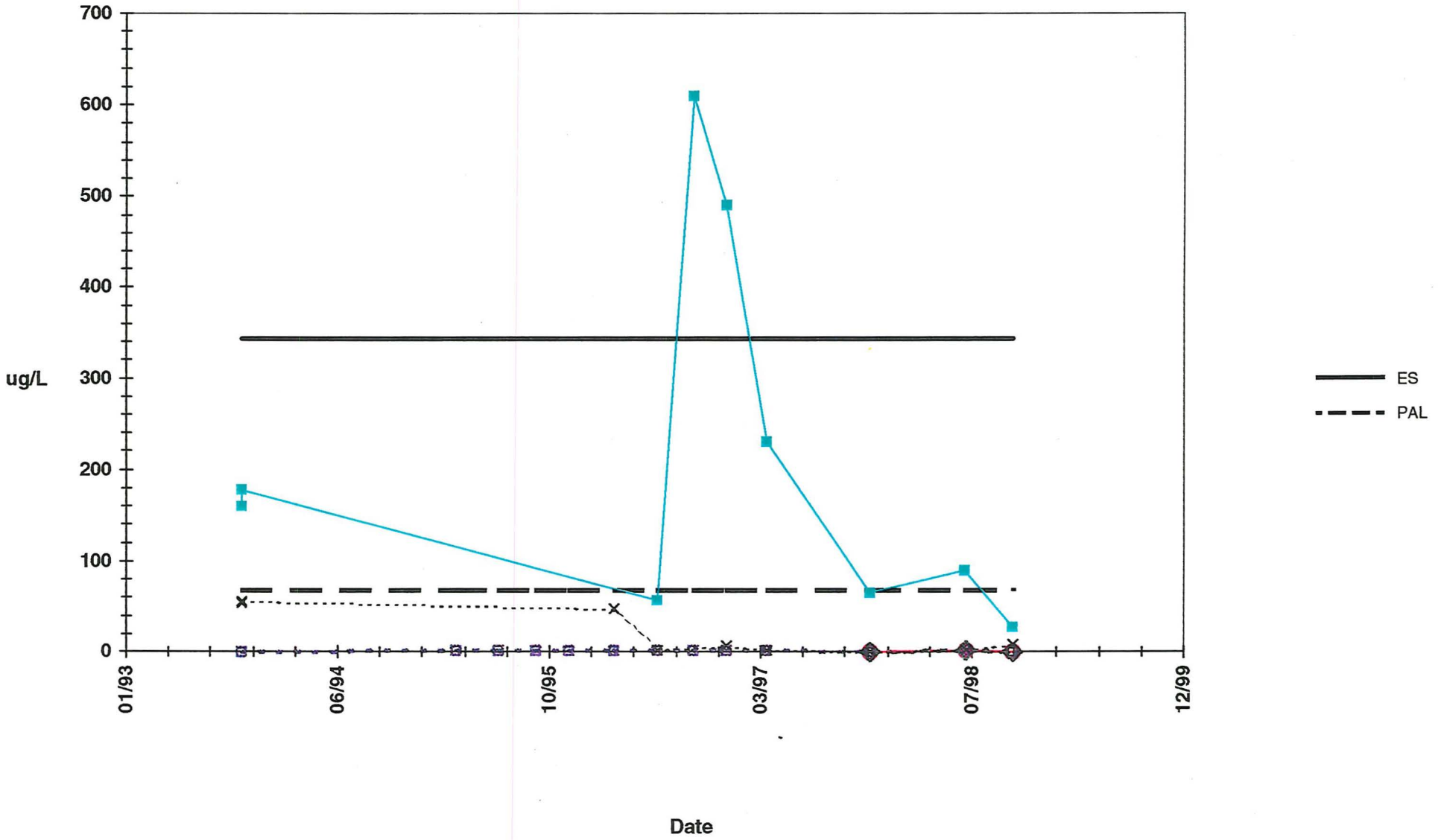
Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Toluene



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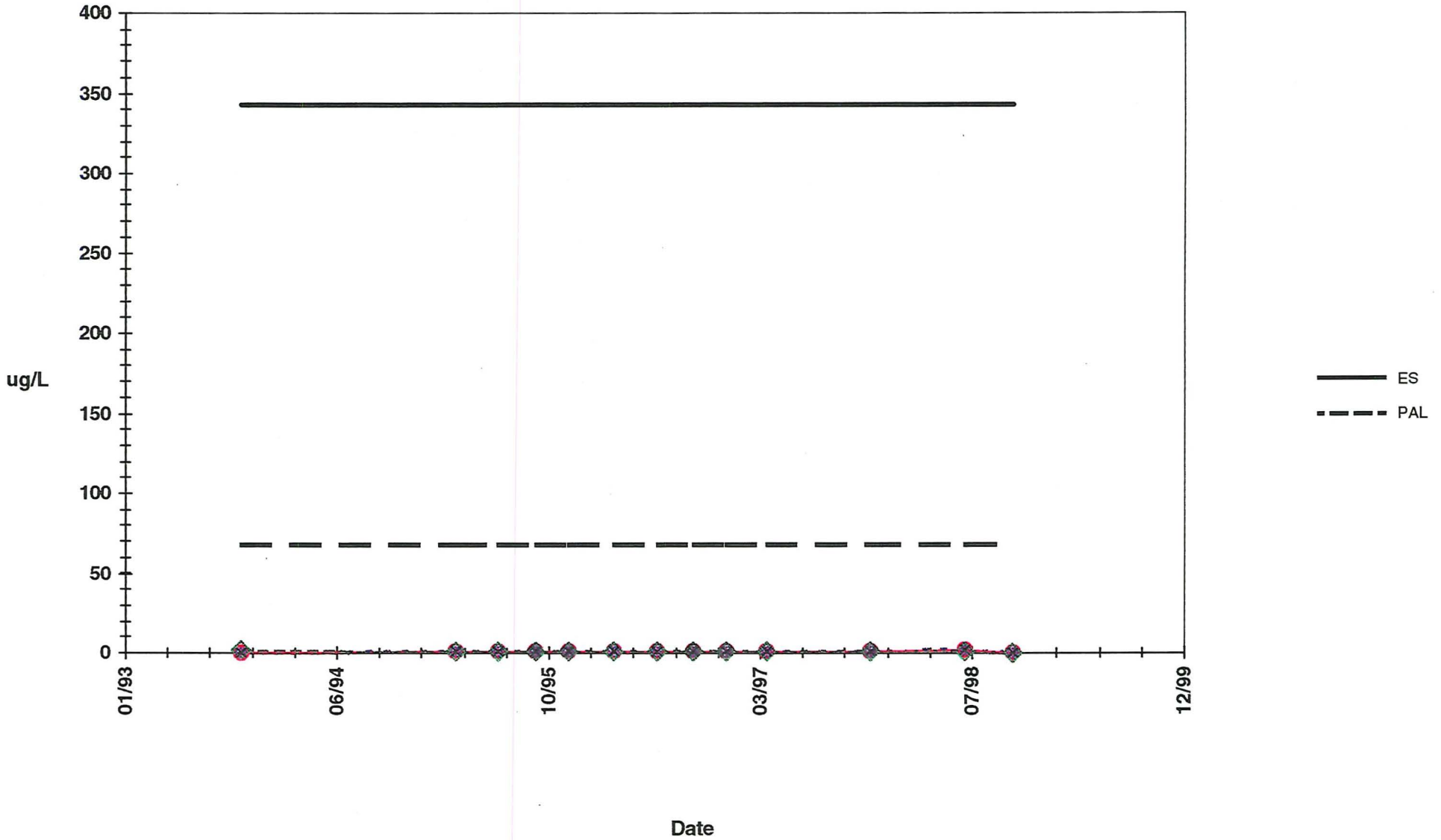
Onalaska Municipal Landfill

MW-06 and MW-08

Toluene



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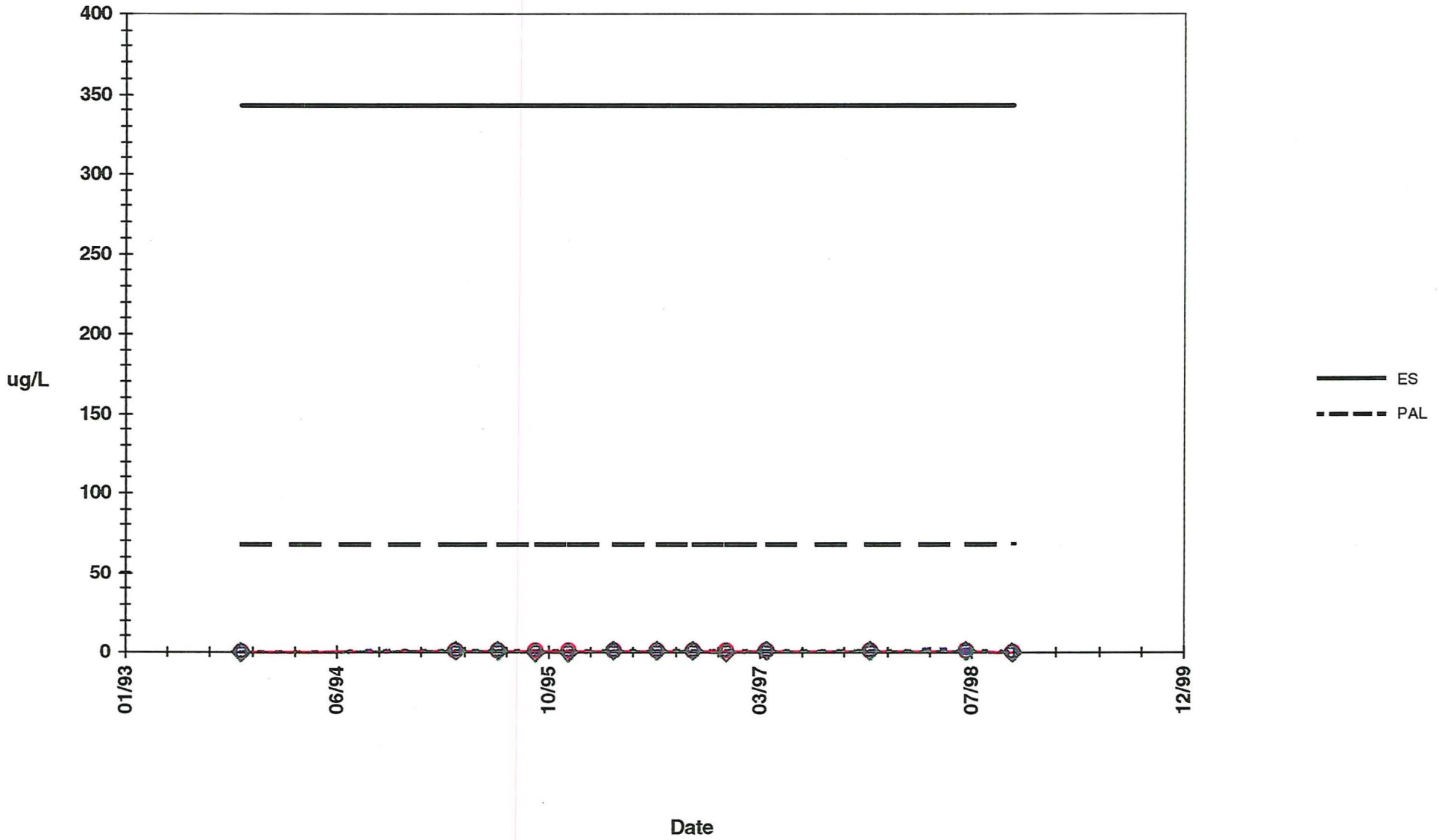
Onalaska Municipal Landfill

MW-12 and MW-14

Toluene



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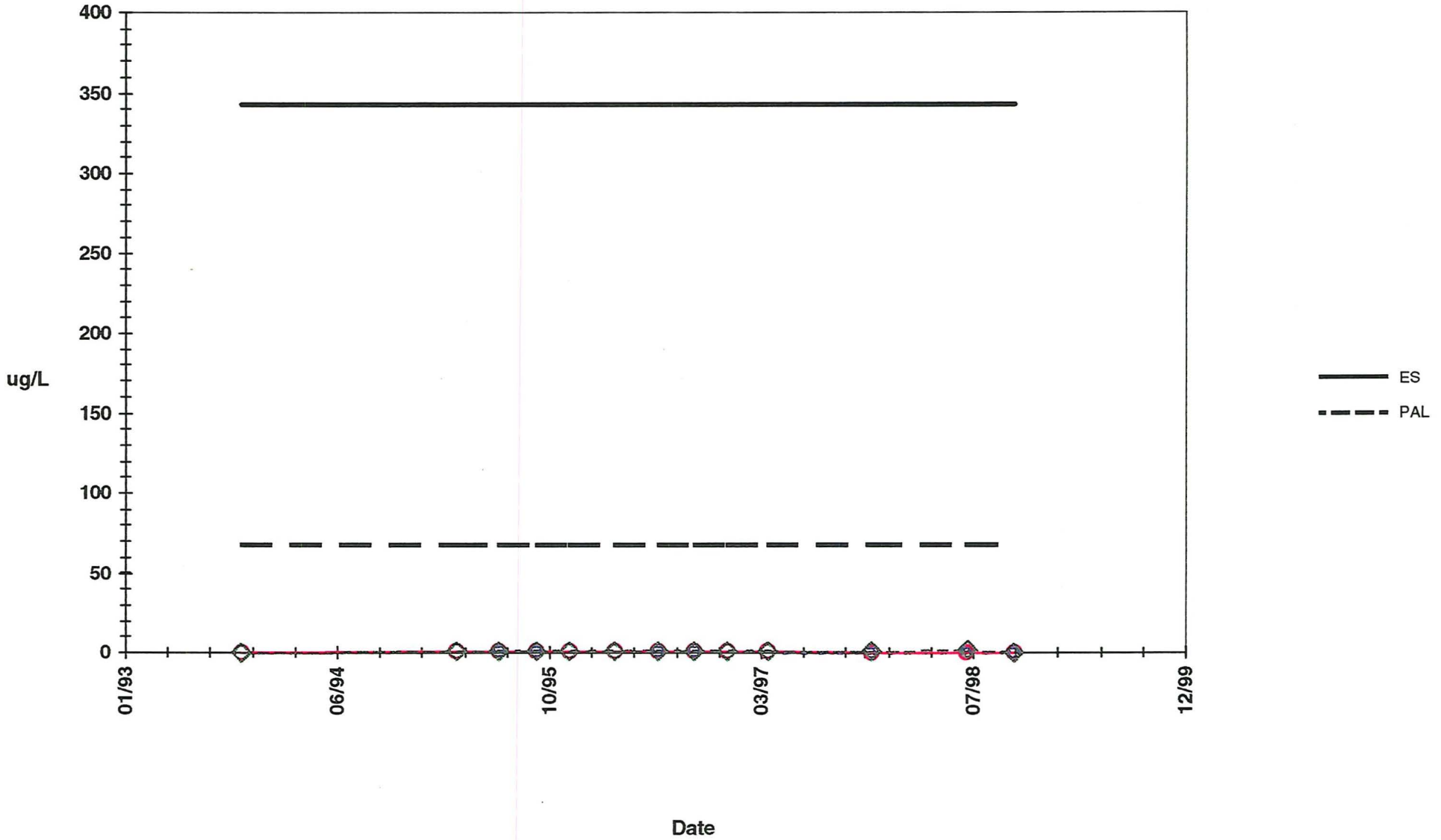
Onalaska Municipal Landfill

Residential Wells

Toluene



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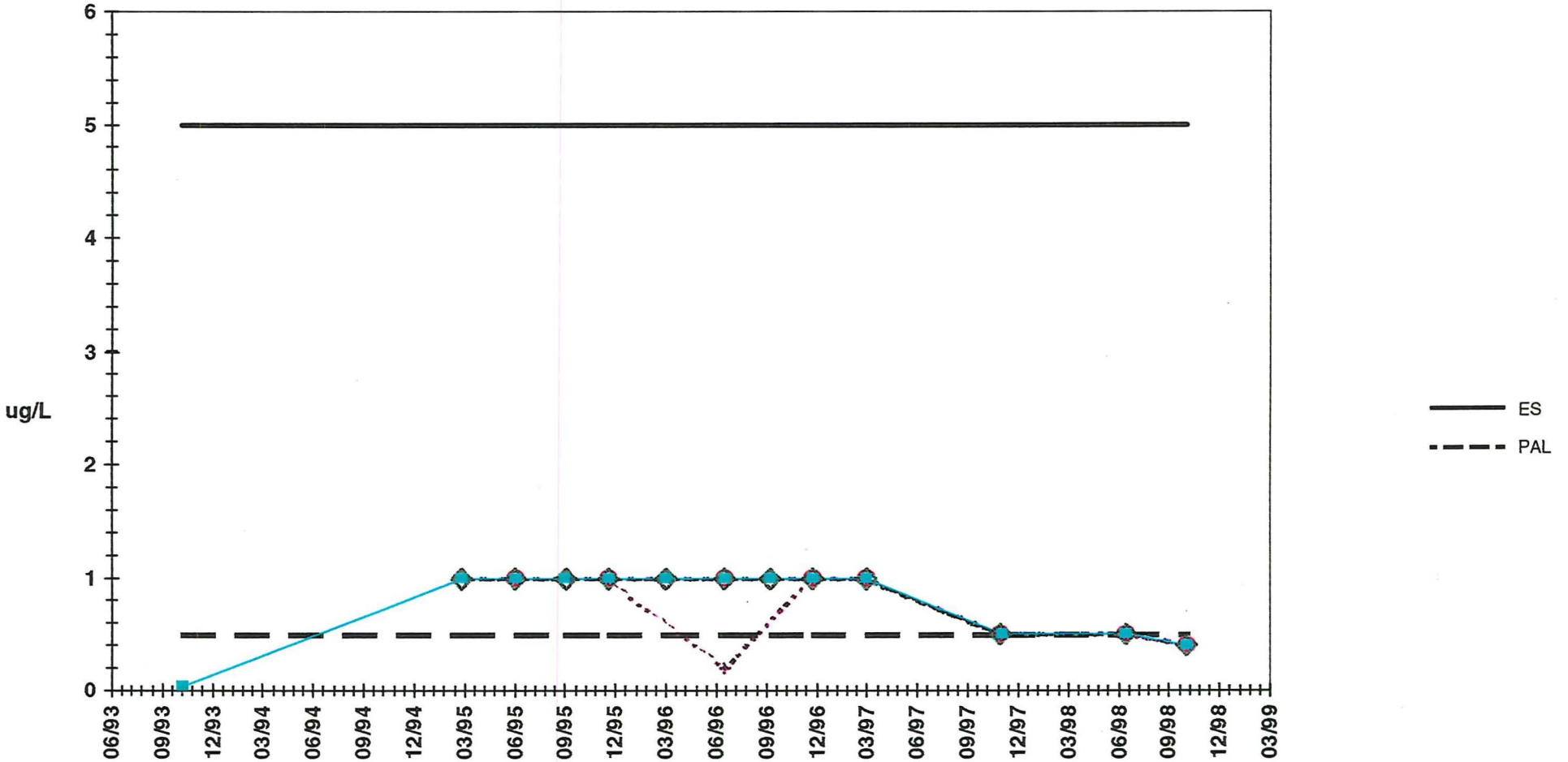
Onalaska Municipal Landfill

Extraction Wells

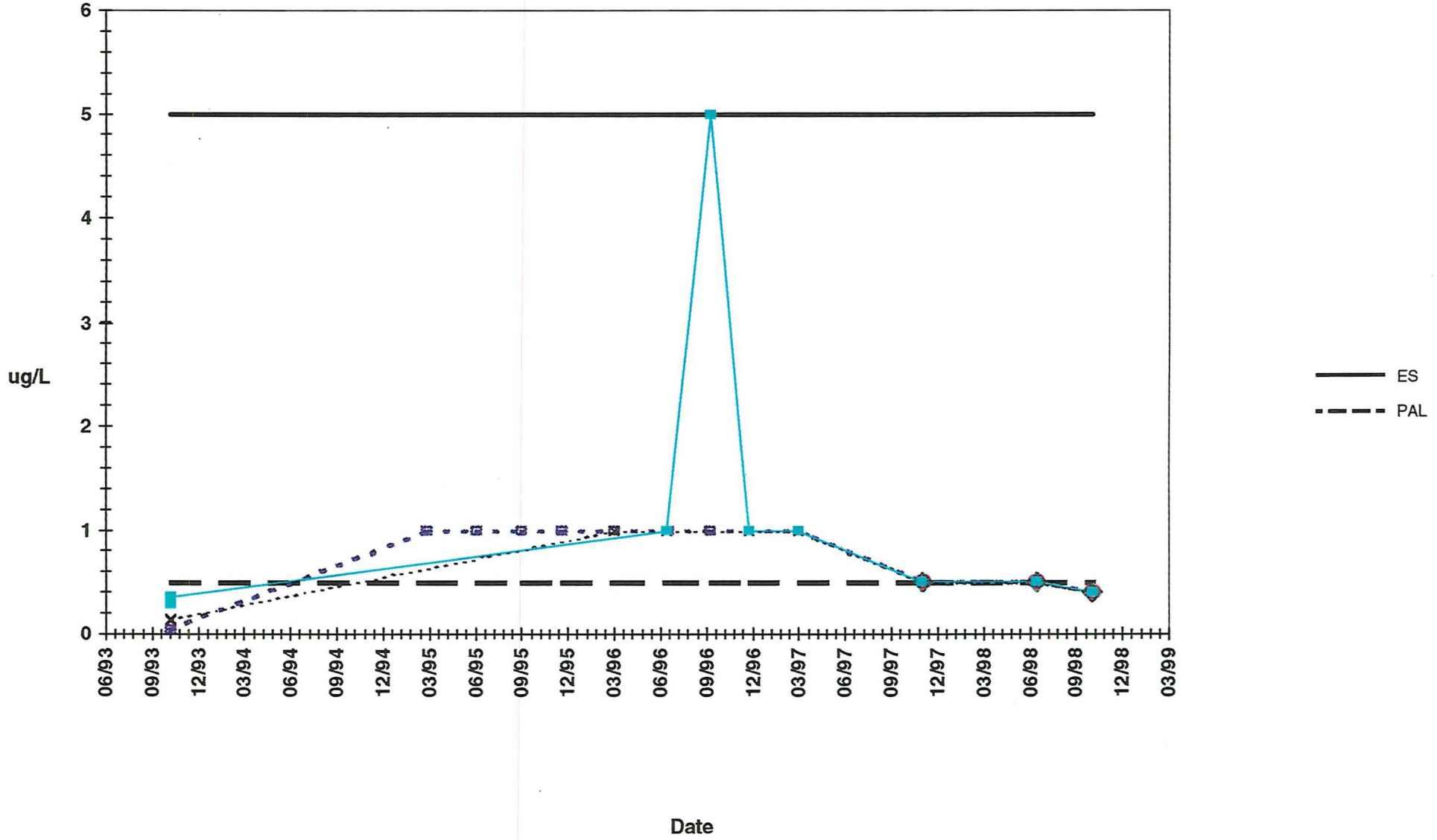
Trichloroethene



Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

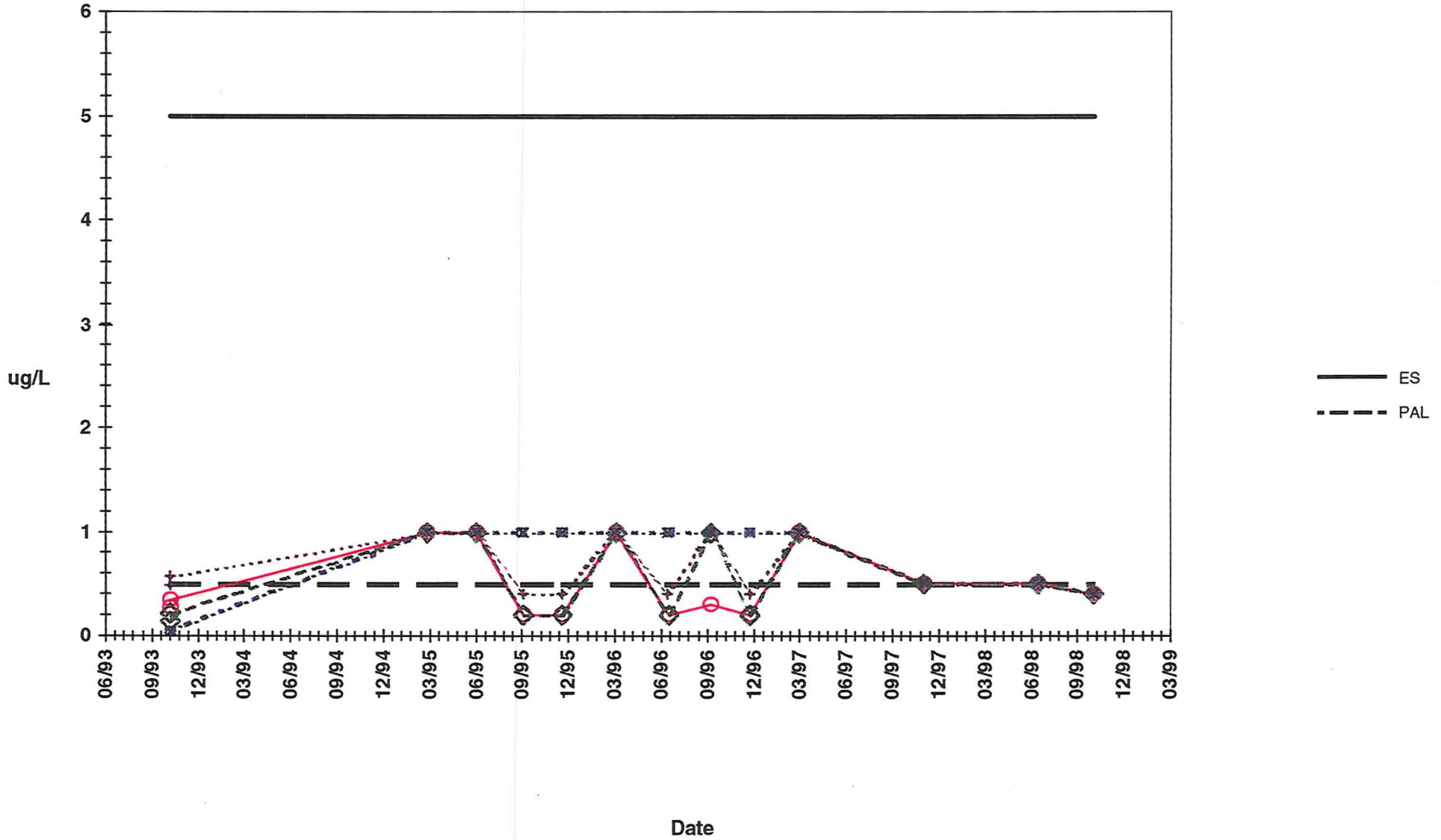
Trichloroethene



Onalaska Municipal Landfill

MW-06 and MW-08

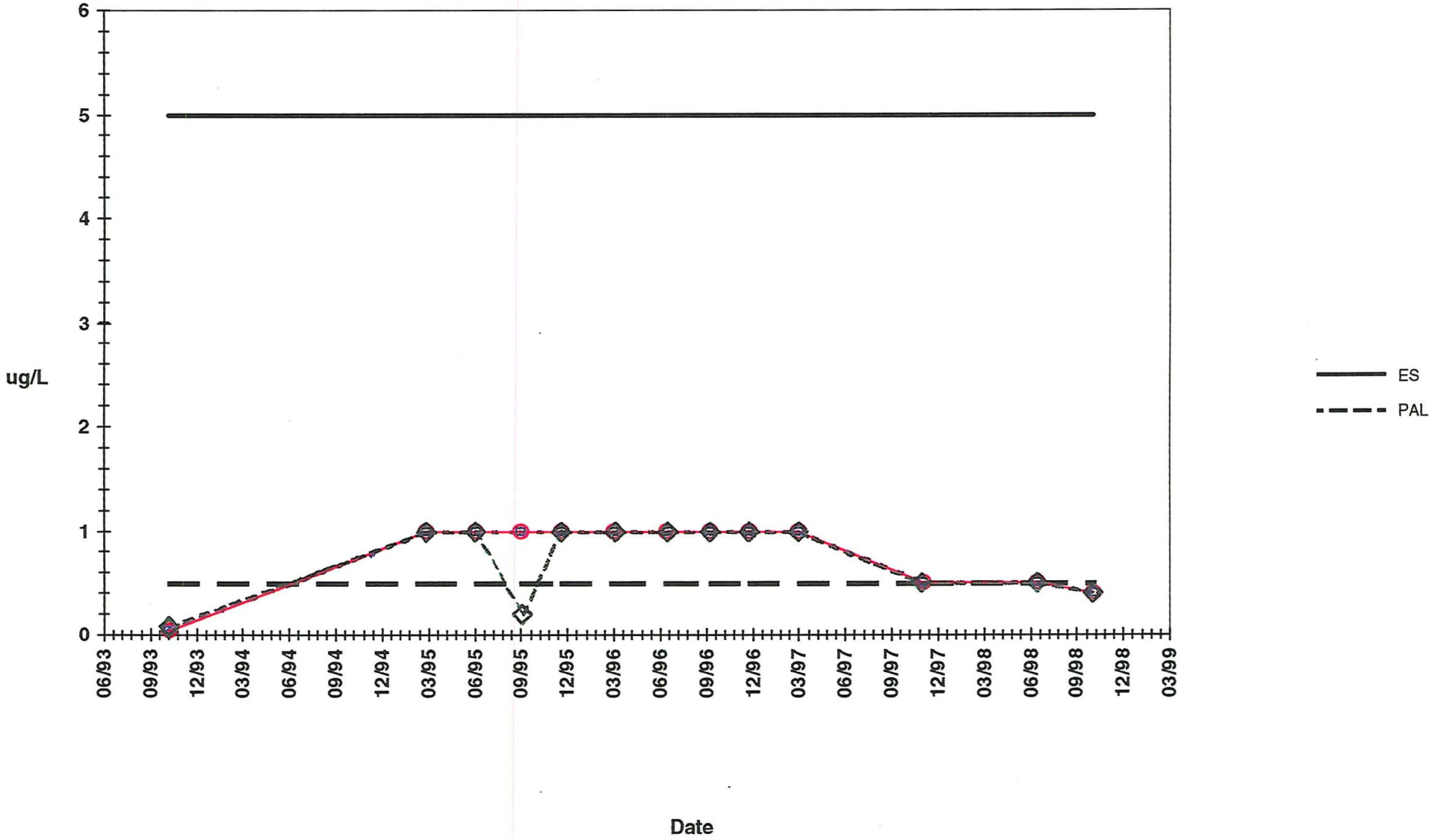
Trichloroethene



Onalaska Municipal Landfill

MW-12 and MW-14

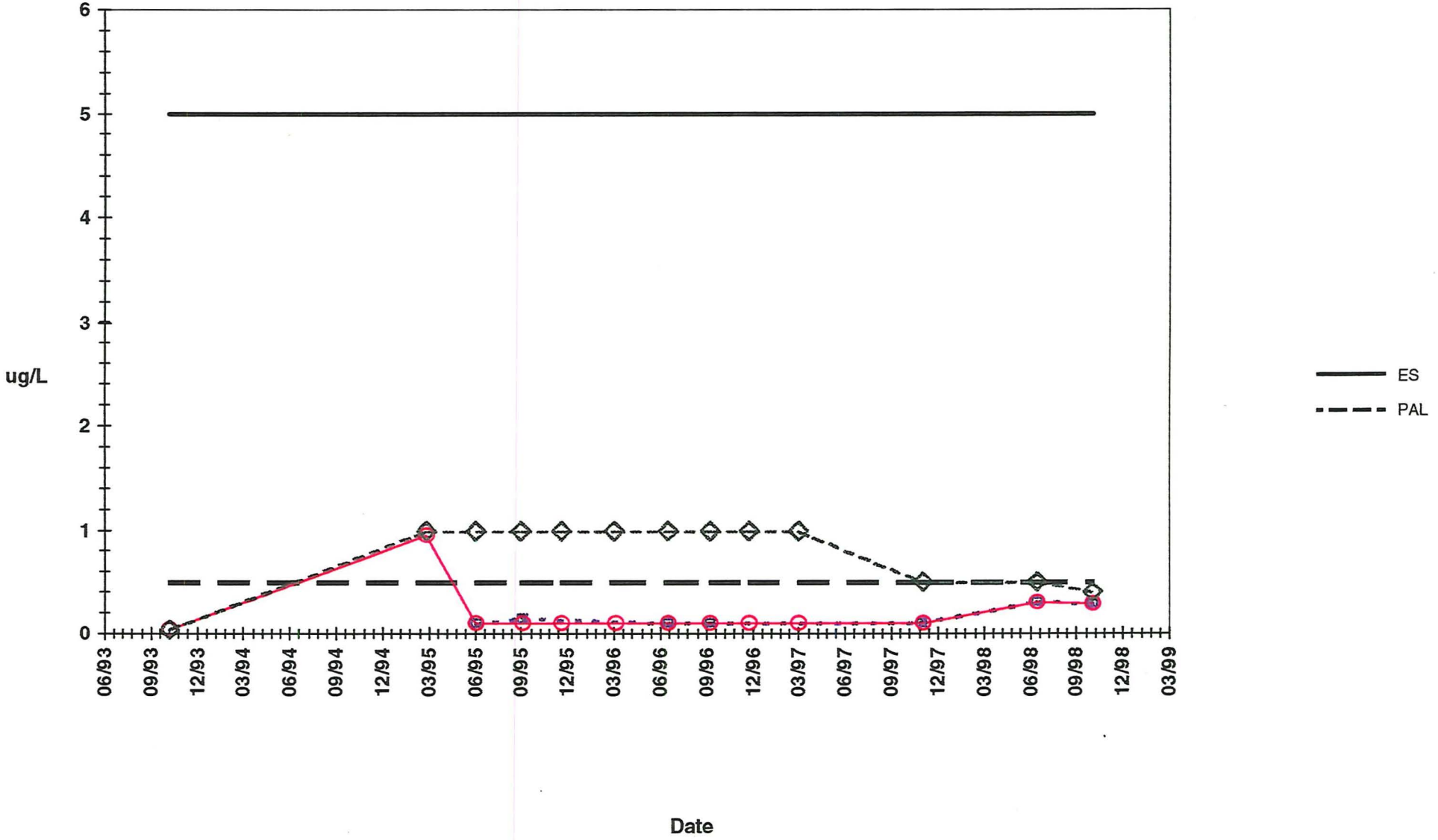
Trichloroethene



Onalaska Municipal Landfill

Residential Wells

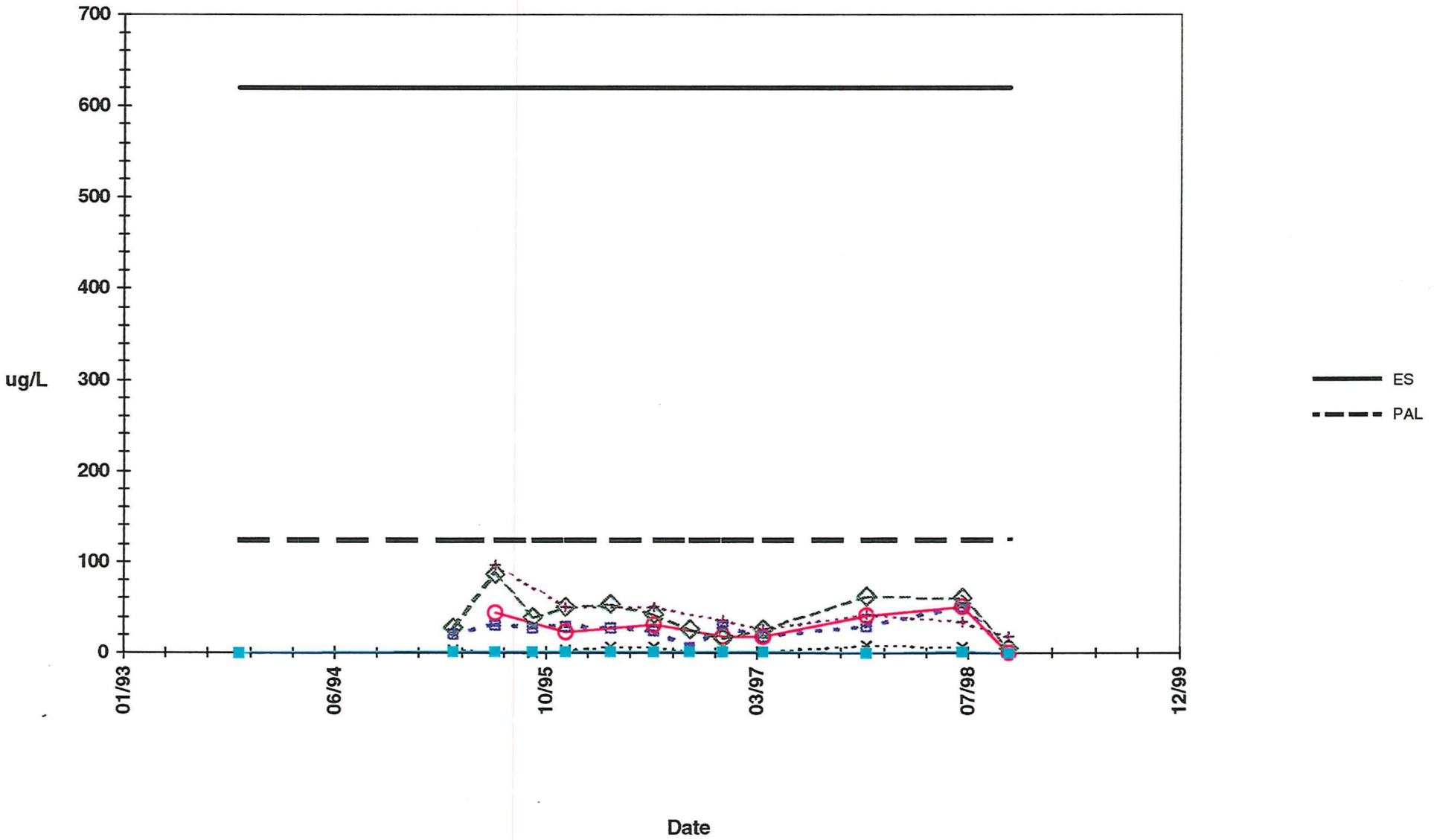
Trichloroethene



Onalaska Municipal Landfill

Extraction Wells

Xylenes, Total

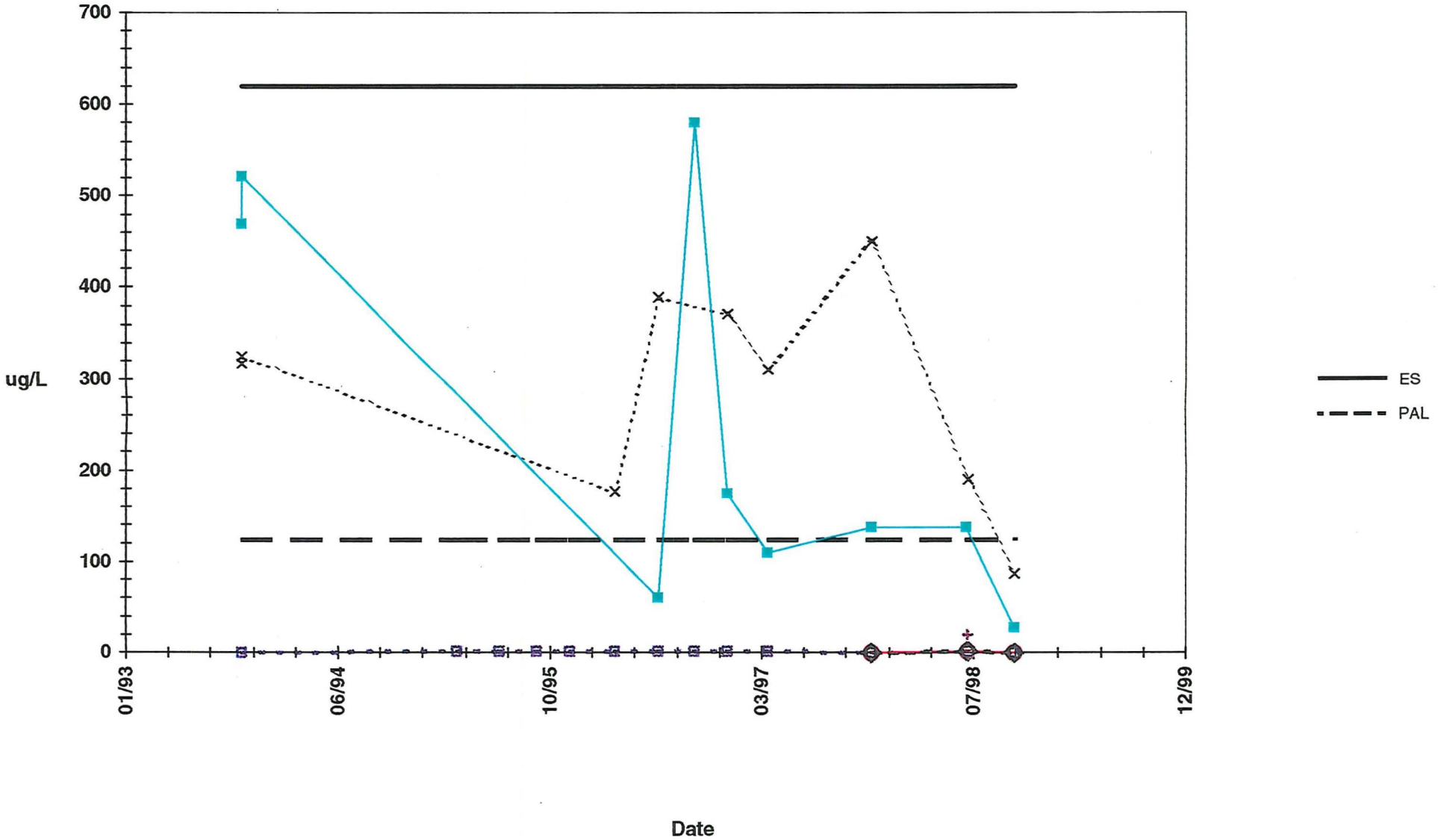


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Xylenes, Total



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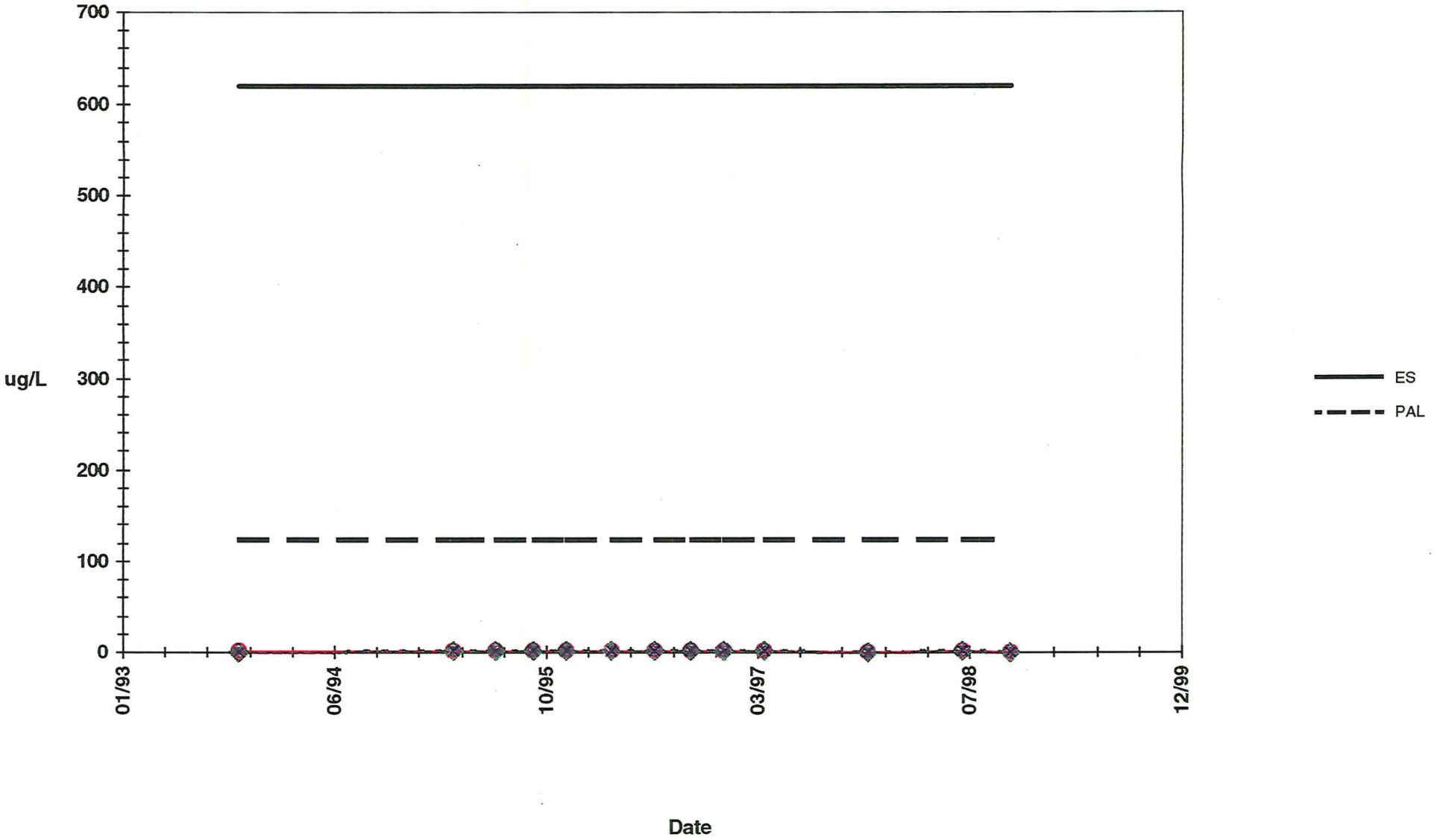
Onalaska Municipal Landfill

MW-06 and MW-08

Xylenes, Total



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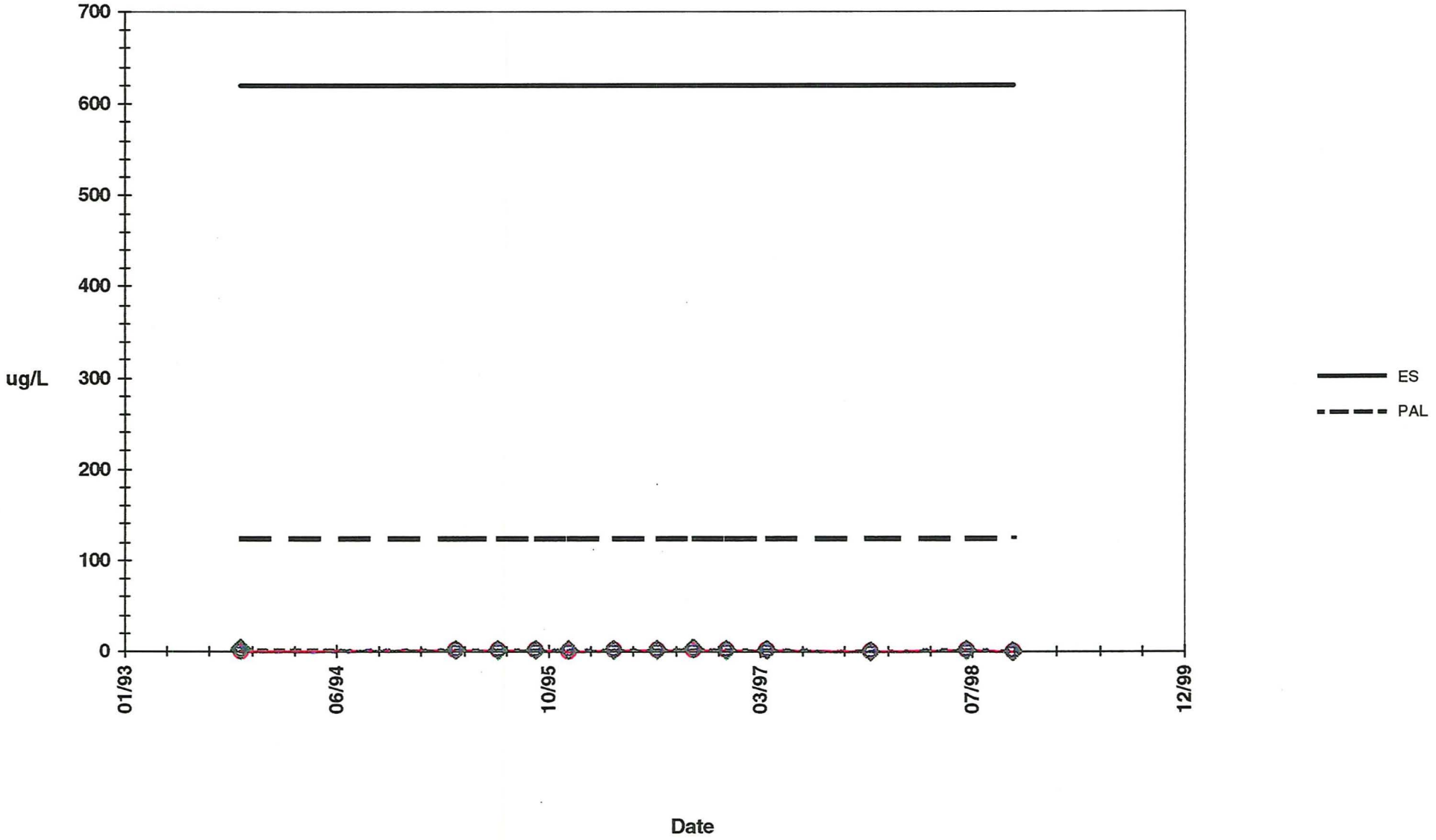
Onalaska Municipal Landfill

MW-12 and MW-14

Xylenes, Total



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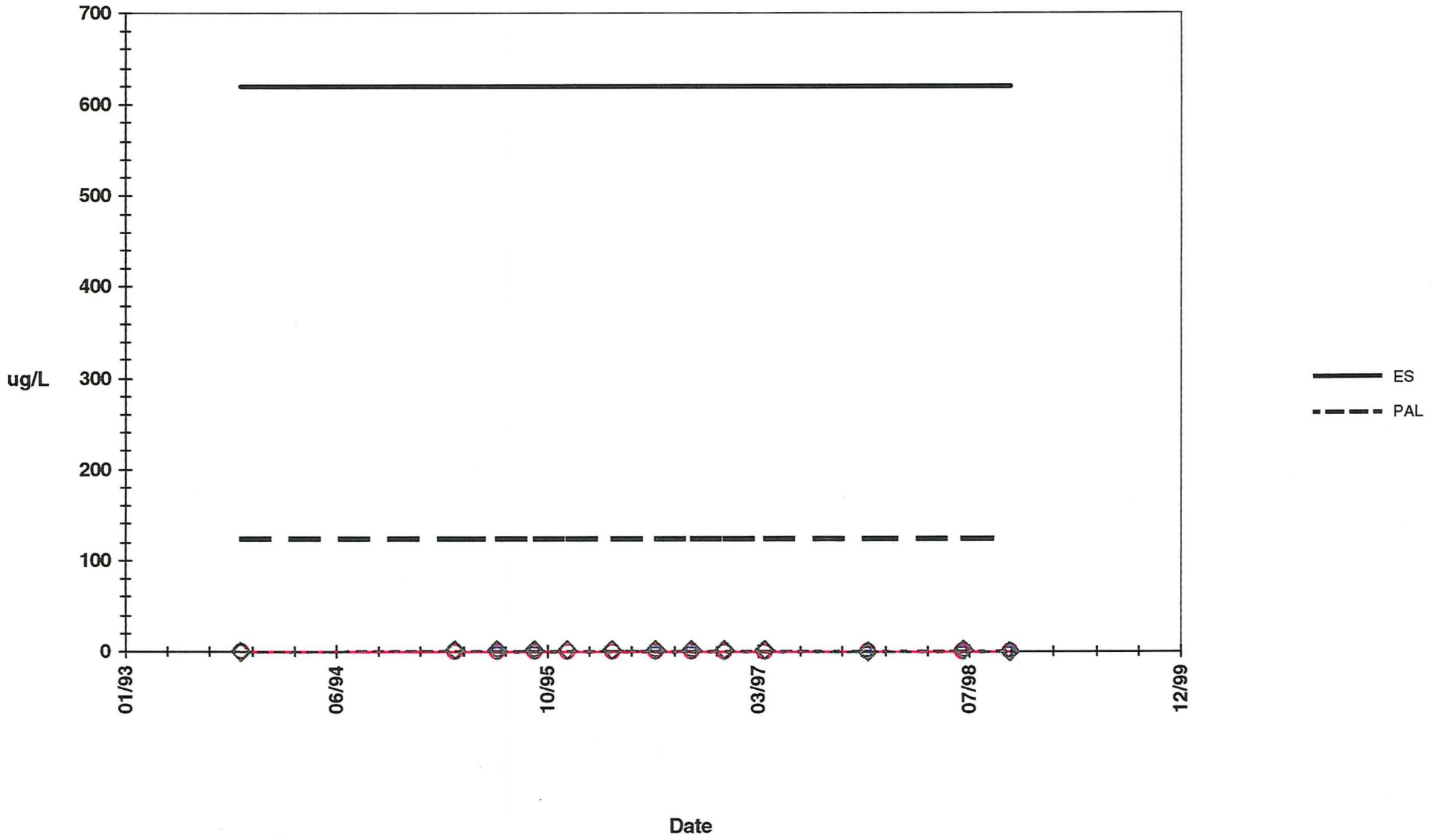
Onalaska Municipal Landfill

Residential Wells

Xylenes, Total

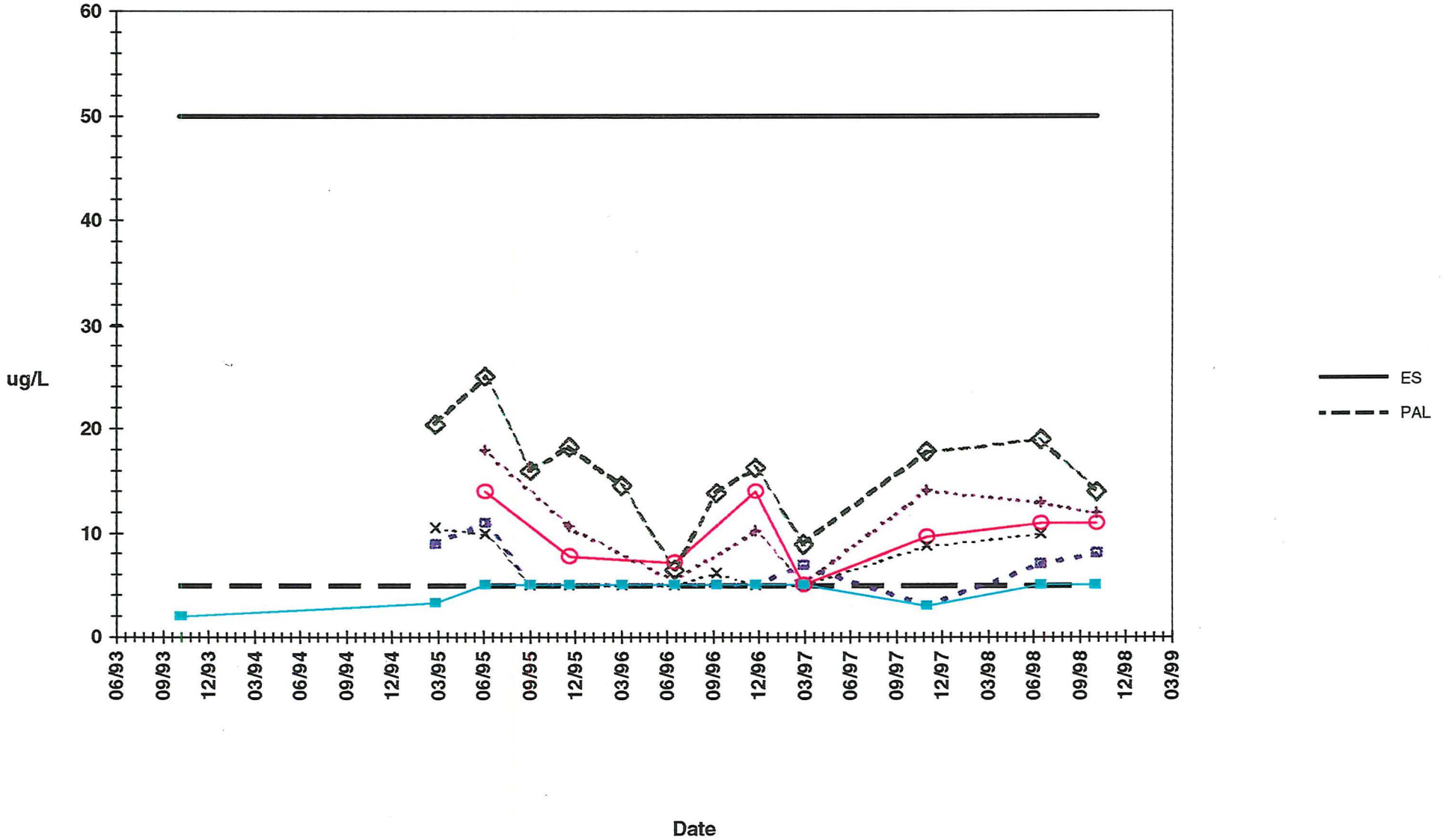


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Extraction Wells

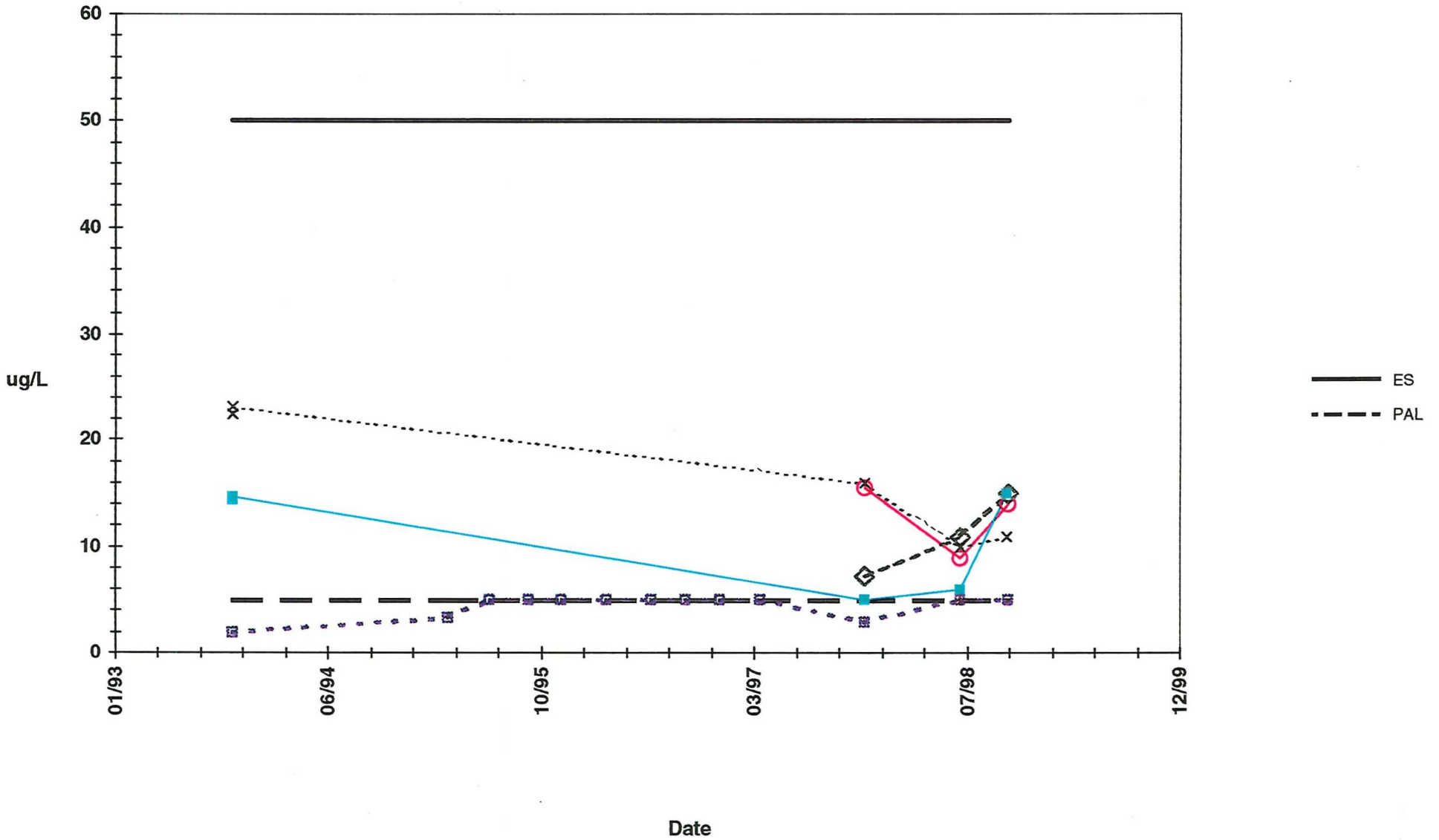
Arsenic



Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Arsenic



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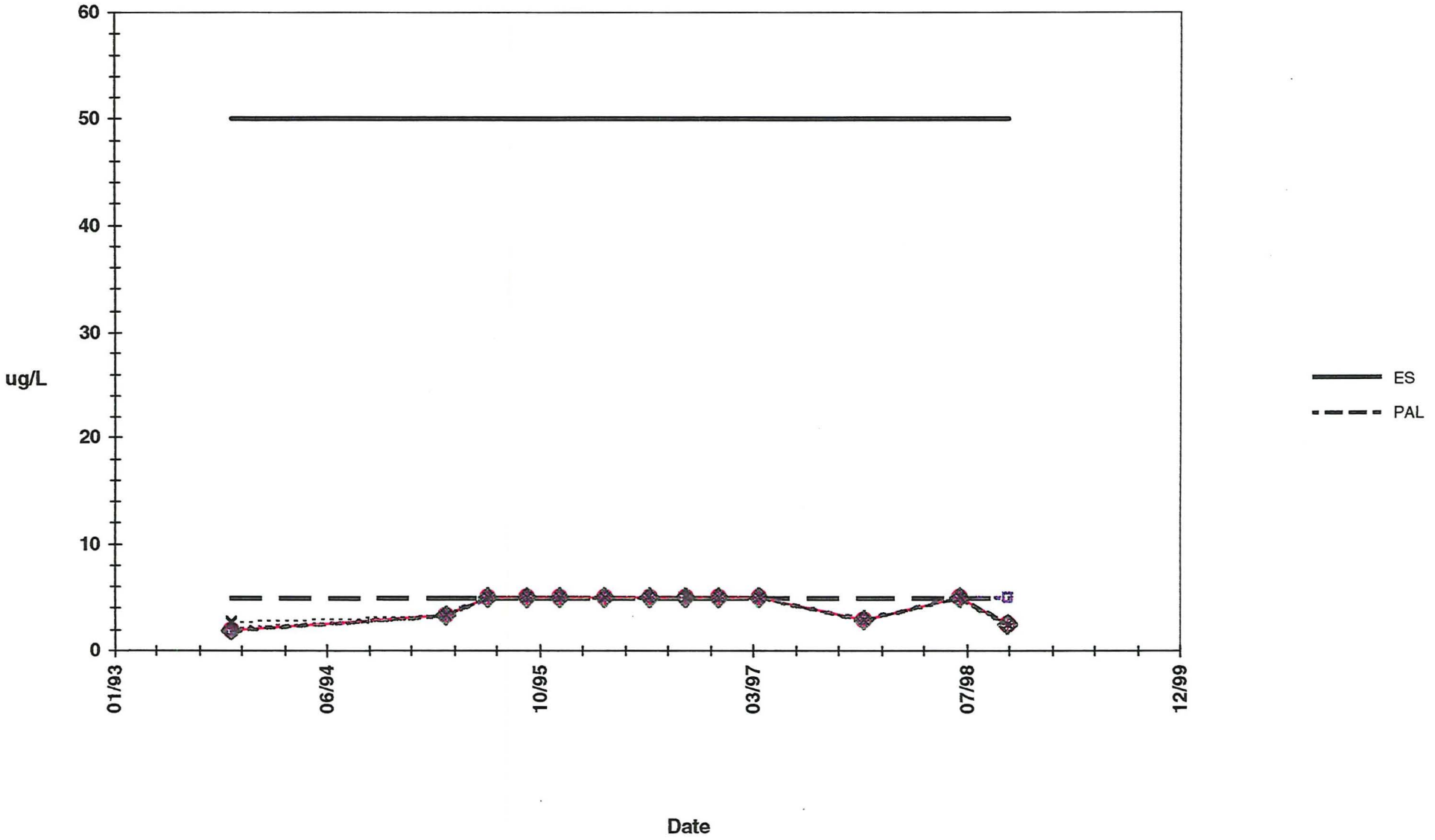
Onalaska Municipal Landfill

MW-06 and MW-08

Arsenic



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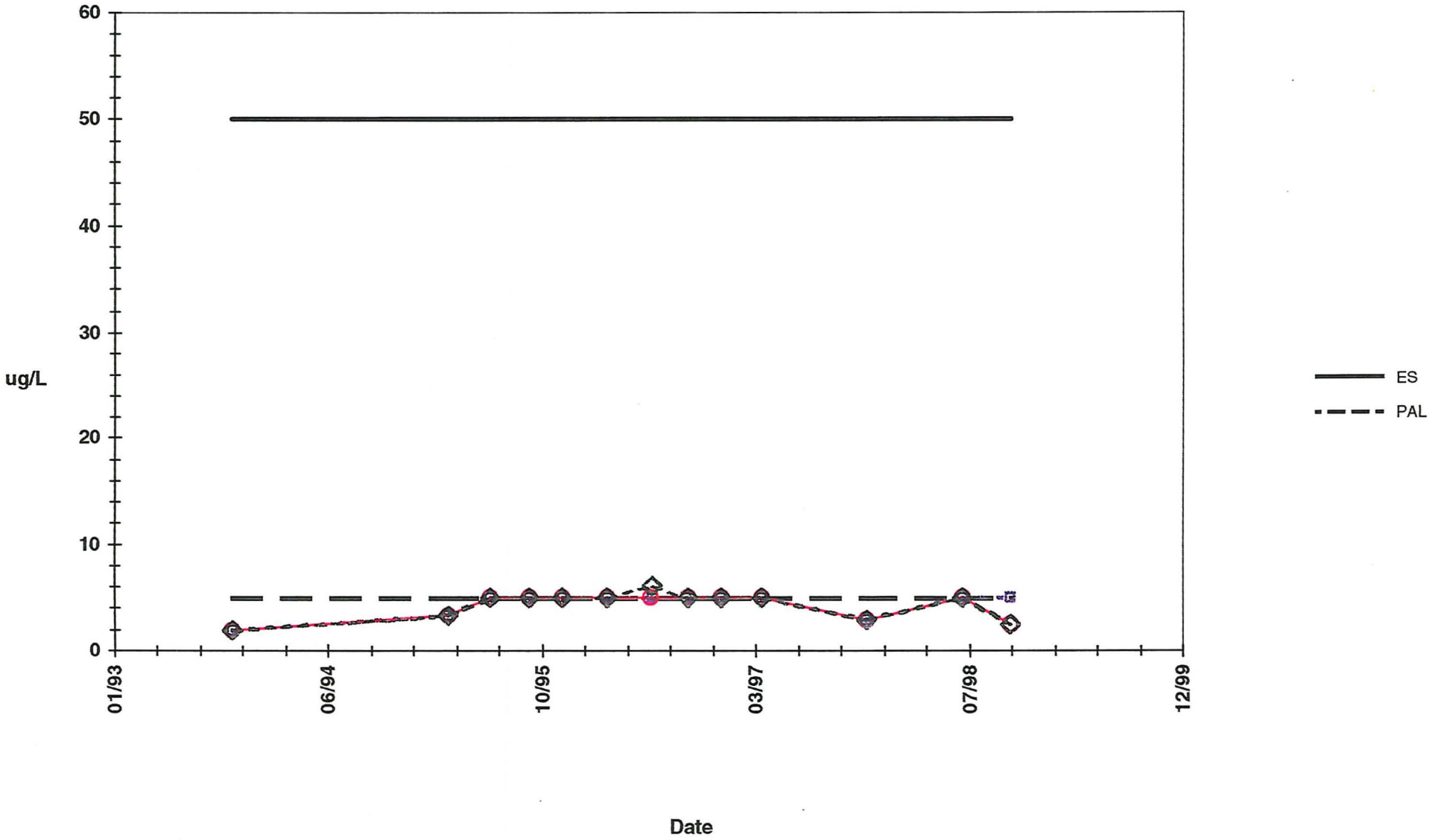
Onalaska Municipal Landfill

MW-12 and MW-14

Arsenic

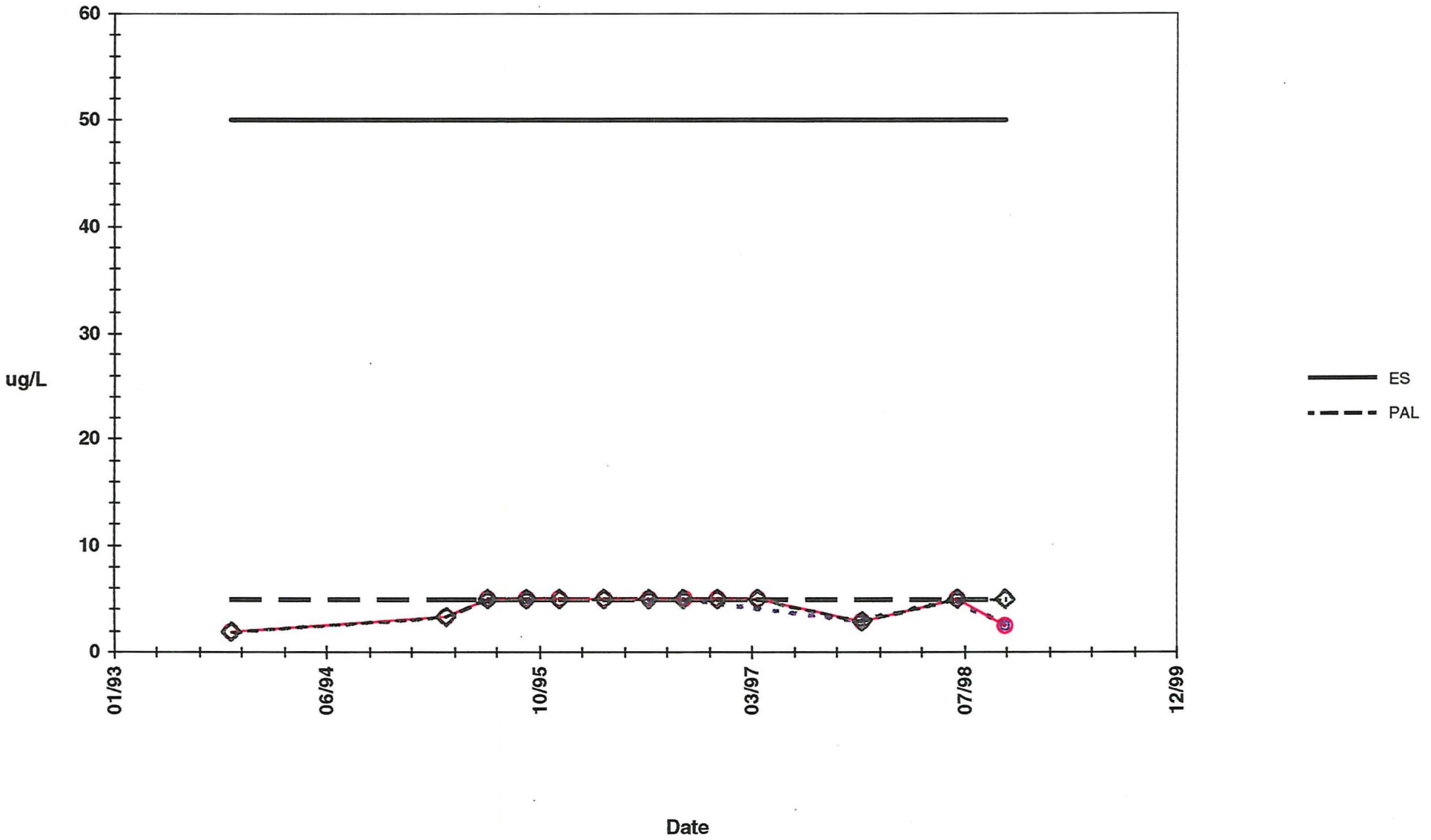


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Residential Wells

Arsenic

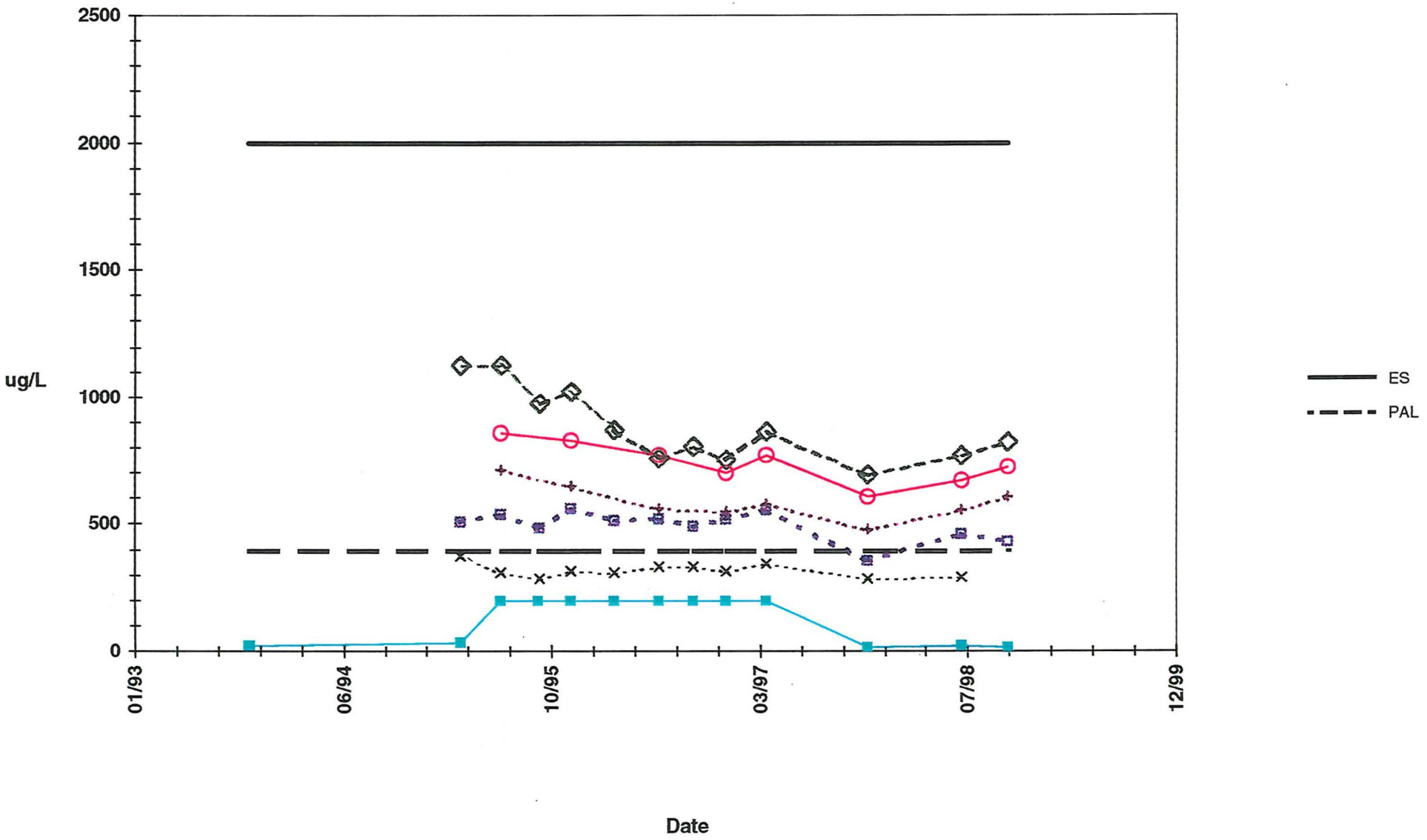


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Extraction Wells

Barium

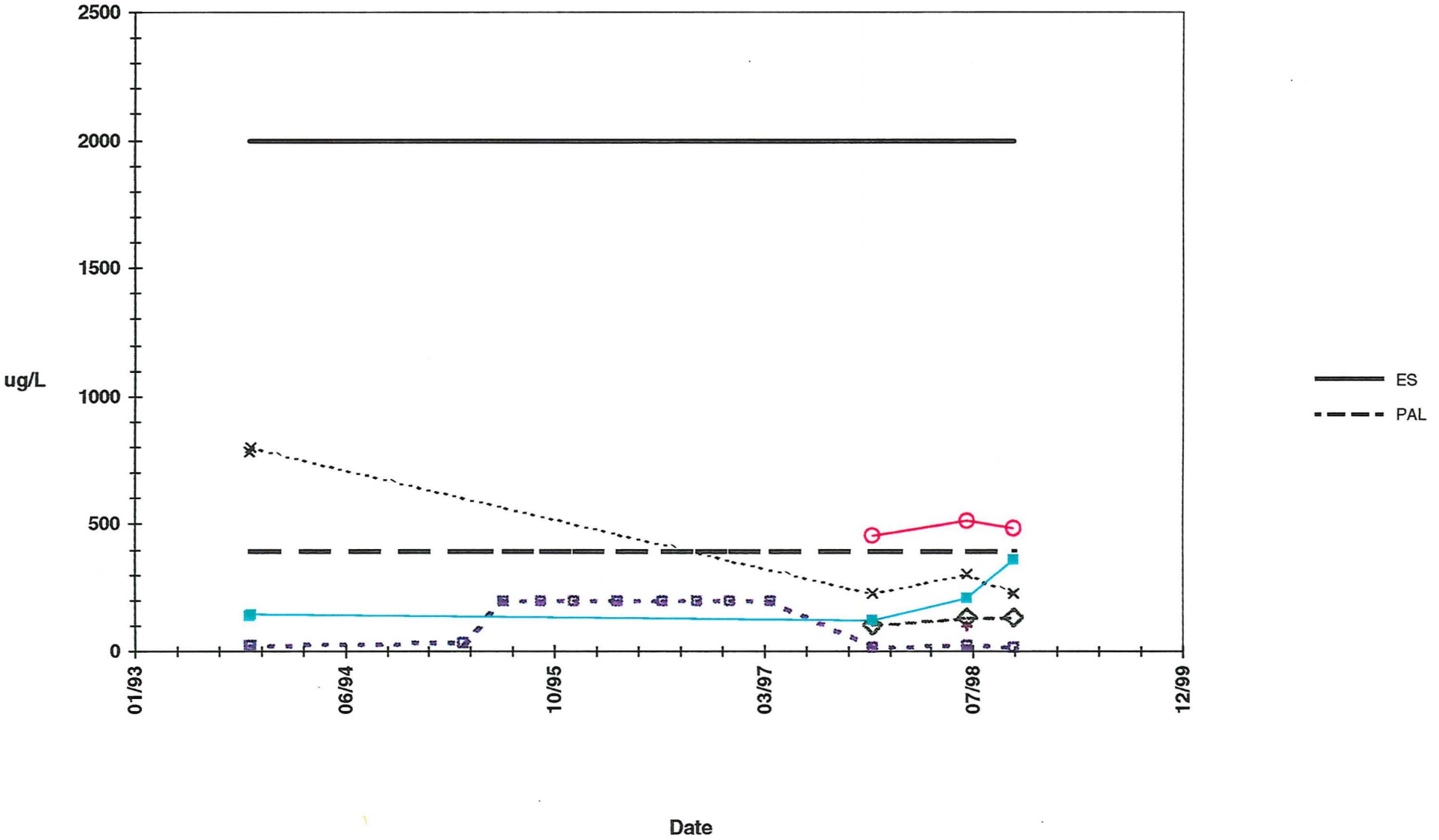


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Barium

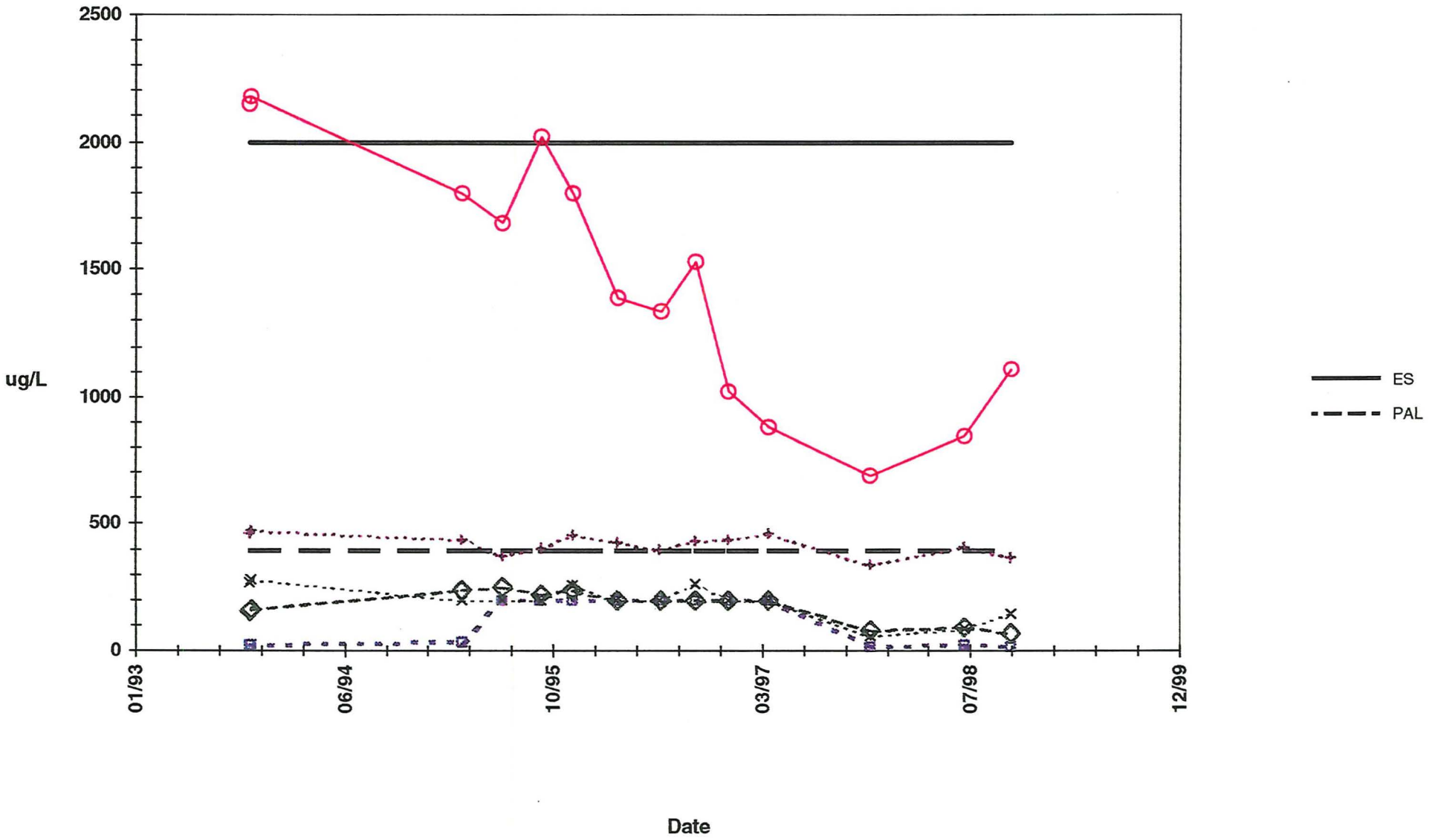


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

Barium

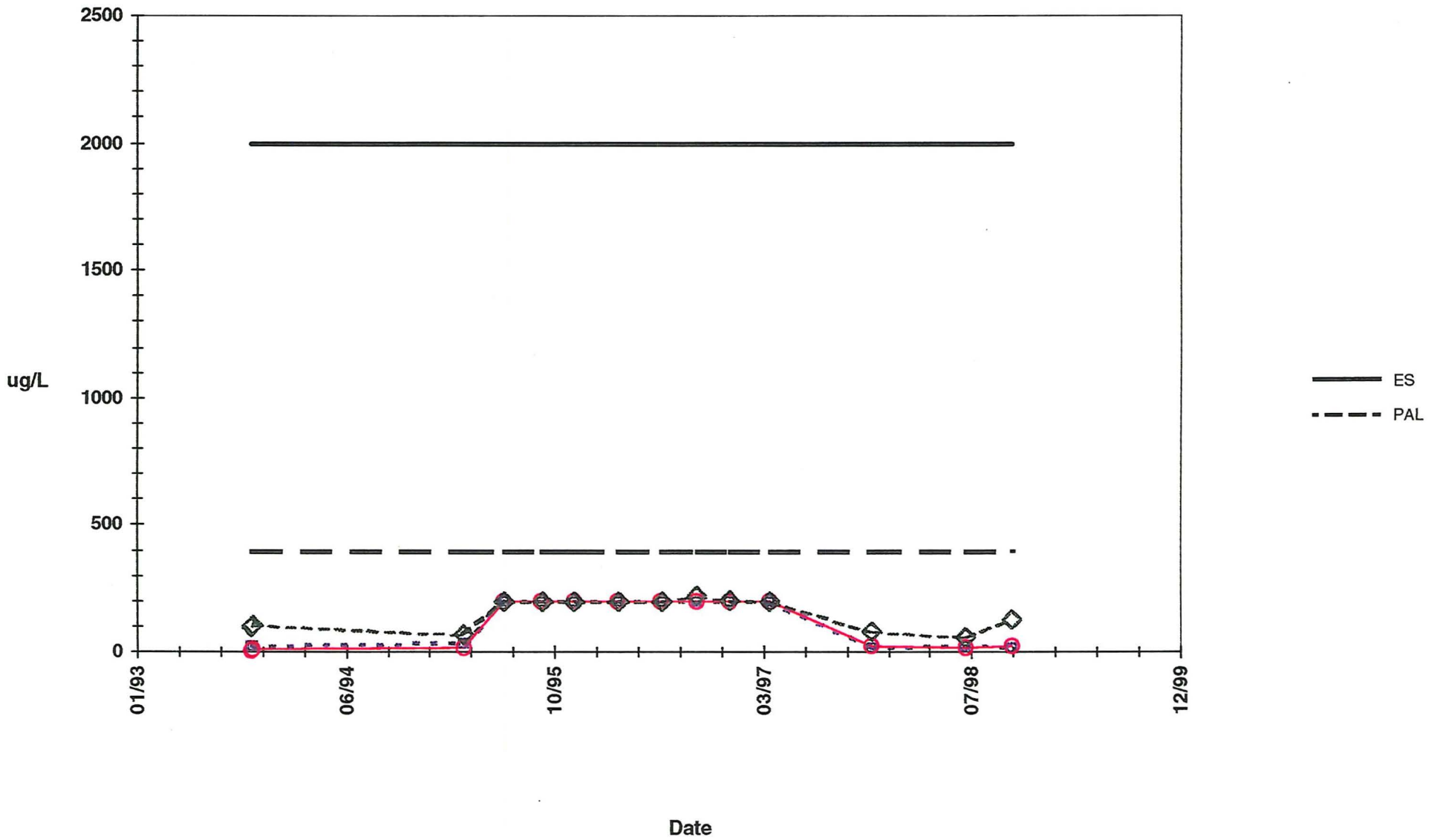


Prepared by CH2M HILL 26-May-99

Onalaska Municipal Landfill

MW-12 and MW-14

Barium

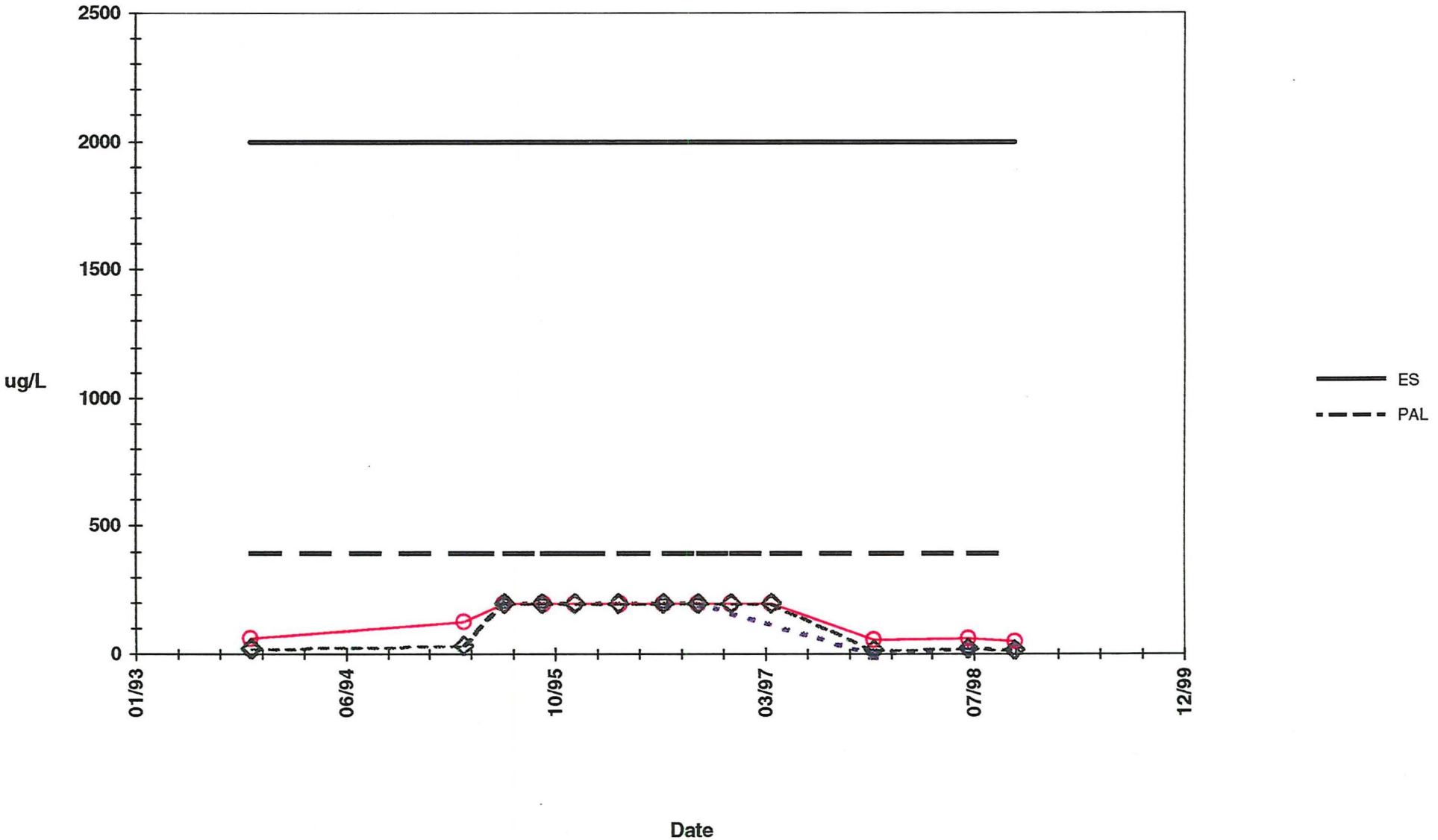


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Residential Wells

Barium

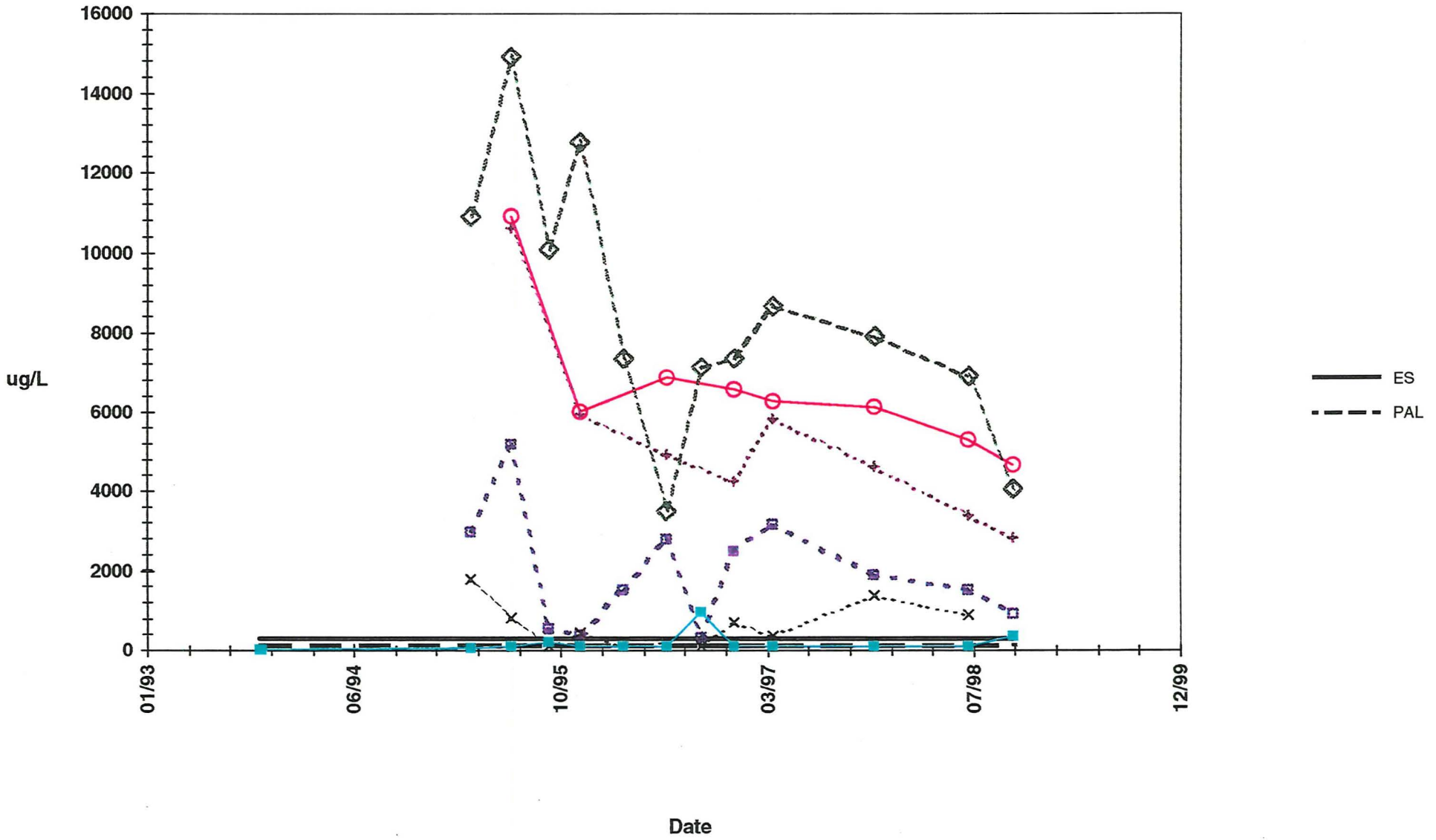


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Extraction Wells

Iron

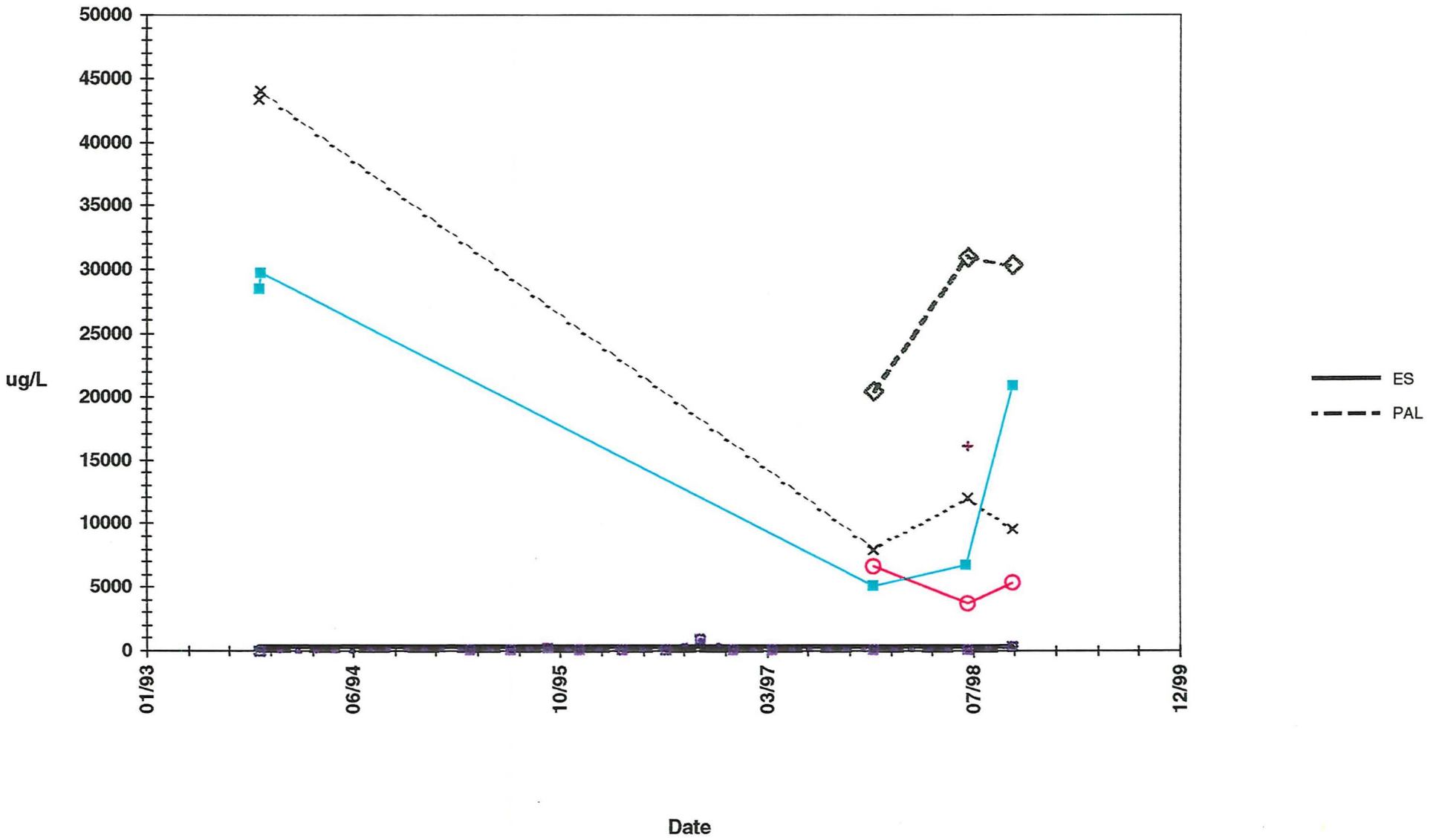


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Iron

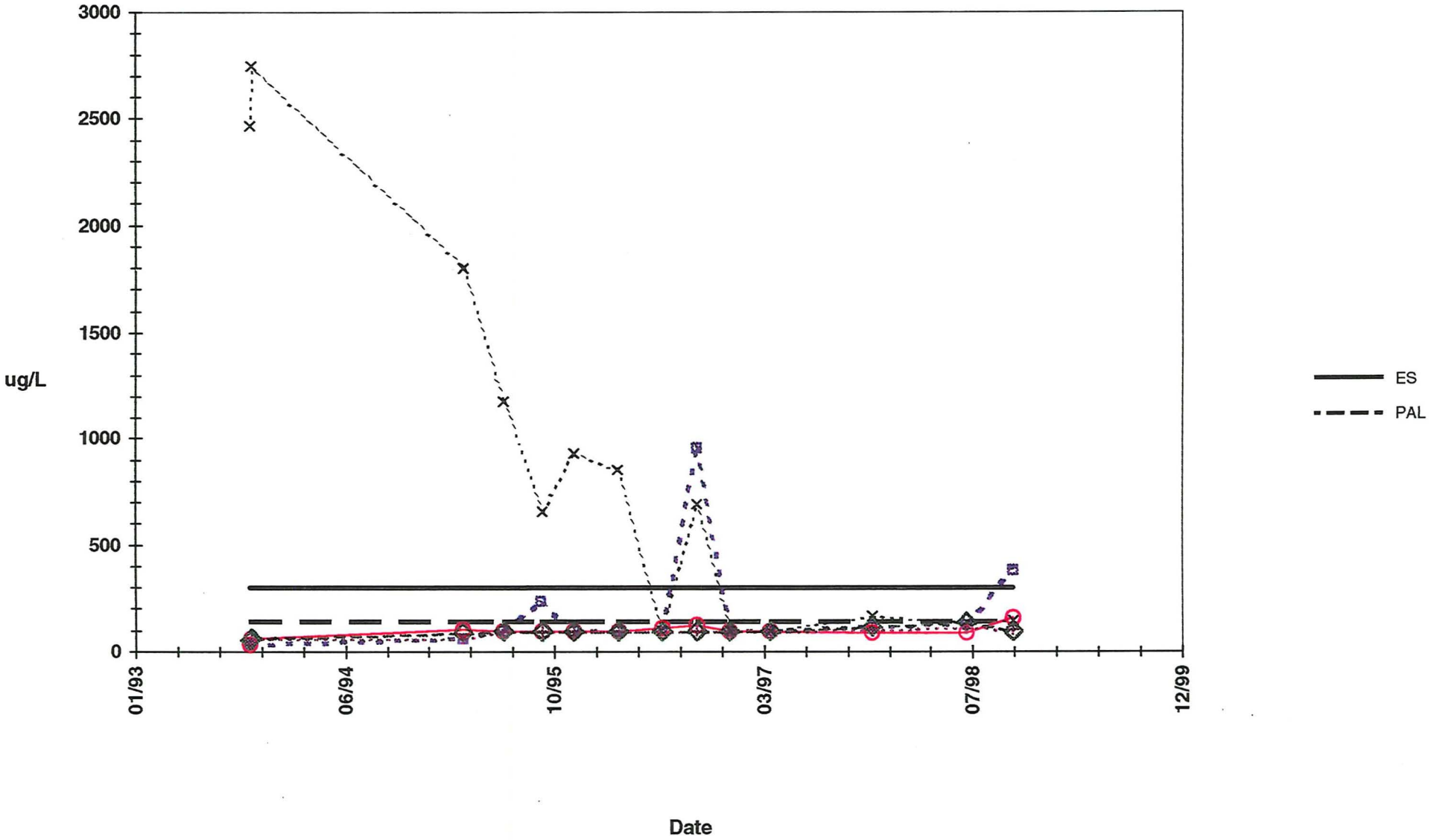


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

Iron

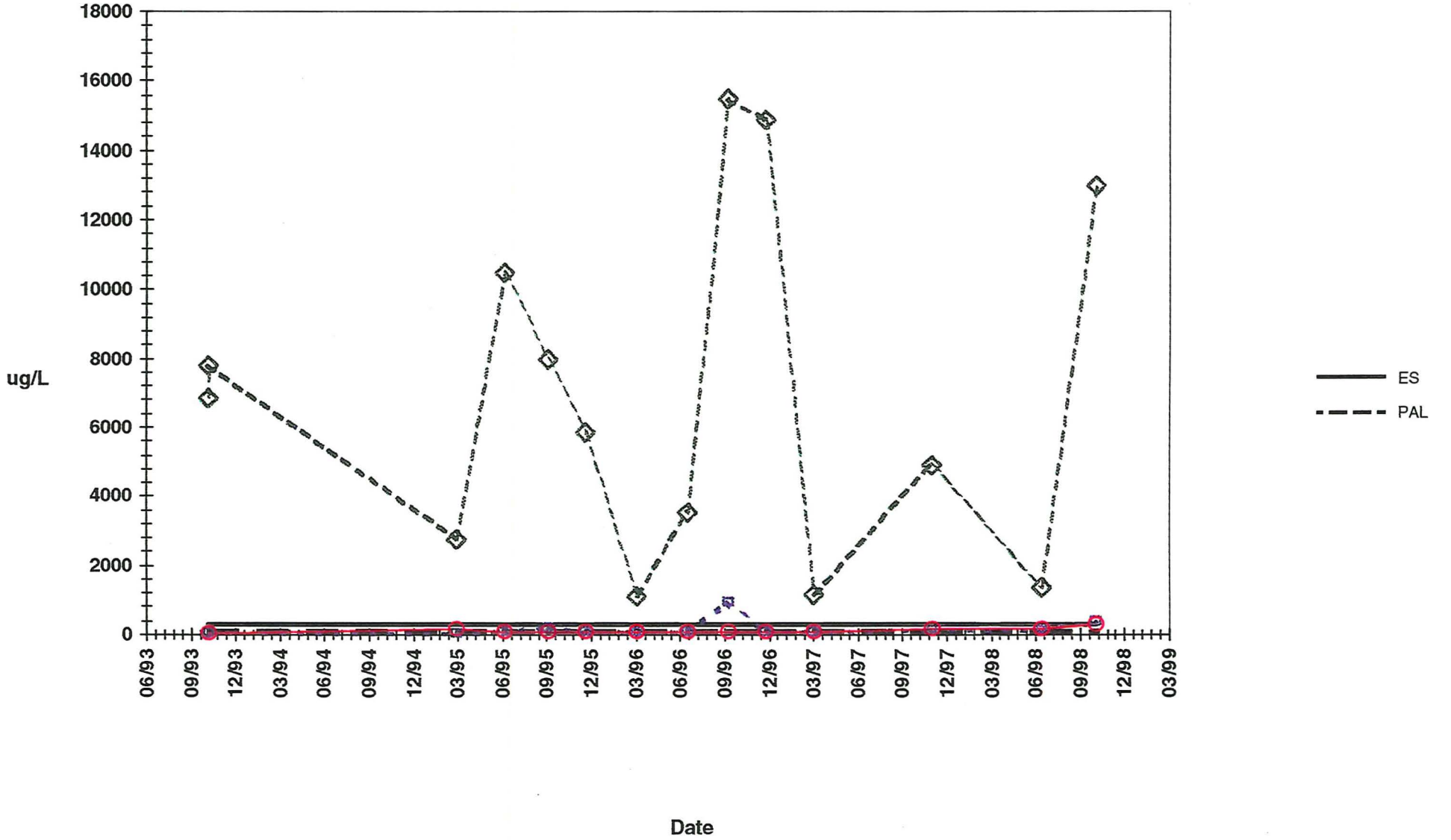


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-12 and MW-14

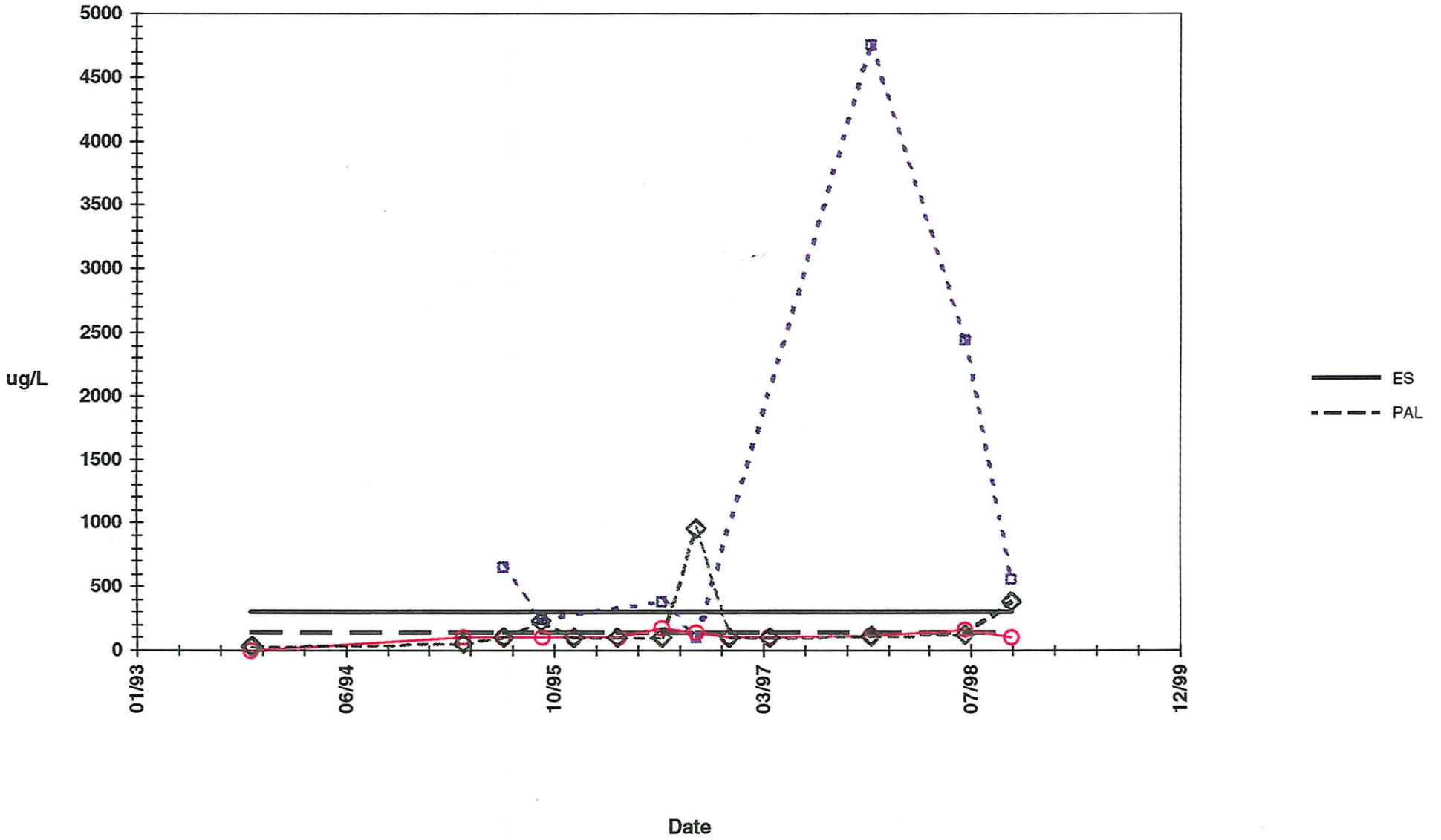
Iron



Onalaska Municipal Landfill

Residential Wells

Iron

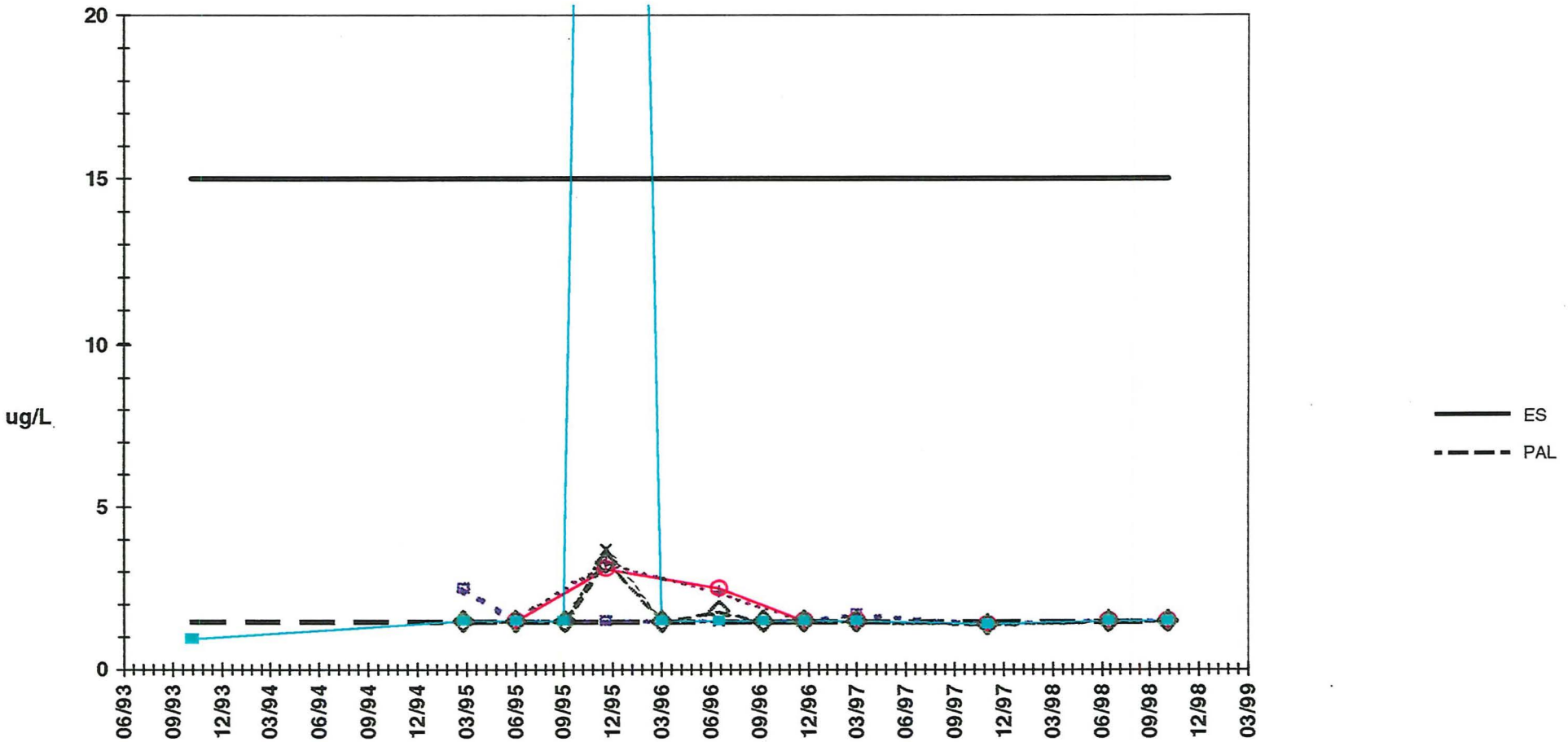


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Extraction Wells

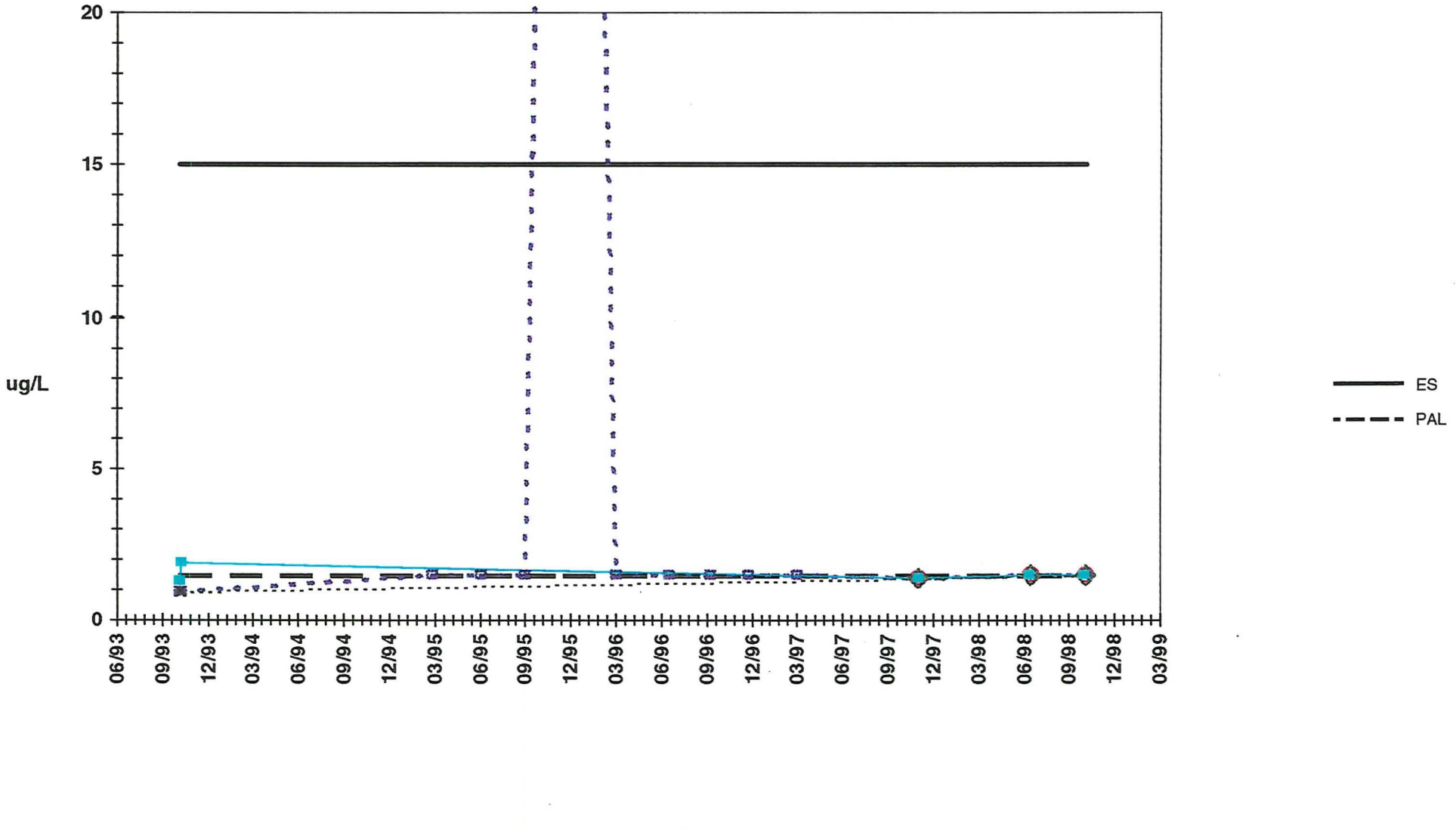
Lead



Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

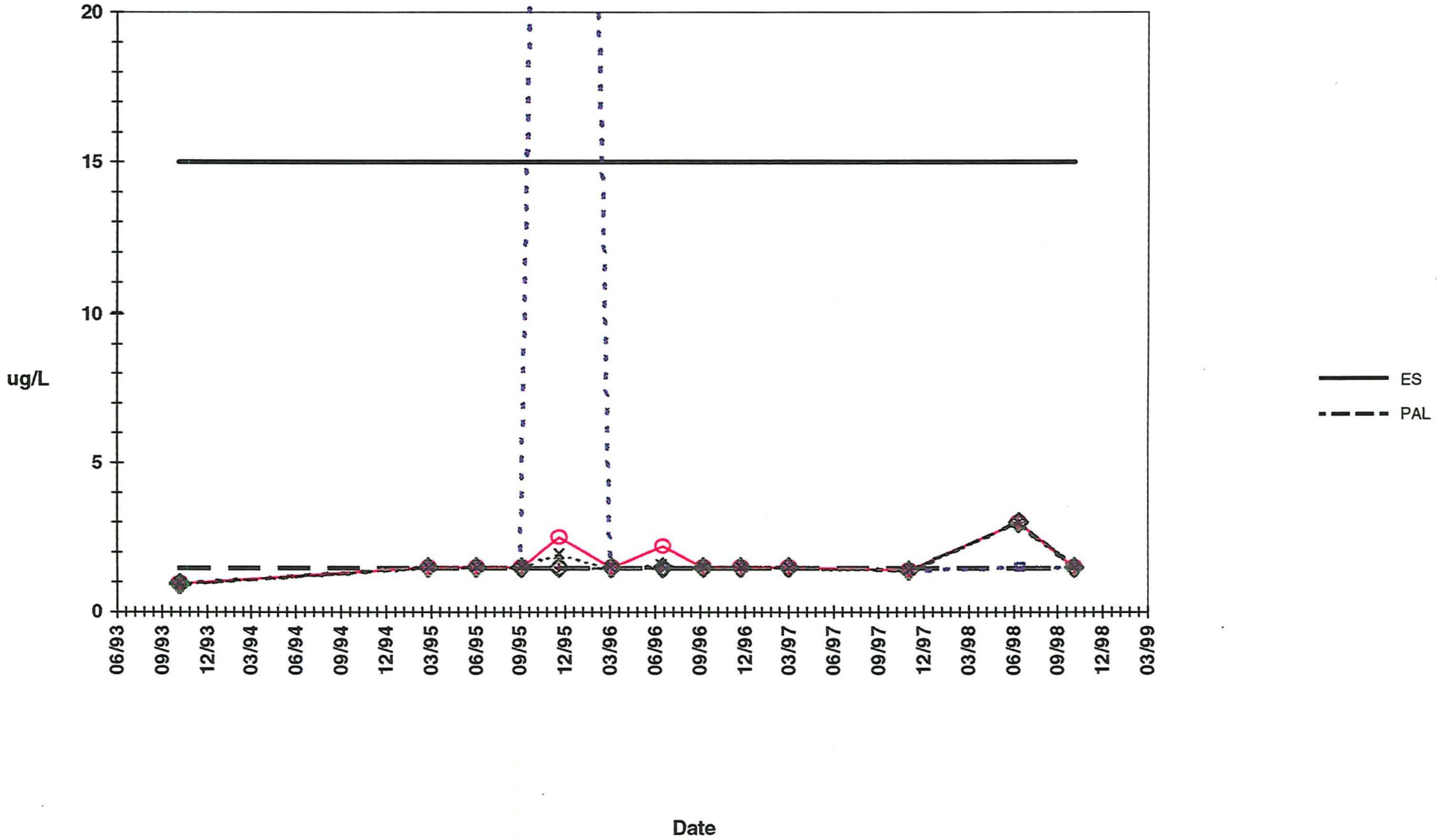
Lead



Onalaska Municipal Landfill

MW-06 and MW-08

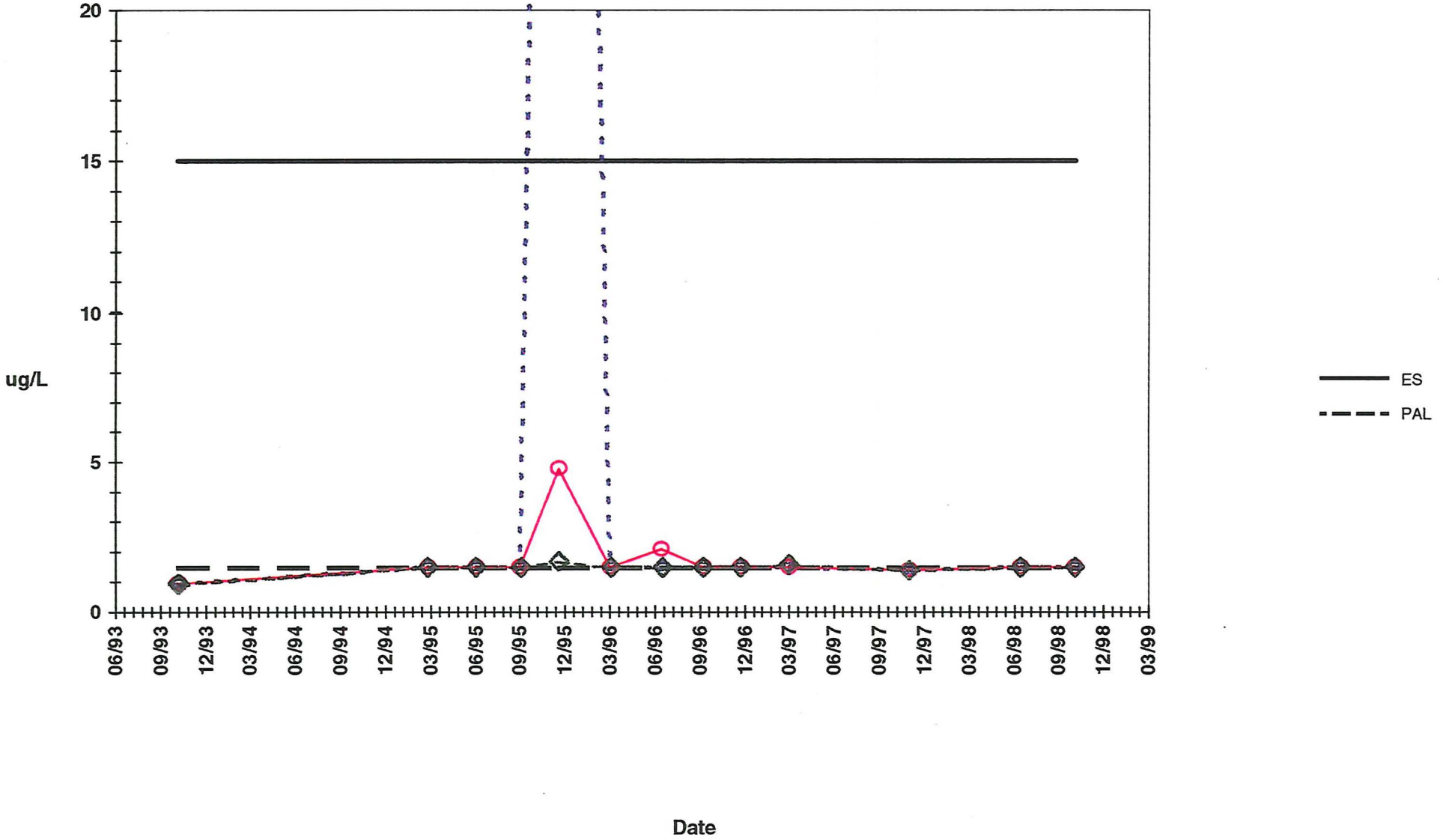
Lead



Onalaska Municipal Landfill

MW-12 and MW-14

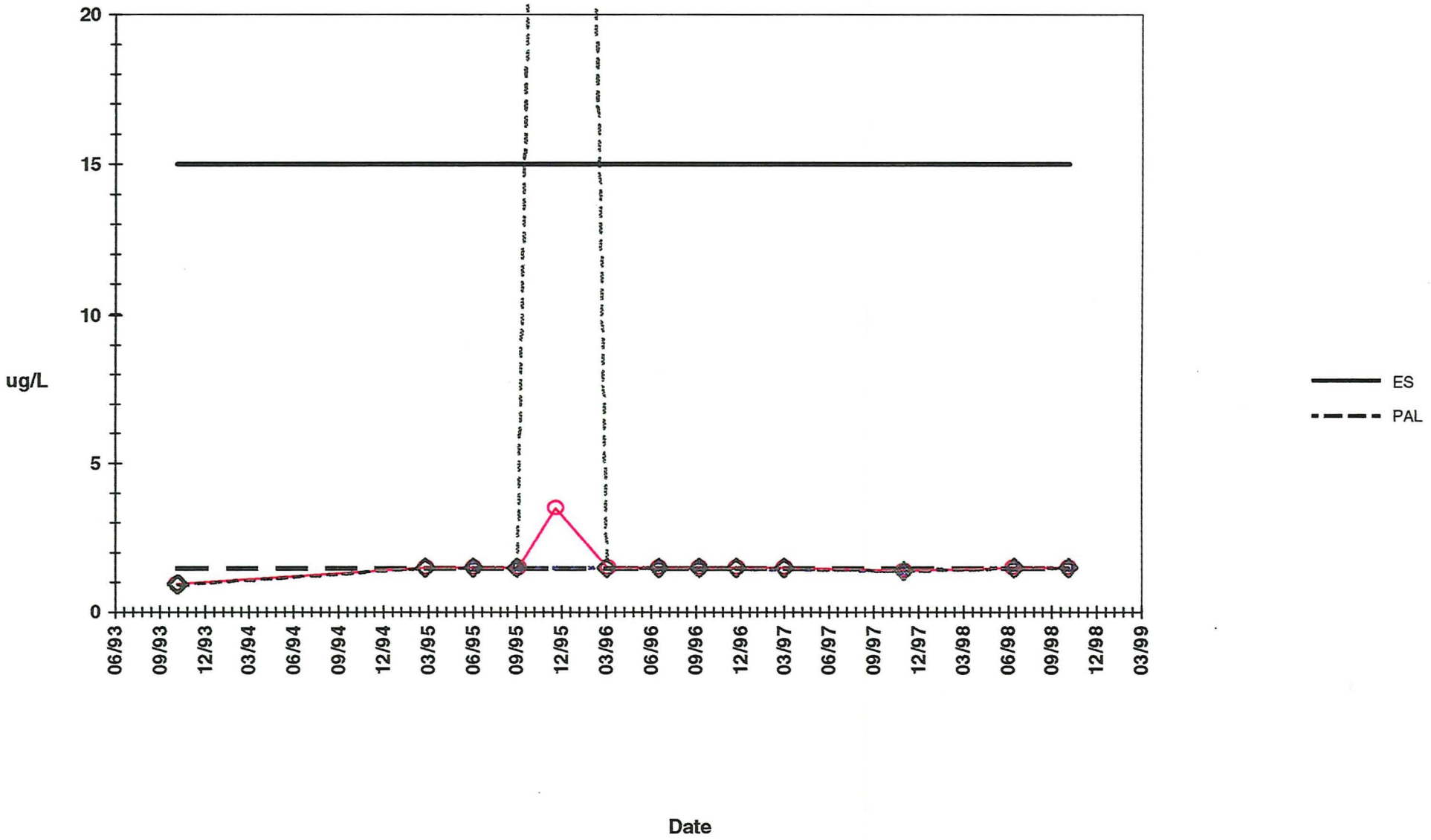
Lead



Onalaska Municipal Landfill

Residential Wells

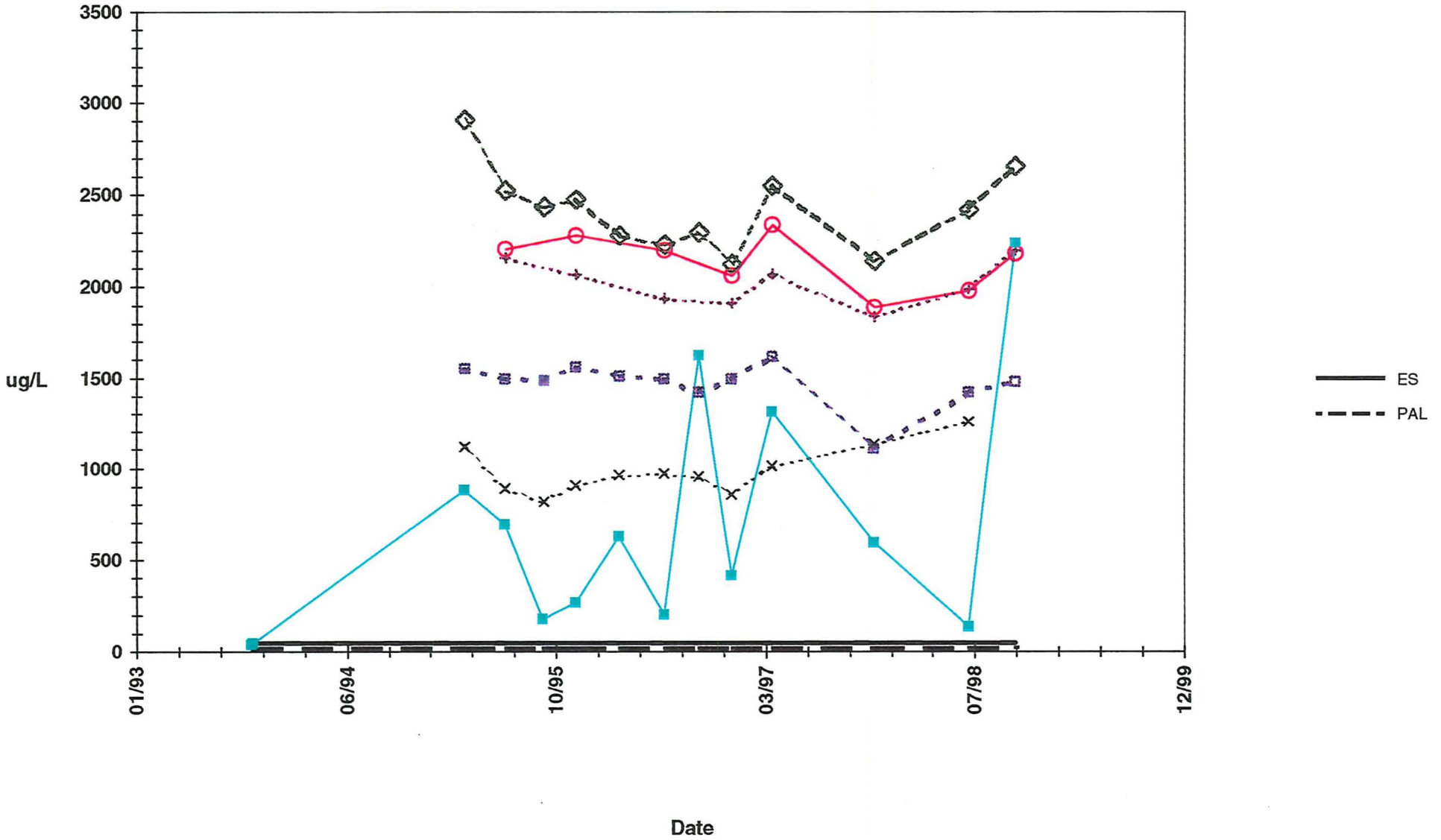
Lead



Onalaska Municipal Landfill

Extraction Wells

Manganese



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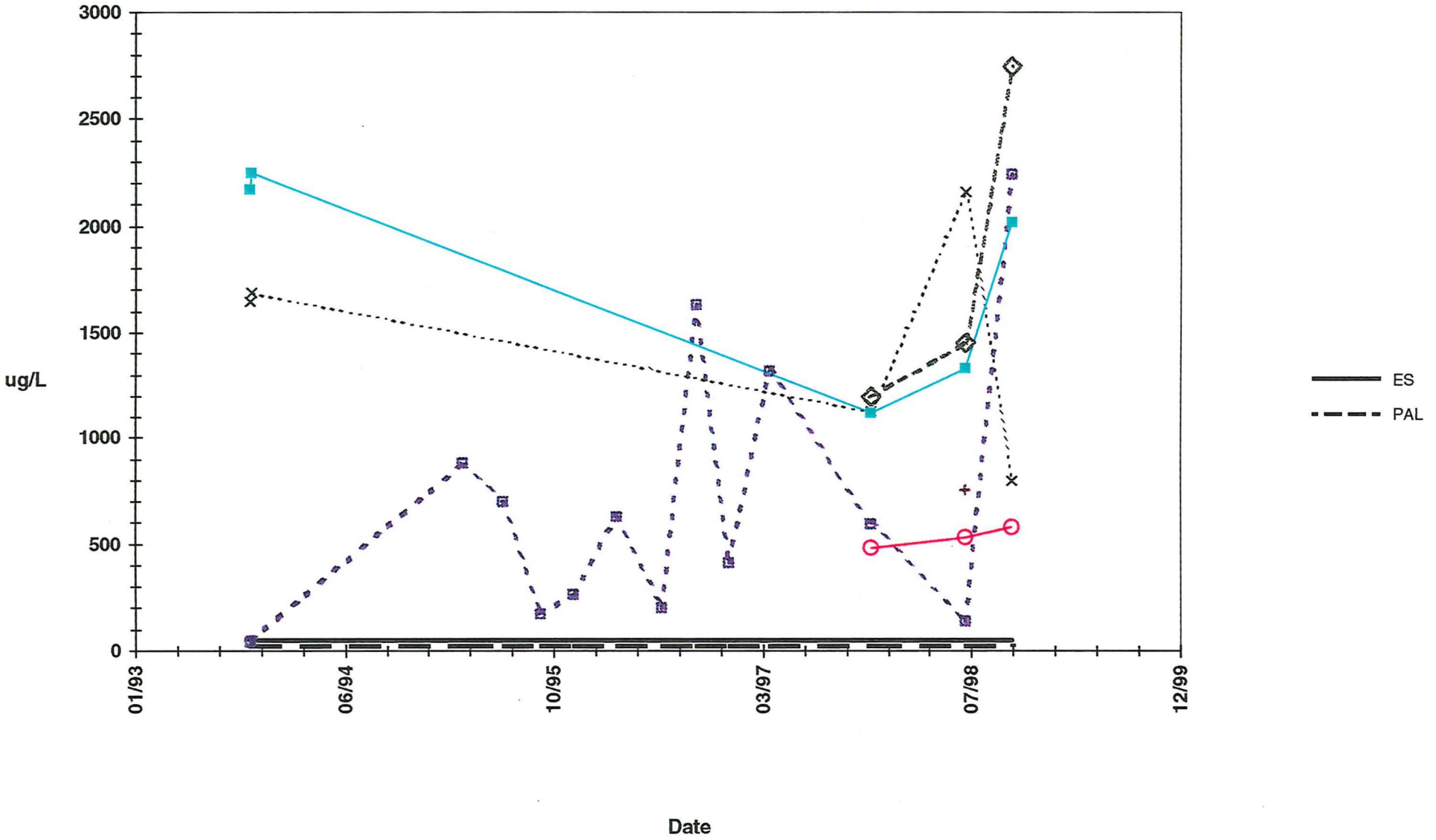
Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

Manganese

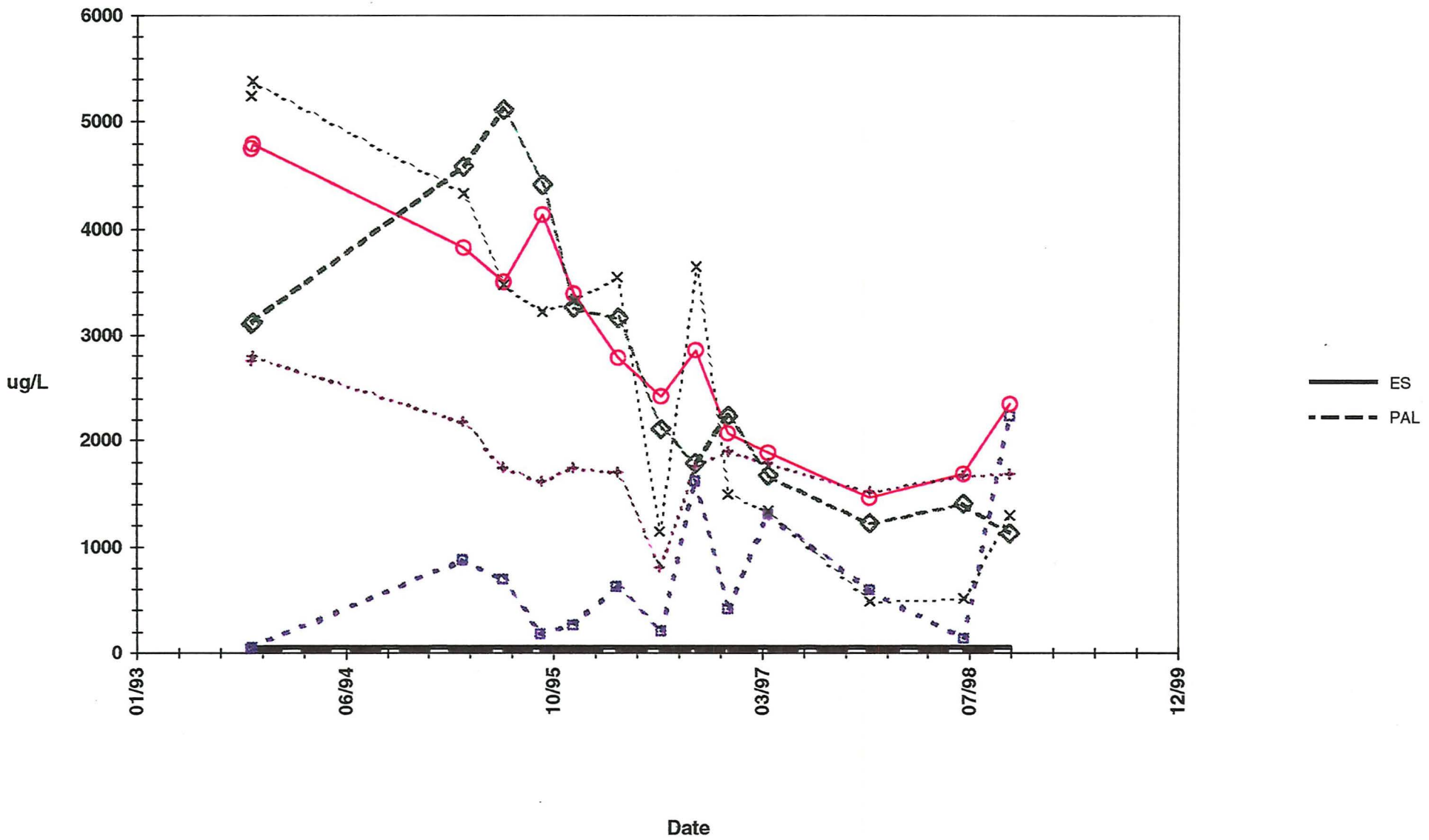


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

Manganese

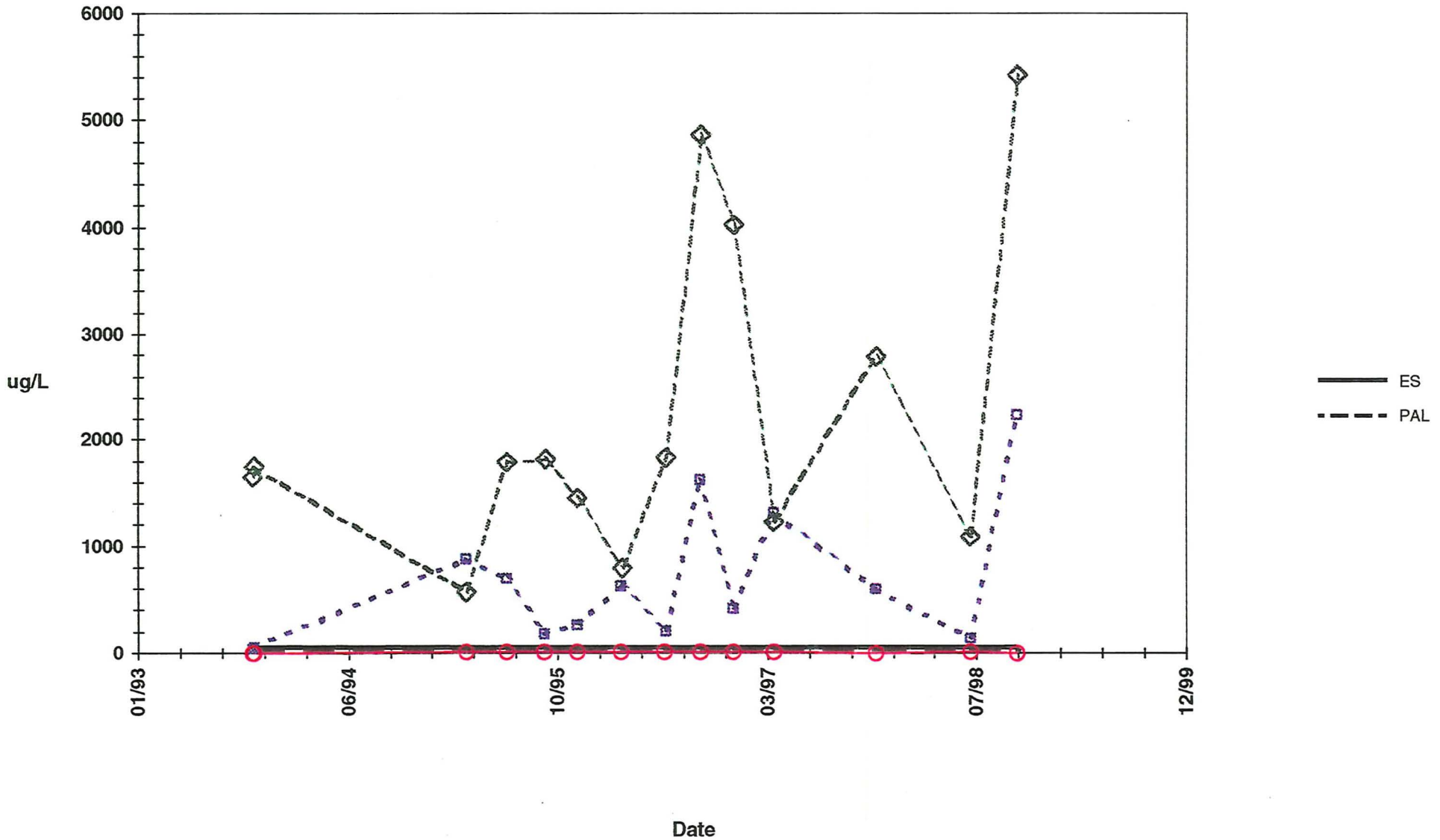


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

MW-12 and MW-14

Manganese

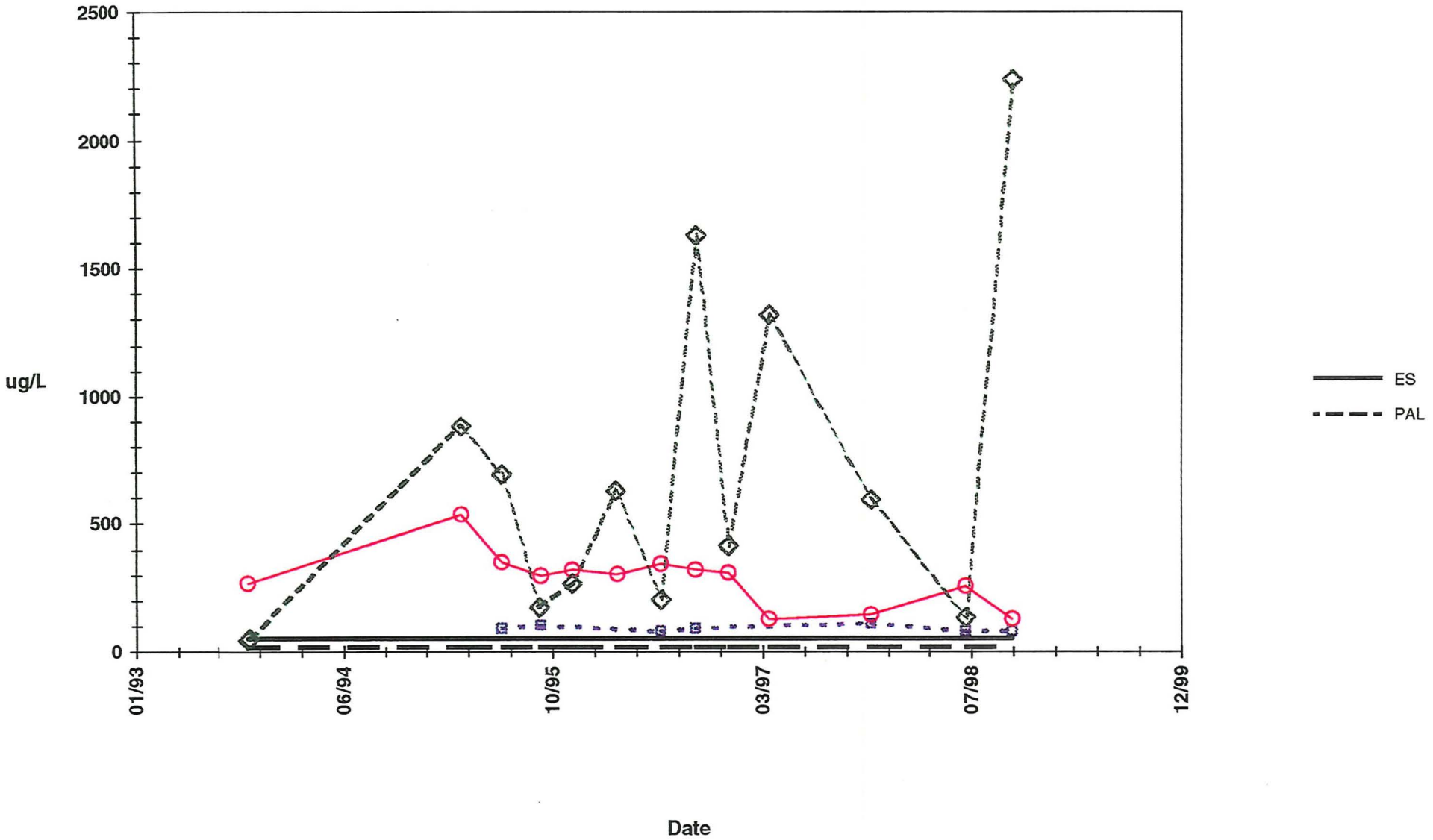


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Residential Wells

Manganese

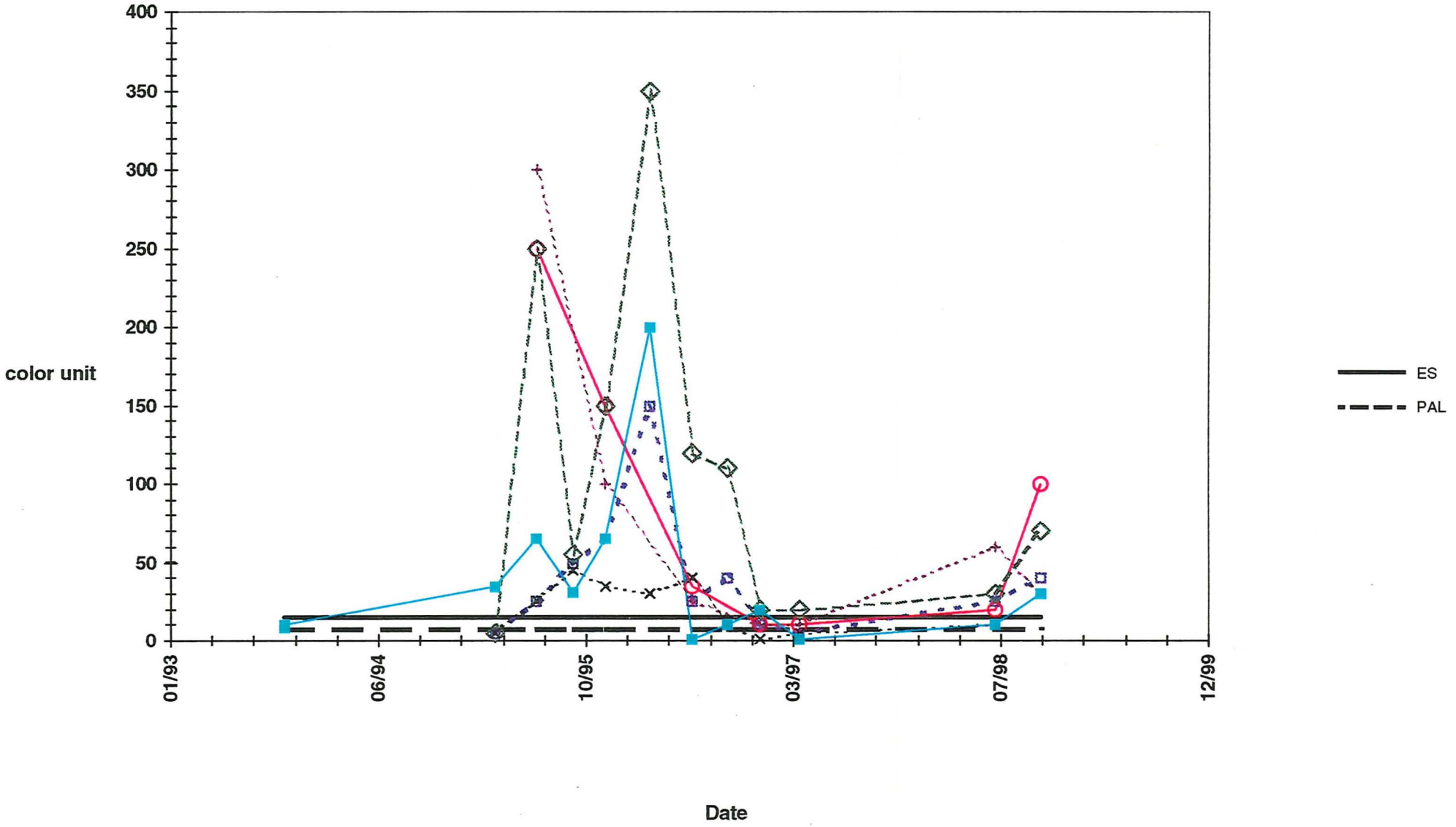


Prepared by CH2M HILL 25-May-99

Onalaska Municipal Landfill

Extraction Wells

Color

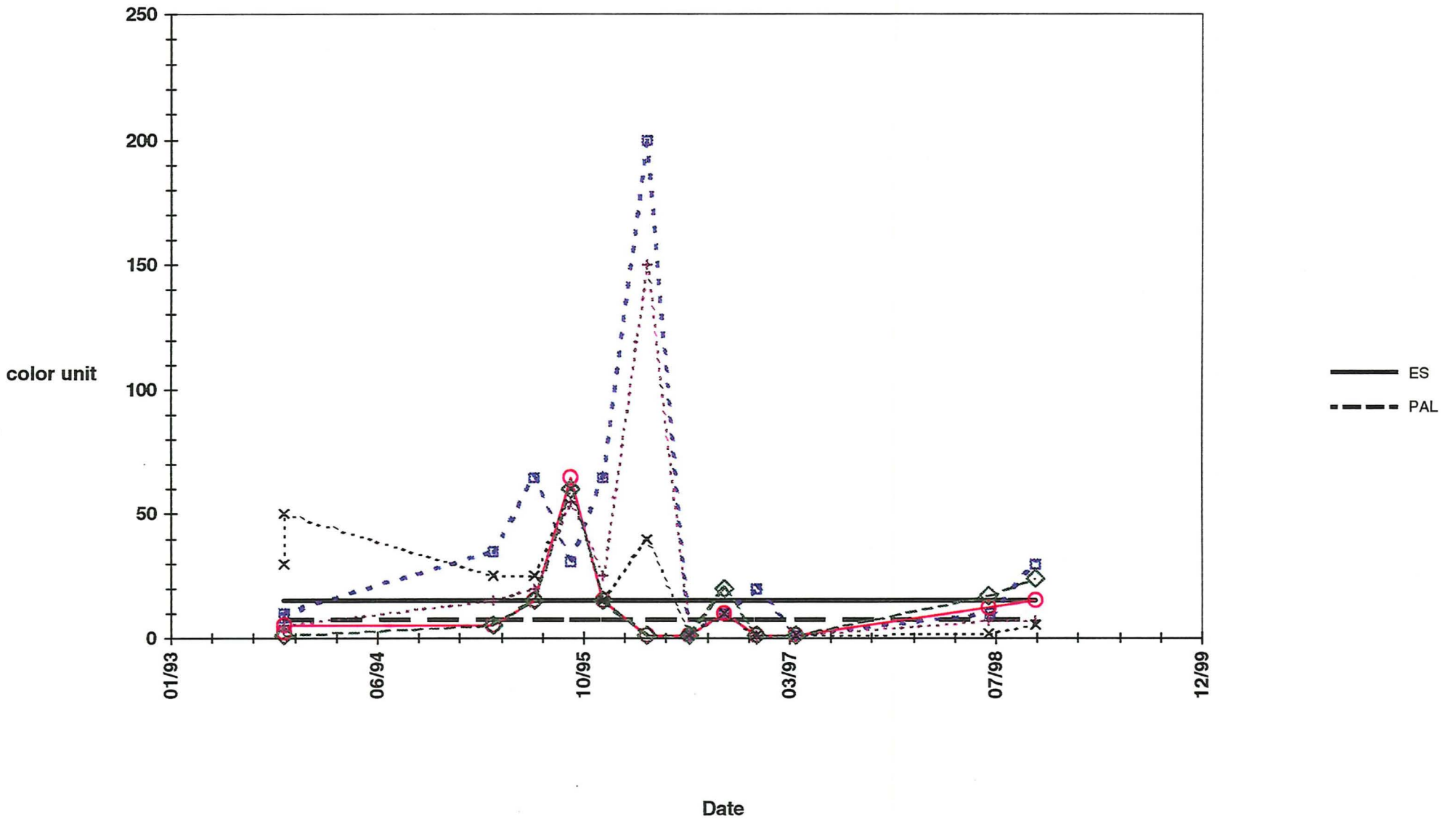


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-06 and MW-08

Color

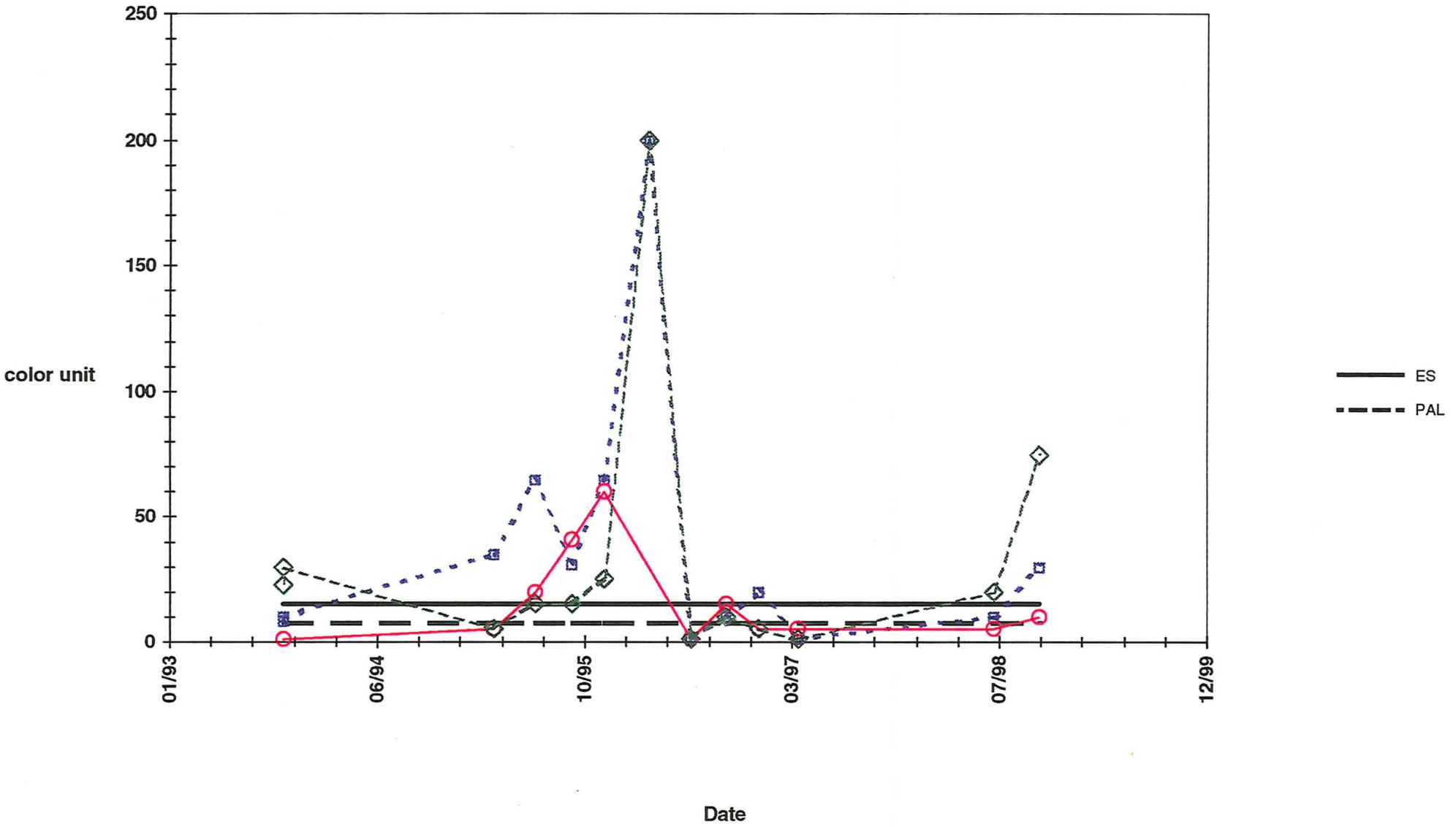


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

MW-12 and MW-14

Color

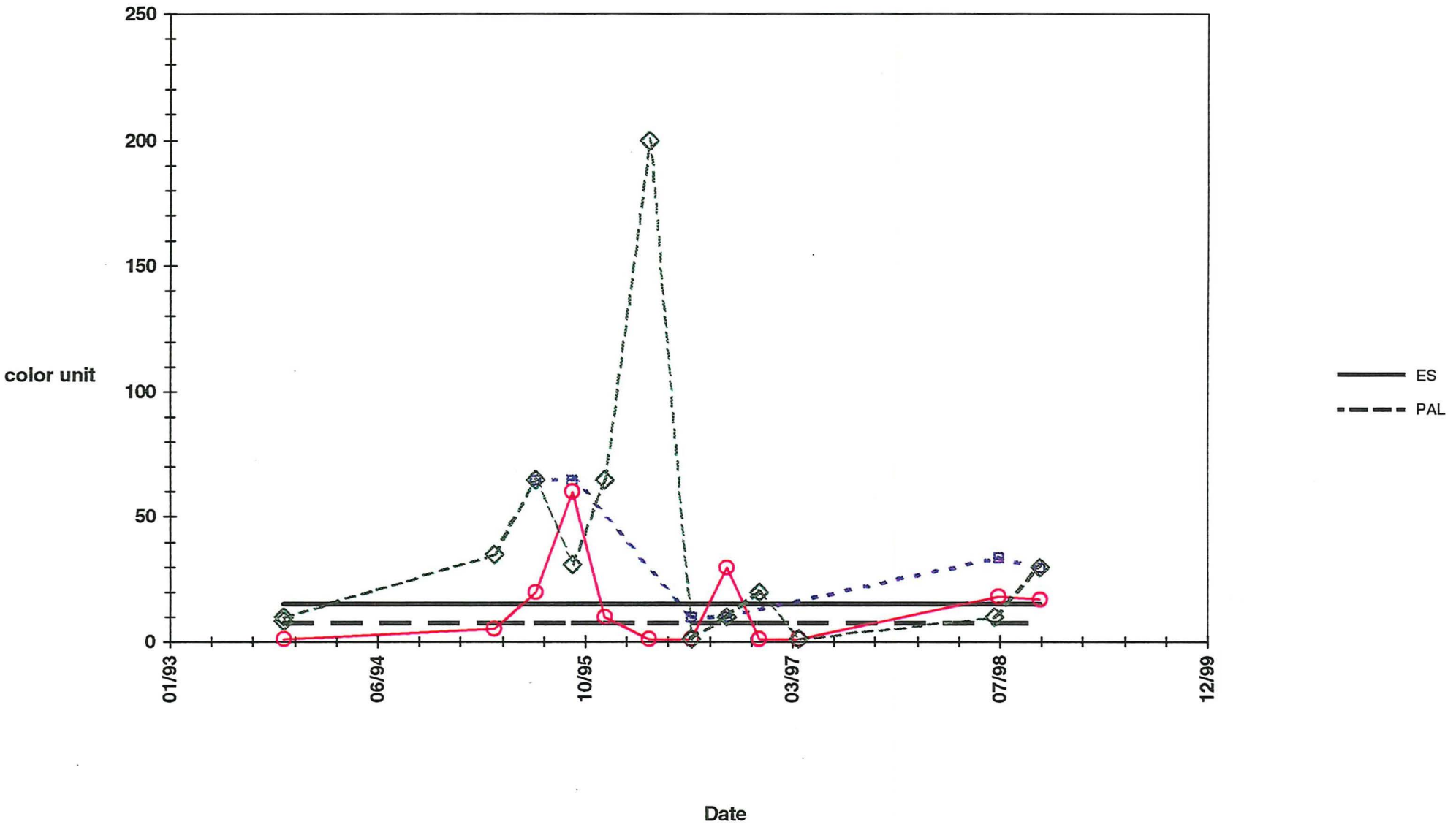


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

Color

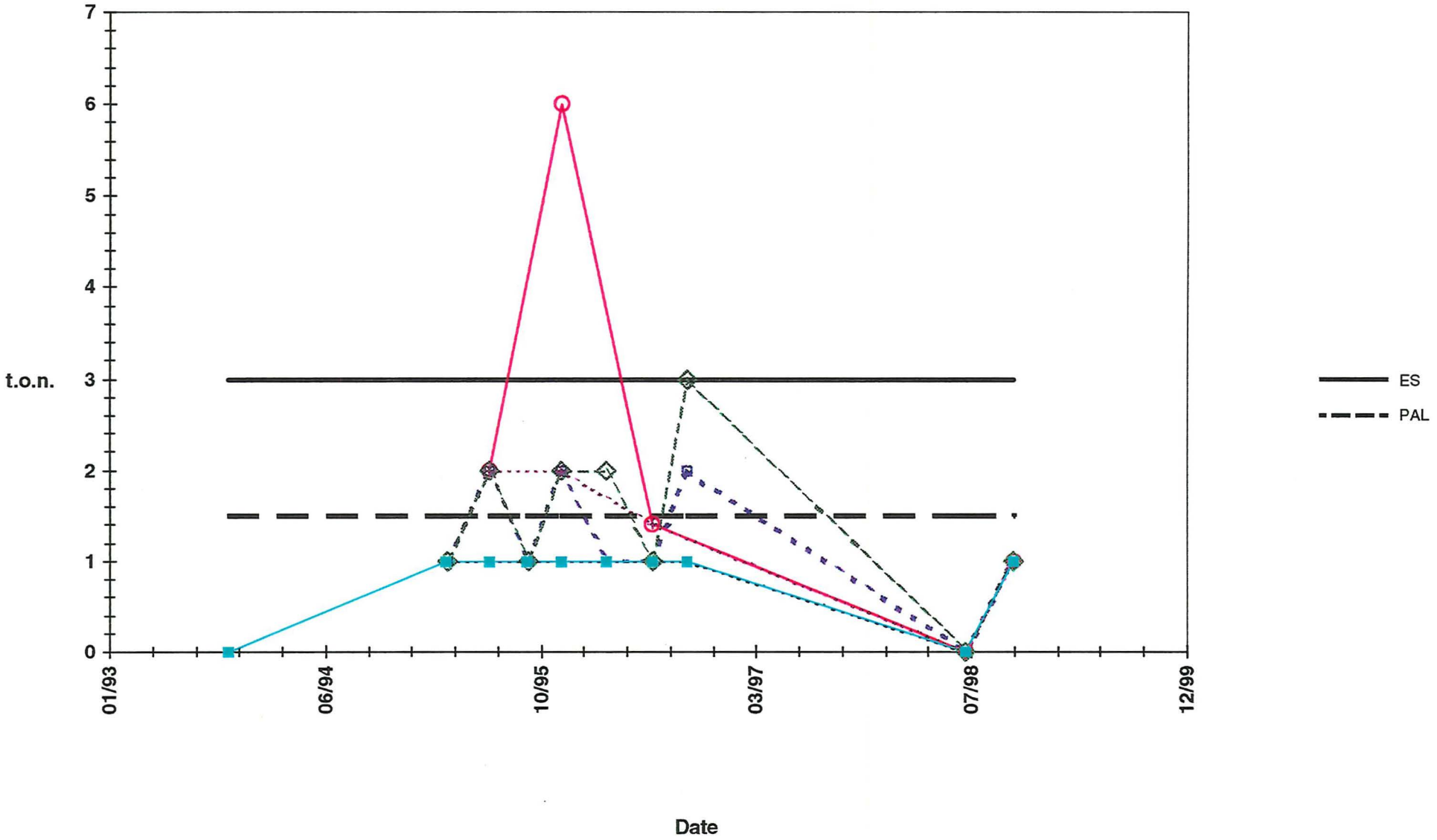


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Extraction Wells

Odor

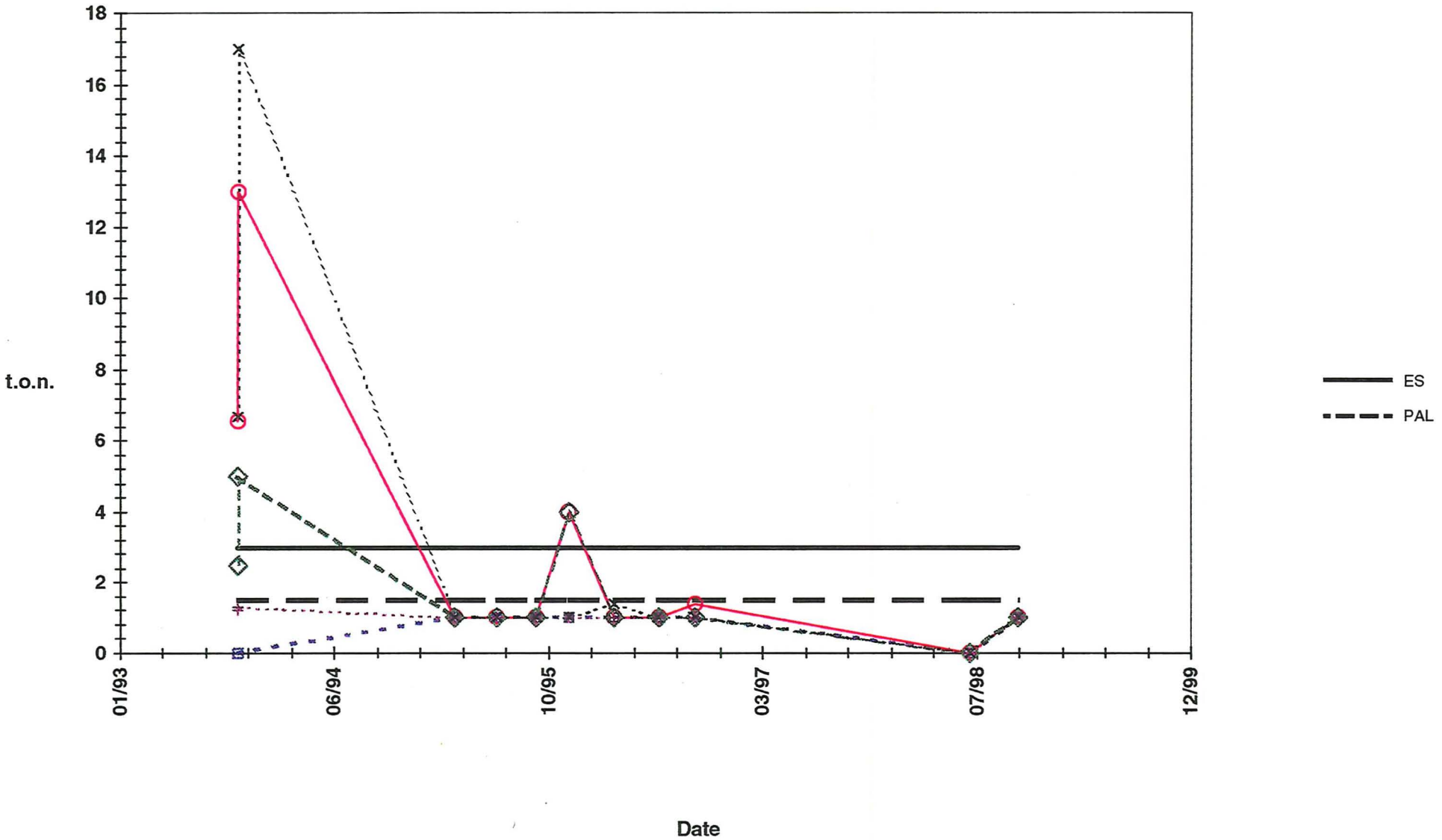


Prepared by CH2M HILL 12-May-99

Onalaska Municipal Landfill

MW-06 and MW-08

Odor

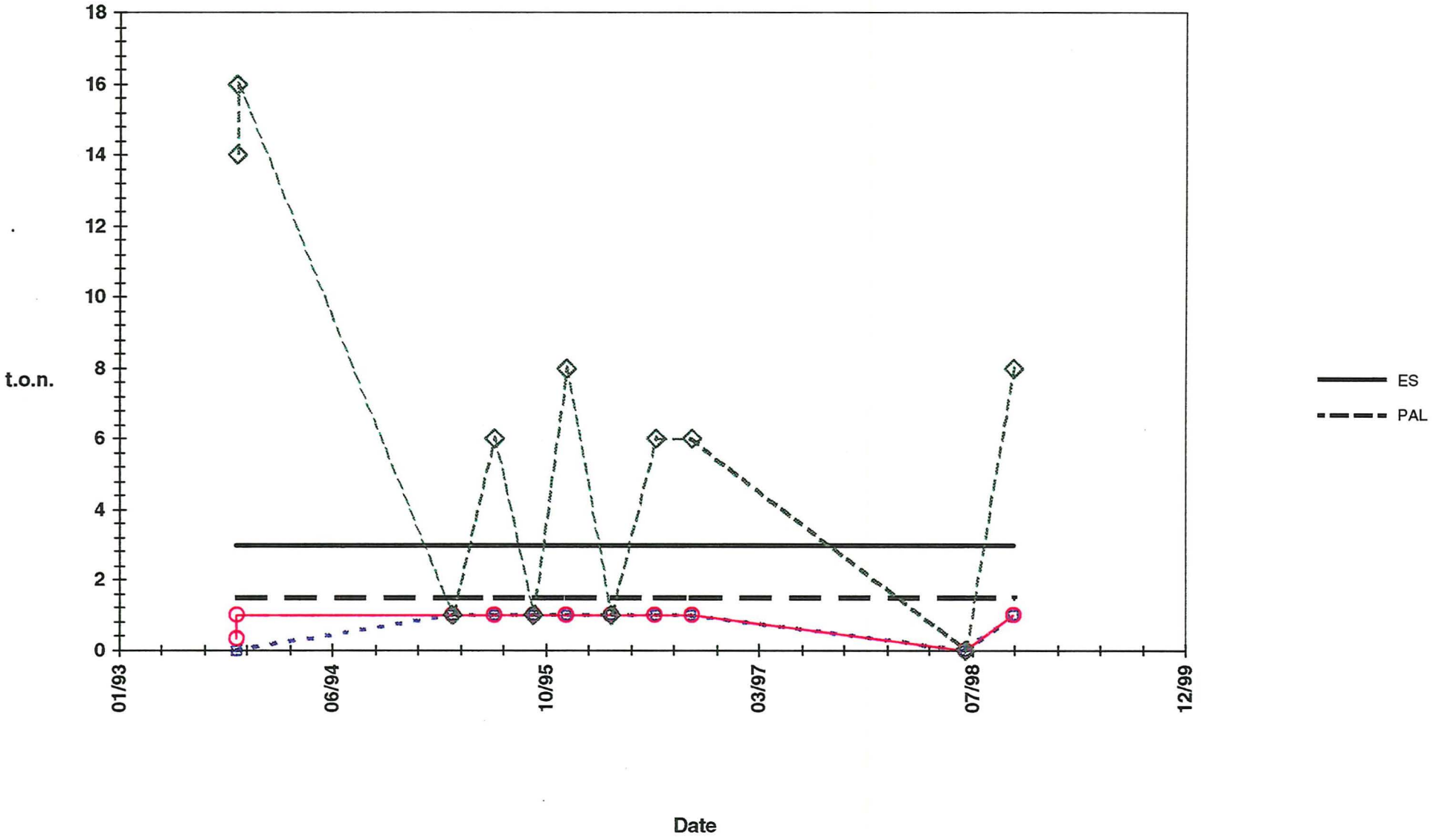


Prepared by CH2M HILL 12-May-99

Onalaska Municipal Landfill

MW-12 and MW-14

Odor

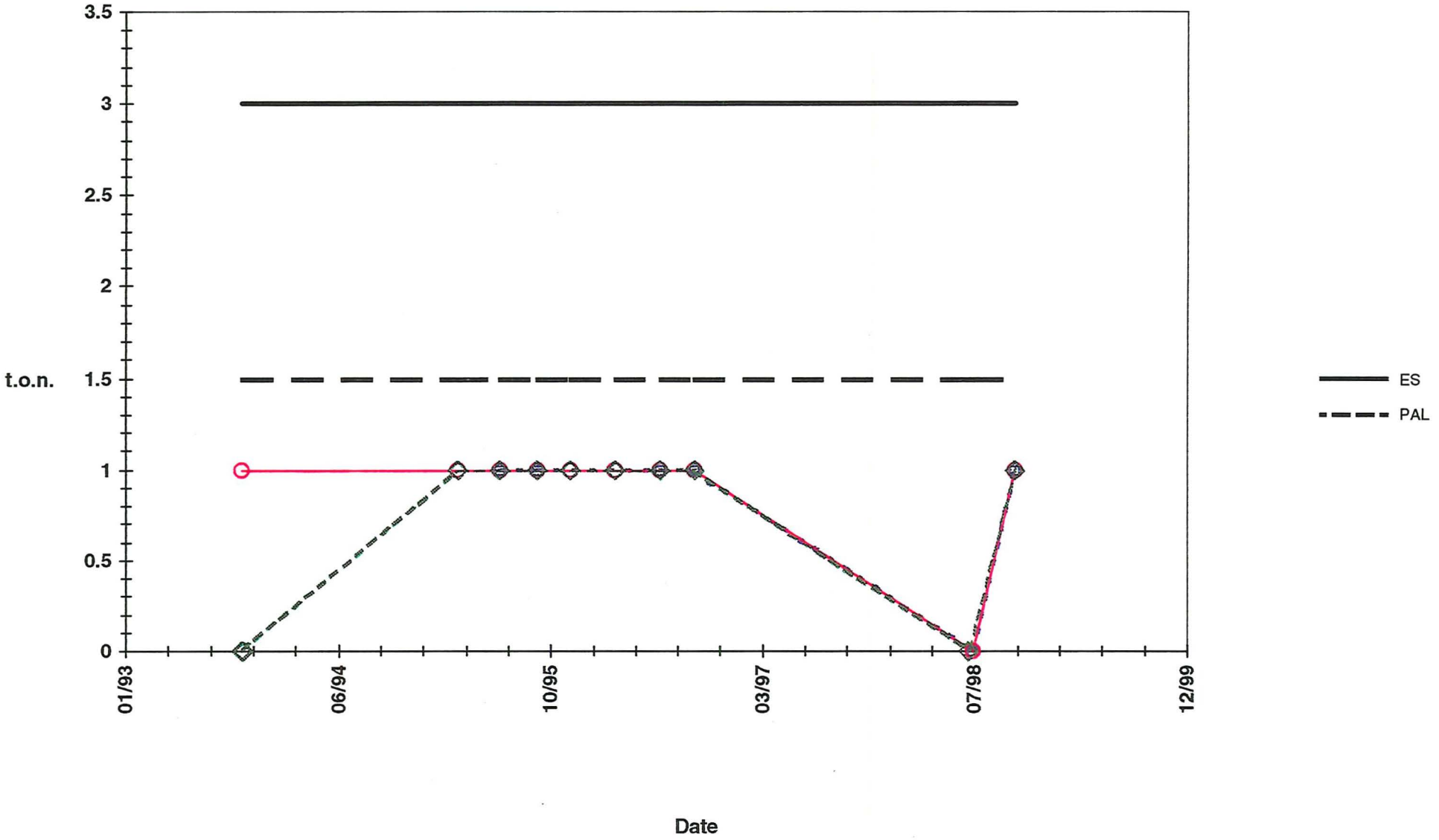


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

Odor

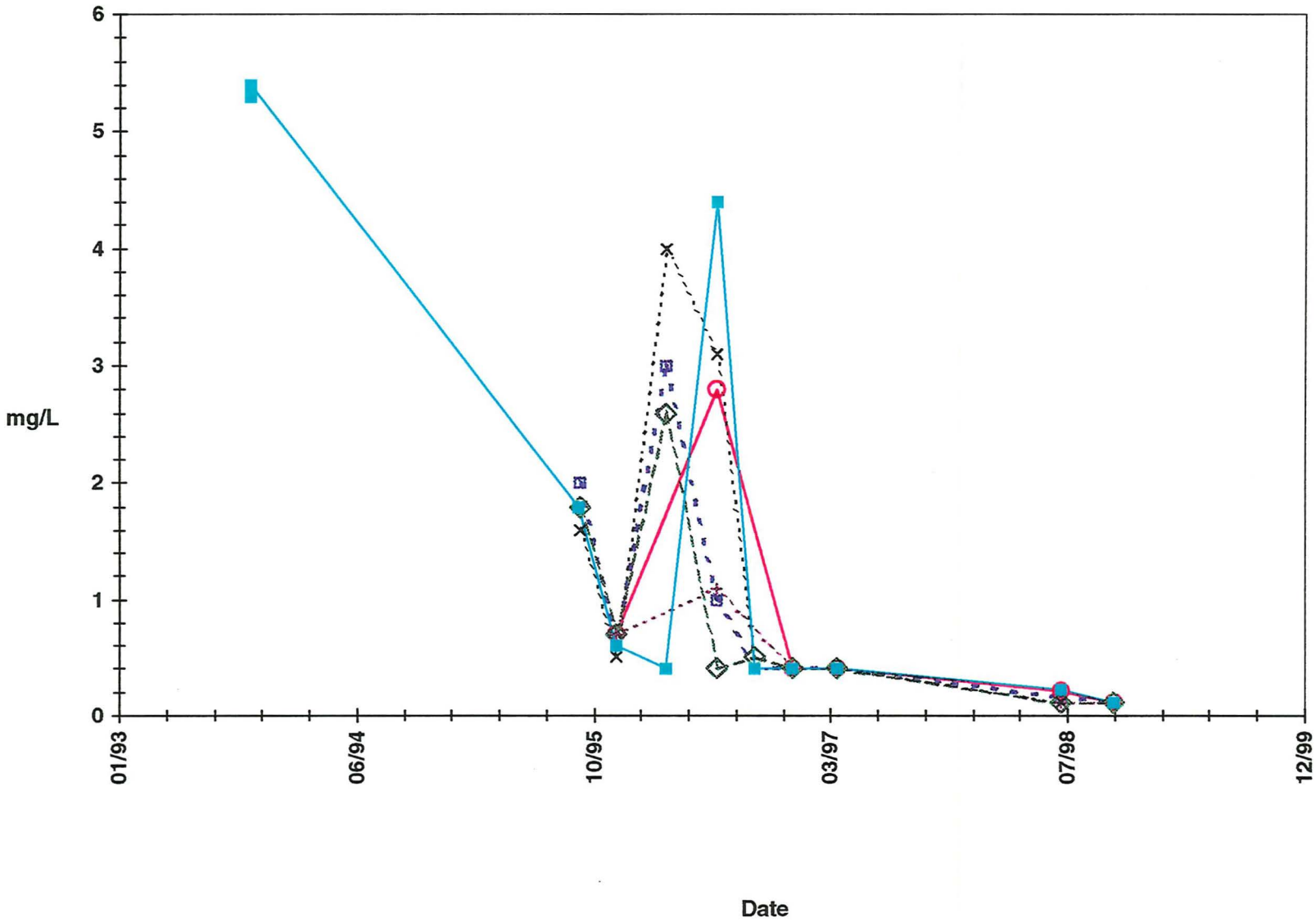


Prepared by CH2M HILL 12-May-99

Onalaska Municipal Landfill

Extraction Wells

Oil & Grease, Total Rec

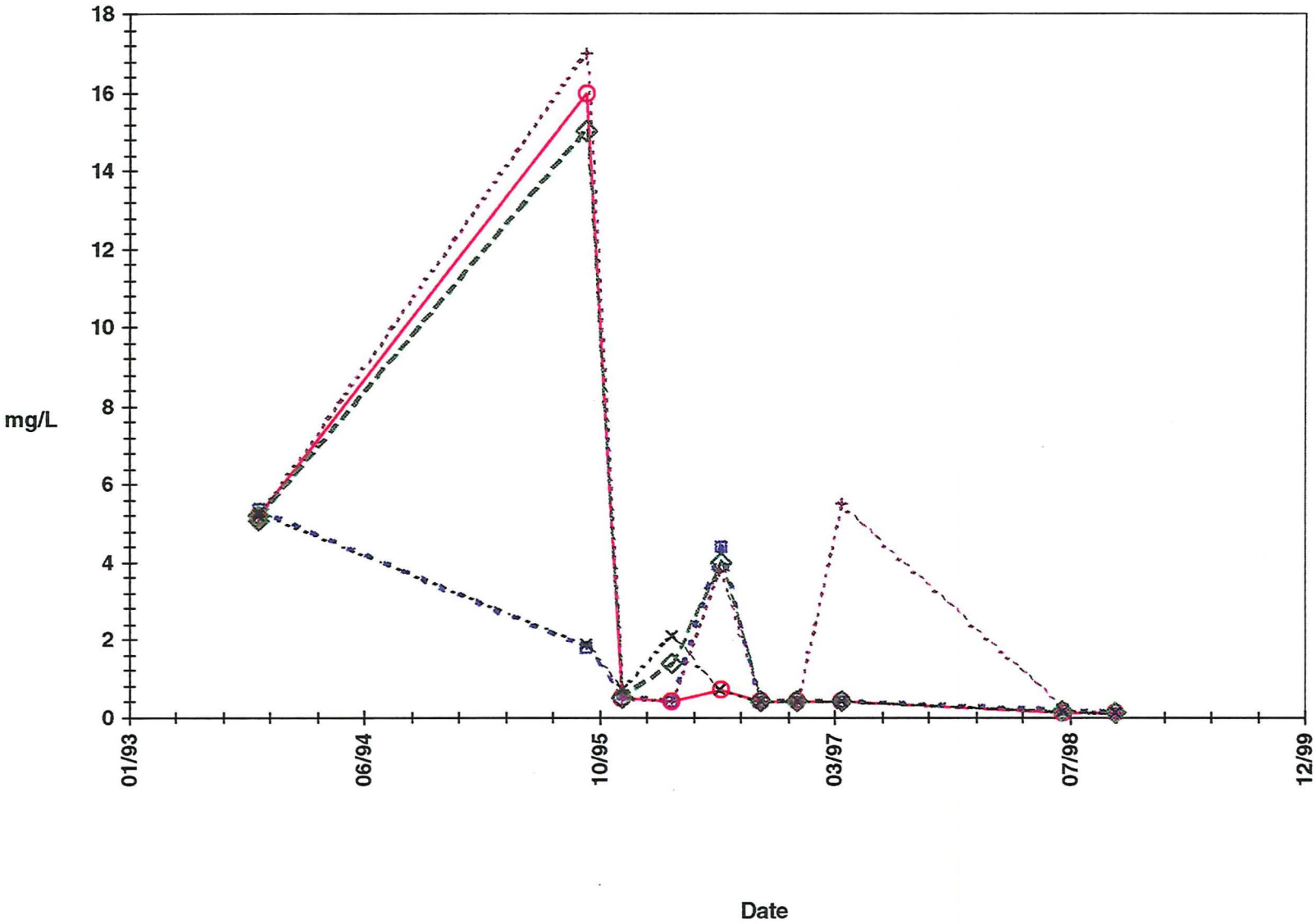


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-06 and MW-08

Oil & Grease, Total Rec

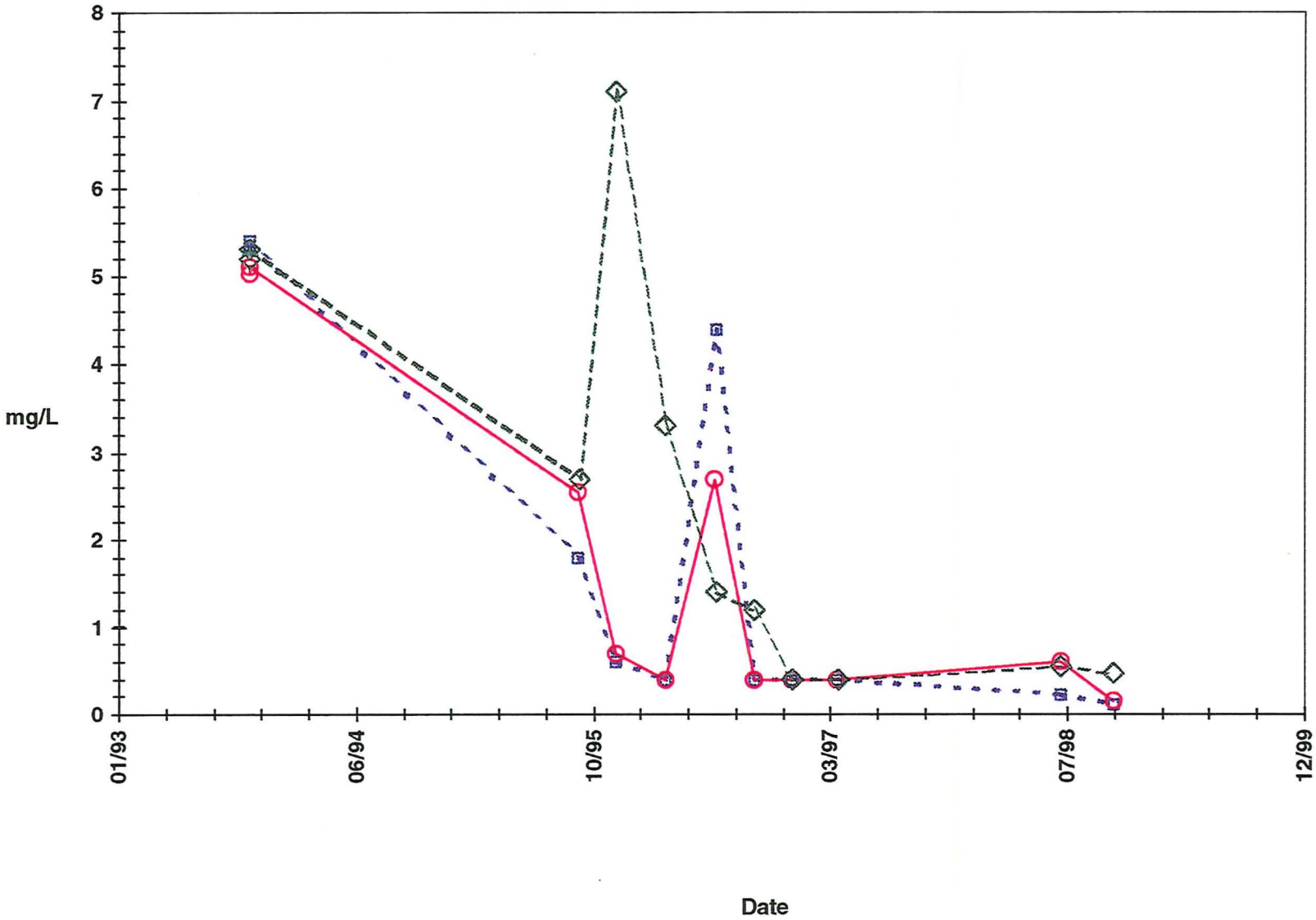


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

MW-12 and MW-14

Oil & Grease, Total Rec

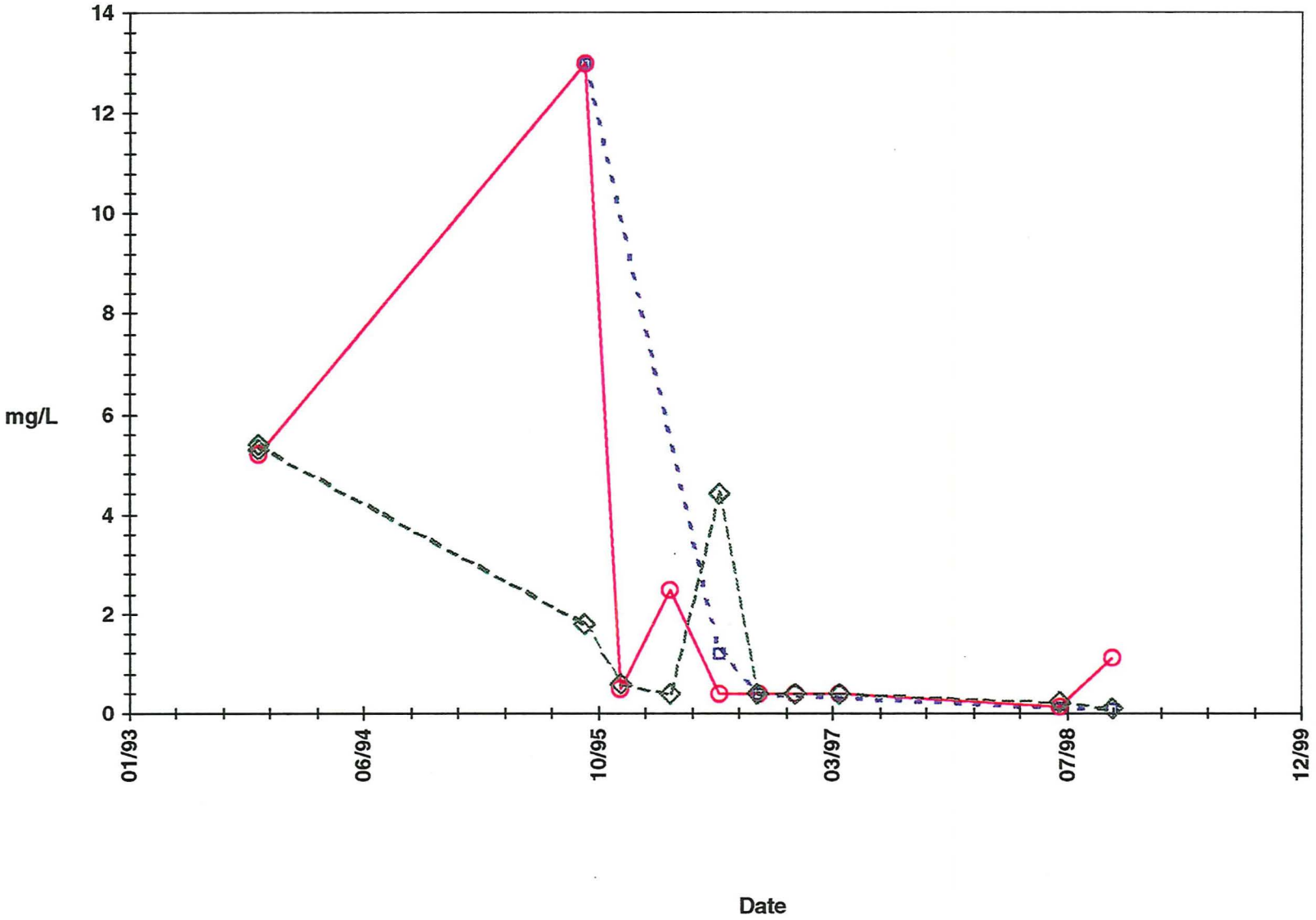


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

Oil & Grease, Total Rec

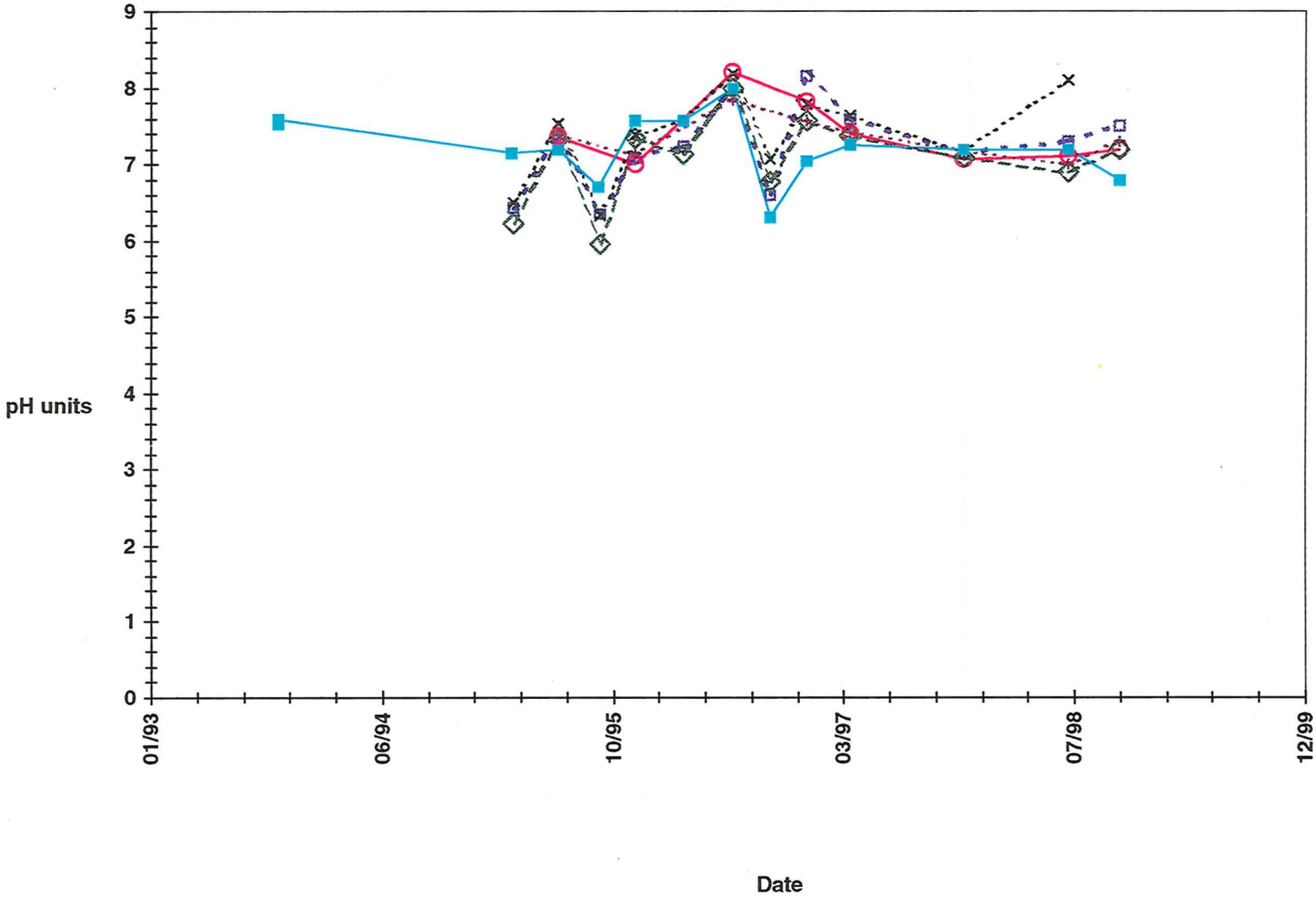


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Extraction Wells

pH

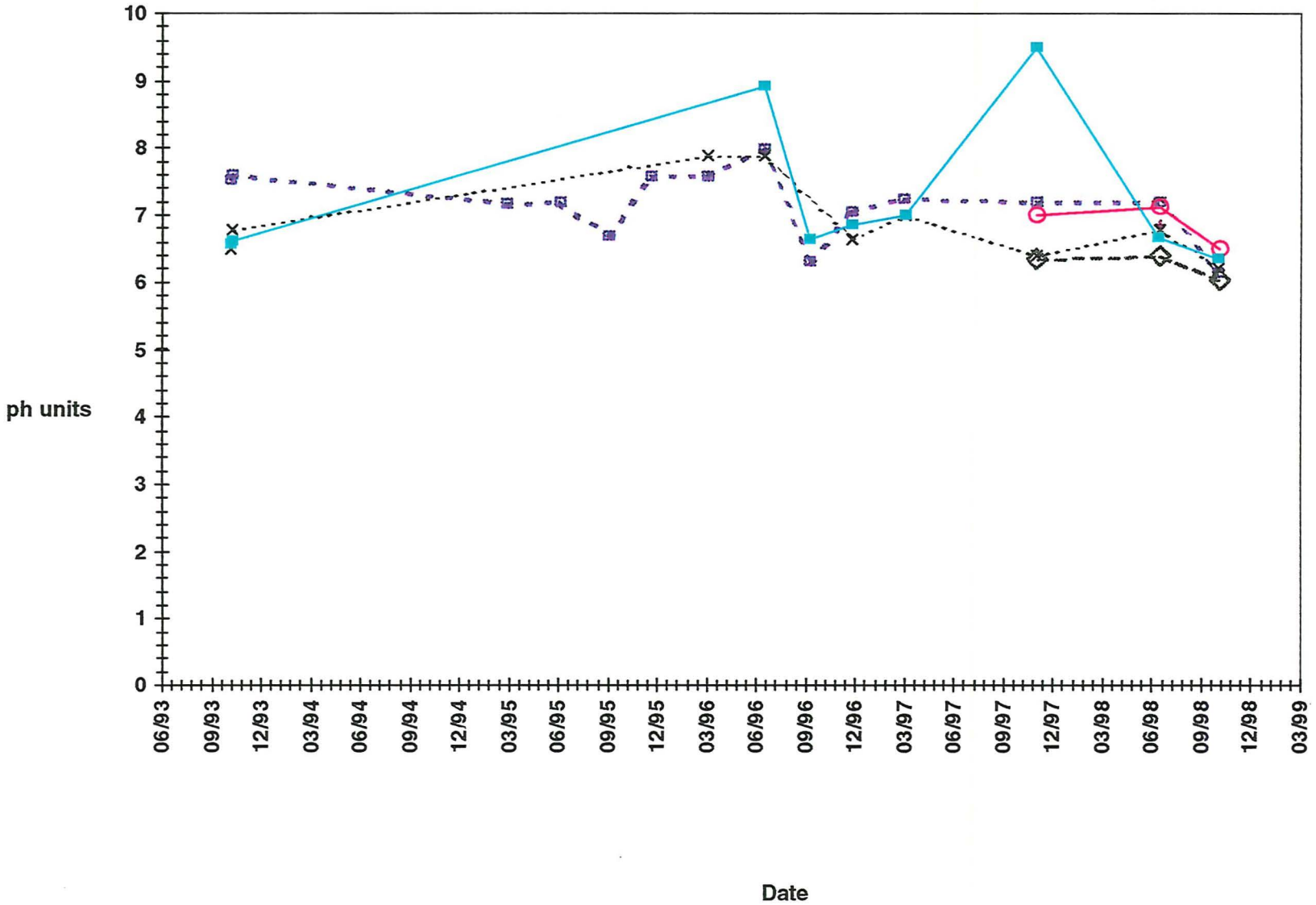


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-02, MW-04 and MW-05

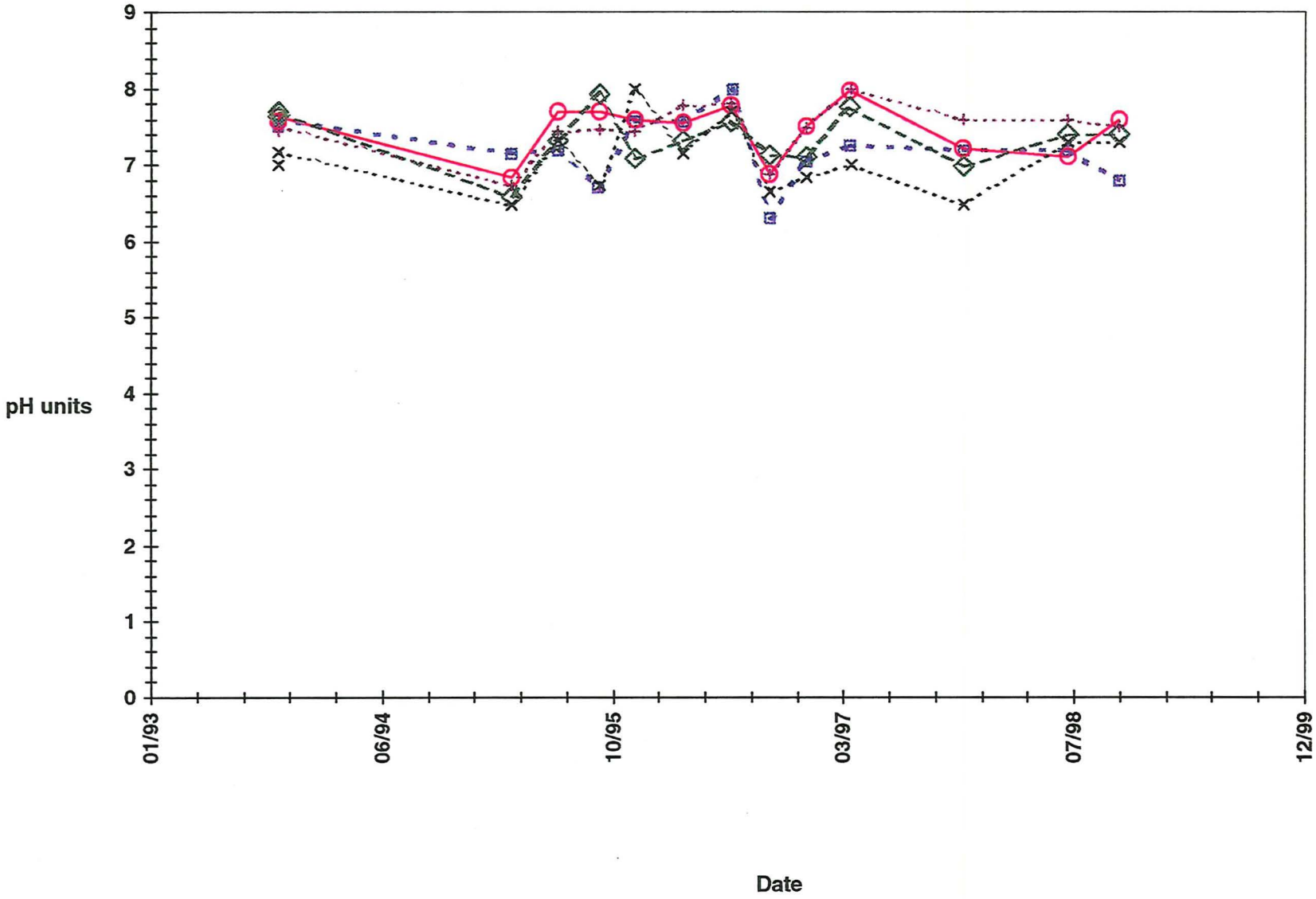
pH



Onalaska Municipal Landfill

MW-06 and MW-08

pH

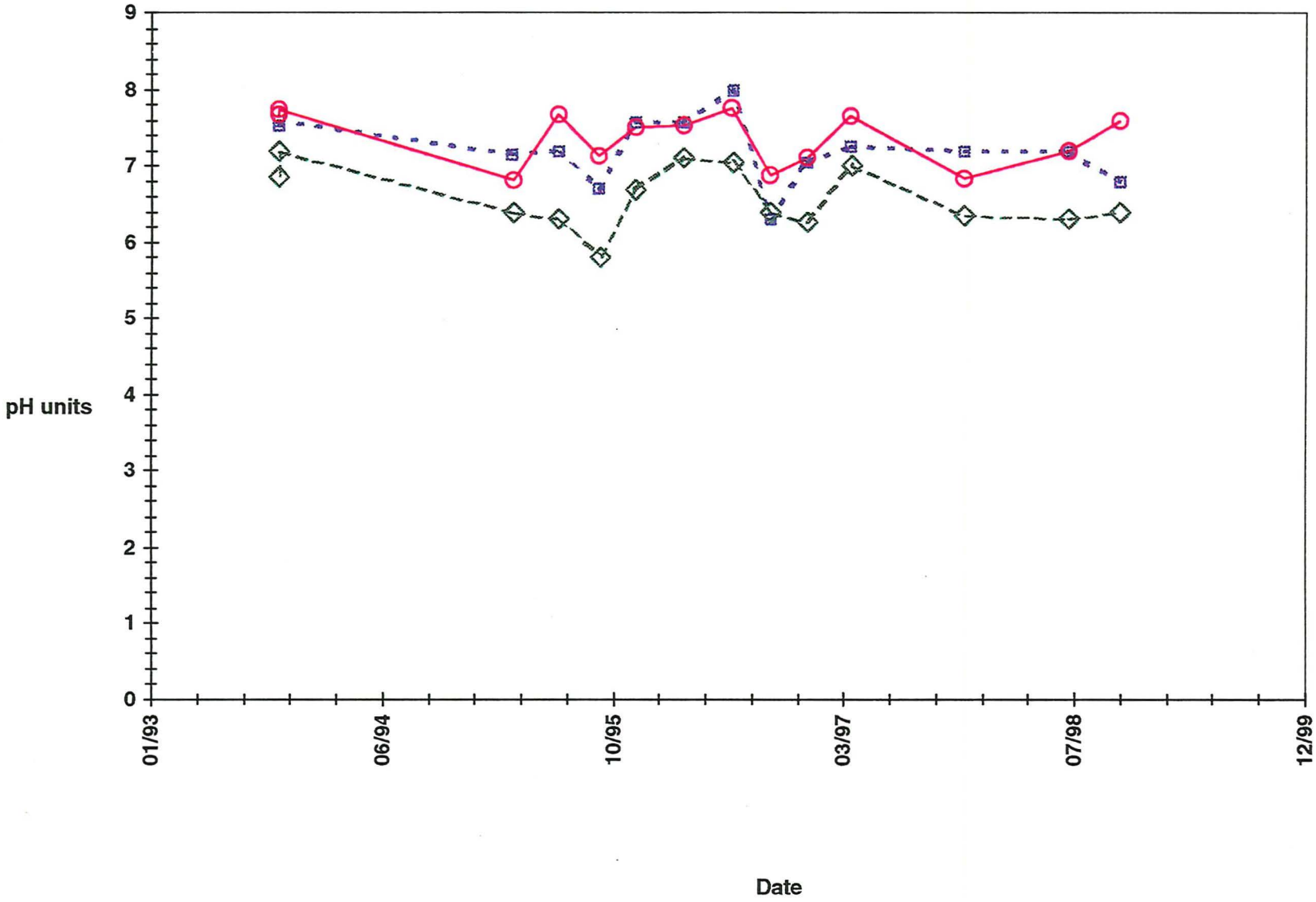


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-12 and MW-14

pH

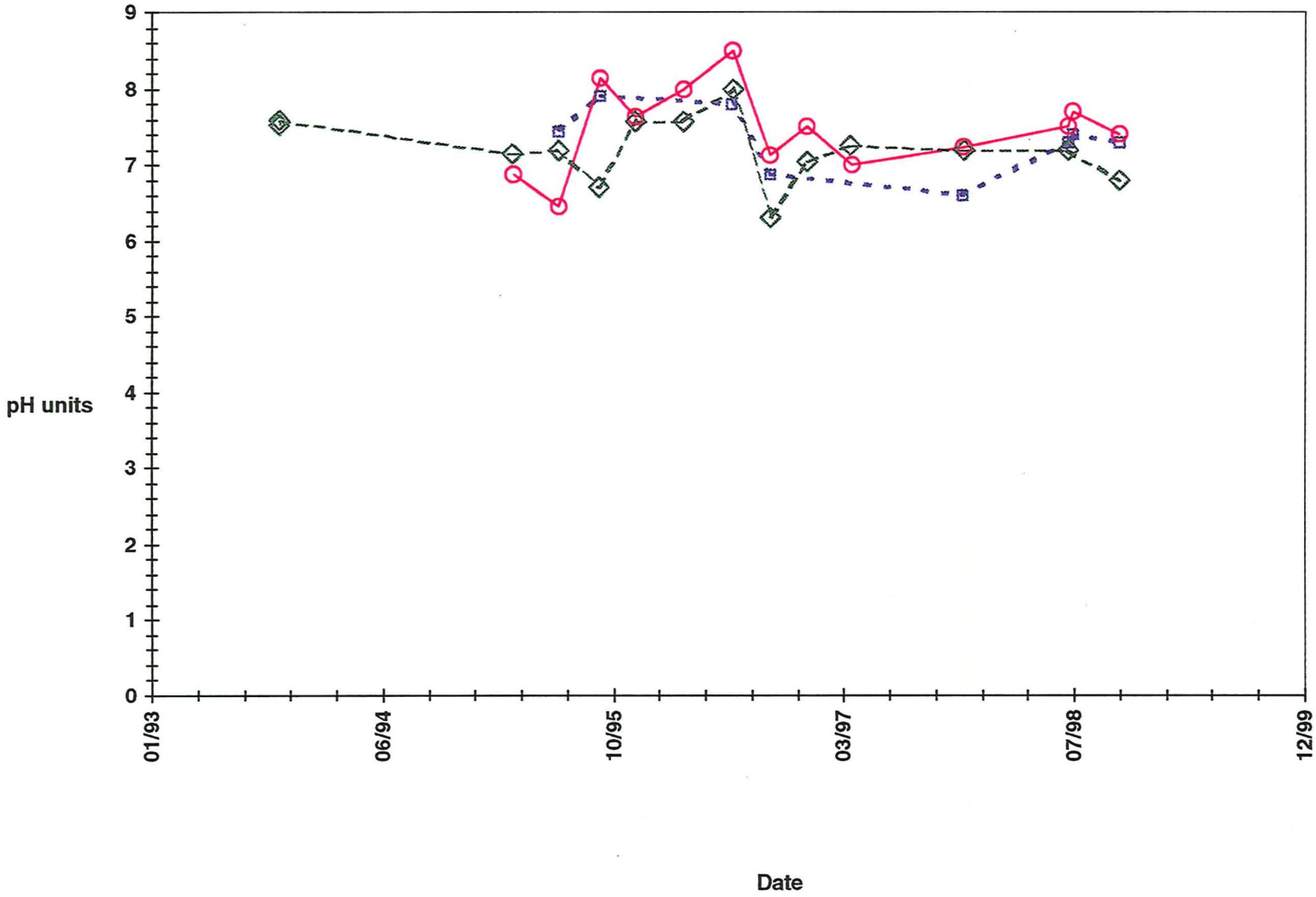


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

Residential Wells

pH

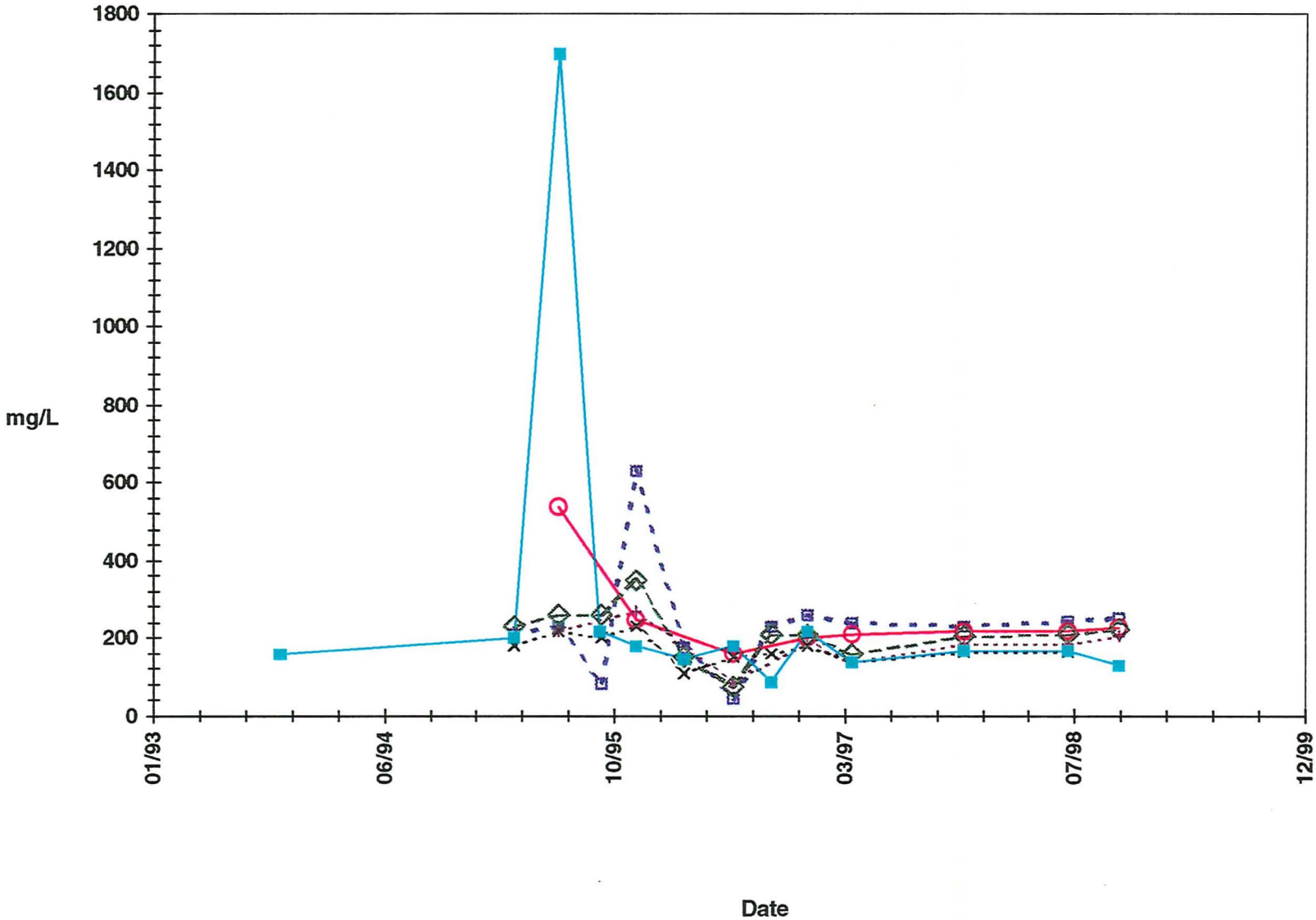


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Extraction Wells

Total Dissolved Solids (Residue, Filterable)

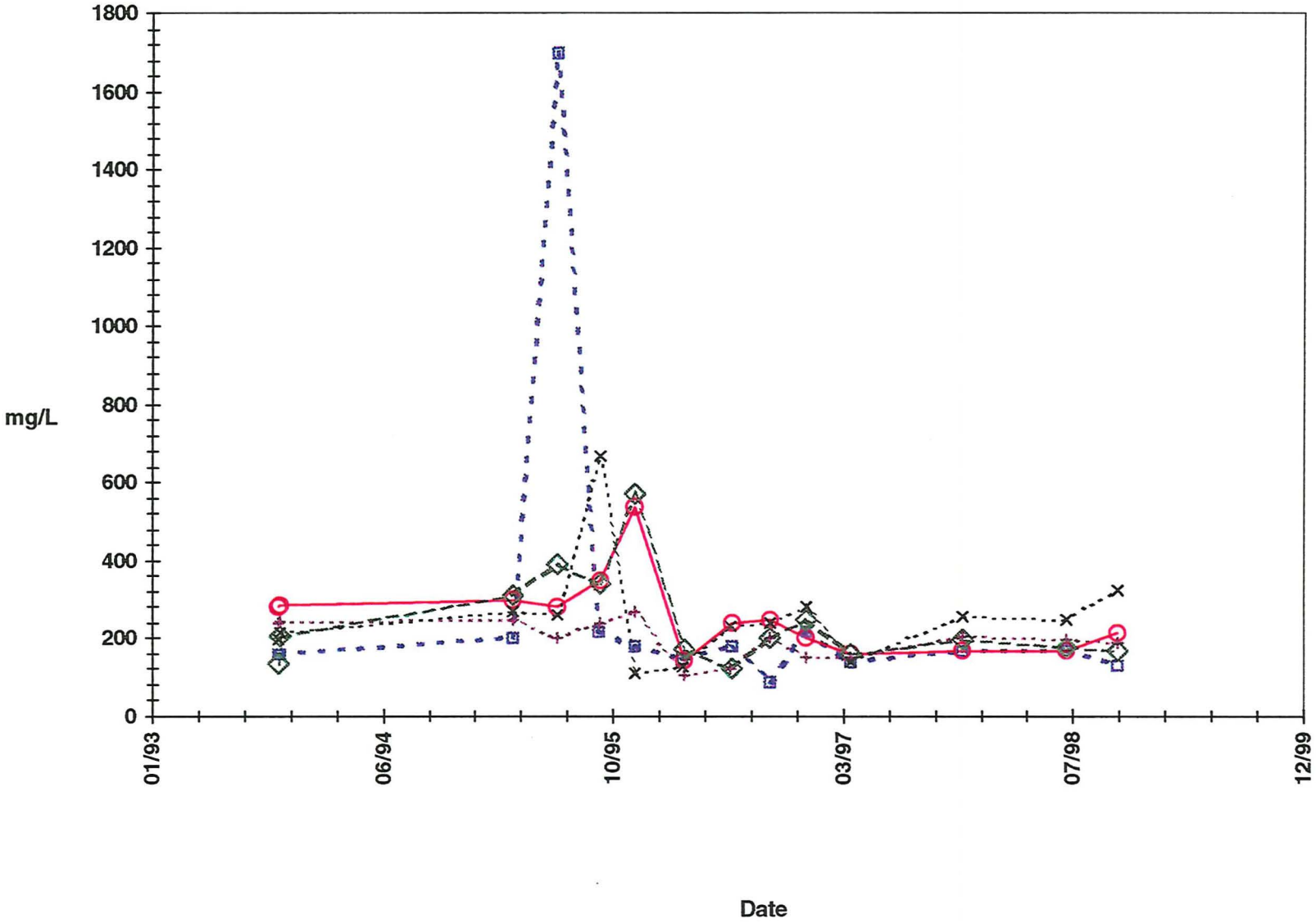


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-06 and MW-08

Total Dissolved Solids (Residue, Filterable)

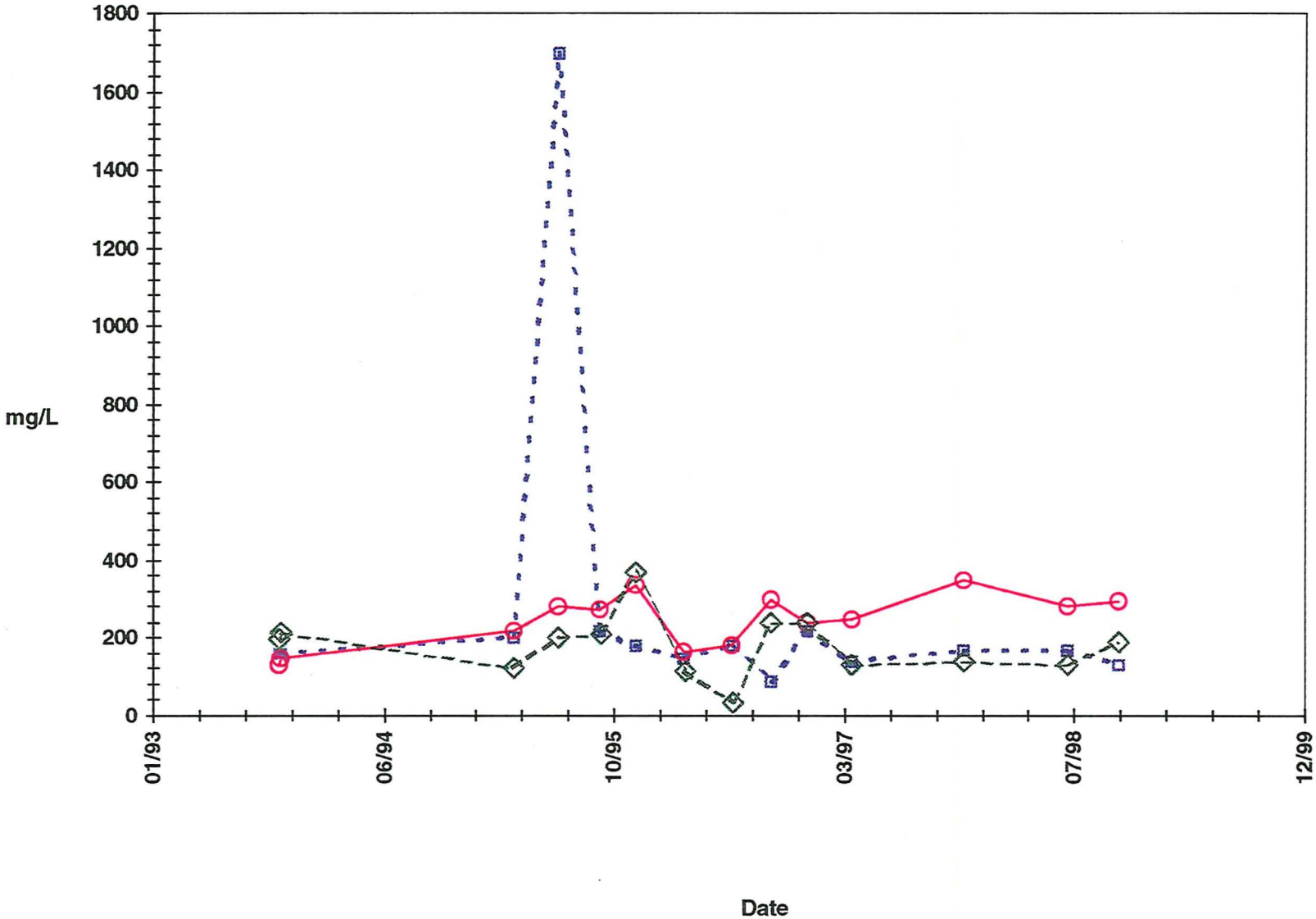


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

MW-12 and MW-14

Total Dissolved Solids (Residue, Filterable)

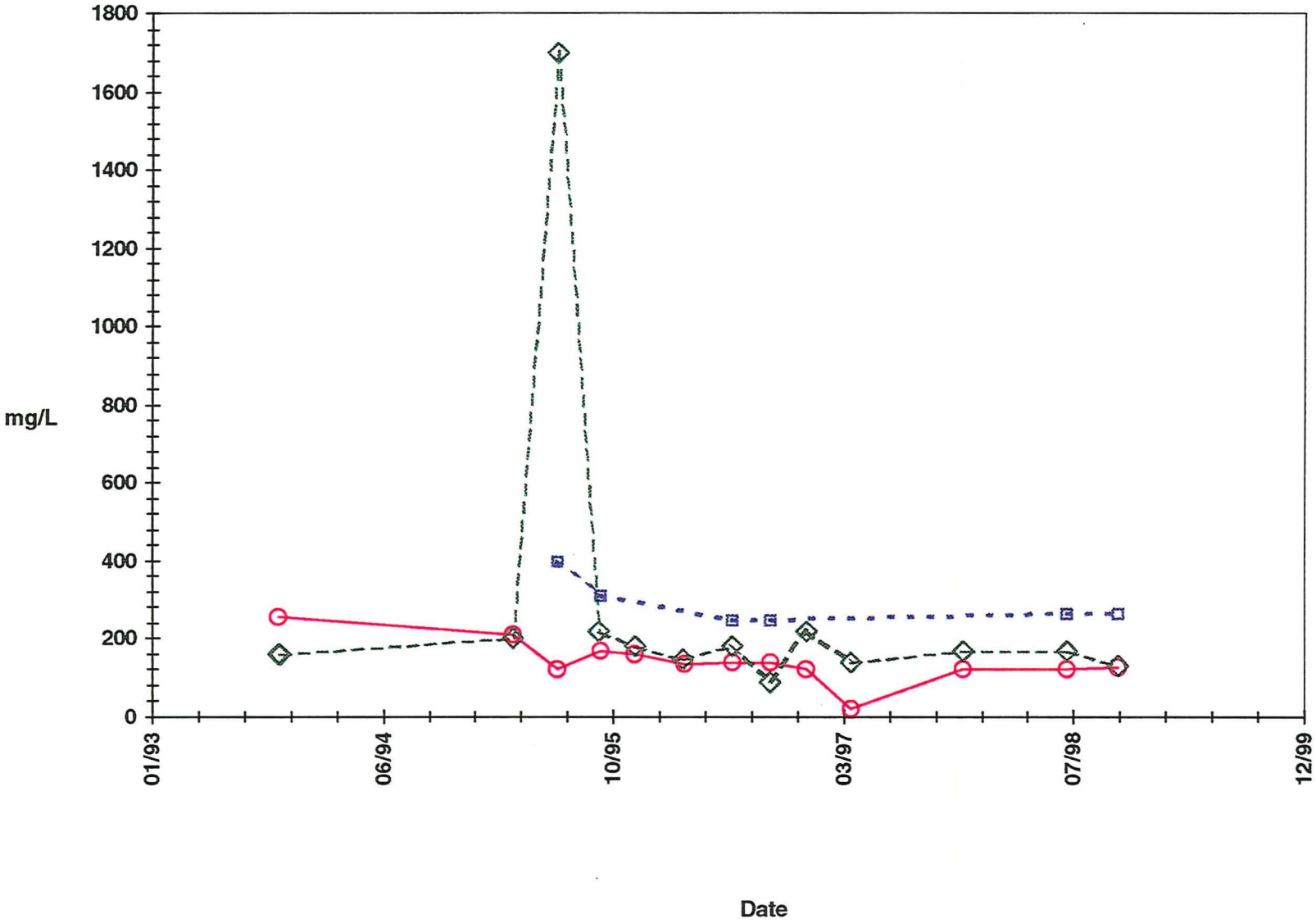


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

Total Dissolved Solids (Residue, Filterable)

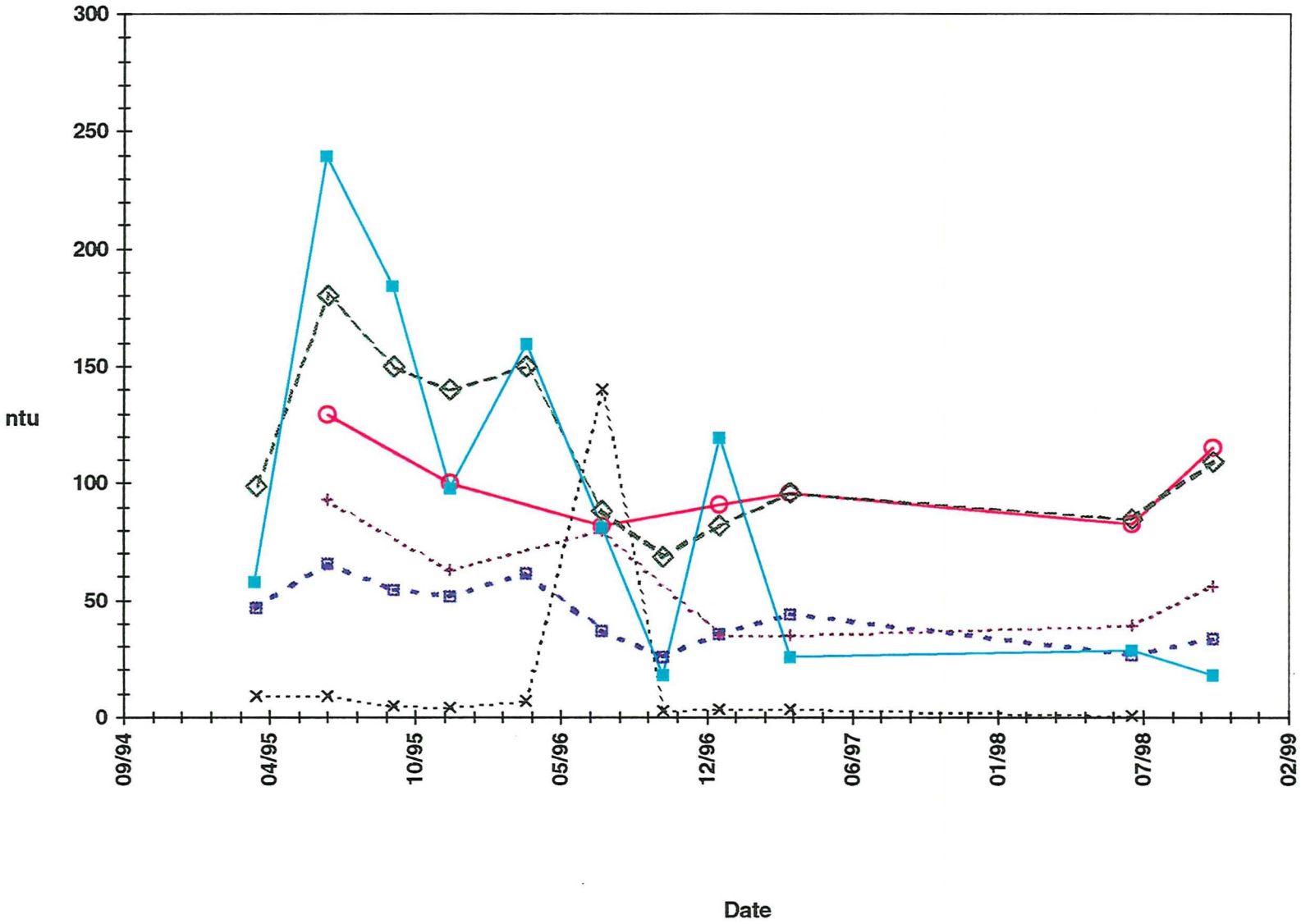


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Extraction Wells

Turbidity

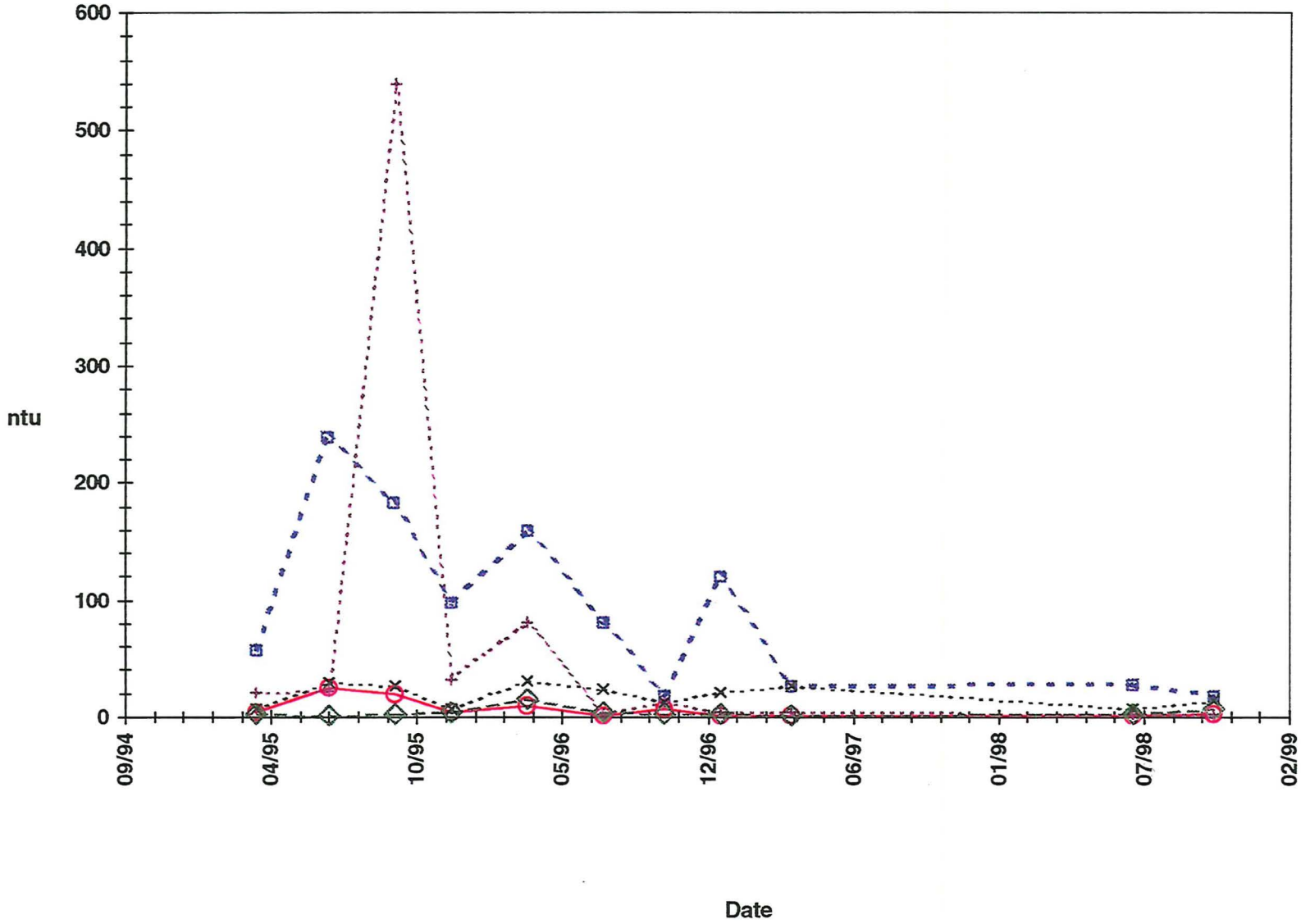


Prepared by CH2M HILL 31-Mar-99

Onalaska Municipal Landfill

MW-06 and MW-08

Turbidity

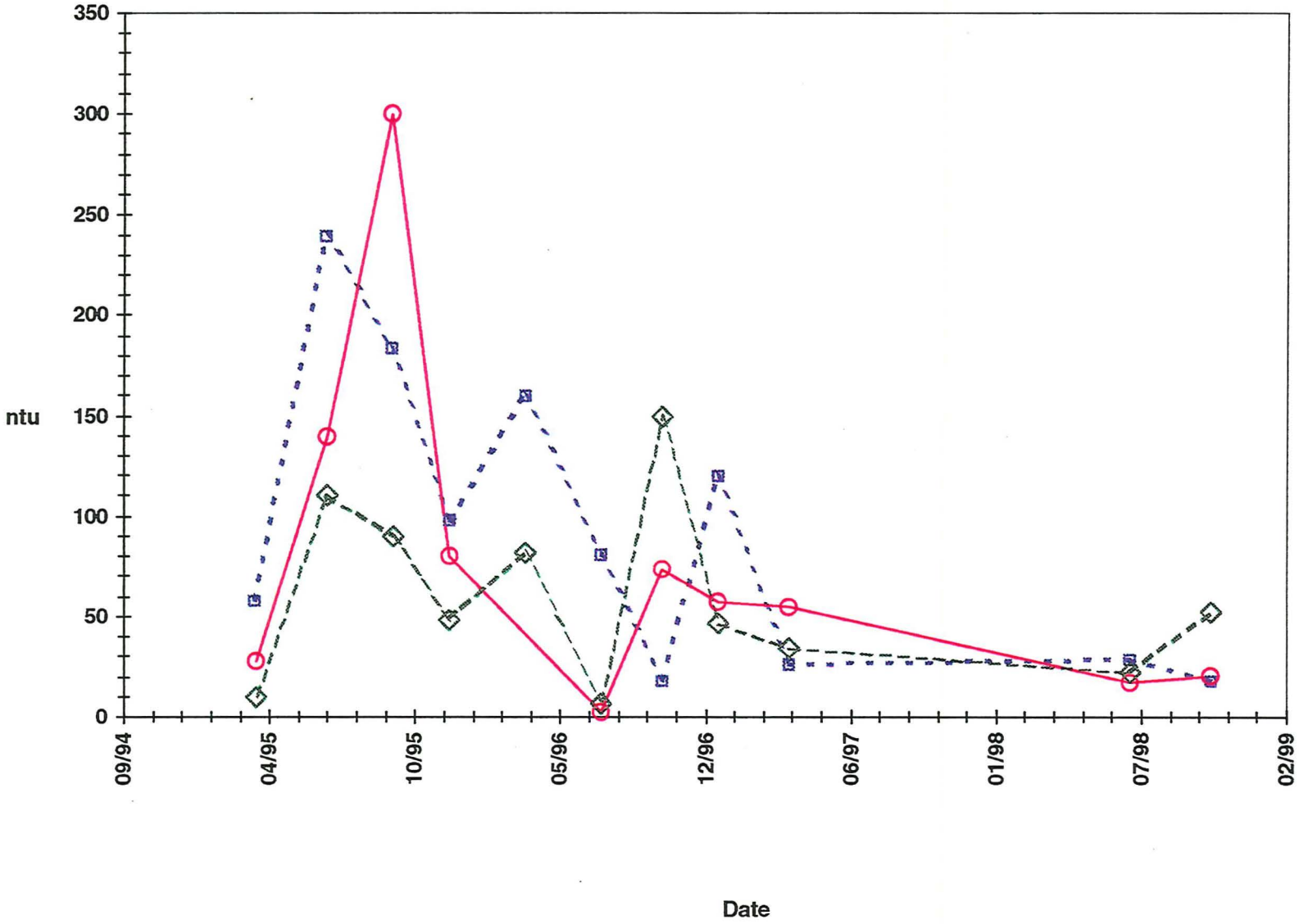


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

MW-12 and MW-14

Turbidity

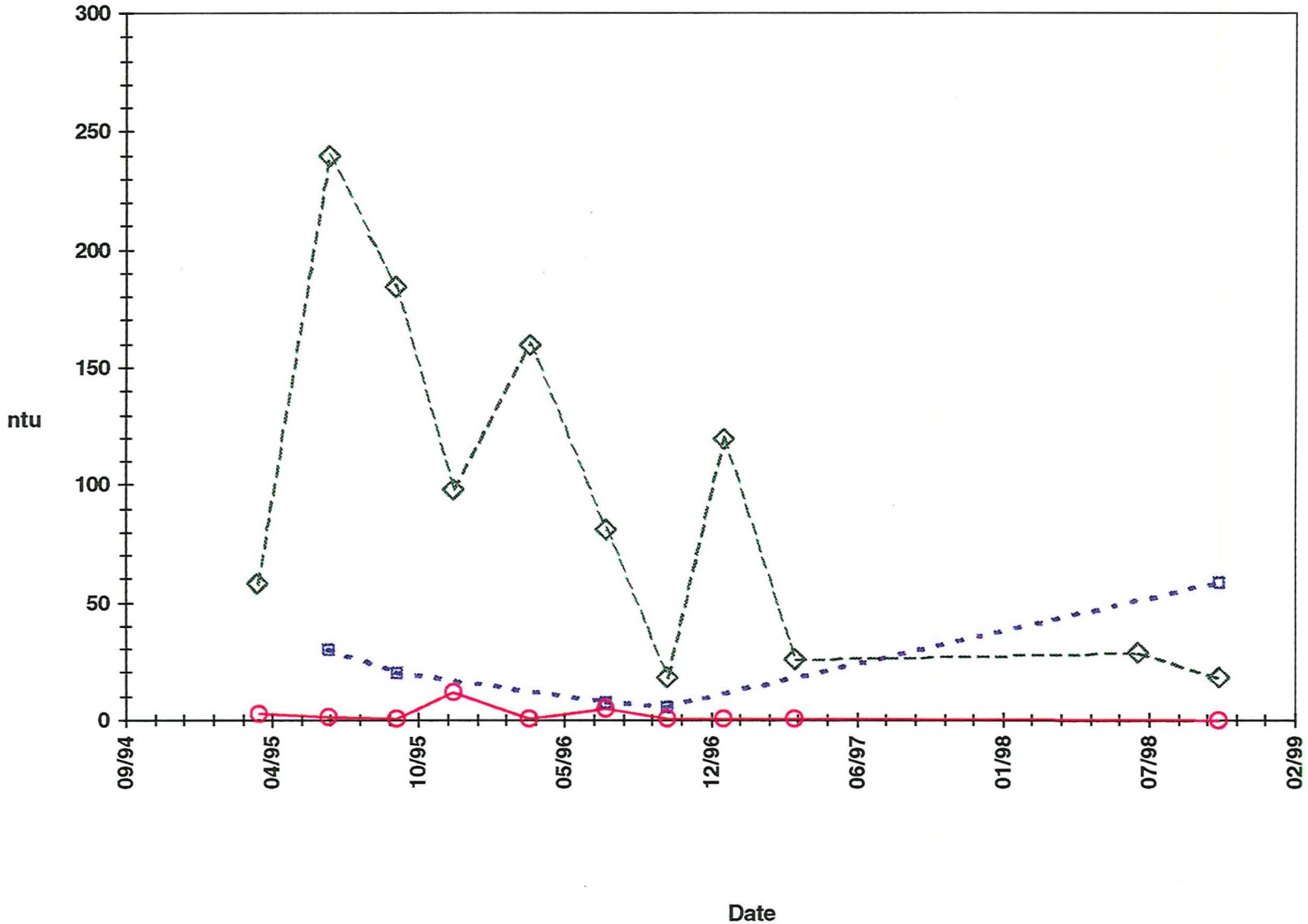


Prepared by CH2M HILL 02-Apr-99

Onalaska Municipal Landfill

Residential Wells

Turbidity



Prepared by CH2M HILL 02-Apr-99