



Environmental Protection Department
Operations and Regulatory Affairs Division

LLNL
Experimental Test Site 300

Compliance Monitoring Program for
RCRA-Closed Landfill Pits 1 and 7

Annual Report
for 2004

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Contents

Summary.....	1
Introduction	2
Compliance Monitoring Program Overview	5
Quality Assurance	5
Description of Report Contents	6
Summary of Analytical Results	7
Inspection and Maintenance Summary	11
References.....	13
Acknowledgments.....	14
List of Abbreviations and Acronyms.....	15

Appendices

Appendix A. Tables of Ground Water COCs Measurements.....	A-1
Appendix B. Statistical Methods for Release Detection	B-1
Appendix C. Quality Assurance for 2004	C-1
Appendix D. Uranium-235/Uranium-238 Ratios for Monitoring Wells K7-01 and K7-03	D-1
Appendix E. Graphs of Ground Water Measurements.....	E-1
Pit 1 Area	E-3
Ground Water Elevation.....	E-3
Field Temperature	E-7
Arsenic	E-11
Barium.....	E-15
Beryllium.....	E-19
Cadmium	E-23
Cobalt	E-27
Copper	E-31
Lead	E-35
Nickel	E-39
Vanadium.....	E-43
Zinc	E-47
Radium 226	E-51
Thorium 232.....	E-55
Thorium 228.....	E-59
Tritium	E-63
Uranium 234+233.....	E-67
Uranium 235+236.....	E-71
Uranium 238	E-75
HMX	E-79
RDX	E-83
Pit 7 Area	E-87
Ground Water Elevation.....	E-87
Field Temperature	E-92
Arsenic	E-97

Barium.....	E-102
Beryllium	E-107
Cadmium	E-112
Cobalt	E-117
Copper	E-122
Lead	E-127
Nickel	E-132
Vanadium	E-137
Zinc	E-142
Radium 226	E-147
Thorium 228.....	E-152
Thorium 232.....	E-157
Tritium	E-162
Uranium 234+233.....	E-167
Uranium 235+236.....	E-172
Uranium 238	E-177
HMX	E-182
RDX	E-187

Figures

1. Location of LLNL Site 300.....	2
2. Locations of RCRA-closed landfill Pits 1 and 7 at LLNL Site 300	3
3. Locations of Pit 1 compliance monitoring wells	3
4. Locations of Pit 7 compliance monitoring wells	4
5. Historical total uranium activities in samples collected from ground water monitoring wells at Pit 1.....	8
6. Historical total uranium activities in samples collected from ground water monitoring wells at Pit 7.....	10

Tables

1. MCLs for radioactivity in drinking water	7
A-1. Pit 1 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004	A-1
A-2. Pit 1 additional PCP constituents and fourth quarter 2004 analytical results	A-4
A-3. Pit 7 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004	A-5
A-4. Pit 7 additional PCP constituents and quarterly analytical results.....	A-8
B-1. Reported WDR 93-100 COCs showing statistical evidence of release	B-2
C-1. Quality Assurance Samples for 2004 at Pit 1	C-1
C-2. Quality Assurance Samples for 2004 at Pit 7	C-8
D-1. Uranium-235/Uranium-235 Mass ratios at wells K7-01 and K7-03 at Pit 7.....	D-1
E-1. Pits 1 and 7 constituents of concern (COC) and monitoring frequencies.....	E-2

LLNL Experimental Test Site 300
Compliance Monitoring Program for
RCRA-Closed Landfill Pits 1 and 7
Fourth Quarter/Annual Report
for 2004

Summary

This report summarizes compliance activities performed during 2004 at two LLNL Site 300 landfills known as Pits 1 and 7 that were closed in 1993 under the Resource Conservation and Recovery Act (RCRA). The compliance activities consist primarily of ground water sampling and analysis. The quarterly visual inspections for the fourth quarter were performed on December 2, 2004 at Pit 1 and November 15, 2004 at Pit 7. Annual engineer inspections for 2004 were conducted during the third quarter 2004 and summarized in that quarterly report. Ground water measurements for all quarters of 2004 are contained in **Appendix A, Tables A-1 to A-4**.

No new release of constituents of concern (COCs) to ground water from either Pit 1 or Pit 7 is evident in the monitoring data obtained during 2004. During the fourth quarter barium, uranium, and tritium were detected above their statistical limits of concentration (SLs) in several ground water samples. Except for uranium, these COCs are most likely from sources other than Pit 1 and Pit 7. The tritium detected in ground water by the network of Pit 1 monitoring wells is likely from a source at the Building 850 firing table. The primary sources of COCs detected by the network of Pit 7 monitoring wells are the closed landfills known as Pits 3 and 5, which are adjacent to Pit 7. Down gradient uranium detections are likely a combination of a release from Pit 7 and natural sources in the rocks and sediments surrounding Pit 7 contributing uranium to the ground water.

No deficiencies requiring corrective maintenance were observed during fourth quarter visual inspections at Pit 1. At Pit 7, animal burrows were noticed near the drainage channel and near the energy dissipater that will be monitored and maintenance will be performed if necessary. The annual inspection during the third quarter recommended that annual land surveys for settlement of the cap continue as already performed by LLNL under DOE Order 5040.

Introduction

This report summarizes compliance monitoring results for 2004, with emphasis on the fourth quarter results, for two closed landfills known as Pit 1 and Pit 7 at the LLNL Experimental Test Site (Site 300). Site 300 is located in the Altamont Hills approximately 13 kilometers (km) (8 miles) southwest of Tracy, California (**Figure 1**) and the landfills are located in the northern portion of the site (**Figure 2**). These Class I waste management units were officially closed in February 1993 under RCRA. Site 300 is owned by the United States Department of Energy (DOE) and is operated by the Regents of the University of California.

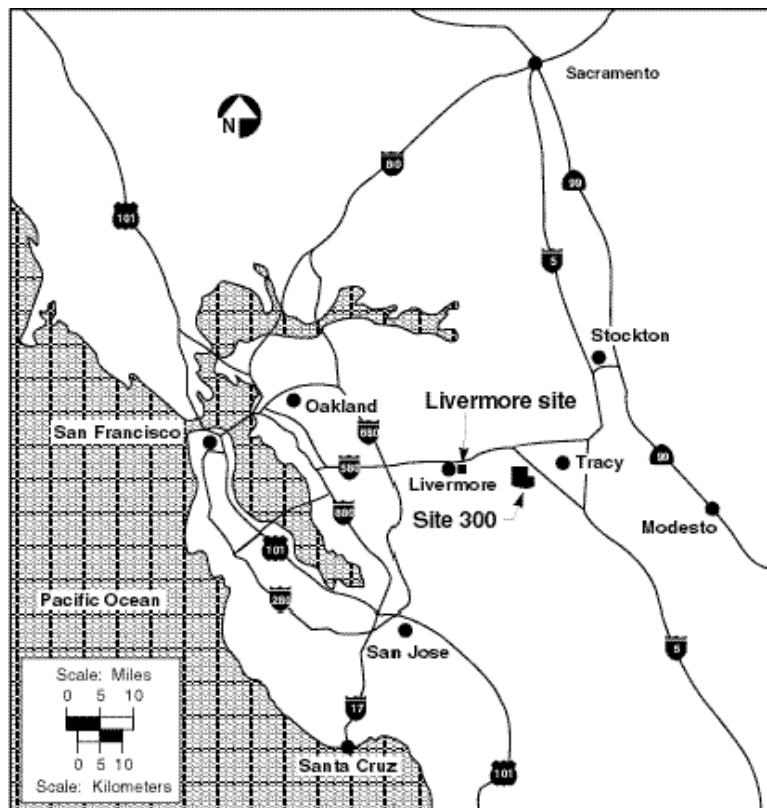


Figure 1. Location of LLNL Site 300.

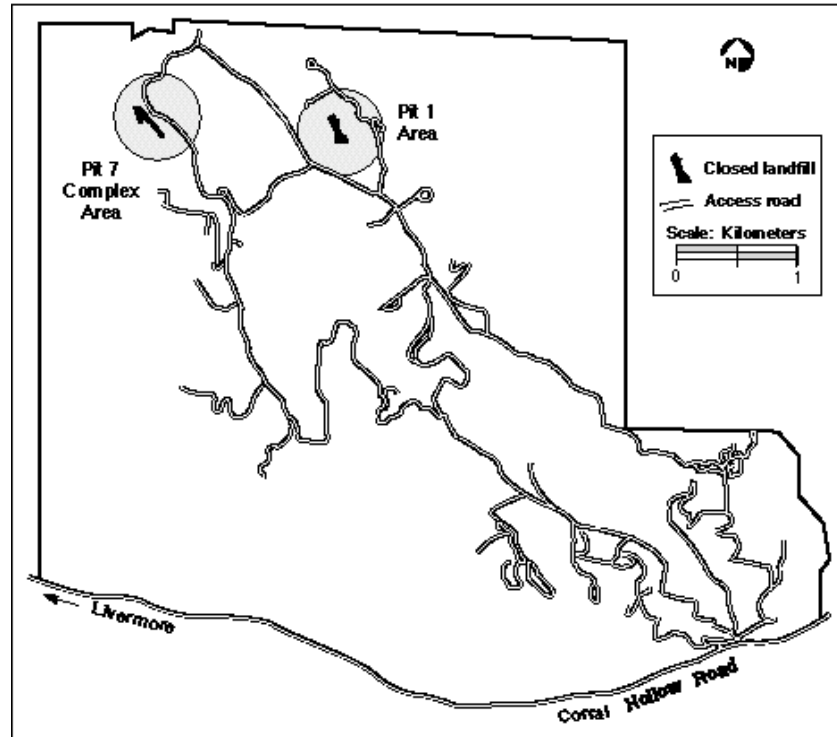


Figure 2. Locations of RCRA-closed landfill Pits 1 and 7 at LLNL Site 300.

Pits 1 and 7 are unlined Class 1 waste management units. Pit 1 is located in the Elk Ravine drainage area, about 300 meters (m) (984 feet [ft]) above mean sea level (MSL). Ground water generally flows in an east-northeast direction beneath Pit 1, following the inclination (dip) of underlying Miocene age sedimentary rocks (Webster-Scholten 1994).

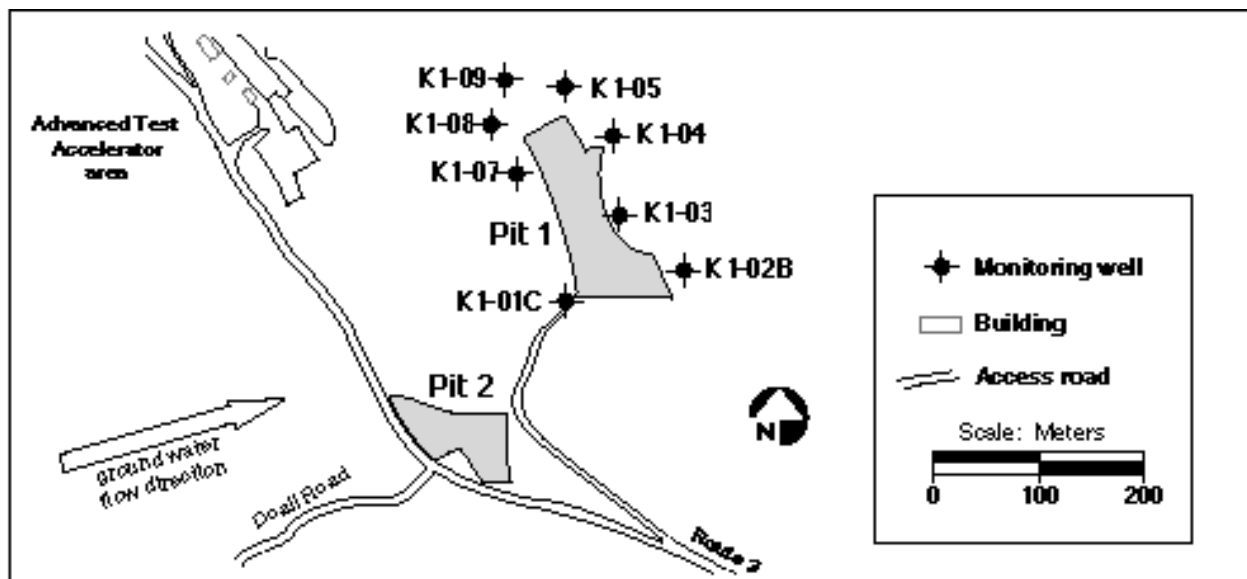


Figure 3. Locations of Pit 1 compliance monitoring wells.

Figure 3 shows the locations of the eight compliance monitoring wells that are used to sample the ground water in the vicinity of Pit 1. Wells K1-01C and K1-07 are hydrologically upgradient from Pit 1. Wells K1-02B, K1-03, K1-04, and K1-05 are

downgradient. Wells K1-08 and K1-09 are cross-gradient. The wells are screened in the uppermost water-bearing zone in the Neroly Formation lower blue sandstone unit (Tnbs₁). The Neroly and Cierbo Formations contain the main aquifers beneath Site 300. Pit 2, which was closed before RCRA was enacted, is hydrologically upgradient from Pit 1. In 1992, a 2.4 m (8 ft) thick RCRA cap, containing an impermeable layer of clay, 0.6 m (2 ft) thick, was constructed over Pit 1. The cap prevents rainwater from percolating through the waste buried in the pit. A water diversion channel was constructed around the pit cap to remove storm water runoff. The diversion channel empties into the arroyo in Elk Ravine.

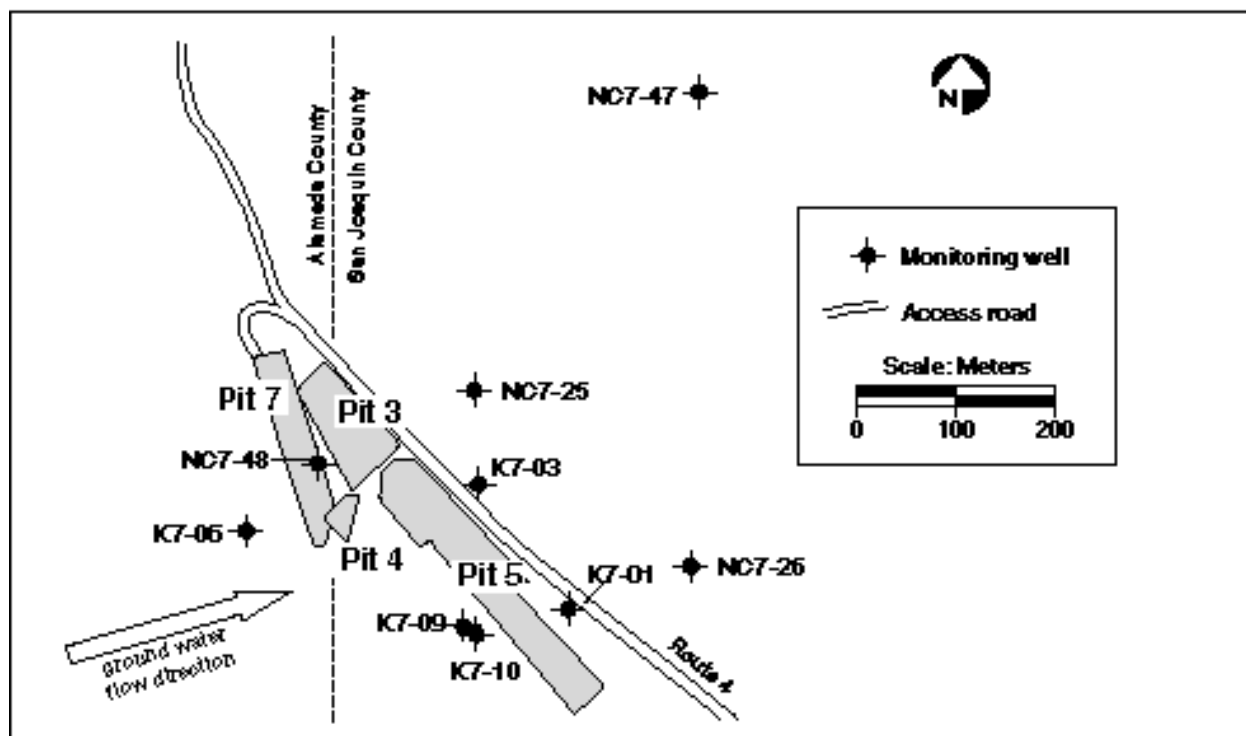


Figure 4. Locations of Pit 7 compliance monitoring wells.

Pit 7 is located in a valley 1.5 km (0.9 miles) west of Pit 1, at an elevation of about 400 m (1312 ft). The Pit 7 Complex comprises Pits 3, 4, 5, and 7. Pits 3, 4, and 5 ceased receiving waste before 1980, when RCRA was enacted. Ground water in bedrock flows 5 to 15 meters per year (m/yr) (16-49 ft/yr) in an east-northeast direction beneath the Pit 7 Complex, following the dip of the underlying Neroly Formation basal sandstone (Tnbs₀) (Webster-Scholten 1994). With sufficient seasonal rainfall, unconfined ground water can rise from bedrock into the more permeable valley-fill alluvium on the northeast side of the Pit 7 Complex and flow southeastward at seepage velocities of up to 40 m/yr (131 ft/yr). Surface drainage from the area also flows southeastward into Doall Ravine where it quickly infiltrates into the sandy soils.

Figure 4 shows the locations of the nine compliance monitoring wells that are used to sample the ground water in the vicinity of Pit 7. Well K7-06 is hydrologically

upgradient from Pit 7. Wells K7-01, K7-03, NC7-25, NC7-26, NC7-47, and NC7-48 are downgradient. Wells K7-09 and K7-10 are cross-gradient. Eight of the nine wells are screened in the Tnbs₀ water-bearing zone. Well K7-09 samples a deeper water-bearing zone within the Neroly Formation basal silty claystone unit (Tnsc₀).

In 1992, a RCRA cap, similar to the Pit 1 cap, was constructed over Pit 7. It, too, contains a layer of impermeable clay, 0.6 m (2 ft) thick, to prevent rain water infiltration. The RCRA cap also covers Pit 4 and about 30% of Pit 3. RCRA construction included surface water diversion channels around the cap and a shallow interflow interceptor trench on the west side (upgradient) of Pit 7. Some shallow recharge water is intercepted and diverted to lessen ground water rise into the unlined landfills.

Compliance Monitoring Program Overview

This report fulfills quarterly and annual requirements set forth in the following two documents: (1.) *Waste Discharge Requirements Order 93-100* (WDR 93-100), and *Revised Programs No. 93-100 and 96-248*, administered by the California Central Valley Regional Water Quality Control Board (CVRWQCB 1993 and 1998); and (2.) *LLNL Site 300 RCRA Closure and Post-Closure Plans, Landfill Pits 1 and 7* (Rogers/Pacific Corporation 1990). The post-closure plan (PCP) was approved by the California Department of Health Services. It is currently administered under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Federal Facility Agreement, with oversight by the U.S. Environmental Protection Agency (EPA) Region 9, the California Environmental Protection Agency (Cal EPA) Department of Toxic Substances Control (DTSC), and the CVRWQCB.

The Compliance Monitoring Program for Pits 1 and 7 combines PCP and WDR 93-100 requirements. The combined requirements include quarterly ground water sampling and analyses to detect potential releases of COCs from landfills, quarterly and annual visual inspections, annual surveys of pit cap marker elevations, repairs as necessary to maintain the integrity of the landfills and their water-diversion systems, and quarterly and annual written reports of work performed.

Quality Assurance

To ensure quality data, we work within the established Quality Assurance (QA) program of the LLNL Environmental Protection Department (EPD). We use protocols and procedures that cover all aspects of ground water sampling, sample tracking, and data management. These written protocols and procedures are contained in the *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)* (Goodrich and Depue 2003), the *Environmental Monitoring Plan* (Woods 2002),

and the *EPD Quality Assurance Management Plan* (Merrigan 2001). SOPs are used to minimize inadvertent sample contamination and maintain sample integrity from the well to the analytical laboratory. Data management SOPs ensure that all laboratory measurements are received, accurately recorded, and properly stored both in a computer database and in hardcopy format.

Each quarter, a duplicate (collocated) set of ground water samples is collected for each monitoring network and a set of blank samples is prepared from a randomly chosen well. In addition, equipment blanks are prepared and analyzed to ensure that sampling equipment is properly cleaned before use. Each day when samples are collected for volatile organic compound (VOC) analysis, a trip blank (prepared at the analytical laboratory) is carried into the field. It is returned unopened to the analytical laboratory for VOC analysis. If VOCs are detected in a trip blank and in any of the routine samples obtained that day, sample results may be discounted and new sampling may be performed.

Description of Report Contents

The **Summary of Analytical Results** section reviews any COCs detected in ground water during the fourth quarter and summarized the results of 2004 monitoring activities. This includes looking not only for instantaneous releases indicated by exceedence of SLs, but also examination of any significant trends in the measured constituents. COC measurements that exceeded SLs or maximum contaminant levels (MCLs) in drinking water are discussed, as are all detections of organic COCs. COC source information is given where it is known from LLNL CERCLA studies.

Appendix A contains the ground water analytical measurements for 2004. Pit 1 data are in **Tables A-1** and **A-2**. Pit 7 data are in **Tables A-3** and **A-4**. Note that the **Appendix A** tables may include some small negative values for radioactivity measurements. These are below the method reporting limits (RLs) and are calculated values. They simply indicate that the radioactivity of the ground water sample is close to zero.

As required by DOE Order 241.1, our measurements are reported in *Système Internationale* (SI) units. The SI unit for radioactivity is the becquerel (Bq), equal to 1 nuclear disintegration per second. The more commonly used unit, picocurie (pCi), is equal to 1 nuclear disintegration per 27 seconds. As a convenience, MCLs for radioactivity in drinking water are given in both becquerels per liter (Bq/L) and picocuries per liter (pCi/L) in **Table 1** below. Note that MCLs are provided for reference only, because this report does not involve wells used for potable domestic, livestock, or industrial water supply.

Table 1. MCLs for radioactivity in drinking water.

Radiological parameter	MCL (Bq/L)	MCL (pCi/L)
Gross alpha	0.555	15
Gross beta	1.85	50
Tritium	740	20,000
Radium (total)	0.185	5
Uranium (total)	0.74	20

Appendix B explains the methods we use to determine the statistical limit of concentration (SL) for a COC. Requirements for statistical treatment of ground water data are established in the *California Code of Regulations (CCR)*, Title 23, Division 3, Chapter 15, Section 2550.7. The statistical methods we use, prediction intervals (PI) and control charts (CC), are consistent with CCR requirements. If a routine quarterly COC measurement exceeds its SL and is confirmed by retesting, it is reported to the CVRWQCB as statistically significant evidence of a release.

Table B-1 lists the COCs for metals and radioisotopes that have exceeded SLs since Pits 1 and 7 were officially closed in February 1993. Under the Federal Facility Agreement, CERCLA Remedial Project Managers (RPMs) may direct LLNL to undertake further study of a COC that shows statistically significant evidence of a release to ground water. Additional studies covering the Pits 1 and 7 areas have been completed for barium, tritium, uranium, and vanadium (Taffet *et al.* 1996).

Appendix C contains the annual summary of quality assurance (QA) sample analyses performed during 2004 at Pit 1 (**Table C-1**) and Pit 7 (**Table C-2**).

Appendix D is a series of tables of uranium-235 and uranium-238 ratios for selected ground water monitoring wells K7-01 and K7-03 at Pit 7 (**Table D-1**). These ratios are presented as potential indicators of uranium origin

Appendix E is the graphic presentation of the complete ground water monitoring data set collected for each monitoring well for all the COCs. Some of these graphs will be discussed in the **Summary of Analytical Results** section in relation to increasing trends in data values.

Summary of Analytical Results

No evidence of a new release of COCs from Pit 1 or Pit 7 is indicated by 2004 measurements. The few COCs that were detected above their SLs are most likely from local natural sources, or from artificial sources other than Pit 1 and Pit 7.

During the fourth quarter at Pit 1, only tritium exceeded SLs in the ground water (**Table A-1**). Tritium activities slightly exceeded SLs in ground water sampled at wells

K1-03 (30 Bq/L, SL=23 Bq/L), K1-04 (4.9 Bq/L, SL=3.7 Bq/L), K1-08 (5.5 Bq/L, SL=3.7 Bq/L) and K1-09 (6.1 Bq/L, SL=4.4 Bq/L). The observed tritium activities likely result from a tritium plume that is slowly extending beneath Pit 1 from an upgradient source beneath the Building 850 firing table (Taffet et al. 1996, Ziagos and Reber-Cox 1998).

As part of the 2004 annual report, total uranium activities are plotted for all the ground water monitoring wells at Pit 1 (**Figure 5**). Historical uranium from sources unrelated to Pit 1 may be seen in the upstream monitoring well K1-01C prior to 1997. Since that time (1998 on) total uranium activities have remained relatively low (below 0.15 Bq/L at most locations). These total uranium data show neither an instantaneous release during 2004 nor a significant trend, therefore there is also no evidence suggesting small releases over time.

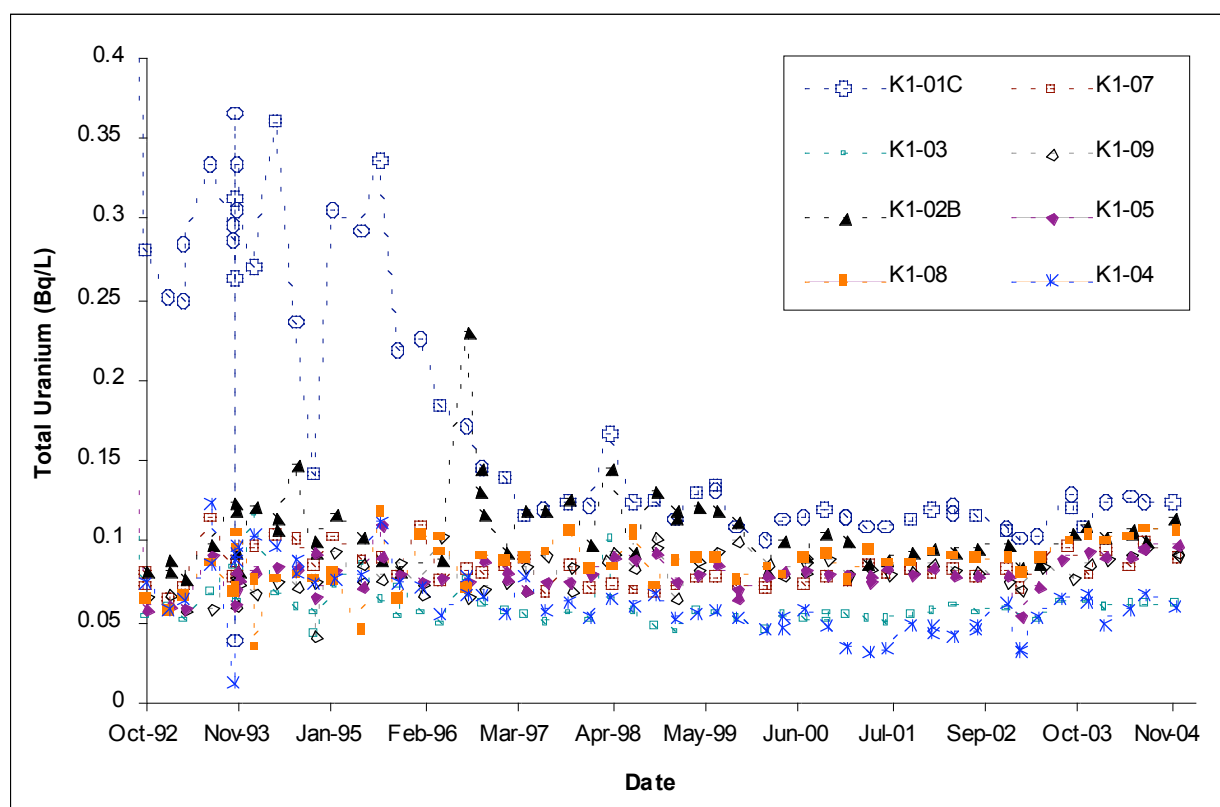


Figure 5. Historical total uranium activities in samples collected from ground water monitoring wells at Pit 1.

At Pit 7, barium, thorium-228 (not confirmed in retest), and total uranium concentrations/activities exceeded their respective SLs in one or more ground water samples (**Table A-3**). However, no new release of these COCs from Pit 7 is indicated. Pit 7 and the adjacent closed landfills known as Pits 3 and 5, together with natural sources in the underlying rocks and sediments, are the primary sources of the COCs detected by the Pit 7 well network.

Barium concentration slightly exceeded SLs in the ground water at monitoring well K7-09 (26 $\mu\text{g/L}$, SL=25 $\mu\text{g/L}$). We have previously reported relatively elevated ground water barium concentrations to be statistical evidence for a release of barium from Pit 7 (**Table B-1**). The barium concentrations in ground water immediately downgradient of Pit 7 at well NC7-48 are historically high (130 $\mu\text{g/L}$ third quarter) with a SL of 400 $\mu\text{g/L}$ (Christofferson and MacQueen 2004). Pit 7 cannot be discounted as a barium source to the ground water at well K7-03. At the same time, Pit 5 is another potential historical source of barium in the ground water, based on the relatively elevated barium concentration in the ground water at nearby well K7-01 (200 $\mu\text{g/L}$, SL=230 $\mu\text{g/L}$).

Thorium-228 activity at well K7-09 was detected slightly above the SL (0.027 Bq/L, SL=0.024 Bq/L). The error on this value was large enough that the true value could have been either above or below the SL. However, resampling was initiated and the measured results from samples on February 3, 2005 and February 10, 2005 were found to be less than the limits of detection of 0.001 Bq/L (**Table A-3**). Given that the latter value is similar to past results measured at this monitoring location it is likely that the initial data is not a valid result. LLNL has learned that not all samples collected during that period were filtered, either in the field or by the analytical laboratory. As the SL was developed based on data results from filtered samples, it is reasonable that results from unfiltered samples could exceed the SL. This is the likely explanation of the initial Th-228 result at monitoring well K-09.

As in past quarters, total uranium activities exceeded its SL in the ground water at monitoring wells K7-01 (0.792 Bq/L, SL=0.636 Bq/L) and K7-03 (0.336 Bq/L, SL=0.224 Bq/L). We have previously reported relatively elevated total uranium activity in the ground water to be statistical evidence for a release of depleted uranium from Pit 7 (**Table B-1**). Previous CERCLA investigations that used mass spectrometry to measure the uranium isotopes present showed that the uranium in the ground water at wells K7-01 and K7-03 was a mixture of depleted uranium, released historically from Pits 3, 5, and 7, and natural uranium that likely originates from the surrounding rocks and sediments (Taffet *et al.* 1996). It appears that oxidation of vegetation in the valley sediment or wood debris in the Pits may increase bicarbonate alkalinity downgradient of the Pits and enhance solubility of natural uranium. For additional information on the total uranium studies, see the graphs for Pit 7 monitoring wells in Christofferson and MacQueen (2004) and Taffet *et al.* (2004a).

Total uranium activities in the ground water monitoring wells at Pit 7 from 1993 to the present are presented in **Figure 6**. Large increases in uranium activity were observed in many wells in the 1997 to 1998 time frame. Ground water elevations were particularly high that year and it appears that intrusion of rising ground water from beneath the pit initiated a release (Christofferson and MacQueen 1999). This release

ended with the recession of ground water elevations after 1998. Since that time (1998), no significant increases in uranium activity have been observed in samples from the monitoring wells. However, a very slight trend may exist in total uranium activities since 1998 at wells K7-01 and K7-03. Observations of uranium isotope atom ratios (U-235/U-238) in water samples from these two wells suggest that the uranium is likely from natural sources (**Table D-1**). The average of the uranium isotope atom ratios for monitoring wells K7-01 and K7-03 are 0.0071 and 0.0073, respectively. Given the natural isotope ratios, the minor rising trend in total uranium activities observed in monitoring well K7-01 and K7-03 in **Figure 6** does not appear to be related to uranium releases from Pit 7. Uranium is normally found in nature as U-234, U-235, and U-238 in mass proportions of 0.0058%, 0.71%, and 99.28%, respectively (Eisenbud and Gesell 1997). This means that a normal atom ratio of U-235 to U-238 would be 0.71 to 99.25 or 0.0072. A complete analysis of these values will be presented in the *Remedial Investigation/Feasibility Study for the Pit 7 Complex at Lawrence Livermore National Laboratory Site 300*, currently in draft final form (Taffet *et al.* 2004a).

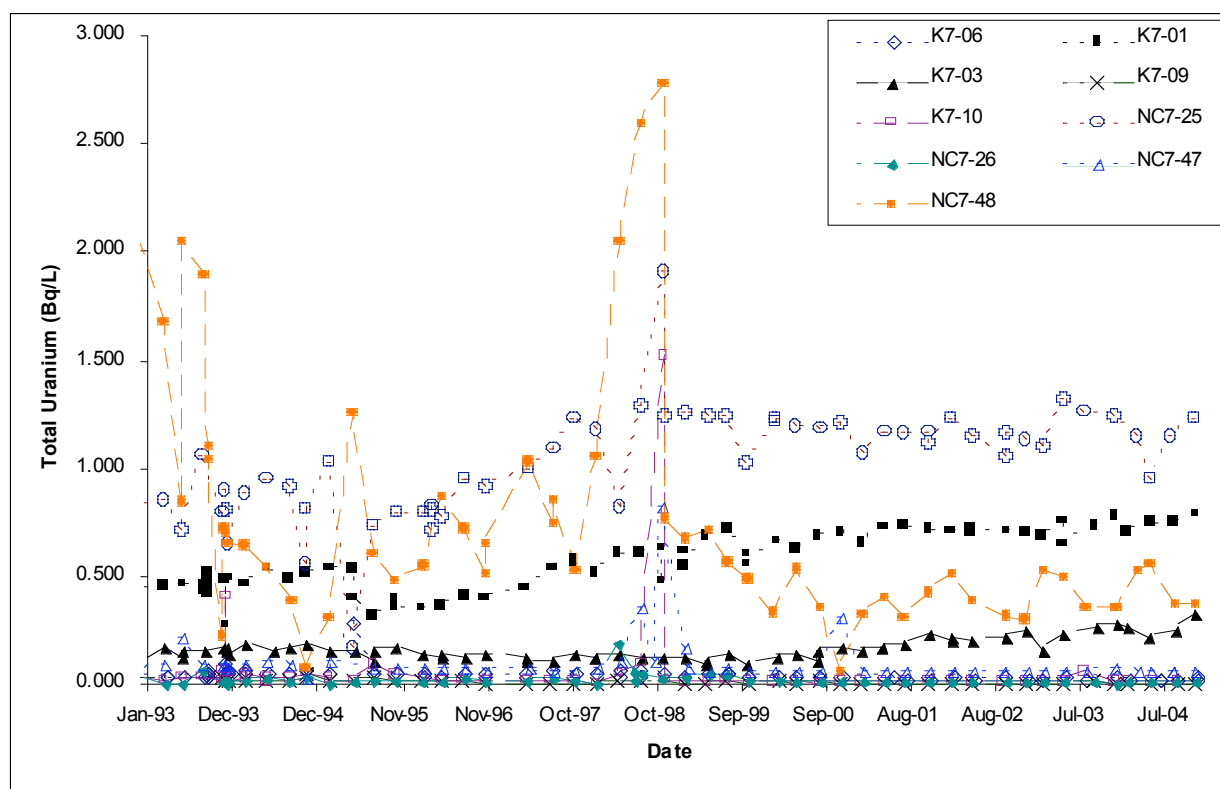


Figure 6. Historical total uranium activities in samples collected from ground water monitoring wells at Pit 7.

The fourth-quarter gross alpha activities (**Table A-4**) in the ground water at monitoring wells K7-01 (0.73 Bq/L) and NC7-25 (0.78 Bq/L) exceeded the gross alpha MCL of 0.56 Bq/L for drinking water. Within the combined uncertainties of the

different measurements, the decay of natural uranium (0.96 Bq/L) accounts for the relatively elevated gross alpha measurement for well NC7-25.

As in the past, tritium activity exceeded the drinking water MCL of 740 Bq/L in the ground water at monitoring wells K7-01 (2453 Bq/L), K7-03 (5883 Bq/L), and NC7-25 (14837 Bq/L). Previous CERCLA investigations have linked the tritium activity in the ground water at monitoring wells K7-01, K7-03, and NC7-25 to slug releases of tritium from Pits 3 and 5 or underlying sediments during the winter of 1992-93, and continuing during successive winters of 1994-95, 1995-96, 1996-97, and 1997-98. Generally the highest water levels in the Pit 7 Complex monitoring wells were observed in 1997-98, when these pits were partially inundated from beneath by rising ground water (Taffet *et al.* 1996 and 2004a, Ziagos and Reber-Cox 1998). The ground water immediately downgradient of Pit 7 at well NC7-48 continued to show very low tritium activity (1.6 Bq/L). CERCLA modeling studies indicate that, given tritium's short half-life of 12.3 years, the relatively slow rate of ground water flow (5-40 m/yr), and the long flow path to the Site 300 boundary, tritium activity in ground water will decrease to several orders of magnitude below the MCL before it can travel off site (Taffet *et al.* 1996 and 2004a).

As in the past, VOCs were detected in the ground water (**Table A-4**). Trichloroethene (TCE) was detected in the ground water at Pit 7 wells K7-01 (1.8 $\mu\text{g/L}$) and K7-03 (2.2 $\mu\text{g/L}$), both below the MCL of 5.0 $\mu\text{g/L}$ for TCE. This VOC is associated with historical releases from Pit 5, not Pit 7 (Webster-Scholten 1994, Taffet *et al.* 1996). In previous Compliance Monitoring Program reports discussion of volatile organic compound (VOCs) has been presented for TCE. In future reports, a new format for presenting VOC data will be used to maintain consistency with the CERCLA Compliance Monitoring Report. The concentrations of all VOCs detected in ground water monitoring wells will be summed and presented as Total VOCs (TVOCs).

Inspection and Maintenance Summary

Inspections of Pits 1 and 7 were conducted by Principle Engineers from Chow Engineering on August 3, 2004 and were appended to the third-quarter report (Campbell 2005). Cap integrity, vegetative cover, and drainage at both of the closed landfills were reported to be satisfactory. Continued annual surveys for land subsidence were recommended. Additional recommendations for Pit 1 include removing soil from the energy dissipater, recompacting a small area near well K1-09, monitoring and maintenance of rodent burrows, monitoring of hairline cracks in and near the drainage channels, and continued monitoring for cracks and erosion. At Pit 7, additional recommendations include to fill and compact animal burrows, remove sediment from energy dissipaters and the southern portion of the channel, compaction and reseeded of a area northeastern portion of the cap, preparation of the center area

for the cap for revegetation, repair of the base of monitoring wells NC7-04 and NC7-36, and the removal of excess and abandoned drums. All the required maintenance was completed by November 9, 2004. The fourth quarter visual inspections of Pits 1 and 7 were performed on December 2, 2004 and November 15, 2004, respectively. No deficiencies requiring corrective maintenance were observed at Pit 1. At Pit 7, animal burrows were noticed near the drainage channel and near the energy dissipater that will be monitored and maintenance will be performed if necessary.

References

- California Code of Regulations*, Title 23, Division 3, Chapter 15, Section 2550.7.
- Campbell, C.G. (2005), *LLNL Experimental Test Site 300 Compliance Monitoring Program for RCRA-Closed Landfill Pits 1 and 7, Third Quarter Report for 2004*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-10191-04-3).
- Christofferson, E., and D. H. MacQueen (2004), *LLNL Experimental Test Site 300 Compliance Monitoring Program for RCRA-Closed Landfill Pits 1 and 7, Annual Report for 2003*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-10191-03-4).
- Christofferson, E., and D. H. MacQueen (1999), *LLNL Experimental Test Site 300 Compliance Monitoring Program for RCRA-Closed Landfill Pits 1 and 7, Annual Report for 1998*, Lawrence Livermore National Laboratory, Livermore, CA (UCAR-10191-98-4).
- Central Valley Regional Water Quality Control Board (1993), *Order No. 93-100, Waste Discharge Requirements for University of California Lawrence Livermore National Laboratory Site 300 and U.S. Department of Energy, Landfill Pits 1 and 7, San Joaquin County* (June 25, 1993).
- Central Valley Regional Water Quality Control Board (1998), *Revised Monitoring and Reporting Programs No. 93-100 and 96-248, Lawrence Livermore National Laboratory Site 300, San Joaquin County* (September 25, 1998).
- Eisenbud, M. and T. Gesell (1997), *Environmental Radioactivity from Natural, Industrial, and Military Sources*. Fourth ed. Academic Press, NY: NY. Pg 134-142.
- Goodrich, R., and R. Depue (Eds.) (2003), *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-MA-109115 Rev. 11).
- Merrigan, J. (2001), *Environmental Protection Department Quality Assurance Management Plan*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-146357, Rev. 4), November 2001.
- Rogers/Pacific Corporation (1990), *Lawrence Livermore National Laboratory Site 300 Resource Conservation and Recovery Act Closure and Post-Closure Plans, Landfill Pits 1 and 7, Volumes I and II*, Lawrence Livermore National Laboratory, Livermore, CA (Cal EPA No. CA2890090002).
- Taffet, M. J., L. K. Green-Horner, L. C. Hall, T. M. Carlsen, and J. A. Oberdorfer (1996), *Addendum to the Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300: Building 850/Pit 7 Complex Operable Unit*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-108131 Add. 1).
- Taffet, M., V. Madrid, T. Carlsen, Z. Demir, J. Valett, M. Dresen, W. Daily, S. Coleman, V. Dibley, and L. Ferry (2004a), *Draft Remedial Investigation/Feasibility Study for the Pit 7 Complex at Lawrence Livermore National Laboratory Site 300*, Livermore National Laboratory, Livermore, CA (UCRL-AR-202492-DR).
- Taffet, M., V. Dibley, L. Ferry, W. Daily, Z. Demir, V. Madrid, J. Valett, and S. Bilir (2004b), *Draft Interim Remedial Design for the Building 850 Subarea at Lawrence Livermore National Laboratory Site 300*, Livermore National Laboratory, Livermore, CA (UCRL-AR-201835).
- U. S. Department of Energy (1998), *Scientific and Technical Information Management* (Order 241.1).
- Webster-Scholten, C. P. (Ed.) (1994), *Final Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-108131).

Woods, N. J. (Ed.) (2002), *Environmental Monitoring Plan*, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-ID-106132 Rev. 3).

Ziagos, J. P., and E. Reber-Cox, to M. Piros, K. Setian, and S. Timm (1998), Letter RE: *Submittal of the Ground Water Tritium Plume Characterization Summary Report for the Building 850/Pits 3 and 5 Operable Unit, Lawrence Livermore National Laboratory Site 300* (10-98ERD/Tritium Plume Char. Summ.rtd, October 30, 1998).

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List of Abbreviations and Acronyms

1,1-DCE	1,1-dichloroethene
Bq	becquerel (SI unit of radioactivity)
Cal EPA	California Environmental Protection Agency
CC	control chart (statistical method)
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	constituent of concern
CVRWQCB	Central Valley Regional Water Quality Control Board
DOE	U.S. Department of Energy
DTSC	Department of Toxic Substances Control (California)
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Department (LLNL)
ft	Foot
GWE	ground water elevation (in feet above MSL)
km	Kilometer
L	Liter
LLNL	Lawrence Livermore National Laboratory
m	Meter
MCL	maximum contaminant level (for drinking water)
mg	Milligram
MSL	mean sea level (datum for elevation measurements)
m/yr	ground water seepage rate in meters per year
μg	Microgram
nd	no detections above reporting limits
nd (exc)	no detections, except as listed
pCi	picocurie (unit of radioactivity equal to 0.037 Bq)
PCP	post-closure plan
PE	Professional Engineer
PI	prediction interval (statistical method)
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RL	reporting limit (contractual concentration near zero)
RPM	Remedial Program Manager
SI	<i>Système Internationale</i> (units of measurement)
Site 300	Experimental Test Site, LLNL
SL	statistically determined concentration limit
SOP	standard operating procedure
TCE	Trichloroethene
Tnbs ₀	Neroly Formation basal sandstone
Tnbs ₁	Neroly Formation lower blue sandstone
Tnsc ₀	Neroly Formation basal silty claystone

VOC
WDR

volatile organic compound
Waste Discharge Requirements (permit)

Appendix A

Tables of Ground Water C.O.Cs Measurements

Table A-1. Pit 1 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
Arsenic ($\mu\text{g/L}$)	K1-01C	– ^(a)	12	13	13	10
	K1-07	– ^(a)	15	15	15	11
	K1-02B	20	13	13	13	10
	K1-03	19	14	14	13	9
	K1-04	19	11	12	12	9
	K1-05	24	16	15	14	11
	K1-08	21	16	16	15	12
	K1-09	19	15	15	15	12
Barium ($\mu\text{g/L}$)	K1-01C	–	< 25	< 25	< 25	< 25
	K1-07	–	28	29	29	25
	K1-02B	25	< 25	< 25	< 25	< 25
	K1-03	25	29	28	27	< 25
	K1-04	32	27	28	27	< 25
	K1-05	41	37	39	37	32
	K1-08	51	45	43	41	36
	K1-09	46	44	47	44	38
Beryllium ($\mu\text{g/L}$)	K1-01C	–	< 0.5	< 0.5	< 0.5	< 0.5
	K1-07	–	< 0.5	< 0.5	< 0.5	< 0.5
	K1-02B	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-03	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-04	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-05	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-08	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-09	0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cadmium ($\mu\text{g/L}$)	K1-01C	–	< 0.5	< 0.5	< 0.5	< 0.5
	K1-07	–	< 0.5	< 0.5	< 0.5	< 0.5
	K1-02B	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-03	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-04	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-05	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-08	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K1-09	0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cobalt ($\mu\text{g/L}$)	K1-01C	–	< 25	< 25	< 25	< 25
	K1-07	–	< 25	< 25	< 25	< 25
	K1-02B	25	< 25	< 25	< 25	< 25
	K1-03	25	< 25	< 25	< 25	< 25
	K1-04	25	< 25	< 25	< 25	< 25
	K1-05	25	< 25	< 25	< 25	< 25
	K1-08	25	< 25	< 25	< 25	< 25
	K1-09	25	< 25	< 25	< 25	< 25
Copper ($\mu\text{g/L}$)	K1-01C	–	13	10	14	< 10
	K1-07	–	< 10	< 10	< 10	< 10
	K1-02B	34	< 10	20	71, 16, 8.5	< 10
	K1-03	34	< 10	< 10	< 10	< 10
	K1-04	34	< 10	< 10	< 10	< 10
	K1-05	34	< 10	< 10	< 10	< 10
	K1-08	34	< 10	< 10	< 10	< 10
	K1-09	34	< 10	< 10	< 10	< 10
Lead ($\mu\text{g/L}$)	K1-01C	–	< 2	< 2	< 2	< 2
	K1-07	–	< 2	< 2	< 2	< 2
	K1-02B	2	< 2	< 2	< 2	< 2
	K1-03	2	< 2	< 2	< 2	< 2
	K1-04	2	< 2	< 2	< 2	< 2
	K1-05	2	< 2	< 2	< 2	< 2
	K1-08	2	< 2	< 2	< 2	< 2
	K1-09	2	< 2	< 2	< 2	< 2
Nickel ($\mu\text{g/L}$)	K1-01C	–	< 5	< 5	< 5	< 5
	K1-07	–	< 5	< 5	< 5	< 5

Table A-1. Pit 1 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
	K1-02B	12	< 5	< 5	< 5	< 5
	K1-03	12	< 5	< 5	< 5	< 5
	K1-04	12	< 5	< 5	< 5	< 5
	K1-05	12	< 5	< 5	< 5	< 5
	K1-08	12	< 5	< 5	< 5	< 5
	K1-09	12	< 5	< 5	< 5	< 5
Vanadium ($\mu\text{g/L}$)	K1-01C	-	68	75	73	58
	K1-07	-	78	77	79	64
	K1-02B	78	55	57	53	47
	K1-03	72	53	52	49	41
	K1-04	48	34	37	36	32
	K1-05	97	76	72	71	61
	K1-08	100	72	75	72	57
	K1-09	92	65	65	61	53
Zinc ($\mu\text{g/L}$)	K1-01C	-	< 20	< 20	< 20	< 20
	K1-07	-	< 20	< 20	< 20	< 20
	K1-02B	94	< 20	33	< 20	< 20
	K1-03	94	< 20	< 20	24	37
	K1-04	94	< 20	< 20	< 20	< 20
	K1-05	94	< 20	< 20	< 20	< 20
	K1-08	94	< 20	< 20	< 20	< 20
	K1-09	94	< 20	< 20	< 20	< 20
Radium 226 (Bq/L)	K1-01C	-	0.003	0.006	0.007	0.002
	K1-07	-	0.002	0.003	0.002	0.002
	K1-02B	0.044	0.004	0.004	0.006	0.008
	K1-03	0.044	0.009	0.001	0.003	0.008
	K1-04	0.044	0.003	0.005	0.002	0.002
	K1-05	0.044	0.004	0.010	0.006	0.004
	K1-08	0.044	0.003	0.005	0.003	0.002
	K1-09	0.044	0.004	0.005	0.004	0.001
Tritium (Bq/L)	K1-01C	-	21	22	18	22
	K1-07	-	1.7	- 0.4 ^(c)	-0.9	-1.72
	K1-02B	- ^(b)	150	150	147	148
	K1-03	23	26	29	25	30
	K1-04	3.7	5.8	2.9	2.1	4.9
	K1-05	3.7	5.8	- ^(d)	0.4	3.6
	K1-08	3.7	7.3	7.7	6.1	5.5
	K1-09	4.4	5.6	5.1	1.6	6.1
Uranium (total, Bq/L)	K1-01C	-	0.121	0.124	0.082	0.122
	K1-07	-	0.092	0.080	0.065	0.087
	K1-02B	0.192	0.100	0.106	0.061	0.113
	K1-03	0.145	0.057	0.058	0.039	0.059
	K1-04	0.124	0.045	0.055	0.041	0.056
	K1-05	0.109	0.088	0.088	0.063	0.095
	K1-08	0.120	0.098	0.101	0.070	0.103
	K1-09	0.109	0.088	0.089	0.064	0.089
Thorium 228 (Bq/L)	K1-01C	-	0.003	0.000	0.000	0.000
	K1-07	-	0.000	0.001	0.000	0.000
	K1-02B	0.023	0.001	- 0.001	0.000	0.000
	K1-03	0.023	0.000	0.000	0.000	-0.001
	K1-04	0.023	0.000	0.000	-0.001	0.000
	K1-05	0.023	- 0.001	0.000	0.000	0.000
	K1-08	0.023	0.000	0.001	0.000	0.000
	K1-09	0.023	0.000	0.000	0.000	0.000
Thorium 232 (Bq/L)	K1-01C	-	0.000	0.000	0.000	0.000
	K1-07	-	0.000	0.000	-0.001	0.000
	K1-02B	0.009	0.000	0.000	-0.001	0.000
	K1-03	0.009	0.000	0.000	0.000	0.000

Table A-1. Pit 1 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
	K1-04	0.009	0.000	0.000	0.000	0.000
	K1-05	0.009	0.000	0.000	0.000	0.000
	K1-08	0.009	0.000	0.000	0.000	0.000
	K1-09	0.009	0.000	0.000	0.000	0.000
HMX ($\mu\text{g/L}$)	K1-01C	-	< 5	< 5	< 5	< 5
	K1-07	-	< 5	< 5	< 5	< 5
	K1-02B	5	< 5	< 5	30,<5,<5	< 5
	K1-03	5	< 5	< 5	< 5	< 5
	K1-04	5	< 5	< 5	< 5	< 5
	K1-05	5	< 5	< 5	< 5	< 5
	K1-08	5	< 5	< 5	< 5	< 5
	K1-09	5	< 5	< 5	< 5	< 5
RDX ($\mu\text{g/L}$)	K1-01C	-	< 5	< 5	< 5	< 5
	K1-07	-	< 5	< 5	< 5	< 5
	K1-02B	5	< 5	< 5	< 5	< 5
	K1-03	5	< 5	< 5	< 5	< 5
	K1-04	5	< 5	< 5	< 5	< 5
	K1-05	5	< 5	< 5	< 5	< 5
	K1-08	5	< 5	< 5	< 5	< 5
	K1-09	5	< 5	< 5	< 5	< 5

(a) Wells K1-01C and K1-07 have no release detection SLs for COCs, because they are upgradient of Pit 1.

(b) K1-02B is an exempt well (deemed to be insensitive to the detection of a tritium release from Pit 1).

(c) Radioactivity measurements are corrected for the background radioactivity inside the measurement chamber.

A negative result for radioactivity indicates that the sample measured lower than the background by the amount shown.

Radioactivity values shown as 0.000 measured less than 0.0005 Bq/L.

(d) Sampling error (sample not submitted for analysis).

Concluded

Table A-2. Pit 1 additional post-closure plan constituents, monitoring wells, and quarterly analytical results for the fourth quarter 2004.

Sample Dates:	22-Nov-04	2-Dec-04	22-Nov-04	30-Nov-04	30-Nov-04	1-Dec-04	2-Dec-04	6-Dec-04
	Monitoring Well							
Constituent (units)	K1-01C	K1-07	K1-02B	K1-03	K1-04	K1-05	K1-08	K1-09
pH (pH units)	7.73	7.72	7.61	7.69	7.7	7.66	7.74	7.73
Specific conductance ($\mu\text{mhos/cm}$)	663	593	694	622	574	606	625	628
Depth to water (ft)	102.08	137.35	130.72	133.69	152.61	167.91	151.74	157.7
Ground water elevation (ft)	979.14	972.25	976.51	974.36	970.06	962.95	970.99	968.98
Temperature ($^{\circ}\text{C}$)	20.6	20.5	20.3	20.4	20.1	19.7	20	20.4
Chromium ($\mu\text{g/L}$)	1	< 1	< 1	< 1	< 1	3	2	< 1
Iron (mg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Manganese (mg/L)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Mercury ($\mu\text{g/L}$)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Selenium ($\mu\text{g/L}$)	< 2	< 2	< 2	< 2	2.7	< 2	< 2	< 2
Silver ($\mu\text{g/L}$)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sodium (mg/L)	40	40	44	40	42	42	42	45
Gross alpha (Bq/L)	0.06031	0.04366	0.030414	0.02294	0.017908	0.09213	0.05624	0.01983
Gross beta (Bq/L)	0.15022	0.12802	0.15799	0.13727	0.14652	0.14356	0.13172	0.11729
VOCs (EPA 624)	nd	nd	nd	nd	nd	nd(exc)	nd(exc)	nd(exc)
Freon 113	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	13	23	40
Semi-VOCs (EPA 625)	nd	nd	nd	nd	nd	nd	nd	nd
Pesticides (EPA 608)	nd(exc)	nd	nd	nd	nd	nd	nd	nd
p,p-DDT	0.044	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
TOC (mg/L,EPA 9060)	< 1	2.9	< 1	< 1	< 1	< 1	< 1	< 1
TOX ($\mu\text{g/L}$,SW9020B)	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Nitrate (mg/L)	36.5	31.2	36.9	31.3	35	36.8	37.3	37
Perchlorate ($\mu\text{g/L}$)	< 4	< 4	6.7	< 4	< 4	< 4	< 4	< 4

Table A-3. Pit 7 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
Arsenic ($\mu\text{g/L}$)	K7-06	— ^(a)	18	20	21	17
	K7-01	14	11	11	9.8	< 10
	K7-03	3.2	2.6	< 2	< 2	< 2
	K7-09	2	2.6,<1,<1	< 2	< 2	< 2
	K7-10	4.2	2.4	2.4	2.1	< 2
	NC7-25	8.6	5.6	4.9	4.8	5.3
	NC7-26	3.6	2.6	< 2	2.1	< 10
	NC7-47	17	14	13	12	11
NC7-48	19	8.6	8.4	6	< 10	
Barium ($\mu\text{g/L}$)	K7-06	—	89	91	86	81
	K7-01	230	220	220	180	200
	K7-03	85	92	88	88	77
	K7-09	25	33	25	25	26
	K7-10	120	48	120	48	41
	NC7-25	140	86	79	82	72
	NC7-26	39	27	27	27	< 25
	NC7-47	63	62	62	65, 56	54
NC7-48	400	130	130	140	130	
Beryllium ($\mu\text{g/L}$)	K7-06	—	< 0.5	< 0.5	< 0.5	< 0.5
	K7-01	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K7-03	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K7-09	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K7-10	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	NC7-25	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	NC7-26	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	NC7-47	0.5	< 0.5	< 0.5	< 0.5	< 0.5
NC7-48	0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Cadmium ($\mu\text{g/L}$)	K7-06	—	< 0.5	< 0.5	< 0.5	< 0.5
	K7-01	0.5	< 0.5	< 0.5	< 0.5	< 4 ^(b)
	K7-03	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K7-09	0.5	< 0.5	< 0.5	< 0.5	< 0.5
	K7-10	1.6	< 0.5	< 0.5	< 0.5	< 0.5
	NC7-25	0.6	< 0.5	< 0.5	< 0.5	< 0.5
	NC7-26	0.5	< 0.5	< 0.5	< 0.5	< 4 ^(b)
	NC7-47	0.5	< 0.5	< 0.5	< 0.5	< 0.5
NC7-48	1.2	< 0.5	< 0.5	< 0.5	< 4 ^(b)	
Cobalt ($\mu\text{g/L}$)	K7-06	—	< 25	< 25	< 25	< 25
	K7-01	25	< 25	< 25	< 25	< 25
	K7-03	25	< 25	< 25	< 25	< 25
	K7-09	25	< 25	< 25	< 25	< 25
	K7-10	25	< 25	< 25	< 25	< 25
	NC7-25	25	< 25	< 25	< 25	< 25
	NC7-26	25	< 25	< 25	< 25	< 25
	NC7-47	25	< 25	< 25	< 25	< 25
NC7-48	25	< 25	< 25	< 25	< 25	

Table A-3. Pit 7 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
Copper ($\mu\text{g/L}$)	K7-06	—	< 10	< 10	< 10	< 10
	K7-01	40	10	< 10	< 10	11
	K7-03	140	12	< 10	21	16
	K7-09	10	< 10	< 10	< 10	< 10
	K7-10	10	< 10	< 10	< 10	< 10
	NC7-25	10	< 10	< 10	< 10	< 10
	NC7-26	10	< 10	< 10	< 10	< 10
	NC7-47	10	< 10	< 10	< 10	< 10
NC7-48	10	< 10	< 10	< 10	< 10	
Lead ($\mu\text{g/L}$)	K7-06	—	< 2	< 2	< 2	< 2
	K7-01	6	< 2	< 2	< 2	< 10
	K7-03	6.1	< 2	< 2	< 2	< 2
	K7-09	5.9	< 2	< 2	< 2	< 2
	K7-10	2	< 2	< 2	< 2	< 2
	NC7-25	2	< 2	< 2	< 2	< 2
	NC7-26	5.1	< 2	< 2	< 2	< 10
	NC7-47	7.6	< 2	< 2	< 2	< 2
NC7-48	2	< 2	< 2	< 2	< 10	
Nickel ($\mu\text{g/L}$)	K7-06	—	< 5	< 5	< 5	< 5
	K7-01	25	< 5	< 5	< 5	< 40
	K7-03	26	79	70	25	11
	K7-09	29	< 5	< 5	< 5	< 5
	K7-10	13	< 5	< 5	< 5	< 5
	NC7-25	13	< 5	< 5	< 5	< 5
	NC7-26	5	6.9	< 5	< 5	< 40
	NC7-47	14	< 5	< 5	< 5	< 5
NC7-48	48	< 5	< 5	< 5	< 40	
Vanadium ($\mu\text{g/L}$)	K7-06	—	42	43	45	37
	K7-01	25	< 25	< 25	50,14,16	< 25
	K7-03	25	< 25	< 25	< 25	< 25
	K7-09	25	< 25	< 25	< 25	< 25
	K7-10	25	< 25	< 25	< 25	< 25
	NC7-25	25	< 25	< 25	< 25	< 25
	NC7-26	25	< 25	< 25	< 25	< 25
	NC7-47	79	76	69	67	54
NC7-48	110	31	< 25	< 25	< 25	
Zinc ($\mu\text{g/L}$)	K7-06	—	< 20	< 20	< 20	< 20
	K7-01	52	< 20	< 20	110,5,4,8,6	< 100
	K7-03	72	100	57	39	42
	K7-09	20	< 20	< 20	< 20	< 20
	K7-10	20	< 20	24	< 20	< 20
	NC7-25	36	< 20	< 20	< 20	< 20
	NC7-26	20	< 20	< 20	< 20	< 100
	NC7-47	50	< 20	< 20	< 20	< 20
NC7-48	44	< 20	< 20	< 20	< 100	

Table A-3. Pit 7 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
						Continued
HMX ($\mu\text{g/L}$)	K7-06	—	< 5	< 5	< 5	< 5
	K7-01	5	< 5	< 5	< 5	< 5
	K7-03	5	< 5	< 5	< 5	< 5
	K7-09	5	< 5	< 5	< 5	< 5
	K7-10	5	< 5	< 50,<5,<5	< 5	< 5
	NC7-25	5	< 5	< 5	7.4,<5,<5	< 5
	NC7-26	5	< 5	< 5	< 5	< 5
	NC7-47	5	< 5	< 5	< 5	< 5
	NC7-48	5	< 5	< 5	< 5	< 5
RDX ($\mu\text{g/L}$)	K7-06	—	< 5	< 5	< 5	< 5
	K7-01	5	< 5	< 5	< 5	< 5
	K7-03	5	< 5	< 5	< 5	< 5
	K7-09	5	< 5	< 5	< 5	< 5
	K7-10	5	< 5	72,<5,<5	< 5	< 5
	NC7-25	5	< 5	< 5	< 5	< 5
	NC7-26	5	< 5	< 5	< 5	< 5
	NC7-47	5	< 5	< 5	< 5	< 5
	NC7-48	5	< 5	< 5	< 5	< 5
Tritium (Bq/L)	K7-06	—	- 0.4 ^(b)	- 2.0	-0.5	2.1
	K7-01	— ^(c)	2430	2560	2438	2453
	K7-03	— ^(c)	4920	5290	5365	5883
	K7-09	4.7	- 0.1	- 2.2	2.0	0.5
	K7-10	4.7	- 0.2	- 5.6	-1.0	0.3
	NC7-25	— ^(c)	16200	15700	14911	14837
	NC7-26	— ^(c)	110	111	92.5	108.0
	NC7-47	4.7	- 1.1	4.4	-0.3	0.2
	NC7-48	16.4	0.1	1.3	-2.9	1.6
Radium 226 (Bq/L)	K7-06	—	0.033	0.013	0.011	0.013
	K7-01	0.080	0.057	0.041	0.074	0.013
	K7-03	0.030	0.009	0.010	0.017	0.008
	K7-09	0.023	0.002	0.004	0.003	0.004
	K7-10	0.032	0.009	0.009	0.008	0.004
	NC7-25	0.054	0.025	0.025	0.017	0.025
	NC7-26	0.034	0.012	0.009	0.011	0.014
	NC7-47	0.022	0.002	0.009	0.001	0.011
	NC7-48	0.040	0.027	0.020	0.014	0.016
Thorium 228 (Bq/L)	K7-06	—	0.000	0.000	0.000	0.004
	K7-01	0.024	0.000	0.004	0.000	0.000
	K7-03	0.024	0.001	0.003	0.000	0.001
	K7-09	0.024	0.000	0.006	0.000	(e) 0.027, 0.000, 0.001
	K7-10	0.024	- 0.001	0.002	0.000	0.000
	NC7-25	0.024	- 0.001	0.000	0.000	0.000
	NC7-26	0.024	0.000	0.001	0.000	0.000
	NC7-47	0.024	- 0.001	0.000	0.000	0.000
	NC7-48	0.024	0.001	0.000	0.000	0.001

Table A-3. Pit 7 COCs, monitoring wells, SLs, and quarterly analytical results for year 2004.

Quarter >			1	2	3	4
COC (units)	Well	SL	Result	Result	Result	Result
Thorium 232 (Bq/L)	K7-06	—	0.000	0.000	0.000	0.000
	K7-01	0.014	- 0.001	0.000	0.001	0.000
	K7-03	0.014	0.000	- 0.001	0.001	0.000
	K7-09	0.014	0.000	0.000	0.000	0.000
	K7-10	0.014	0.000	0.000	0.000	0.000
	NC7-25	0.014	0.000	0.000	-0.001	-0.001
	NC7-26	0.014	0.000	0.001	0.000	-0.001
	NC7-47	0.014	0.000	0.000	0.000	0.000
	NC7-48	0.014	0.000	0.000	0.000	0.000
Uranium (total, Bq/L)	K7-06	—	0.031	0.026	0.028	0.032
	K7-01	0.636	0.704	0.751	0.752	0.792
	K7-03	0.224	0.268	0.216	0.255	0.336
	K7-09	0.035	0.001	0.001	0.000	0.001
	K7-10	0.083	0.013	0.008	0.009	0.008
	NC7-25	1.262	1.148	0.955	1.151	1.235
	NC7-26	0.034	0.009	0.010	0.008	0.010
	NC7-47	0.178	0.069	0.069	0.065	0.070
	NC7-48	2.327	0.527	0.556	0.373	0.373

- (a) Well K7-06 has no SLs for COCs, because it is upgradient from Pit 7.
- (b) Radioactivity measurements are corrected for the background radioactivity inside the measurement chamber.
A negative result for radioactivity indicates that the sample measured lower than the background by the amount shown.
Radioactivity values shown as 0.000 are less than 0.0005 Bq/L.
- (c) Exempt well (insensitive to further detection of tritium releases).
- (d) The MDL for these analyses was the reported 4 ug/L, however, the results did not indicate an exceedance of SLs
unofficial reported values for these wells were 0.1 for K7-01, none detected for NC7-26, and 0.06 ug/L for NC7-48.
- (e) Retests for this well were performed in the following quarter on 2/3/05 and 2/10/05.

Table A-4. Pit 7 additional PCP constituents and quarterly analytical results

Constituent (units)	Monitoring Well									
	K7-06	K7-01	K7-03	K7-09	K7-10	NC7-25	NC7-26	NC7-47	NC7-48	
Ground water elevation (ft)	1387.2	1298.1	1309.0	1295.7	1306.48	1299.2	1256.8	1205.7	1344.6	
Field pH	4 7.49	7.11	7.13	7.92	7.62	7.06	7.36	7.66	6.85	
Gross alpha	4 0.072	0.725	-0.010	0.014	-0.007	0.781	0.079	0.015	0.224	
Gross beta	4 0.132	0.692	0.144	0.518	0.187	0.588	0.137	0.162	0.352	
TCE ($\mu\text{g/L}$)	4 nd	1.8 *	2.2	nd	nd	nd	nd	nd	nd	
Nitrate (as NO ₃)	4 14.8	40.6	31	< 0.44	< 0.44	36	< 0.44	71.9	18.9	
Perchlorate	4 < 4	21	19	< 4	< 4	18	< 4	< 4	< 4	

* Shaded areas correspond to the shaded sampling date above.

Appendix B

Statistical Methods

for Release Detection

Appendix B

Statistical Methods for Release Detection

Monitoring and reporting provisions of the RCRA closure and post-closure plan (PCP) for landfill Pits 1 and 7 require the use of U.S. EPA-approved statistical methods to evaluate the monitoring data. Waste Discharge Requirements (WDR) Order 93-100 requires statistical methods from the California Code of Regulations (CCR), Title 23. LLNL applies statistical methods from CCR, Title 23, Division 3, Chapter 15, Section 2550.7, as they are also consistent with U.S. EPA guidance.

We use statistically determined concentration limits (SLs) to detect potential releases of constituents of concern (COCs) to ground water from solid wastes contained in closed landfills. We employ two statistical methods, prediction intervals (PIs) and control charts (CCs), to generate SLs. Both methods are sensitive to COC concentration increases. Both methods are cost-effective, requiring only one measurement of a COC per quarter per monitoring well.

We prefer the PI method when COC concentrations in ground water are similar upgradient and downgradient from the monitored unit. We use parametric PI methods when the upgradient COC concentration data are all above the detection limit and the data are approximately normally distributed. Analysts also use parametric methods on log-transformed data, if the transformed data follow a normal distribution. Nonparametric PI methods are more effective when the data cannot be transformed to a normal distribution, or when they contain nondetections.

When the concentration of a COC is spatially variable in the vicinity of a monitored unit, we develop a control chart for each downgradient monitoring well. The control chart compares each new quarterly COC measurement with its concentration history for that well.

Wherever sufficient historical detections of a COC exist, we calculate an SL such that a single future measurement has approximately a 1-in-100 chance of exceeding the SL, when no change in concentration has actually occurred. This yields a statistical test with a significance level of approximately 0.01. Where historical detections exist, but nondetections constitute part of the data, we set the SL equal to the highest concentration measured. If historical analyses show all nondetections of a COC, then we select the analytical laboratory reporting limit (RL) as the SL. To test false-positive results, we employ a verification procedure containing two discrete retests, in accordance with CCR Title 23, Chapter 15, Section 2550.7.

Table B-1 lists all COCs that have indicated statistically significant evidence of release to ground water from Pit 1 or Pit 7, the date when the CVRWQCB was notified by letter, and the status of any further investigation.

Table B-1. Reported WDR 93-100 COCs showing statistical evidence of release.

COC	Pit	Reported to CVRWQCB	Status of release investigation
Metals			
Arsenic	1	06/03/94	Transferred to CERCLA
Arsenic	7	10/17/95	Transferred to CERCLA
Barium	1	10/17/95	Transferred to CERCLA
Barium	1	06/14/96	Transferred to CERCLA
Barium	1	10/25/00	Transferred to CERCLA
Barium	7	11/09/93	Completed ^(a)
Barium	7	07/10/97	Transferred to CERCLA
Barium	7	08/03/00	Transferred to CERCLA
Barium	7	02/08/01	Transferred to CERCLA
Cadmium	7	10/17/95	Transferred to CERCLA
Copper	1	02/08/01	Transferred to CERCLA
Copper	7	10/17/95	Transferred to CERCLA
Lead	1	04/01/99	Transferred to CERCLA
Nickel	7	10/17/95	Transferred to CERCLA
Nickel	7	05/03/96	Transferred to CERCLA
Nickel	7	07/10/01	Transferred to CERCLA
Vanadium	7	06/03/94	Completed ^(a)
Zinc	7	10/17/95	Transferred to CERCLA
Zinc	7	04/19/99	Transferred to CERCLA
Radioisotopes			
Radium-226	7	10/17/95	Transferred to CERCLA
Tritium	1	10/21/96	Transferred to CERCLA
Tritium	1	01/14/99	Transferred to CERCLA
Tritium	7	01/11/93	Completed ^(a)
Uranium	1	02/17/94	Completed ^(a)
Uranium	1	10/21/96	Transferred to CERCLA
Uranium	7	09/10/93	Completed ^(a)
Uranium	7	11/10/98	Transferred to CERCLA

(a) Taffet *et al.* 1996.

Appendix C
Quality Assurance
for 2004

Table C-1. Quality Assurance Samples for 2004 at Pit 1

First Quarter		QA samples		
Constituent (units)	Units	Well K1-03 routine	Well K1-03 duplicate	Pit 1 field blank
Arsenic	$\mu\text{g/L}$	14	14	< 2
Barium	$\mu\text{g/L}$	29	29	< 25
Beryllium	$\mu\text{g/L}$	< 0.5	< 0.5	< 0.5
Cadmium	$\mu\text{g/L}$	< 0.5	< 0.5	< 0.5
Cobalt	$\mu\text{g/L}$	< 25	< 25	< 25
Copper	$\mu\text{g/L}$	< 10	< 10	< 10
Lead	$\mu\text{g/L}$	< 2	< 2	< 2
Nickel	$\mu\text{g/L}$	< 5	< 5	< 5
Vanadium	$\mu\text{g/L}$	53	52	< 25
Zinc	$\mu\text{g/L}$	< 20	< 20	< 20
HMX	$\mu\text{g/L}$	< 5	< 5	< 5
RDX	$\mu\text{g/L}$	< 5	< 5	< 5
Gross alpha	Bq/L	0.04 ± 0.03	0.04 ± 0.03	0.004 ± 0.007
Gross beta	Bq/L	0.16 ± 0.05	0.14 ± 0.04	0.02 ± 0.03
Radium 226	Bq/L	0.006 ± 0.003	0.003 ± 0.002	0.003 ± 0.002
Thorium 228	Bq/L	0.0004 ± 0.0009	-0.0003 ± 0.0005	-0.0004 ± 0.0007
Thorium 232	Bq/L	-0.0004 ± 0.0006	-0.0004 ± 0.0005	-0.0001 ± 0.0005
Tritium	Bq/L	26.5 ± 3.7	25.8 ± 3.6	0.8 ± 2.1
Uranium (total)	Bq/L	0.06 ± 0.01	0.06 ± 0.01	-0.0002 ± 0.0008

Table C-1 *cont.*

Second Quarter		QA samples		
Constituent (units)	Units	Well K1-02B routine	Well K1-02B duplicate	Pit 1 field blank
Arsenic	$\mu\text{g/L}$	13	13	< 2
Barium	$\mu\text{g/L}$	< 25	< 25	< 25
Beryllium	$\mu\text{g/L}$	< 0.5	< 0.5	< 0.5
Cadmium	$\mu\text{g/L}$	< 0.5	< 0.5	< 0.5
Cobalt	$\mu\text{g/L}$	< 25	< 25	< 25
Copper	$\mu\text{g/L}$	20	< 10	< 10
Lead	$\mu\text{g/L}$	< 2	< 2	< 2
Nickel	$\mu\text{g/L}$	< 5	< 5	< 5
Vanadium	$\mu\text{g/L}$	57	56	< 25
Zinc	$\mu\text{g/L}$	33	< 20	< 20
HMX	$\mu\text{g/L}$	< 5	< 5	< 5
RDX	$\mu\text{g/L}$	< 5	< 5	< 5
Gross alpha	Bq/L	0.207 ± 0.074	0.041 ± 0.032	0.002 ± 0.008
Gross beta	Bq/L	0.338 ± 0.089	0.075 ± 0.052	-0.005 ± 0.021
Radium 226	Bq/L	0.004 ± 0.003	0.006 ± 0.004	0.001 ± 0.002
Thorium 228	Bq/L	-0.001 ± 0.0002	-0.0002 ± 0.001	-0.001 ± 0.001
Thorium 232	Bq/L	-0.0001 ± 0.001	-0.0002 ± 0.0005	-0.0003 ± 0.001
Tritium	Bq/L	152 ± 15.9	152 ± 15.5	^(b)
Uranium (total)	Bq/L	0.106 ± 0.010	0.102 ± 0.010	-0.0001 ± 0.001

Table C-1 *cont.*

Third Quarter		QA samples		
Constituent (units)	Units	K1-05 routine	K1-05 duplicate	PIT1 field blank
Arsenic	$\mu\text{g/L}$	14	14	< 2
Barium	$\mu\text{g/L}$	38	37	< 25
Beryllium	$\mu\text{g/L}$	< 0.5	< 0.5	< 0.5
Cadmium	$\mu\text{g/L}$	< 0.5	< 0.5	< 0.5
Cobalt	$\mu\text{g/L}$	< 25	< 25	< 25
Copper	$\mu\text{g/L}$	< 10	< 10	< 10
Lead	$\mu\text{g/L}$	< 2	< 2	< 2
Nickel	$\mu\text{g/L}$	< 5	< 5	< 5
Vanadium	$\mu\text{g/L}$	72	71	< 25
Zinc	$\mu\text{g/L}$	< 20	< 20	< 20
HMX	$\mu\text{g/L}$	< 5	< 5	< 5
RDX	$\mu\text{g/L}$	< 5	< 5	< 5
Grossalpha	Bq/L	0.049 \pm 0.030	-0.006 \pm 0.023	-0.010 \pm 0.009
Grossbeta	Bq/L	0.164 \pm 0.048	0.139 \pm 0.041	-0.012 \pm 0.024
Radium226	Bq/L	0.002 \pm 0.002	0.006 \pm 0.003	0.004 \pm 0.003
Thorium228	Bq/L	0.000 \pm 0.001	0.000 \pm 0.001	0.000 \pm 0.001
Thorium232	Bq/L	0.000 \pm 0.000	0.000 \pm 0.001	0.000 \pm 0.001
Tritium	Bq/L	5.3 \pm 2.2	0.4 \pm 2.1	-2.1 \pm 1.9
Uranium (total)	Bq/L	0.092 \pm 0.0088	0.093 \pm 0.0088	0.000 \pm 0.0008

Table C-1 *cont.*

Fourth Quarter		QA samples		
		K1-09	K1-09	PIT1
Constituent	Units	routine	duplicate	field blank
Arsenic	ug/L	12	12	< 2
Barium	ug/L	38	38	< 25
Beryllium	ug/L	< 0.5	< 0.5	< 0.5
Cadmium	ug/L	< 0.5	< 0.5	< 0.5
Chromium	ug/L	< 1	< 1	< 1
Cobalt	ug/L	< 25	< 25	< 25
Copper	ug/L	< 10	< 10	< 10
Iron	ug/L	< 100	< 100	< 100
Lead	ug/L	< 2	< 2	< 2
Manganese	ug/L	< 100	< 100	< 100
Mercury	ug/L	< 0.2	< 0.2	< 0.2
Nickel	ug/L	< 5	< 5	< 5
Selenium	ug/L	< 2	< 2	< 2
Silver	ug/L	< 0.5	< 0.5	< 0.5
Sodium	mg/L	45	46	< 1
Vanadium	ug/L	53	53	< 25
Zinc	ug/L	< 20	< 20	< 20
Aldrin	ug/L	< 0.005	< 0.005	< 0.005
BHC, alpha isomer	ug/L	< 0.005	< 0.005	< 0.005
BHC, beta isomer	ug/L	< 0.005	< 0.005	< 0.005
BHC, delta isomer	ug/L	< 0.005	< 0.005	< 0.005
BHC, gamma isomer (Lindar	ug/L	< 0.005	< 0.005	< 0.005
Chlordane	ug/L	< 1	< 1	< 1
Dieldrin	ug/L	< 0.005	< 0.005	< 0.005
Endosulfan I	ug/L	< 0.005	< 0.005	< 0.005
Endosulfan II	ug/L	< 0.005	< 0.005	< 0.005
Endosulfan sulfate	ug/L	< 0.005	< 0.005	< 0.005
Endrin	ug/L	< 0.005	< 0.005	< 0.005
Endrin aldehyde	ug/L	< 0.005	< 0.005	< 0.005
Heptachlor	ug/L	< 0.005	< 0.005	< 0.005
Heptachlor epoxide	ug/L	< 0.005	< 0.005	< 0.005
Methoxychlor	ug/L	< 0.01	< 0.01	< 0.01
Toxaphene	ug/L	< 2	< 2	< 2
p,p-DDD	ug/L	< 0.005	< 0.005	< 0.005
p,p-DDE	ug/L	< 0.005	< 0.005	< 0.005
p,p-DDT	ug/L	< 0.005	< 0.005	< 0.005
PCB 1016	ug/L	< 0.2	< 0.2	< 0.2
PCB 1221	ug/L	< 0.2	< 0.2	< 0.2
PCB 1232	ug/L	< 0.2	< 0.2	< 0.2
PCB 1242	ug/L	< 0.2	< 0.2	< 0.2
PCB 1248	ug/L	< 0.2	< 0.2	< 0.2
PCB 1254	ug/L	< 0.2	< 0.2	< 0.2
PCB 1260	ug/L	< 0.2	< 0.2	< 0.2
1,1,1-Trichloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	ug/L	< 0.5	< 0.5	< 0.5

1,1-Dichloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	ug/L	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	ug/L	< 0.5	< 0.5	< 0.5
trans-1,2-Dichloroethene	ug/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	ug/L	< 1	< 1	< 1
1,2-Dichloropropane	ug/L	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
cis-1,2-Dichloroethene	ug/L	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	ug/L	< 0.5	< 0.5	< 0.5
2-Butanone	ug/L	< 20	< 20	< 20
2-Chloroethylvinylether	ug/L	< 10	< 10	< 10
trans-1,3-Dichloropropene	ug/L	< 0.5	< 0.5	< 0.5
2-Hexanone	ug/L	< 20	< 20	< 20
4-Methyl-2-pentanone	ug/L	< 20	< 20	< 20
Acetone	ug/L	< 20	< 20	< 20
Benzene	ug/L	< 0.5	< 0.5	< 0.5
Bromodichloromethane	ug/L	< 0.5	< 0.5	< 0.5
Bromoform	ug/L	< 0.5	< 0.5	< 0.5
Bromomethane	ug/L	< 1	< 1	< 1
Carbon disulfide	ug/L	< 1	< 1	< 1
Carbon tetrachloride	ug/L	< 0.5	< 0.5	< 0.5
Chlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
Chloroethane	ug/L	< 0.5	< 0.5	< 0.5
Chloroform	ug/L	< 0.5	< 0.5	< 0.5
Chloromethane	ug/L	< 0.5	< 0.5	< 0.5
Dibromochloromethane	ug/L	< 0.5	< 0.5	< 0.5
Dibromomethane	ug/L	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	ug/L	< 0.5	< 0.5	< 0.5
Ethanol	ug/L	< 800	< 800	< 800
Ethylbenzene	ug/L	< 0.5	< 0.5	< 0.5
Freon 113	ug/L	40	38	< 0.5
Methylene chloride	ug/L	< 1	< 1	< 1
Naphthalene	ug/L	< 0.5	< 0.5	< 0.5
Styrene	ug/L	< 0.5	< 0.5	< 0.5
Tetrachloroethene	ug/L	< 0.5	< 0.5	< 0.5
Toluene	ug/L	< 0.5	< 0.5	< 0.5
Total xylene isomers	ug/L	< 1	< 1	< 1
Trichloroethene	ug/L	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	ug/L	< 0.5	< 0.5	< 0.5
Vinyl chloride	ug/L	< 0.5	< 0.5	< 0.5
1,2,4-Trichlorobenzene	ug/L	< 2	< 2	< 2
1,2-Dichlorobenzene	ug/L	< 2	< 2	< 2
1,2-Diphenylhydrazine	ug/L	< 2	< 2	< 2
1,3-Dichlorobenzene	ug/L	< 2	< 2	< 2
1,4-Dichlorobenzene	ug/L	< 2	< 2	< 2
2,4,5-Trichlorophenol	ug/L	< 5	< 5	< 5
2,4,6-Trichlorophenol	ug/L	< 5	< 5	< 5
2,4-Dichlorophenol	ug/L	< 2	< 2	< 2
2,4-Dimethylphenol	ug/L	< 2	< 2	< 2
2,4-Dinitrophenol	ug/L	< 10	< 10	< 10
2,4-Dinitrotoluene	ug/L	< 2	< 2	< 2

2,6-Dinitrotoluene	ug/L	< 2	< 2	< 2
2-Chloronaphthalene	ug/L	< 2	< 2	< 2
2-Chlorophenol	ug/L	< 2	< 2	< 2
2-Methyl-4,6-dinitrophenol	ug/L	< 10	< 10	< 10
2-Methylnaphthalene	ug/L	< 2	< 2	< 2
2-Naphthylamine	ug/L	< 20	< 20	< 20
2-Nitroaniline	ug/L	< 2	< 2	< 2
2-Nitrophenol	ug/L	< 2	< 2	< 2
3,3-Dichlorobenzidine	ug/L	< 10	< 10	< 10
3-Nitroaniline	ug/L	< 2	< 2	< 2
4-Bromophenylphenylether	ug/L	< 2	< 2	< 2
4-Chloro-3-methylphenol	ug/L	< 5	< 5	< 5
4-Chloroaniline	ug/L	< 2	< 2	< 2
4-Chlorophenylphenylether	ug/L	< 2	< 2	< 2
4-Nitroaniline	ug/L	< 5	< 5	< 5
4-Nitrophenol	ug/L	< 2	< 2	< 2
Acenaphthene	ug/L	< 2	< 2	< 2
Acenaphthylene	ug/L	< 2	< 2	< 2
Aldrin	ug/L	< 2	< 2	< 2
Aniline	ug/L	< 5	< 5	< 5
Anthracene	ug/L	< 2	< 2	< 2
BHC, alpha isomer	ug/L	< 2	< 2	< 2
BHC, beta isomer	ug/L	< 2	< 2	< 2
BHC, delta isomer	ug/L	< 2	< 2	< 2
BHC, gamma isomer (Lindar	ug/L	< 2	< 2	< 2
Benzidine	ug/L	< 20	< 20	< 20
Benzo(a)anthracene	ug/L	< 2	< 2	< 2
Benzo(a)pyrene	ug/L	< 2	< 2	< 2
Benzo(b)fluoranthene	ug/L	< 2	< 2	< 2
Benzo(g,h,i)perylene	ug/L	< 2	< 2	< 2
Benzo(k)fluoranthene	ug/L	< 2	< 2	< 2
Benzoic Acid	ug/L	< 10	< 10	< 10
Benzyl Alcohol	ug/L	< 2	< 2	< 2
Bis(2-chloroethoxy)methane	ug/L	< 2	< 2	< 2
Bis(2-chloroethyl)ether	ug/L	< 2	< 2	< 2
Bis(2-chloroisopropyl)ether	ug/L	< 2	< 2	< 2
Bis(2-ethylhexyl)phthalate	ug/L	< 5	< 5	< 5
Butylbenzylphthalate	ug/L	< 2	< 2	< 2
Chrysene	ug/L	< 2	< 2	< 2
Di-n-octylphthalate	ug/L	< 2	< 2	< 2
Dibenzo(a,h)anthracene	ug/L	< 3	< 3	< 3
Dibenzofuran	ug/L	< 2	< 2	< 2
Dibutylphthalate	ug/L	< 2	< 2	< 2
Dieldrin	ug/L	< 3	< 3	< 3
Diethylphthalate	ug/L	< 2	< 2	< 2
Dimethylphthalate	ug/L	< 2	< 2	< 2
Endosulfan I	ug/L	< 10	< 10	< 10
Endosulfan II	ug/L	< 10	< 10	< 10
Endosulfan sulfate	ug/L	< 3	< 3	< 3
Endrin	ug/L	< 2	< 2	< 2
Endrin aldehyde	ug/L	< 10	< 10	< 10
Fluoranthene	ug/L	< 2	< 2	< 2
Fluorene	ug/L	< 2	< 2	< 2

Heptachlor	ug/L	< 2	< 2	< 2
Heptachlor epoxide	ug/L	< 2	< 2	< 2
Hexachlorobenzene	ug/L	< 2	< 2	< 2
Hexachlorobutadiene	ug/L	< 2	< 2	< 2
Hexachlorocyclopentadiene	ug/L	< 2	< 2	< 2
Hexachloroethane	ug/L	< 2	< 2	< 2
Indeno(1,2,3-c,d)pyrene	ug/L	< 2	< 2	< 2
Isophorone	ug/L	< 2	< 2	< 2
N-Nitrosodimethylamine	ug/L	< 2	< 2	< 2
N-Nitrosodi-n-propylamine	ug/L	< 2	< 2	< 2
N-Nitrosodiphenylamine	ug/L	< 2	< 2	< 2
Naphthalene	ug/L	< 2	< 2	< 2
Nitrobenzene	ug/L	< 2	< 2	< 2
Pentachlorophenol	ug/L	< 10	< 10	< 10
Phenanthrene	ug/L	< 2	< 2	< 2
Phenol	ug/L	< 2	< 2	2.1
Pyrene	ug/L	< 2	< 2	< 2
m- and p- Cresol	ug/L	< 2	< 2	< 2
o-Cresol	ug/L	< 2	< 2	< 2
p,p-DDD	ug/L	< 2	< 2	< 2
p,p-DDE	ug/L	< 3	< 3	< 3
p,p-DDT	ug/L	< 2	< 2	< 2
HMX	ug/L	< 5	< 5	< 5
RDX	ug/L	< 5	< 5	< 5
Total Organic Carbon (TOC)	mg/L	< 1	< 1	< 1
Gross alpha	Bq/L	0.020 ± 0.022	0.038 ± 0.029	-0.009 ± 0.008
Gross beta	Bq/L	0.117 ± 0.032	0.110 ± 0.031	-0.002 ± 0.021
Radium 226	Bq/L	0.001 ± 0.002	0.001 ± 0.002	0.003 ± 0.003
Tritium	Bq/L	6.105 ± 2.109	4.847 ± 2.109	-3.582 ± 1.998
Thorium 228	Bq/L	0.000 ± 0.001	0.000 ± 0.001	0.000 ± 0.001
Thorium 232	Bq/L	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Uranium (total)	Bq/L	0.089 ± 0.009	0.090 ± 0.009	0.000 ± 0.001

(a) Radioactivity is corrected for the background radioactivity inside the measurement apparatus.

Negative radioactivity indicates that the sample measured less than the background by the amount shown.

Radioactivity equal to or less than the 2-sigma uncertainty shown is considered to be a nondetection.

(b). Sample not submitted for analysis (sampling error).

Table C-2. Quality Assurance Samples for 2004 at Pit 7

First Quarter 2004		QA Samples		
Constituent ^(a)	Units	Well K7-01 routine	Well K7-01 duplicate	Pit 7 field blank
Arsenic	µg/L	11	12	< 2
Barium	µg/L	220	220	< 25
Beryllium	µg/L	< 0.5	< 0.5	< 0.5
Cadmium	µg/L	< 0.5	< 0.5	< 0.5
Cobalt	µg/L	< 25	< 25	< 25
Copper	µg/L	10	< 10	< 10
Lead	µg/L	< 2	< 2	< 2
Nickel	µg/L	< 5	< 5	< 5
Vanadium	µg/L	< 25	< 25	< 25
Zinc	µg/L	< 20	< 20	< 20
1,1,1-Trichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	µg/L	< 1	< 1	< 1
1,2-Dichloropropane	µg/L	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
2-Chloroethylvinylether	µg/L	< 10	< 10	< 10
Bromodichloromethane	µg/L	< 0.5	< 0.5	< 0.5
Bromoform	µg/L	< 0.5	< 0.5	< 0.5
Bromomethane	µg/L	< 1	< 1	< 1
Carbon tetrachloride	µg/L	< 0.5	< 0.5	< 0.5
Chlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
Chloroethane	µg/L	< 0.5	< 0.5	< 0.5
Chloroform	µg/L	< 0.5	< 0.5	< 0.5
Chloromethane	µg/L	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	µg/L	< 0.5	< 0.5	< 0.5
Dibromochloromethane	µg/L	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	µg/L	< 0.5	< 0.5	< 0.5
Freon 113	µg/L	< 0.5	< 0.5	< 0.5
Methylene chloride	µg/L	< 1	< 1	< 1
Tetrachloroethene	µg/L	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	µg/L	< 0.5	< 0.5	< 0.5
Trichloroethene	µg/L	2.1	2.2	< 0.5
Trichlorofluoromethane	µg/L	< 0.5	< 0.5	< 0.5
Vinyl chloride	µg/L	< 0.5	< 0.5	< 0.5
Perchlorate	µg/L	18	19	< 4
Nirrate	mg/L	44	43	< 0.44
HMX	µg/L	< 5	< 5	< 5
RDX	µg/L	< 5	< 5	< 5
Gross alpha (Bq/L) ^(b)	Bq/L	0.61 ± 0.16	0.51 ± 0.14	0.004 ± 0.010
Gross beta (Bq/L)	Bq/L	0.53 ± 0.13	0.44 ± 0.11	0.01 ± 0.02
Radium 226 (Bq/L)	Bq/L	0.06 ± 0.01	0.05 ± 0.01	0.005 ± 0.003
Thorium 228 (Bq/L)	Bq/L	0.0003 ± 0.0010	0.0014 ± 0.0013	0.0000 ± 0.0007
Thorium 232 (Bq/L)	Bq/L	-0.001 ± 0.001	-0.0005 ± 0.0003	-0.0002 ± 0.0005
Tritium (Bq/L)	Bq/L	2400 ± 240	2400 ± 240	-1.8 ± 2.2
Uranium (total) (Bq/L)	Bq/L	0.70 ± 0.05	0.71 ± 0.05	0.001 ± 0.001

Table C-2. cont.**Second Quarter 2004**

Constituent ^(a)	Units	QA Samples		
		Well K7-06 routine	Well K7-06 duplicate	Pit 7 field blank
Arsenic	µg/L	20	21	< 2
Barium	µg/L	91	91	< 25
Beryllium	µg/L	< 0.5	< 0.5	< 0.5
Cadmium	µg/L	< 0.5	< 0.5	< 0.5
Cobalt	µg/L	< 25	< 25	< 25
Copper	µg/L	< 10	< 10	< 10
Lead	µg/L	< 2	< 2	< 2
Nickel	µg/L	< 5	< 5	< 5
Vanadium	µg/L	43	45	< 25
Zinc	µg/L	< 20	< 20	< 20
1,1,1-Trichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	µg/L	< 1	< 1	< 1
1,2-Dichloropropane	µg/L	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
2-Chloroethylvinylether	µg/L	< 10	< 10	< 10
Bromodichloromethane	µg/L	< 0.5	< 0.5	< 0.5
Bromoform	µg/L	< 0.5	< 0.5	< 0.5
Bromomethane	µg/L	< 1	< 1	< 1
Carbon tetrachloride	µg/L	< 0.5	< 0.5	< 0.5
Chlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
Chloroethane	µg/L	< 0.5	< 0.5	< 0.5
Chloroform	µg/L	< 0.5	< 0.5	< 0.5
Chloromethane	µg/L	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	µg/L	< 0.5	< 0.5	< 0.5
Dibromochloromethane	µg/L	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	µg/L	< 0.5	< 0.5	< 0.5
Freon 113	µg/L	< 0.5	< 0.5	< 0.5
Methylene chloride	µg/L	< 1	< 1	< 1
Tetrachloroethene	µg/L	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	µg/L	< 0.5	< 0.5	< 0.5
Trichloroethene	µg/L	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	µg/L	< 0.5	< 0.5	< 0.5
Vinyl chloride	µg/L	< 0.5	< 0.5	< 0.5
Perchlorate	µg/L	< 4	< 4	< 4
Nitrate	mg/L	14.9	14.6	< 0.44
HMX	µg/L	< 5	< 5	< 5
RDX	µg/L	< 5	< 5	< 5
Gross alpha (Bq/L) ^(b)	Bq/L	0.030 ± 0.023	0.041 ± 0.026	-0.0002 ± 0.006
Gross beta (Bq/L)	Bq/L	0.091 ± 0.034	0.135 ± 0.041	0.0003 ± 0.023
Radium 226 (Bq/L)	Bq/L	0.013 ± 0.005	0.013 ± 0.005	0.005 ± 0.003
Thorium 228 (Bq/L)	Bq/L	0.0002 ± 0.001	0.0002 ± 0.001	0.0000 ± 0.001
Thorium 232 (Bq/L)	Bq/L	-0.0002 ± 0.0002	0.0000 ± 0.001	-0.0003 ± 0.0005
Tritium (Bq/L)	Bq/L	-2.0 ± 1.9	-2.4 ± 1.9	0.2 ± 1.8
Uranium (total) (Bq/L)	Bq/L	0.026 ± 0.004	0.027 ± 0.004	0.001 ± 0.001

Table C-2. cont.

Third Quarter 2004		QA samples		
Constituent (units)	Units	NC7-47	NC7-47	PIT7
		routine	duplicate	field blank
Arsenic	µg/L	11	12	< 2
Barium	µg/L	56	65	< 25
Beryllium	µg/L	< 0.5	< 0.5	< 0.5
Cadmium	µg/L	< 0.5	< 0.5	< 0.5
Cobalt	µg/L	< 25	< 25	< 25
Copper	µg/L	< 10	< 10	< 10
Lead	µg/L	< 2	< 2	< 2
Nickel	µg/L	< 5	< 5	< 5
Vanadium	µg/L	60	67	< 25
Zinc	µg/L	< 20	< 20	< 20
1,1,1-Trichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	µg/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	µg/L	< 1	< 1	< 1
1,2-Dichloropropane	µg/L	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
2-Chloroethylvinylether	µg/L	< 10	< 10	< 10
Bromodichloromethane	µg/L	< 0.5	< 0.5	< 0.5
Bromoform	µg/L	< 0.5	< 0.5	< 0.5
Bromomethane	µg/L	< 1	< 1	< 1
Carbontetrachloride	µg/L	< 0.5	< 0.5	< 0.5
Chlorobenzene	µg/L	< 0.5	< 0.5	< 0.5
Chloroethane	µg/L	< 0.5	< 0.5	< 0.5
Chloroform	µg/L	< 0.5	< 0.5	< 0.5
Chloromethane	µg/L	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	µg/L	< 0.5	< 0.5	< 0.5
Dibromochloromethane	µg/L	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	µg/L	< 0.5	< 0.5	< 0.5
Freon113	µg/L	< 0.5	< 0.5	< 0.5
Methylenechloride	µg/L	< 1	< 1	< 1
Tetrachloroethene	µg/L	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	µg/L	< 0.5	< 0.5	< 0.5
Trichloroethene	µg/L	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	µg/L	< 0.5	< 0.5	< 0.5
Vinylchloride	µg/L	< 0.5	< 0.5	< 0.5
TotalTrihalomethanes	µg/L	< 2	< 2	< 2
Perchlorate	mg/L	< 4	< 4	< 4
HMX	µg/L	< 5	< 5	< 5
RDX	µg/L	< 5	< 5	< 5
Gross alpha (Bq/L)	Bq/L	0.039 ± 0.037	0.021 ± 0.037	0.000 ± 0.006
Gross beta (Bq/L)	Bq/L	0.186 ± 0.063	0.198 ± 0.048	0.020 ± 0.024
Radium 226 (Bq/L)	Bq/L	0.002 ± 0.003	0.001 ± 0.002	0.004 ± 0.003
Thorium 228 (Bq/L)	Bq/L	0.000 ± 0.000	0.000 ± 0.001	0.000 ± 0.001
Thorium 232 (Bq/L)	Bq/L	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Tritium (Bq/L)	Bq/L	1.0 ± 1.8	-0.3 ± 1.9	6.3 ± 2.2
Uranium (total) (Bq/L)	Bq/L	0.068 ± 0.007	0.065 ± 0.007	0.000 ± 0.000

Table C-2. cont.**Fourth Quarter 2004****QA Samples**

Constituent	Units	NC7-47 routine	NC7-47 duplicate	PIT7 field blank
Arsenic	ug/L	12	11	< 2
Barium	ug/L	65	56	< 25
Beryllium	ug/L	< 0.5	< 0.5	< 0.5
Cadmium	ug/L	< 0.5	< 0.5	< 0.5
Cobalt	ug/L	< 25	< 25	< 25
Copper	ug/L	< 10	< 10	< 10
Lead	ug/L	< 2	< 2	< 2
Nickel	ug/L	< 5	< 5	< 5
Vanadium	ug/L	67	60	< 25
Zinc	ug/L	< 20	< 20	< 20
1,1,1-Trichloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1,2-Trichloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	ug/L	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	ug/L	< 0.5	< 0.5	< 0.5
1,2-Dichloroethene (total)	ug/L	< 1	< 1	< 1
1,2-Dichloropropane	ug/L	< 0.5	< 0.5	< 0.5
1,3-Dichlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
1,4-Dichlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
2-Chloroethylvinylether	ug/L	< 10	< 10	< 10
Bromodichloromethane	ug/L	< 0.5	< 0.5	< 0.5
Bromoform	ug/L	< 0.5	< 0.5	< 0.5
Bromomethane	ug/L	< 1	< 1	< 1
Carbon tetrachloride	ug/L	< 0.5	< 0.5	< 0.5
Chlorobenzene	ug/L	< 0.5	< 0.5	< 0.5
Chloroethane	ug/L	< 0.5	< 0.5	< 0.5
Chloroform	ug/L	< 0.5	< 0.5	< 0.5
Chloromethane	ug/L	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	ug/L	< 0.5	< 0.5	< 0.5
Dibromochloromethane	ug/L	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	ug/L	< 0.5	< 0.5	< 0.5
Freon 113	ug/L	< 0.5	< 0.5	< 0.5
Methylene chloride	ug/L	< 1	< 1	< 1
Tetrachloroethene	ug/L	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	ug/L	< 0.5	< 0.5	< 0.5
Trichloroethene	ug/L	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	ug/L	< 0.5	< 0.5	< 0.5
Vinyl chloride	ug/L	< 0.5	< 0.5	< 0.5
Total Trihalomethanes	ug/L	< 2	< 2	< 2
HMX	ug/L	< 5	< 5	< 5
RDX	ug/L	< 5	< 5	< 5
Gross alpha	Bq/L	0.021 ± 0.037	0.039 ± 0.037	0.000 ± 0.006
Gross beta	Bq/L	0.198 ± 0.048	0.186 ± 0.063	0.020 ± 0.024
Radium 226	Bq/L	0.001 ± 0.002	0.002 ± 0.003	0.004 ± 0.003
Tritium	Bq/L	-0.30 ± 1.85	0.95 ± 1.81	6.33 ± 2.18
Thorium 228	Bq/L	0.000 ± 0.001	0.000 ± 0.000	0.000 ± 0.001
Thorium 232	Bq/L	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Uranium (total)	Bq/L	0.065 ± 0.007	0.068 ± 0.0069	0.000 ± 0.000

(a) Constituent units are micrograms per liter ($\mu\text{g/L}$) unless otherwise indicated.

(b) Radioactivity is corrected for background and negative values indicate that the sample is less than background

Appendix D

Uranium-235/Uranium-238 Ratios for Monitoring Wells K7-01 and K7-03

Appendix D

Uranium-235/Uranium-238 Ratios for Monitoring Wells K7-01 and K7-03

Table D-1. Uranium mass element ratios for ground water samples collected from Pit 7 monitoring wells K7-01 and K7-03 (Natural=0.0072)

Well K7-01	U-235	U-238	U235/U238
Date	(Bq/L)	(Bq/L)	mass ratio
September 8, 1993	0.0076	0.1628	0.0073
December 9, 1993	0.0077	0.1635	0.0073
February 8, 1994	0.0077	0.1632	0.0073
January 22, 1997	0.0078	0.1669	0.0073
January 22, 1997	0.0078	0.1635	0.0074
February 11, 2000	0.0153	0.3293	0.0072
April 25, 2000	0.0163	0.3491	0.0073
April 25, 2000	0.0149	0.3186	0.0073
July 24, 2000	0.0171	0.3604	0.0074
October 30, 2000	0.0173	0.3676	0.0073
October 30, 2000	0.0162	0.3456	0.0073
January 23, 2001	0.0191	0.4108	0.0073
April 24, 2001	0.0171	0.3708	0.0072
July 17, 2001	0.0180	0.3875	0.0072
July 17, 2001	0.0163	0.3489	0.0073
October 24, 2001	0.0177	0.3801	0.0073
January 23, 2002	0.0170	0.3659	0.0072
April 22, 2002	0.0159	0.3426	0.0072
April 22, 2002	0.0173	0.3728	0.0072
September 13, 2002	0.0159	0.3437	0.0072
November 27, 2002	0.0179	0.3837	0.0073
November 27, 2002	0.0159	0.3432	0.0072
February 10, 2003	0.0177	0.3811	0.0072
May 1, 2003	0.0165	0.3522	0.0073
May 1, 2003	0.0172	0.3667	0.0073
September 9, 2003	0.0112	0.5561	0.0031
December 2, 2003	0.0175	0.3758	0.0073
January 21, 2004	0.0175	0.3817	0.0072
April 28, 2004	0.0172	0.3696	0.0072
August 4, 2004	0.0186	0.4114	0.0071
November 2, 2004	0.0146	0.3136	0.0073
		Average	0.0071

Well K7-03	U-235	U-238	U235/U238
Date	(Bq/L)	(Bq/L)	mass ratio
September 8, 1993	0.0030	0.0640	0.0072
December 9, 1993	0.0030	0.0644	0.0073
February 9, 1994	0.0026	0.0555	0.0073
January 23, 1997	0.0023	0.0490	0.0073
February 11, 2000	0.0030	0.0639	0.0073
April 25, 2000	0.0032	0.0687	0.0072
July 24, 2000	0.0035	0.0762	0.0072
October 30, 2000	0.0030	0.0644	0.0073
January 23, 2001	0.0041	0.0875	0.0073
April 17, 2001	0.0043	0.0926	0.0073
April 17, 2001	0.0048	0.1020	0.0073
July 17, 2001	0.0045	0.0959	0.0073
October 24, 2001	0.0054	0.1143	0.0073
January 23, 2002	0.0047	0.1009	0.0073
January 23, 2002	0.0051	0.1085	0.0073
April 22, 2002	0.0048	0.1033	0.0073
September 6, 2002	0.0052	0.1119	0.0073
September 6, 2002	0.0054	0.1156	0.0073
November 27, 2002	0.0047	0.0997	0.0073
February 7, 2003	0.0060	0.1289	0.0073
February 7, 2003	0.0045	0.0958	0.0073
May 1, 2003	0.0043	0.0908	0.0073
September 17, 2003	0.0061	0.1299	0.0073
December 9, 2003	0.0058	0.1251	0.0073
January 27, 2004	0.0067	0.1561	0.0067
April 20, 2004	0.0054	0.1177	0.0072
August 10, 2004	0.0060	0.1310	0.0072
October 29, 2004	0.0088	0.1890	0.0072
		Average	0.0073

Appendix E

Graphs of Ground Water

Measurements

Appendix E

As required by the monitoring and reporting provisions of WDR 93-100, this appendix contains graphs of COC concentrations measured during 2004. Historical data have been added to most of the graphs to show post-closure trends. Annual graphs of ground water measurements specific to the post-closure plan (**Table E-1**) are not required, but they have been included for completeness. Pit 1 data are plotted first.

The sequence of graphs is by COC and by well. For each COC, the sequence of wells is the same. Upgradient (background) well results are plotted first. Graphs show concentration (or other parameter) on the y axis, with time on the x axis (time in years is divided into quarterly sample periods). The header and the vertical axis labels on each plot give the units of measurement. Three different symbols are used to plot the data: a black diamond, an inverted white triangle, and a plus sign. Their different uses are explained below.

COC detections are plotted as black diamonds. Analytical laboratories report COC measurements above analytical reporting limits (RLs) as detections. (The RL for a COC is a contractual concentration value near zero.) COC concentrations below RLs are nondetections and are reported as "less than the RL." For nonradioactive COCs, nondetections are assigned RL values and appear as inverted white triangles in the data graphs.

Nondetections of radioactive COCs are treated differently. Activities below RLs have been estimated since 1992. Estimated activities below RLs appear as plus signs in the graphs of radioactive COCs. Estimated activities below RLs for historical data are not available prior to 1992. Total uranium activity is obtained by adding activities of its three main isotopes: uranium-234, uranium-235, and uranium-238. If one or more of the activities is estimated, total uranium is plotted as a plus sign.

Statistical limits of concentration (SLs) are shown on the COC graphs as horizontal dotted lines. The numerical value of an SL is given in the plot legend. If the SL for a COC is the same for all wells (prediction interval), then it appears on all of the well graphs (e.g., beryllium). If the SL for a COC is variable (control chart), then it appears only on the downgradient wells to which it applies (e.g., arsenic).

Wherever the vertical axis scale has been adjusted to graphically show more detail for the majority of the data by excluding a small number of outliers, the footnote "Data omitted" has been added to the graph.

Table E-1. Pits 1 and 7 constituents of concern (COC) and monitoring frequencies.^(a)

Constituent	WDR ^(b)	PCP ^(c)	Pit 1	Pit 7
Arsenic	X		Q	Q
Barium	X		Q	Q
Beryllium	X		Q	Q
Cadmium	X		Q	Q
Chloride		X	A	
Chromium		X	SA	
Cobalt	X		Q	Q
Copper	X		Q	Q
Iron		X	SA	
Lead	X		Q	Q
Manganese		X	SA	
Mercury		X	SA	
Nickel	X		Q	Q
Nitrate		X	SA	
Selenium		X	SA	
Silver		X	SA	
Sodium		X	SA	
Sulfate		X	A	
Vanadium	X		Q	Q
Zinc	X		Q	Q
Total organic carbon (TOC)		X	A	
Total organic halides (TOX)		X	A	
EPA Method 601		X		Q
EPA Method 624		X	A	
EPA Method 625		X	A	
EPA Method 608		X	A	
Gross alpha and gross beta		X	SA	Q
Radium 226	X		Q	Q
Thorium 228	X		Q	Q
Thorium 232	X		Q	Q
Tritium	X		Q	Q
Uranium (total)	X		Q	Q
HMX	X		Q	Q
RDX	X		Q	Q
Ground water elevation		X	SA	Q
Ground water temperature		X	SA	
pH		X	SA	
Specific conductance		X	SA	

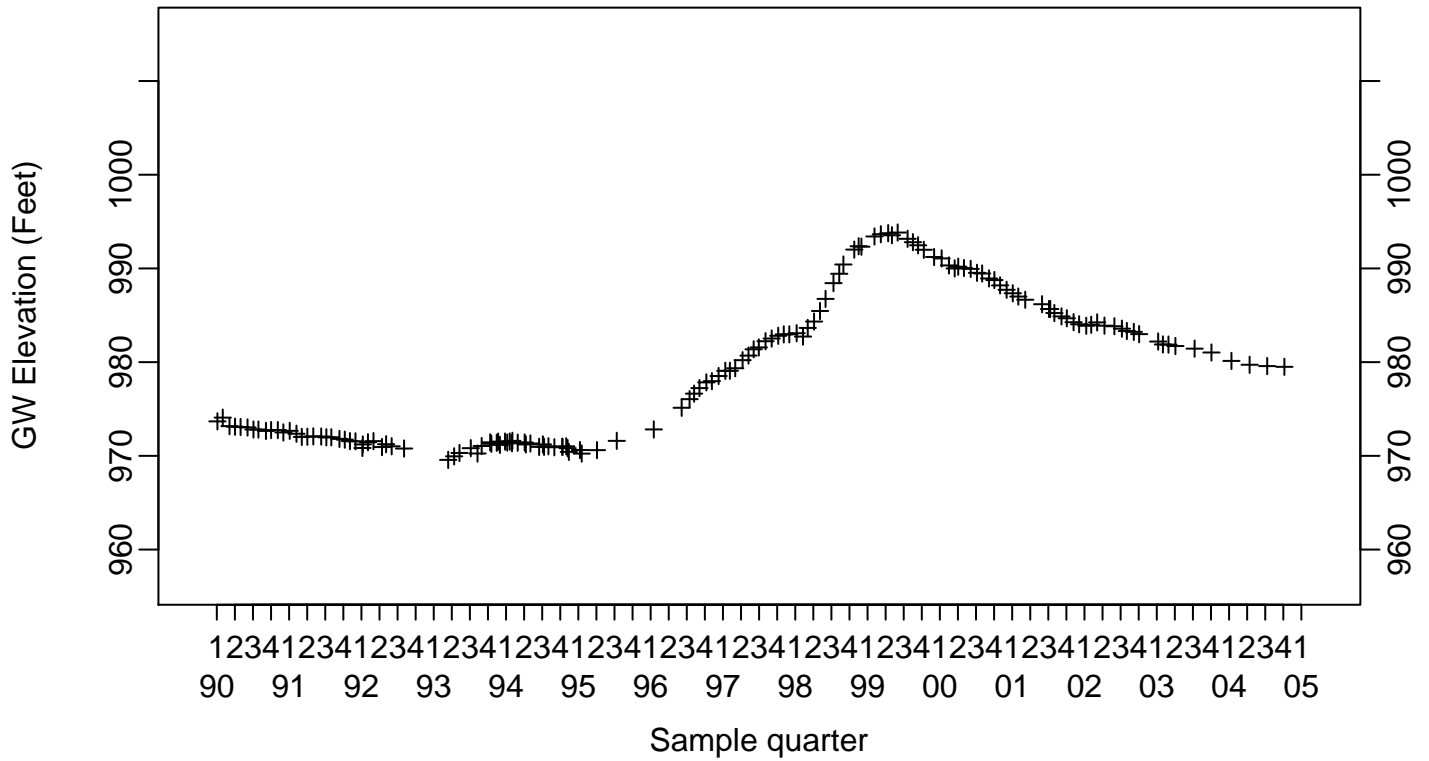
(a) Monitoring frequencies are: Q (quarterly); SA (semiannually); A (annually).

(b) COCs required to be monitored by WDR 93-100 Rev. 2 (CVRWQCB 1998).

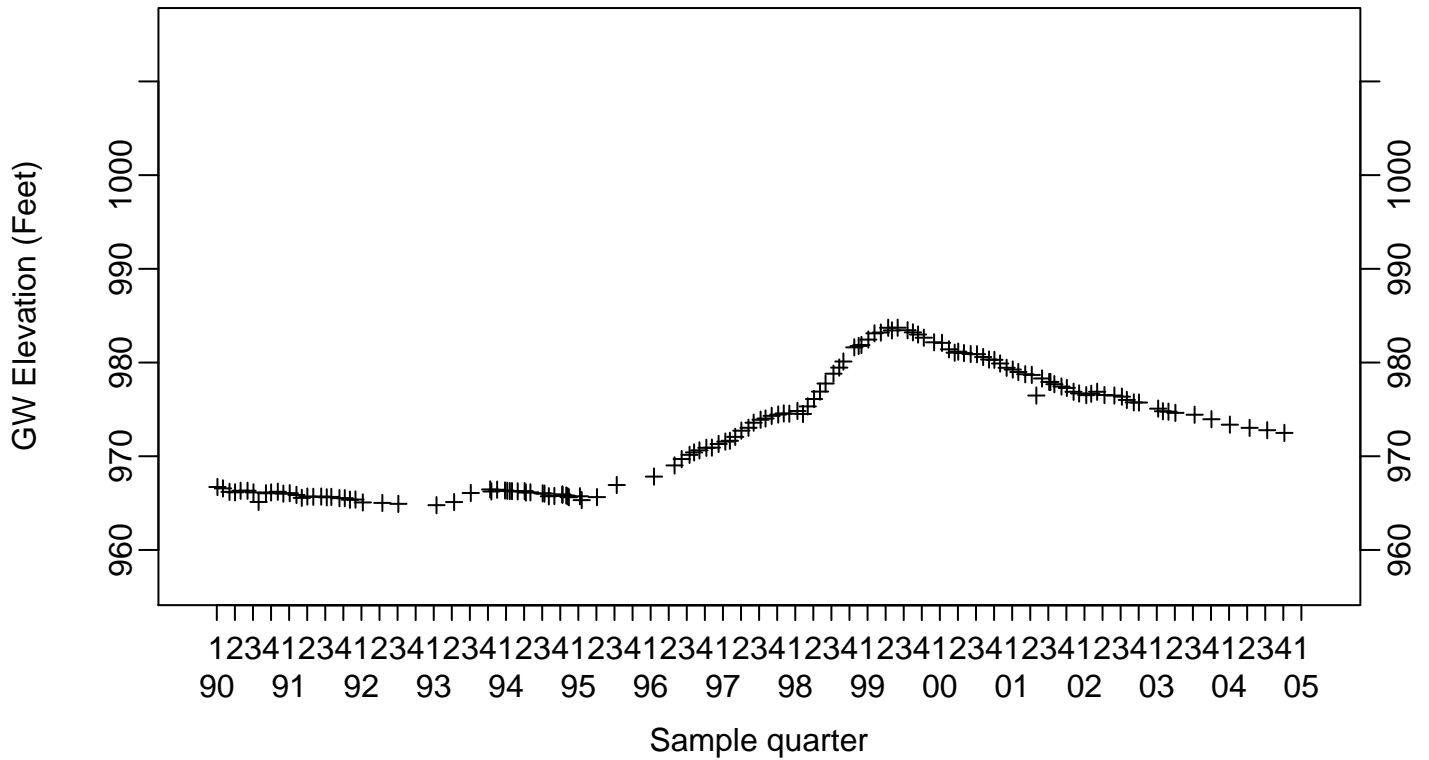
(c) Additional COCs required to be monitored by the post-closure plan (Rogers/Pacific Corporation 1990).

Pit 1 Area GW Elevation (Feet)

Background Monitoring Point K1-01C

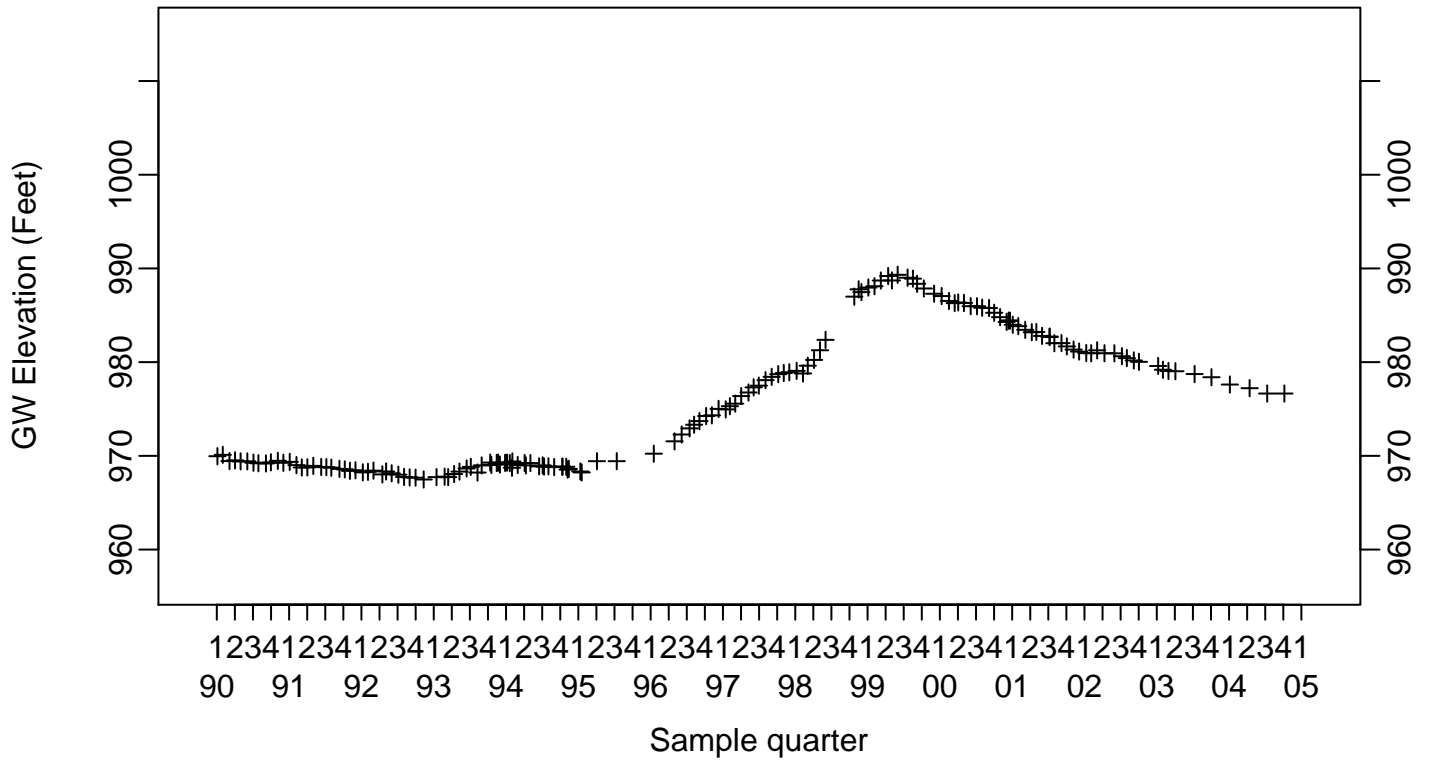


Background Monitoring Point K1-07

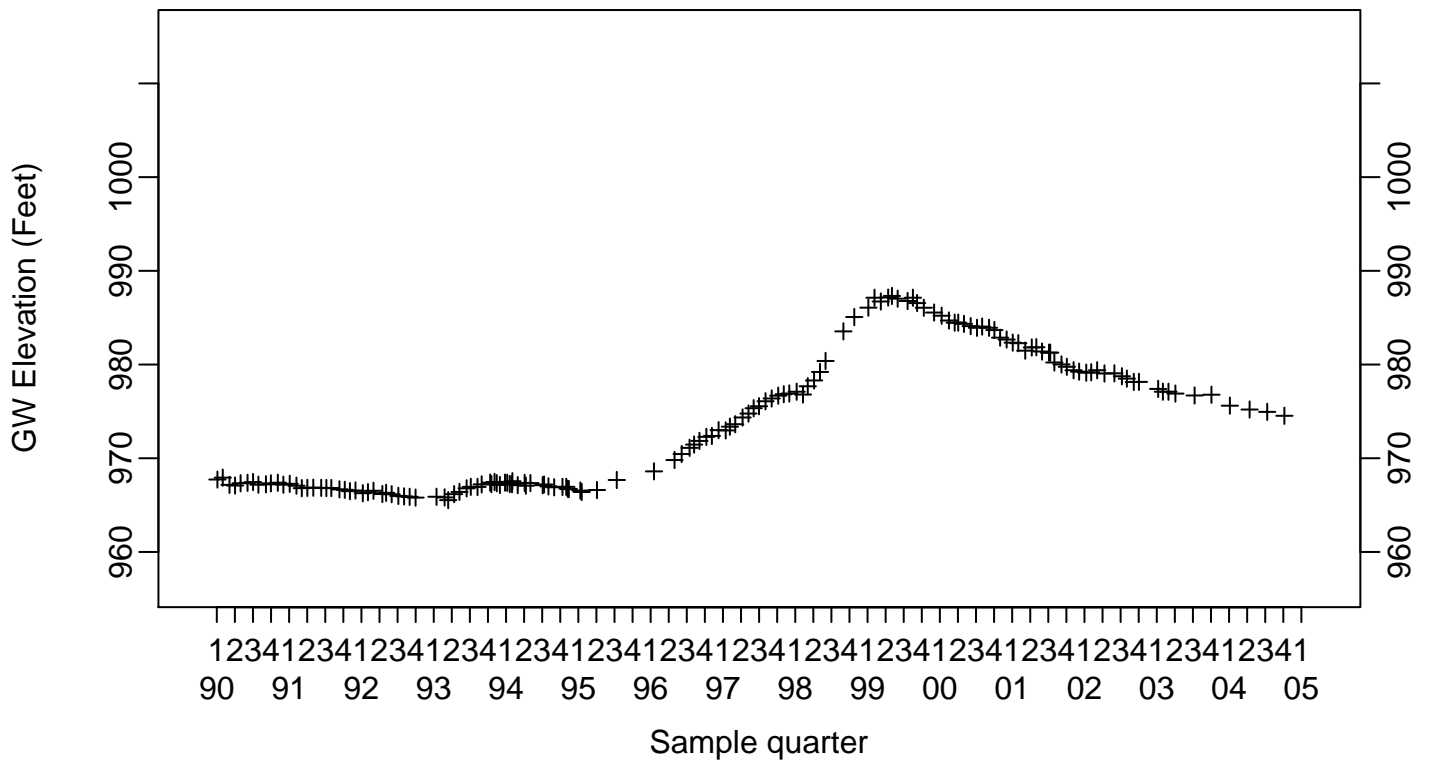


Pit 1 Area GW Elevation (Feet)

Compliance Monitoring Point K1-02B

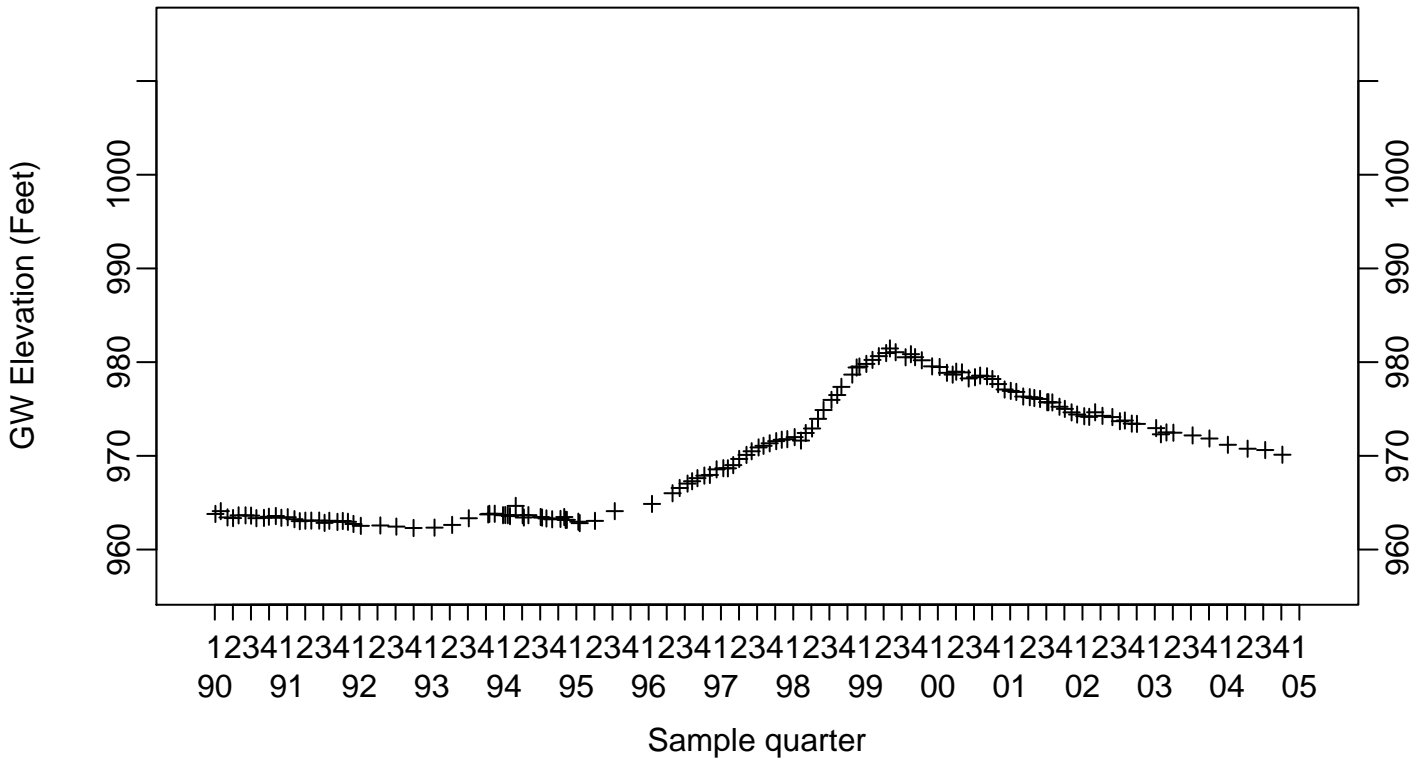


Compliance Monitoring Point K1-03

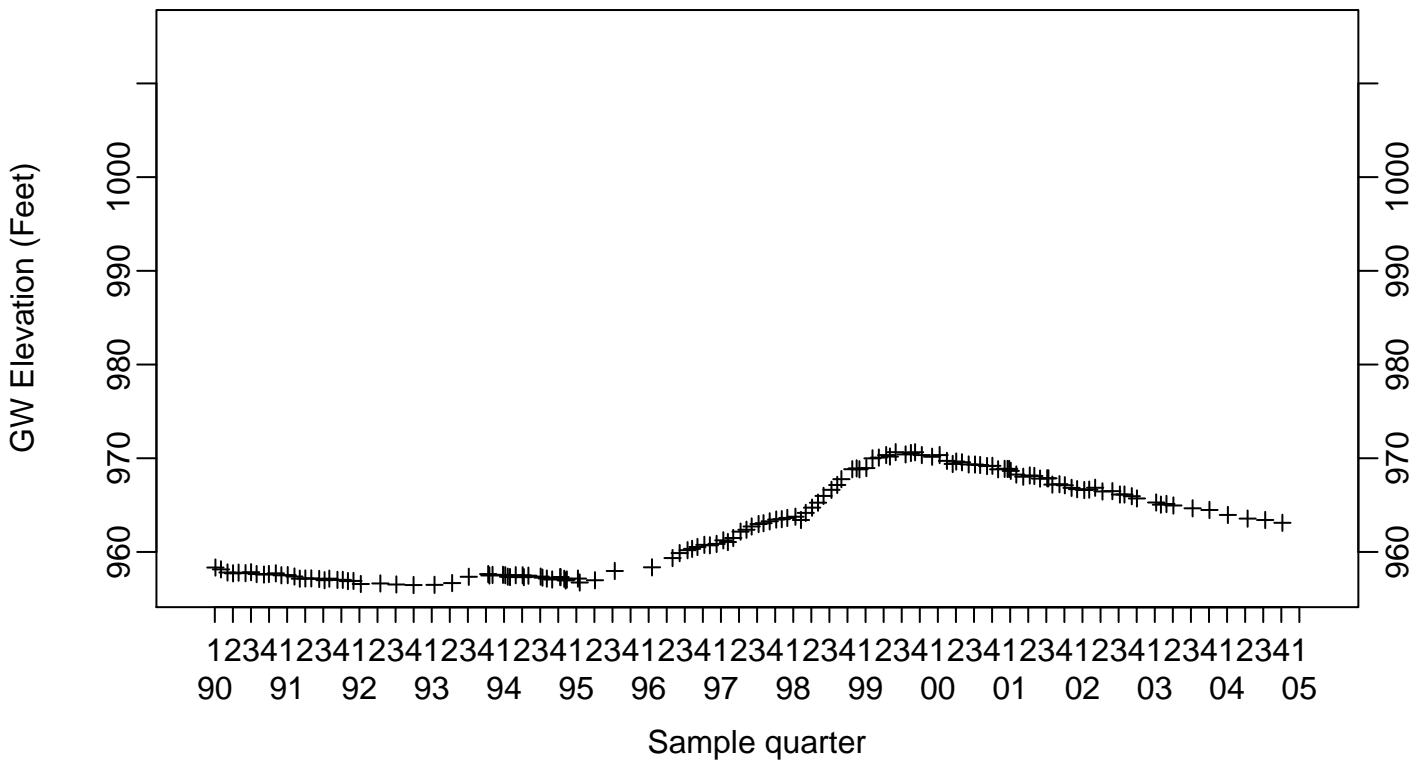


Pit 1 Area GW Elevation (Feet)

Compliance Monitoring Point K1-04

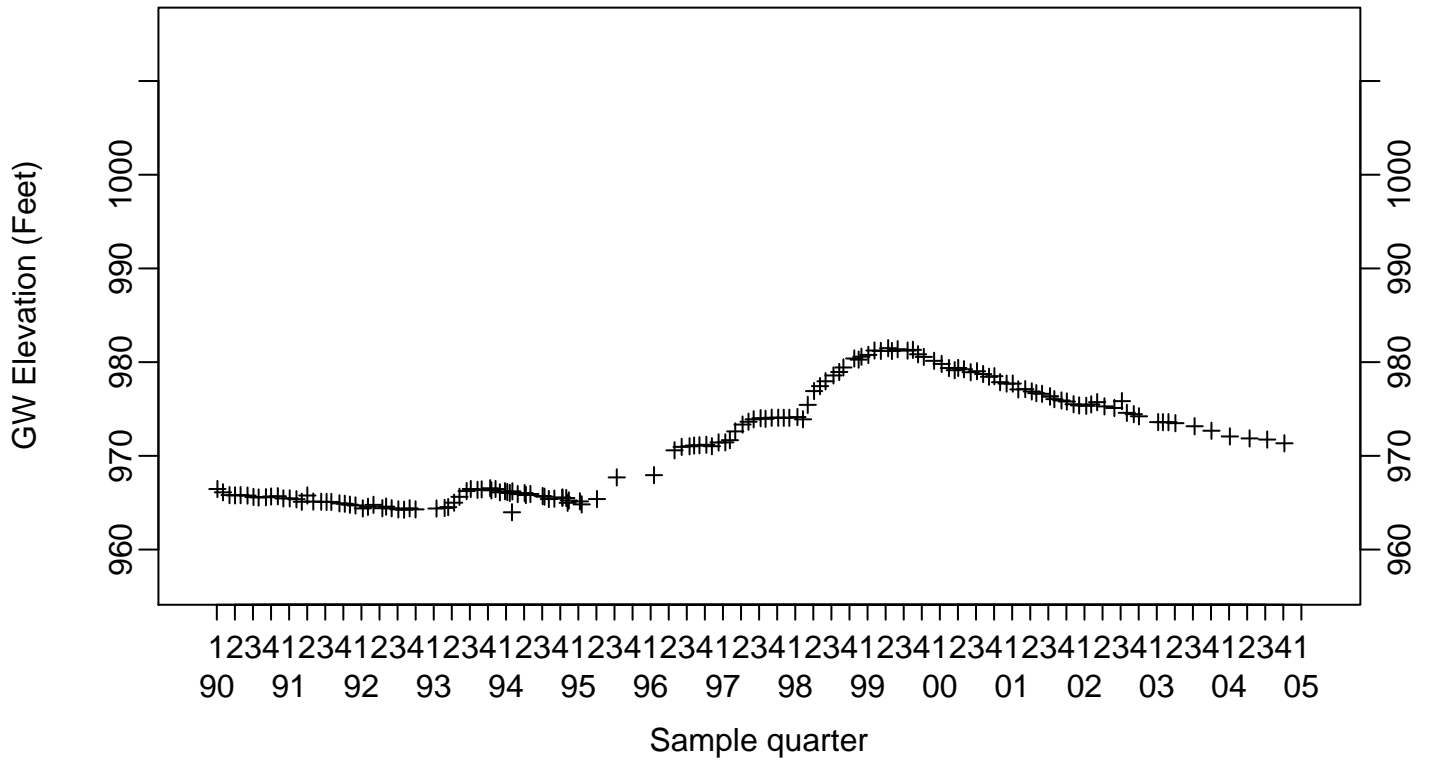


Compliance Monitoring Point K1-05

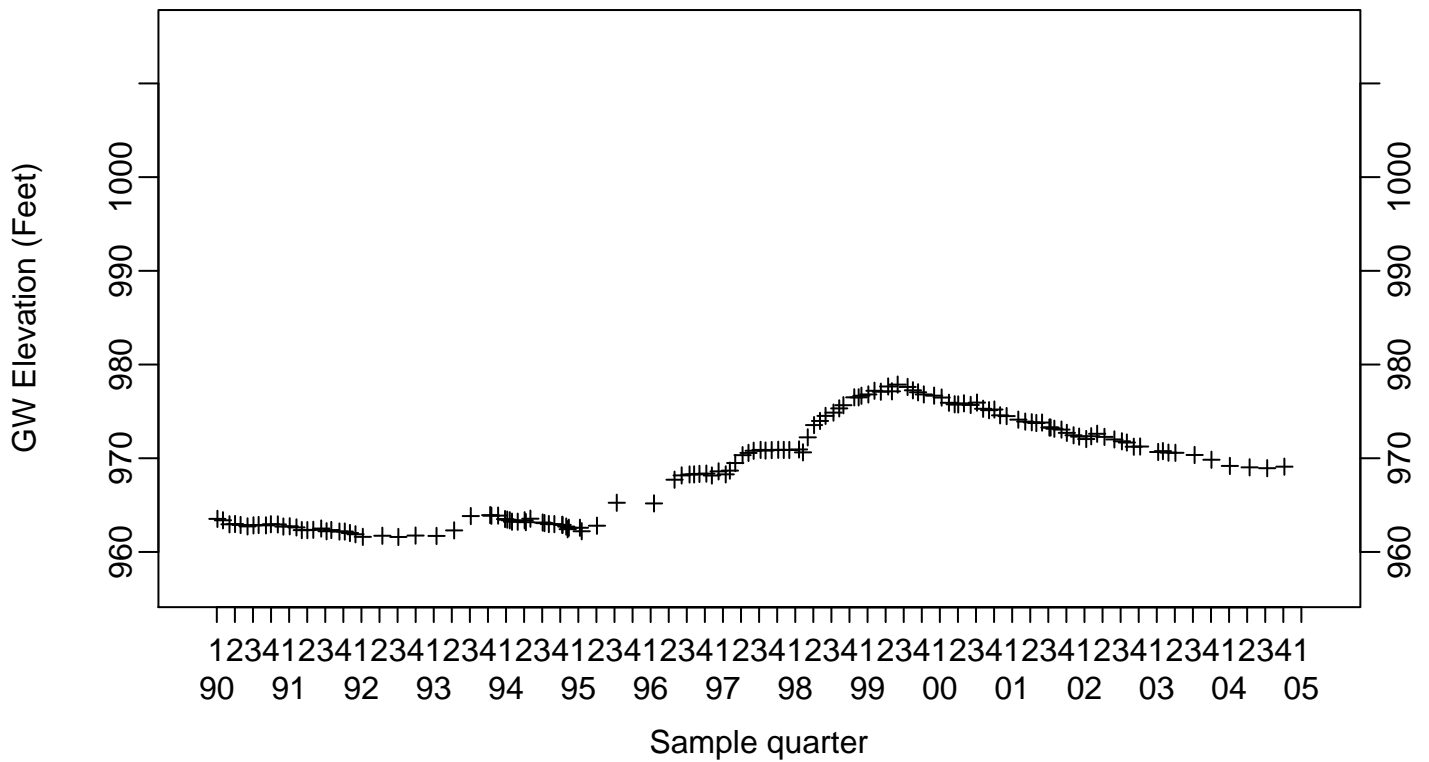


Pit 1 Area GW Elevation (Feet)

Compliance Monitoring Point K1-08

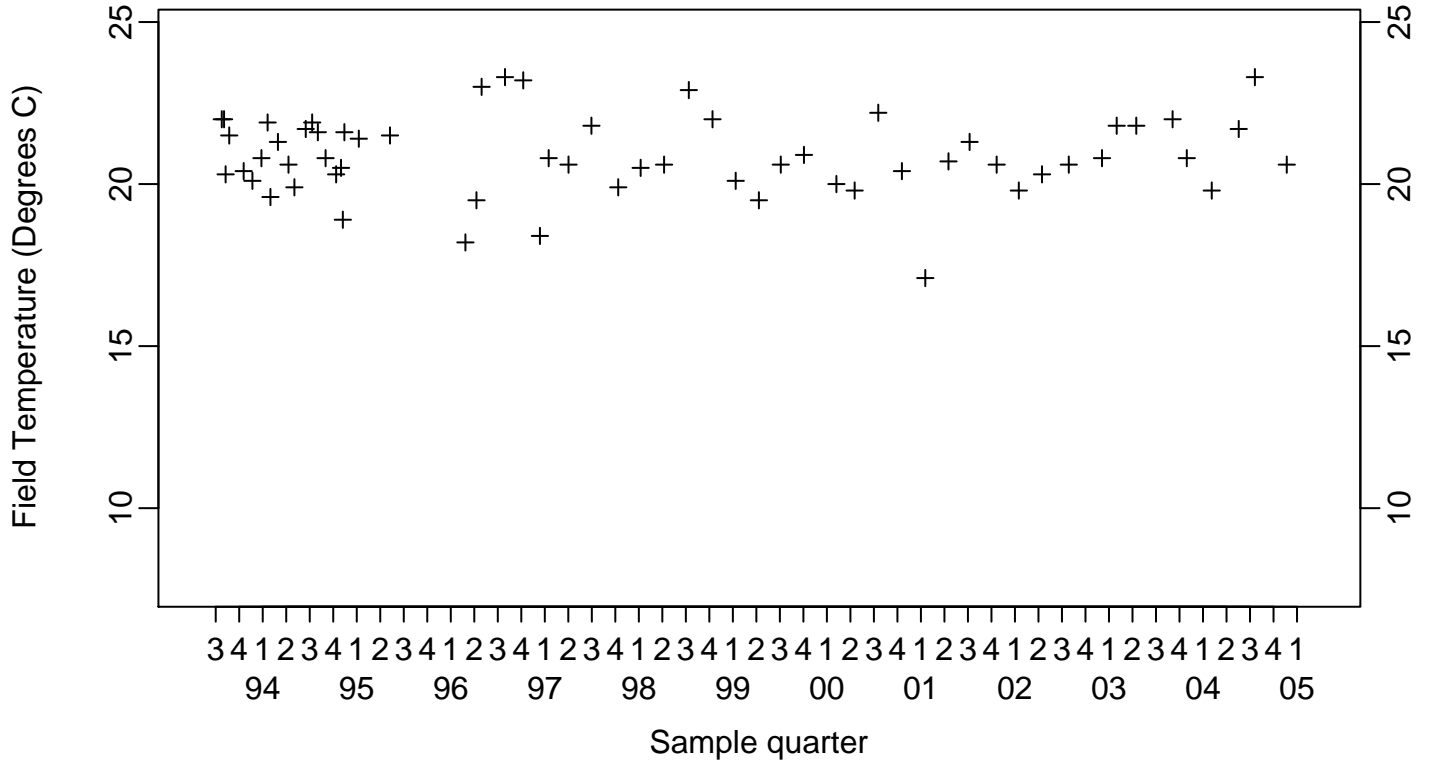


Compliance Monitoring Point K1-09

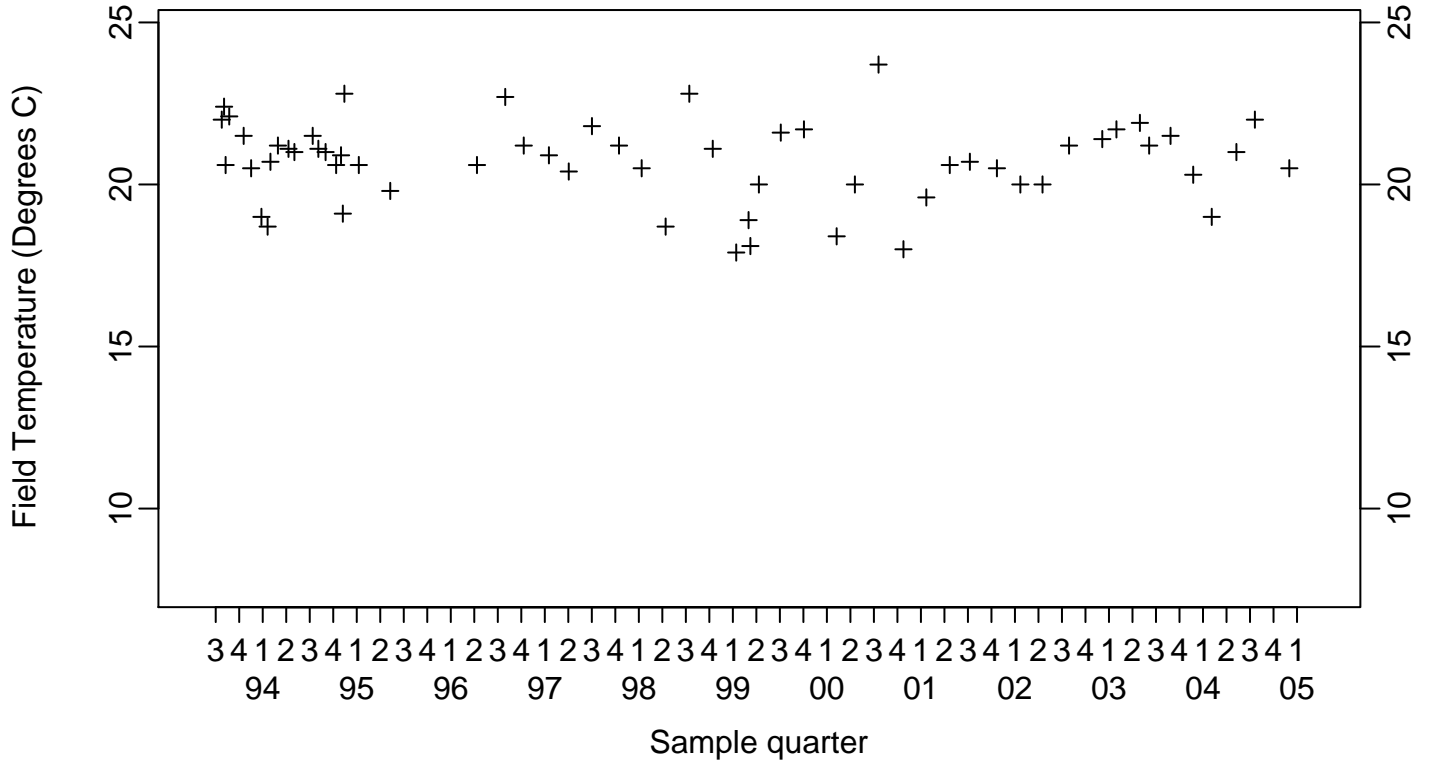


Pit 1 Area Field Temperature (Degrees C)

Background Monitoring Point K1-01C

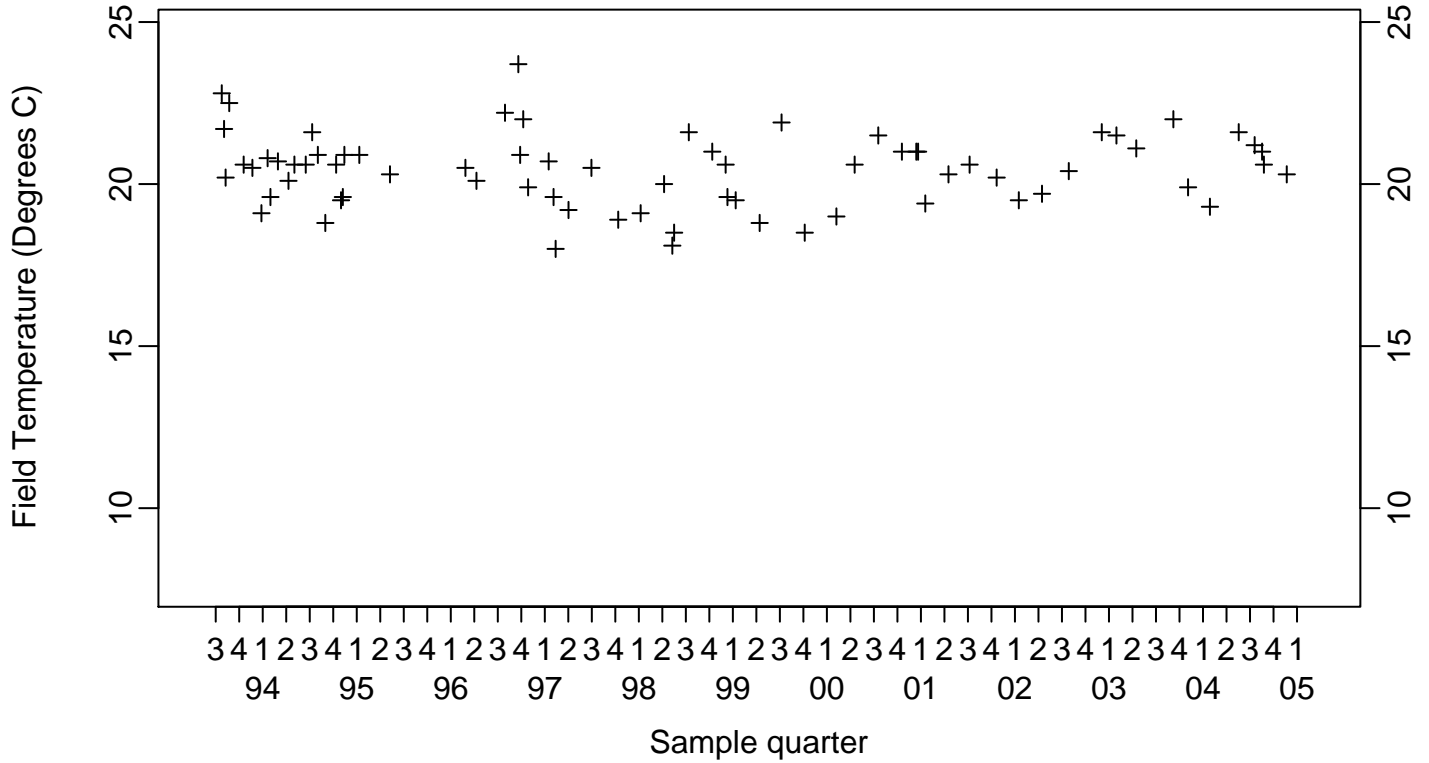


Background Monitoring Point K1-07

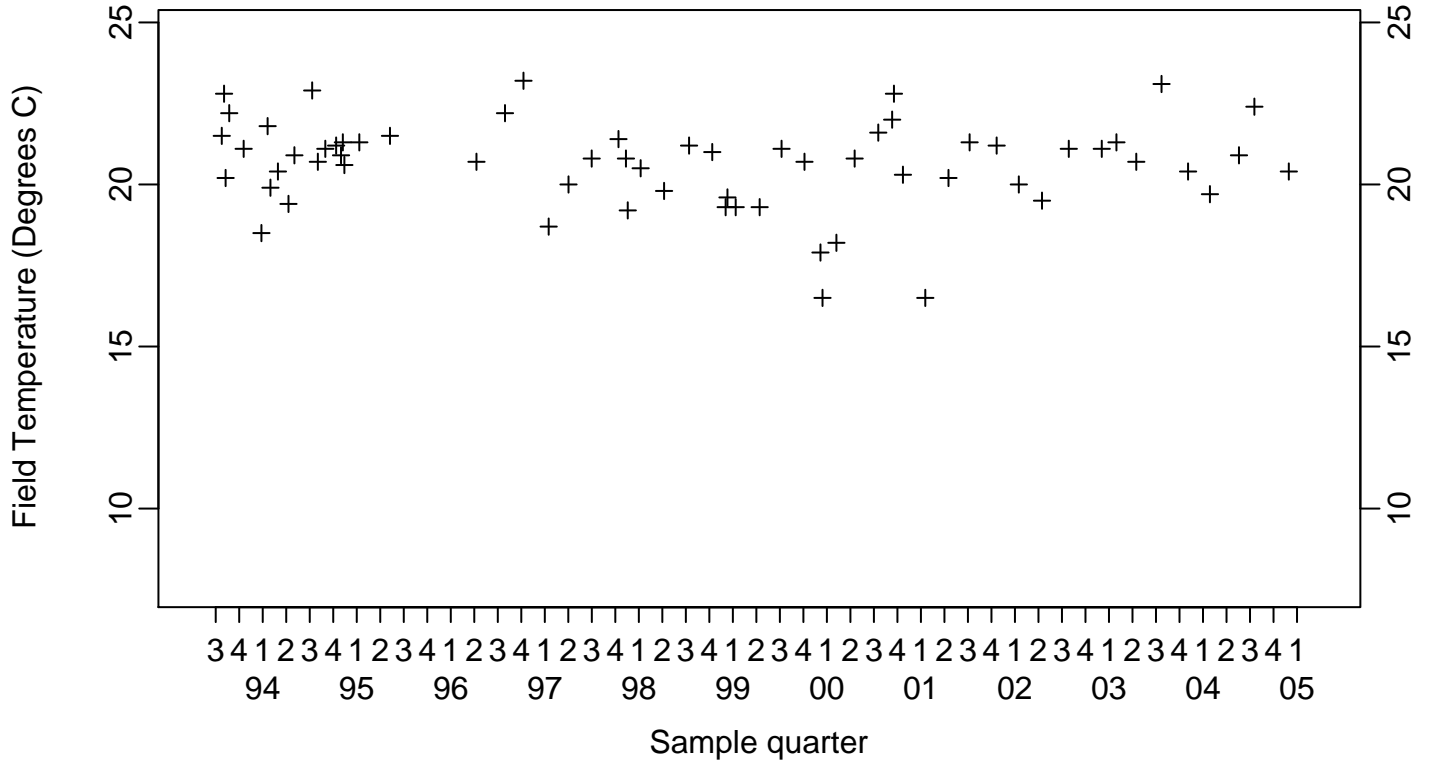


Pit 1 Area Field Temperature (Degrees C)

Compliance Monitoring Point K1-02B

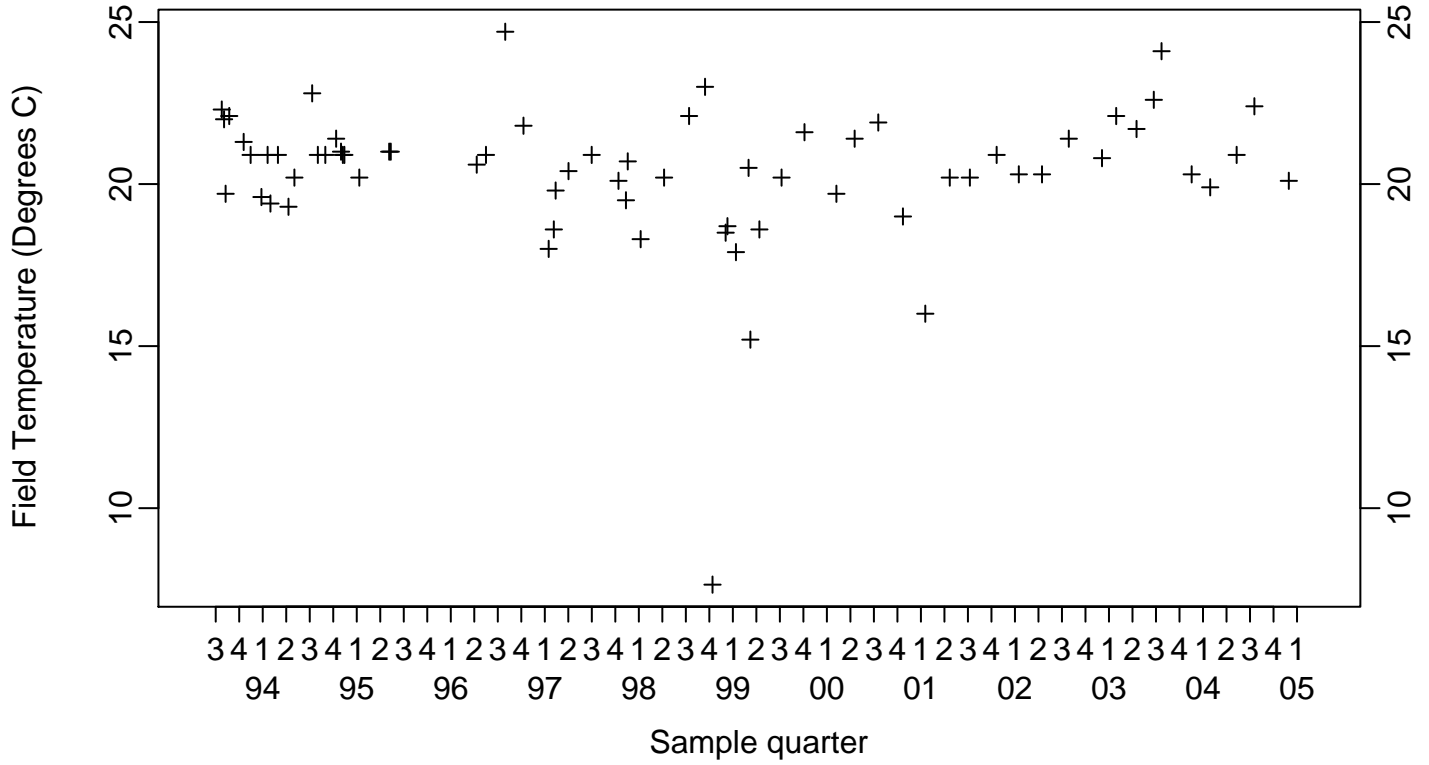


Compliance Monitoring Point K1-03

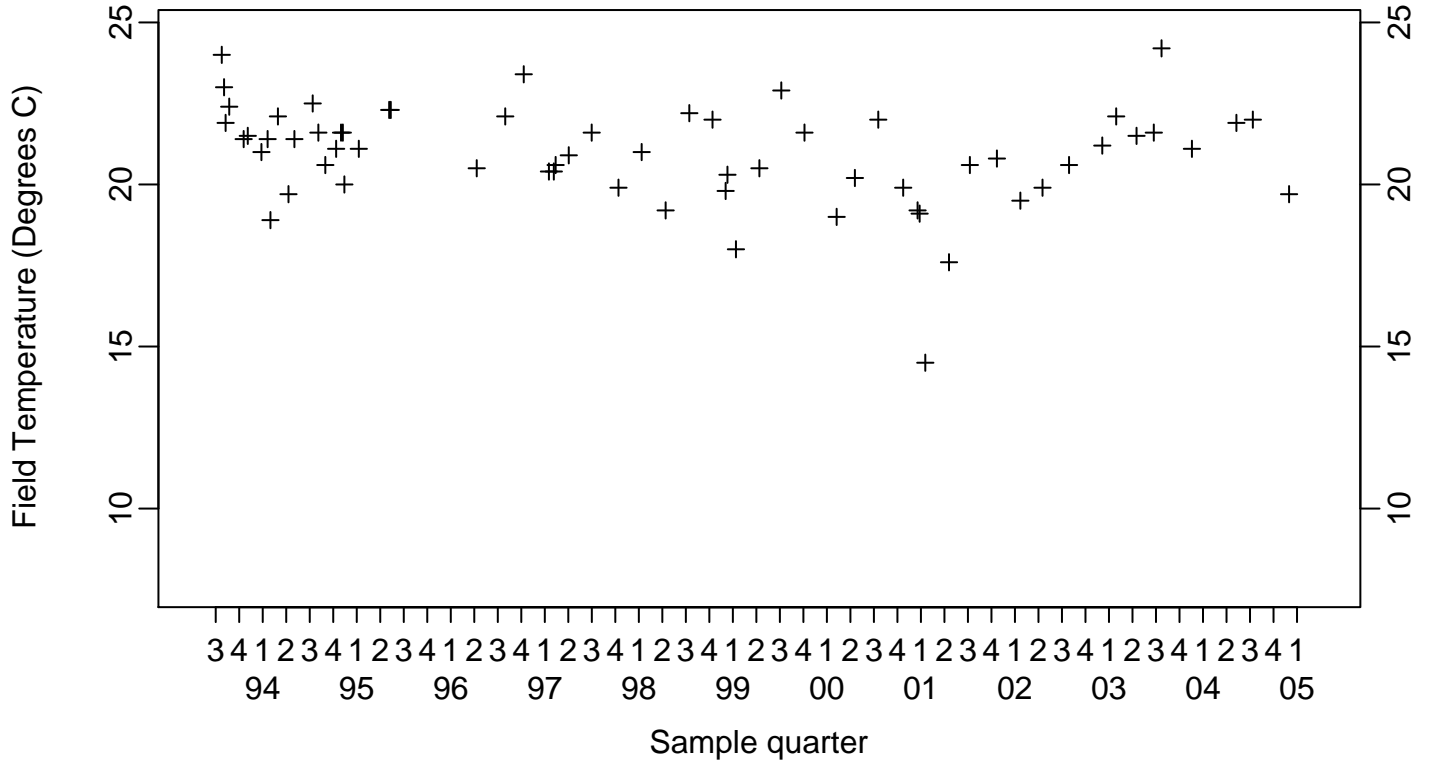


Pit 1 Area Field Temperature (Degrees C)

Compliance Monitoring Point K1-04

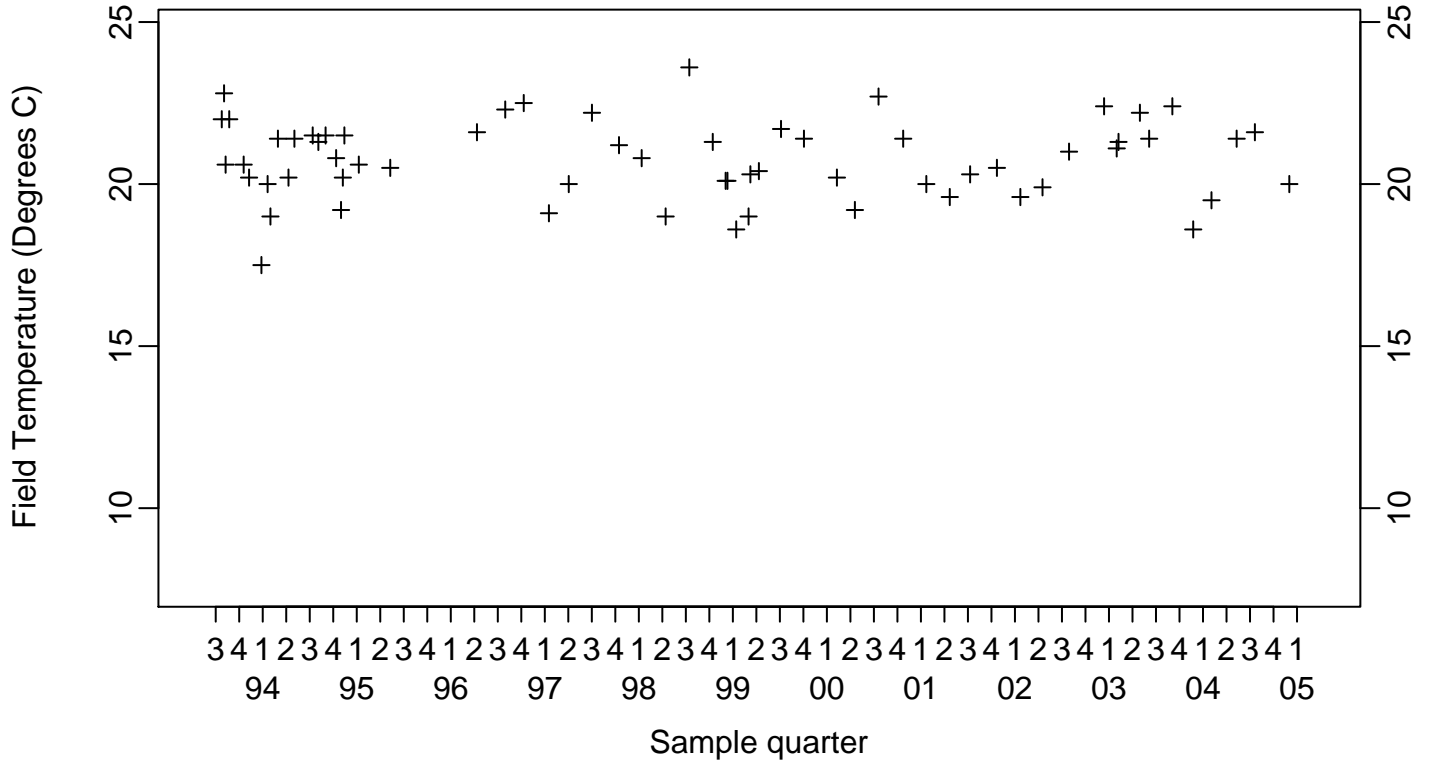


Compliance Monitoring Point K1-05

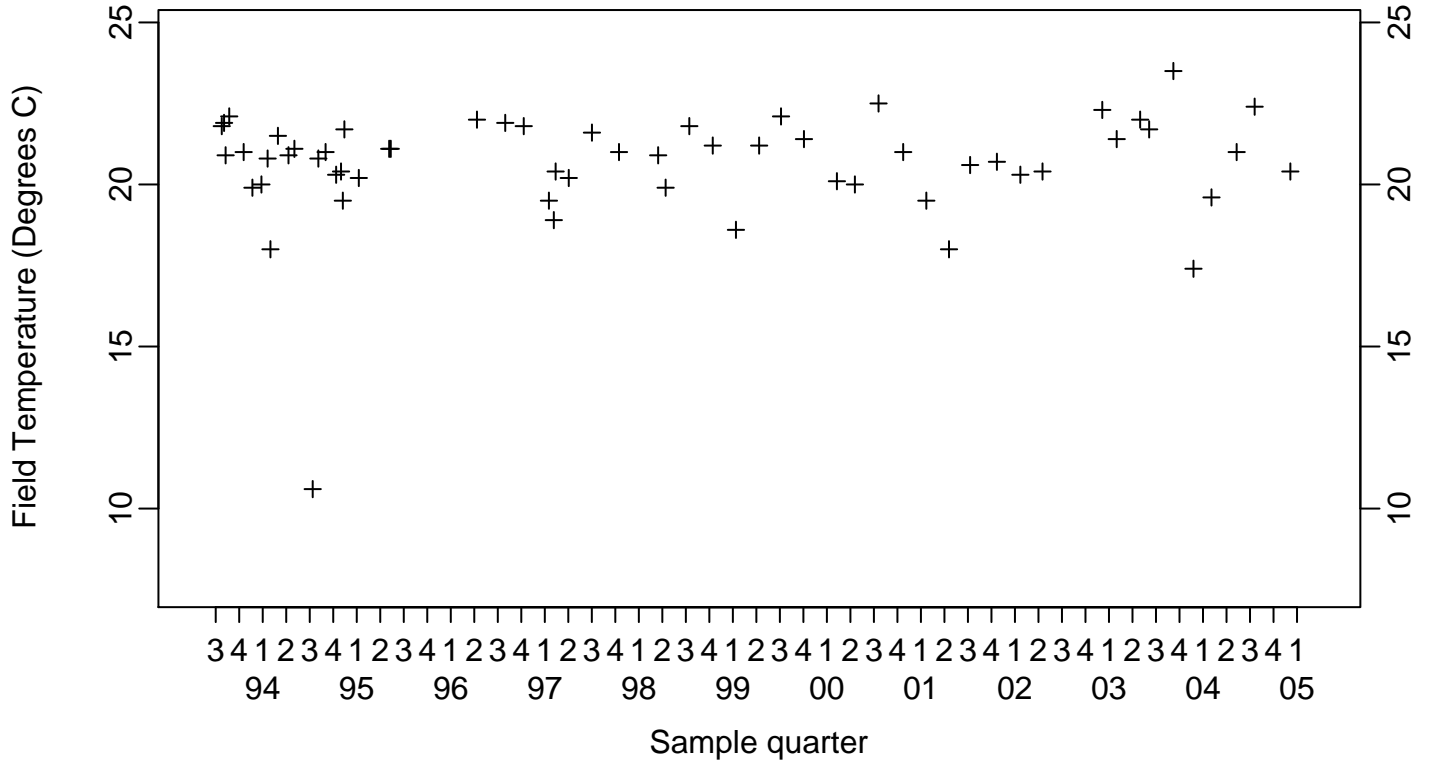


Pit 1 Area Field Temperature (Degrees C)

Compliance Monitoring Point K1-08



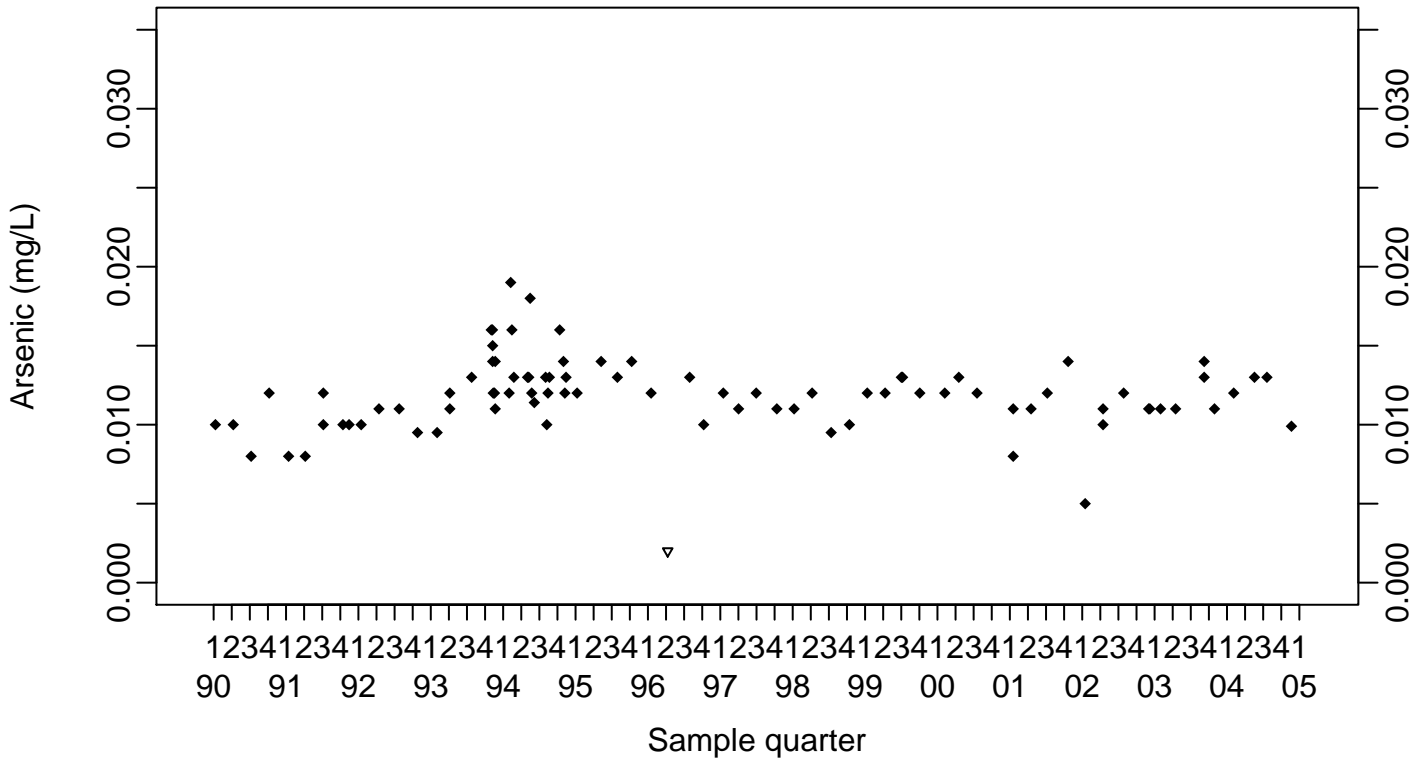
Compliance Monitoring Point K1-09



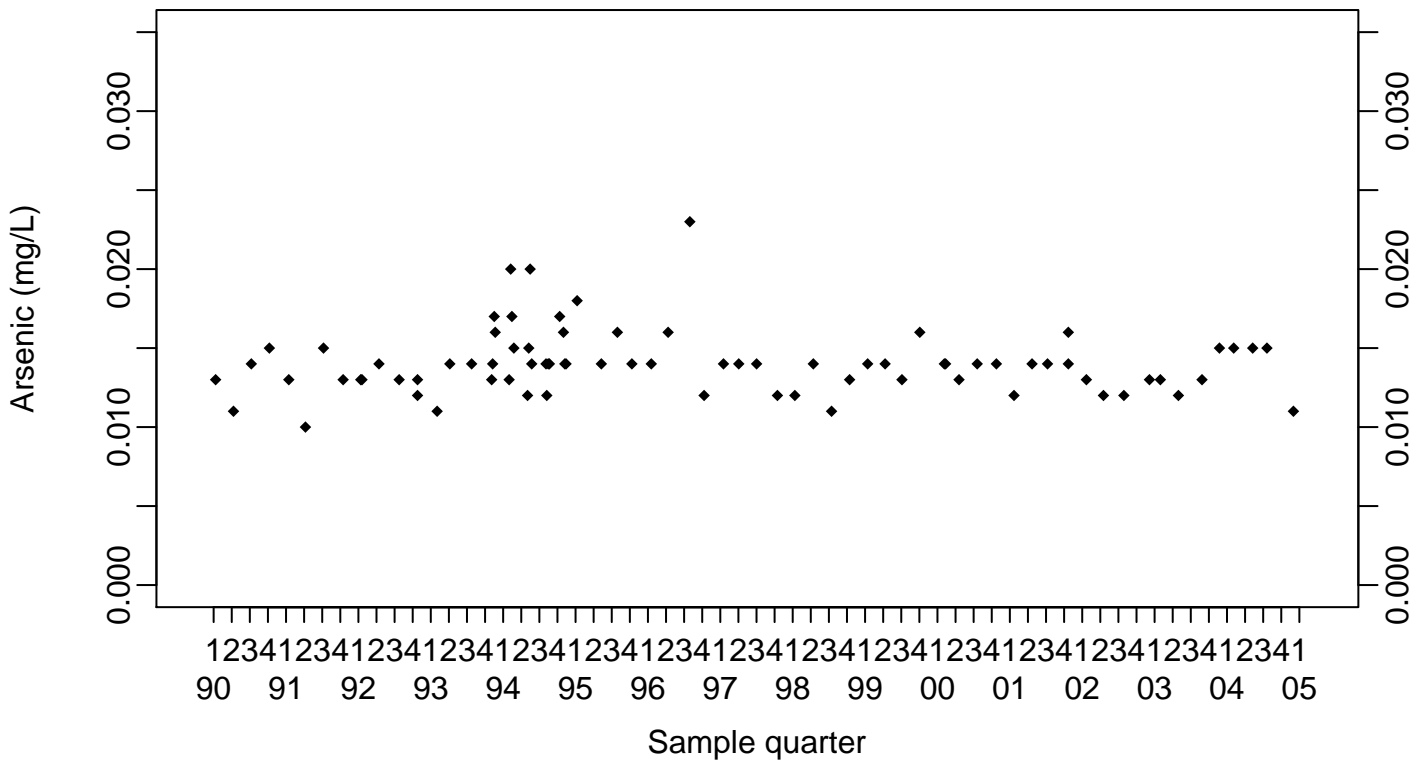
Pit 1 Area Arsenic (mg/L)

Background Monitoring Point K1-01C

◆ Above RL
▽ Below RL



Background Monitoring Point K1-07

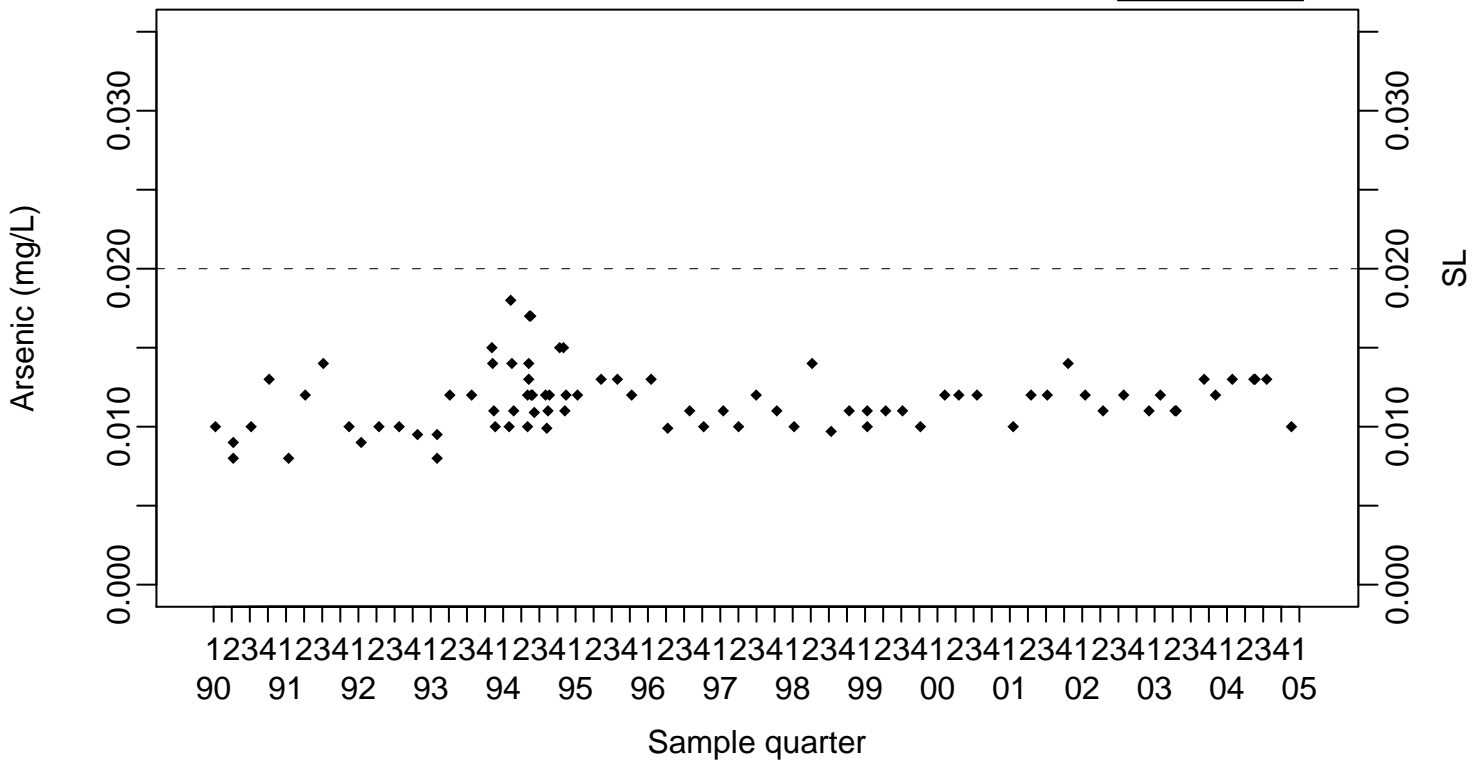


Pit 1 Area Arsenic (mg/L)

SL=0.02

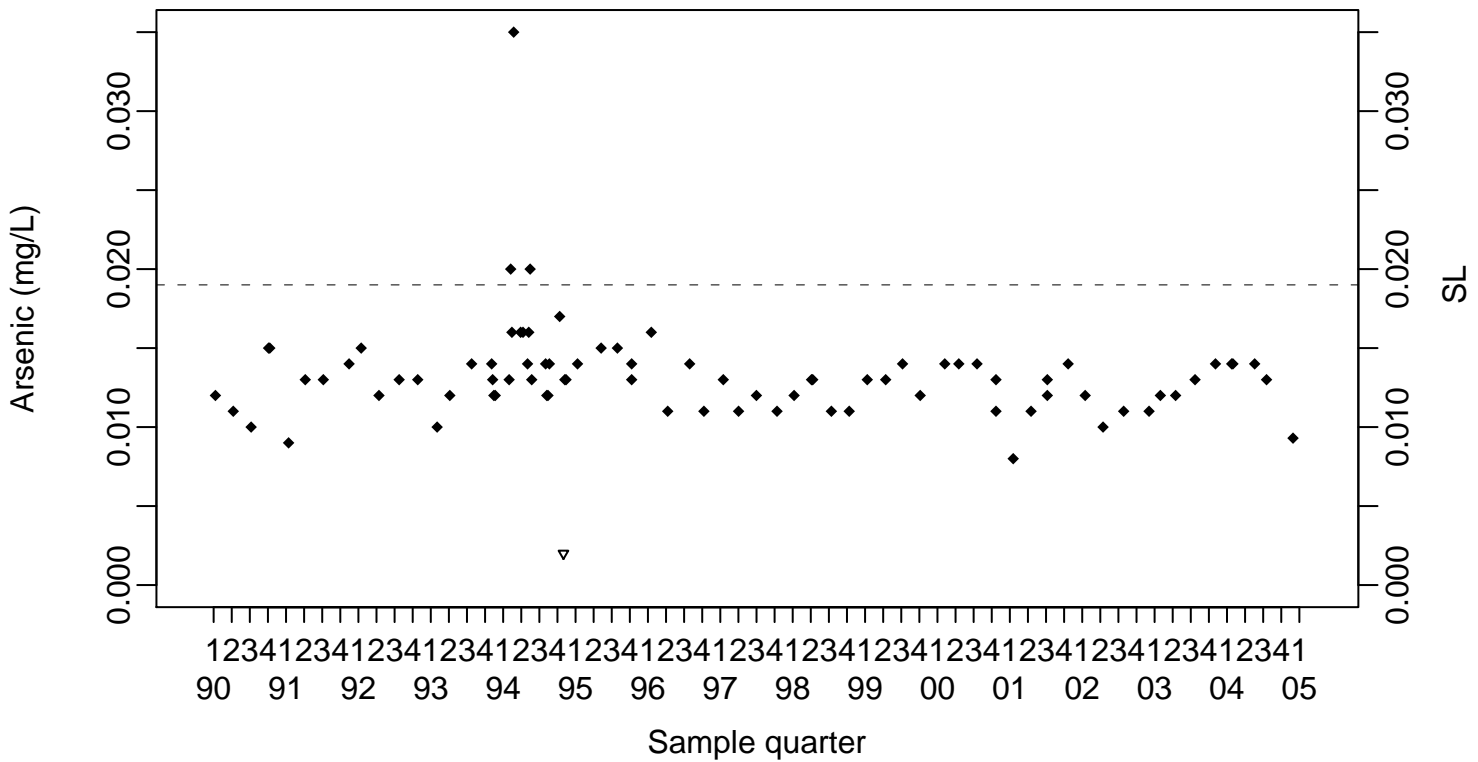
◆ Above RL
▽ Below RL

Compliance Monitoring Point K1-02B



SL=0.019

Compliance Monitoring Point K1-03

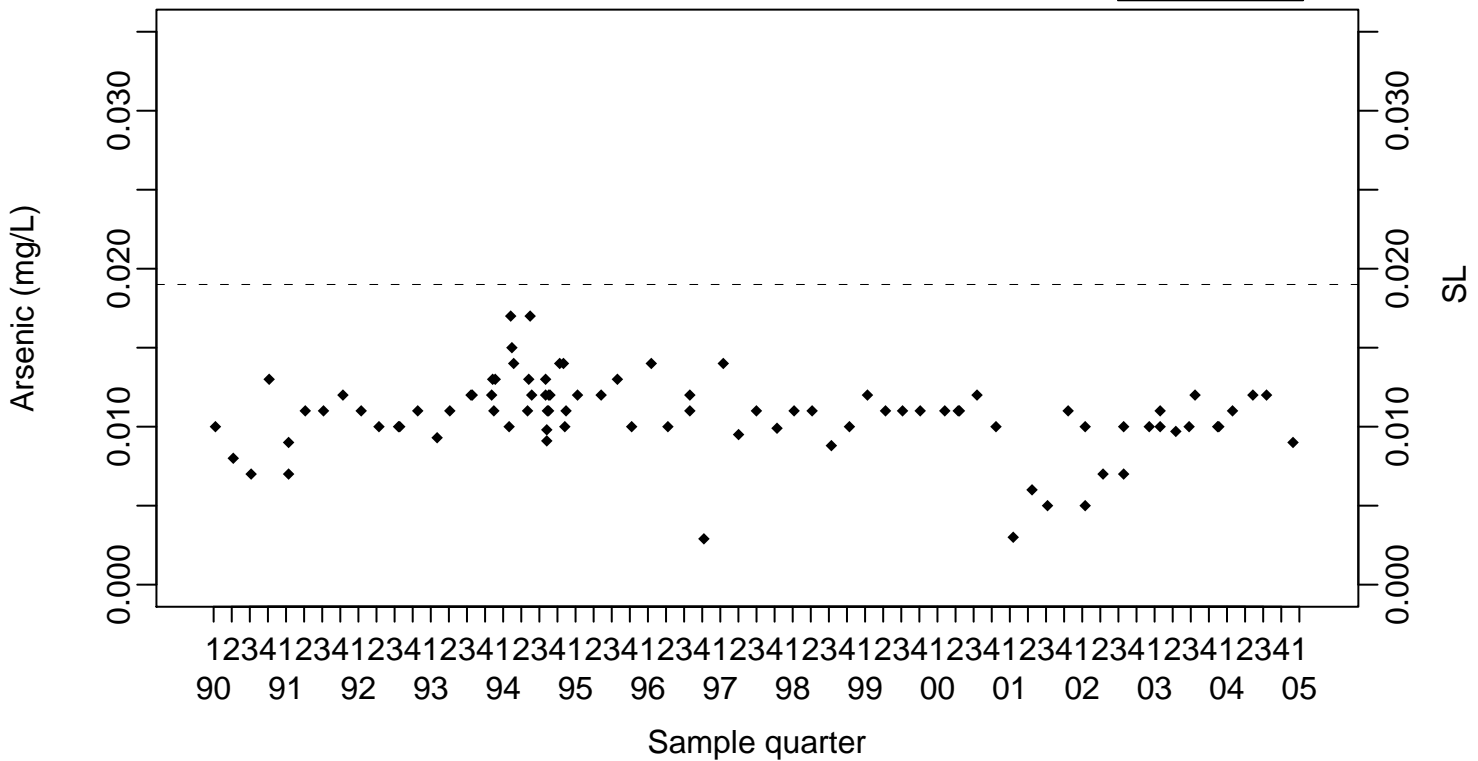


Pit 1 Area Arsenic (mg/L)

SL=0.019

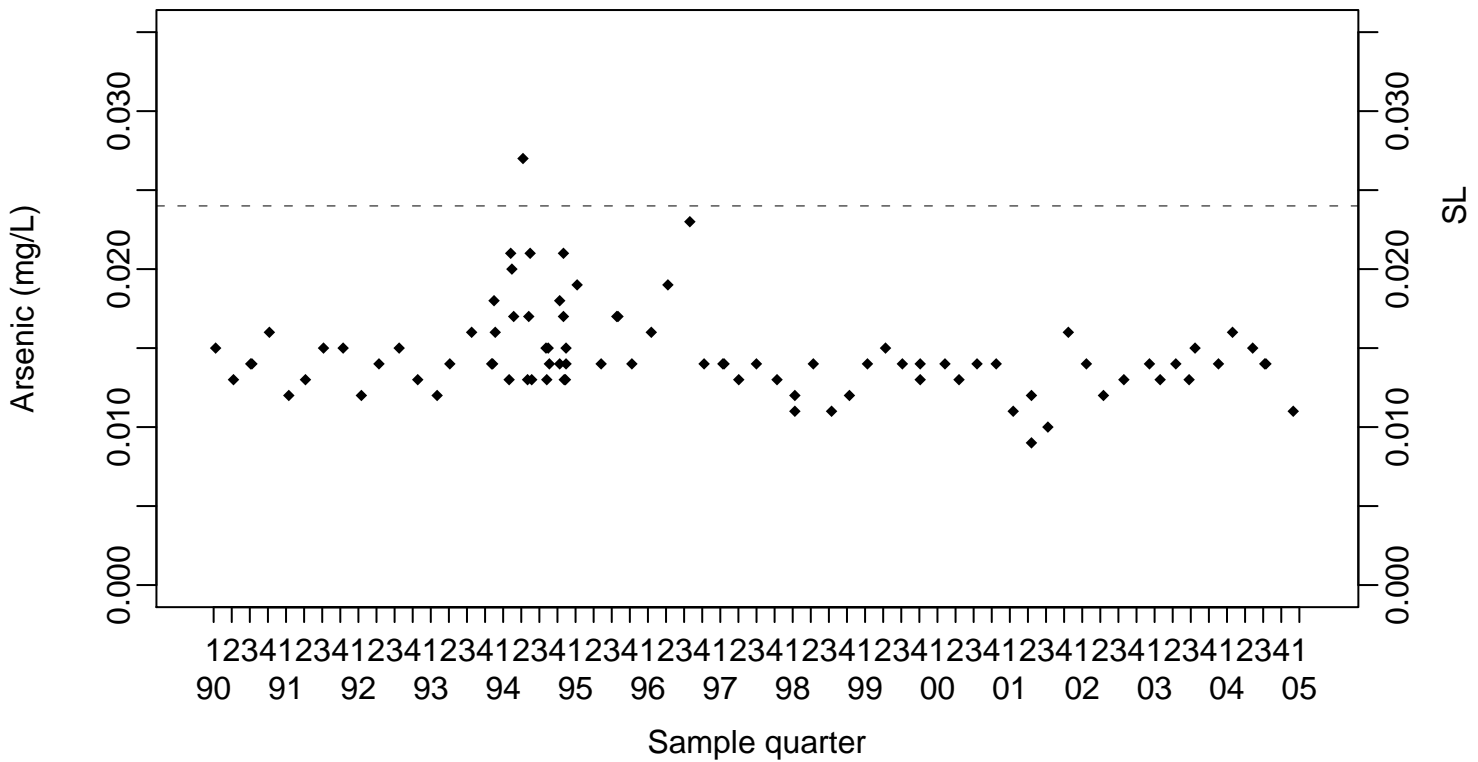
◆ Above RL
▽ Below RL

Compliance Monitoring Point K1-04



SL=0.024

Compliance Monitoring Point K1-05

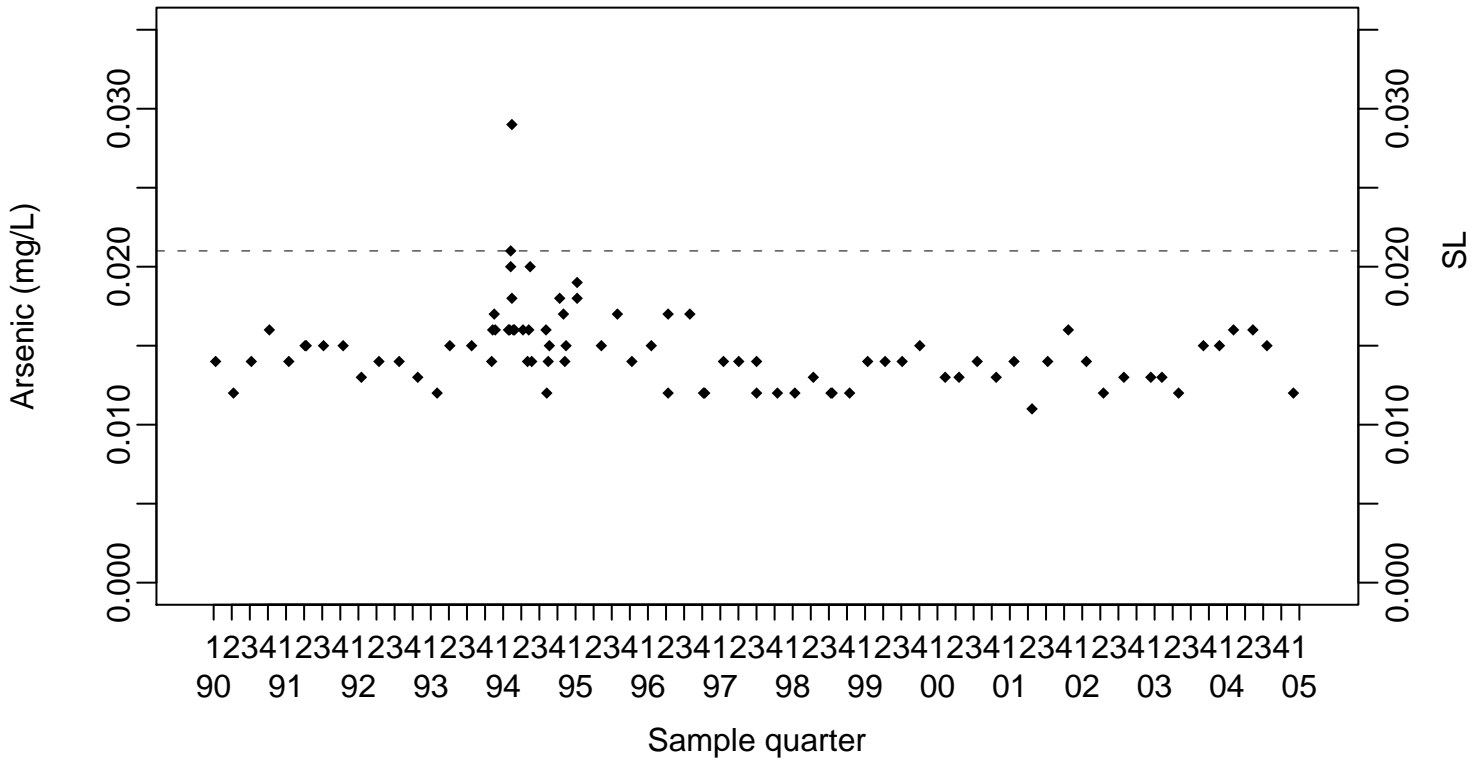


Pit 1 Area Arsenic (mg/L)

SL=0.021

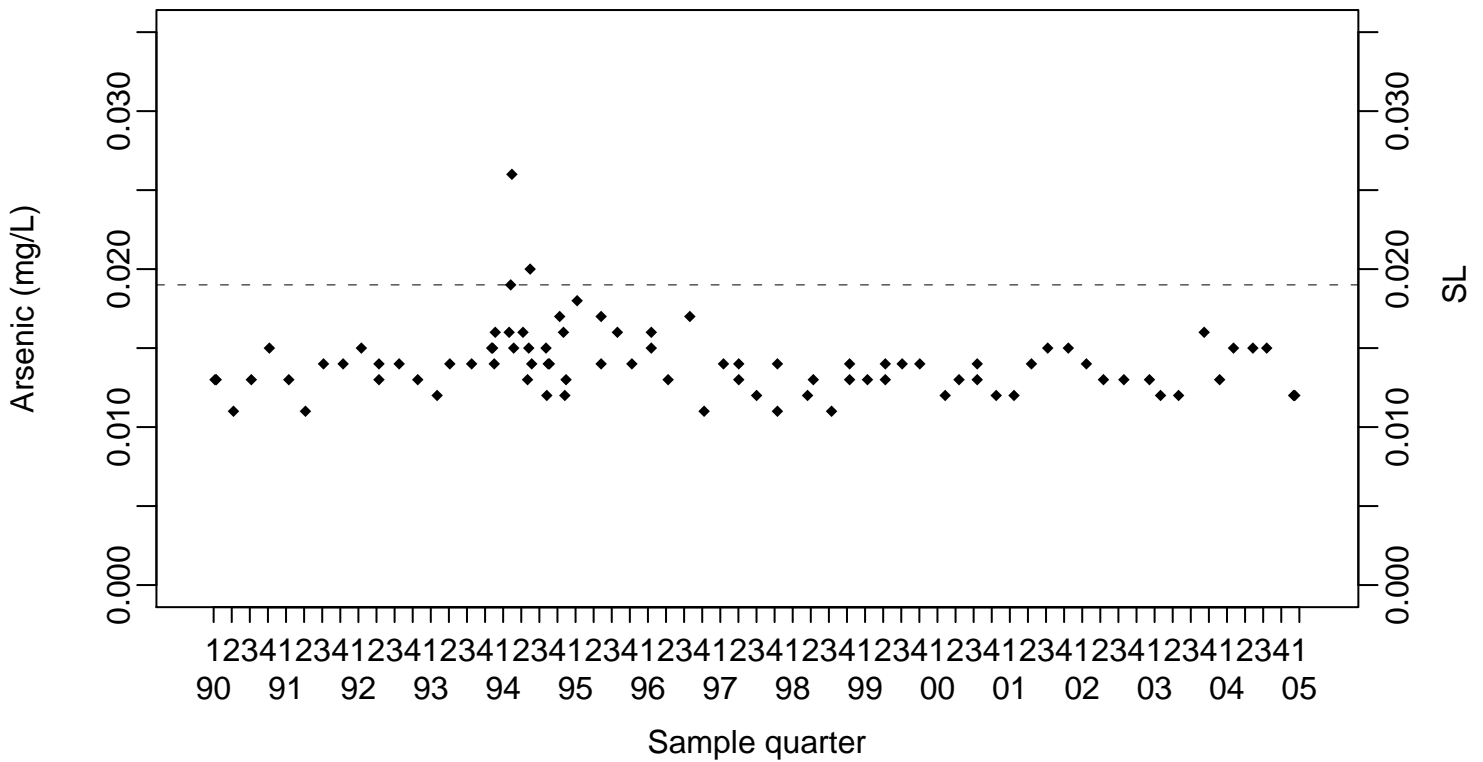
◆ Above RL
▽ Below RL

Compliance Monitoring Point K1-08



SL=0.019

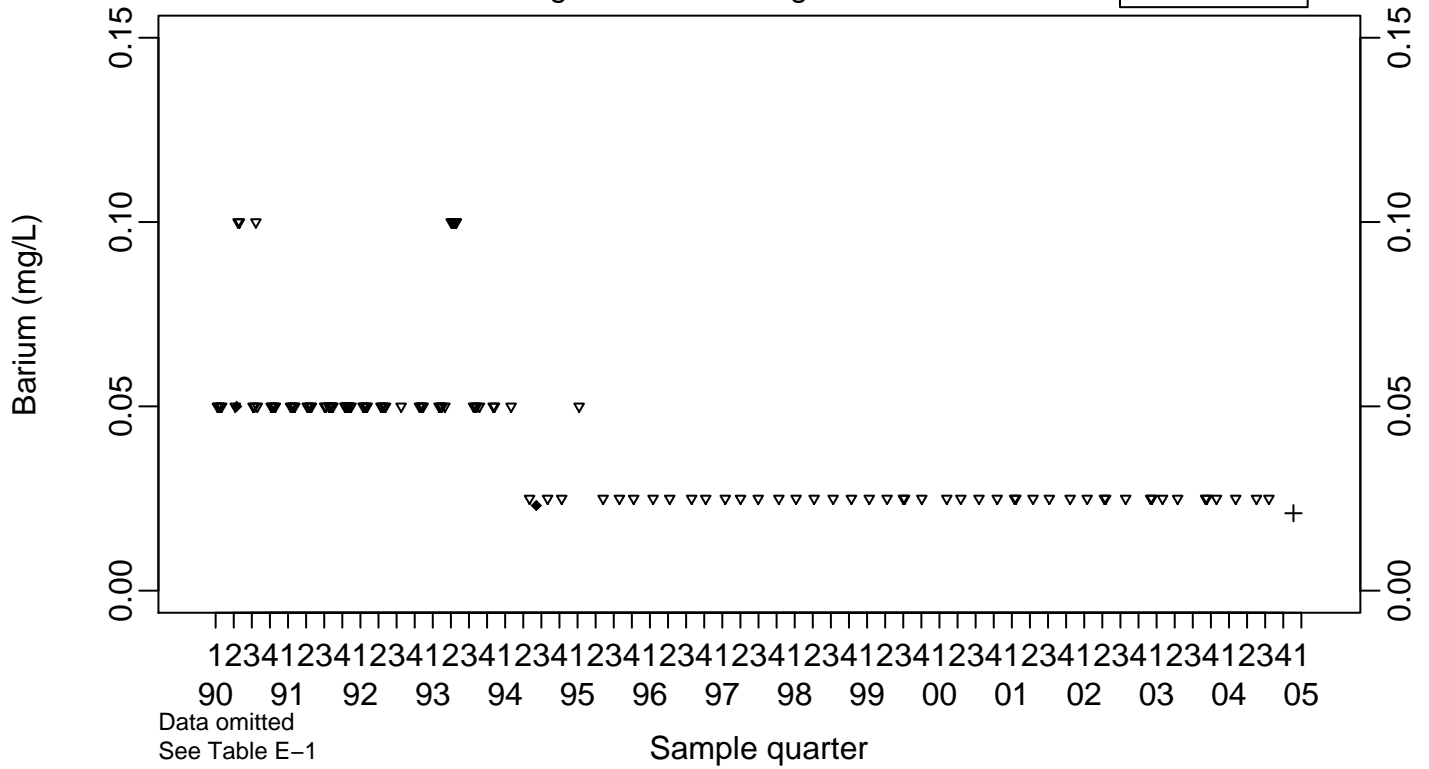
Compliance Monitoring Point K1-09



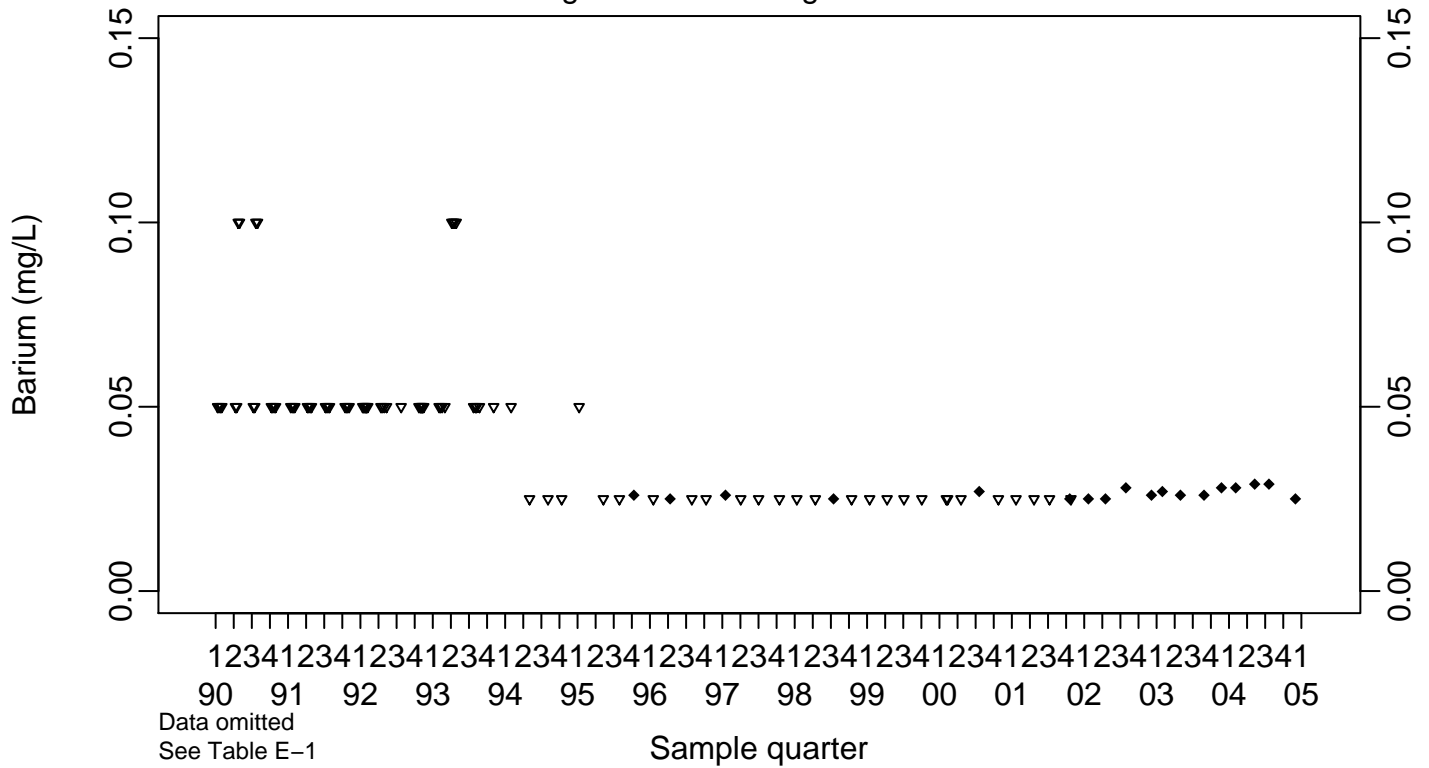
Pit 1 Area
Barium (mg/L)

Background Monitoring Point K1-01C

- ◆ Above RL
- ▽ Below RL
- + Estimated



Background Monitoring Point K1-07

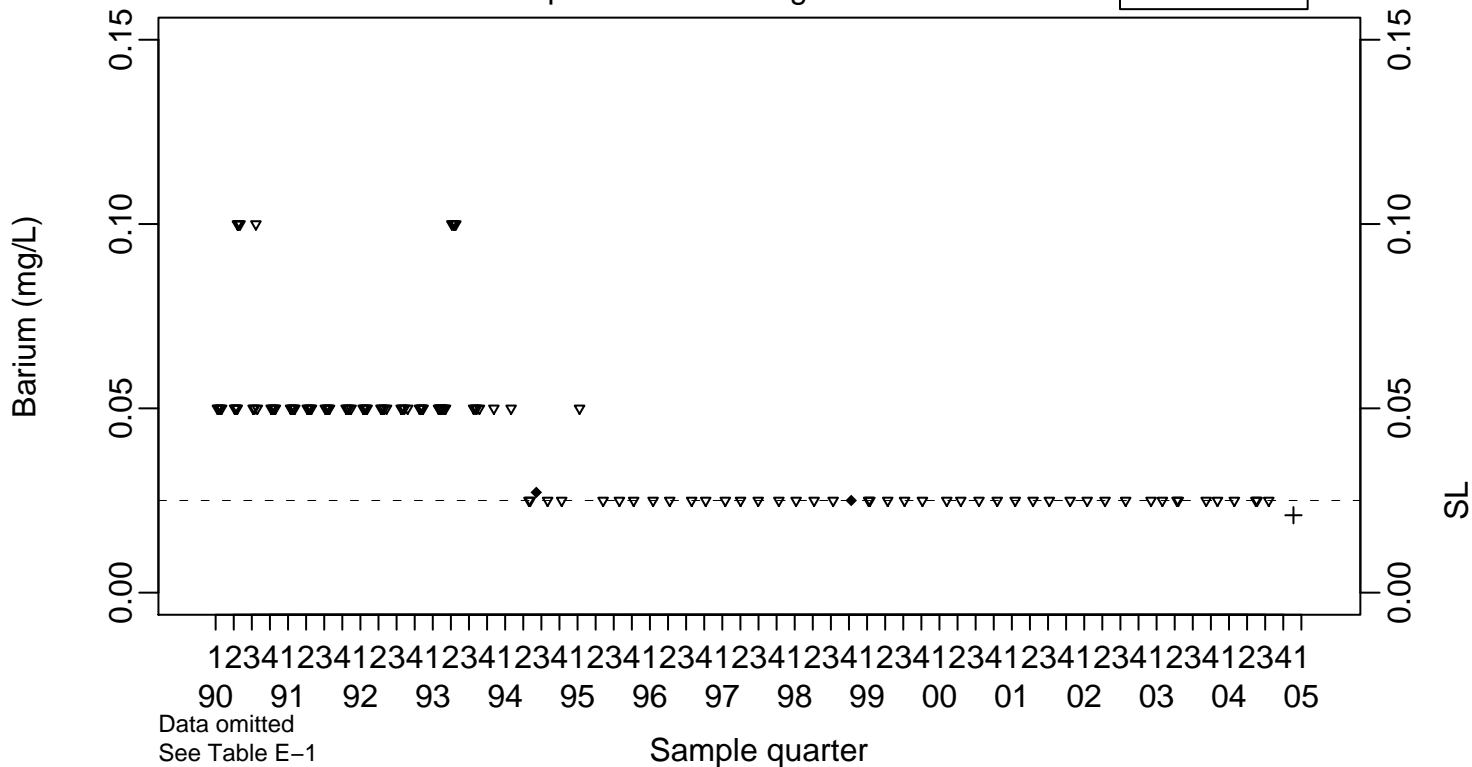


Pit 1 Area Barium (mg/L)

Compliance Monitoring Point K1-02B

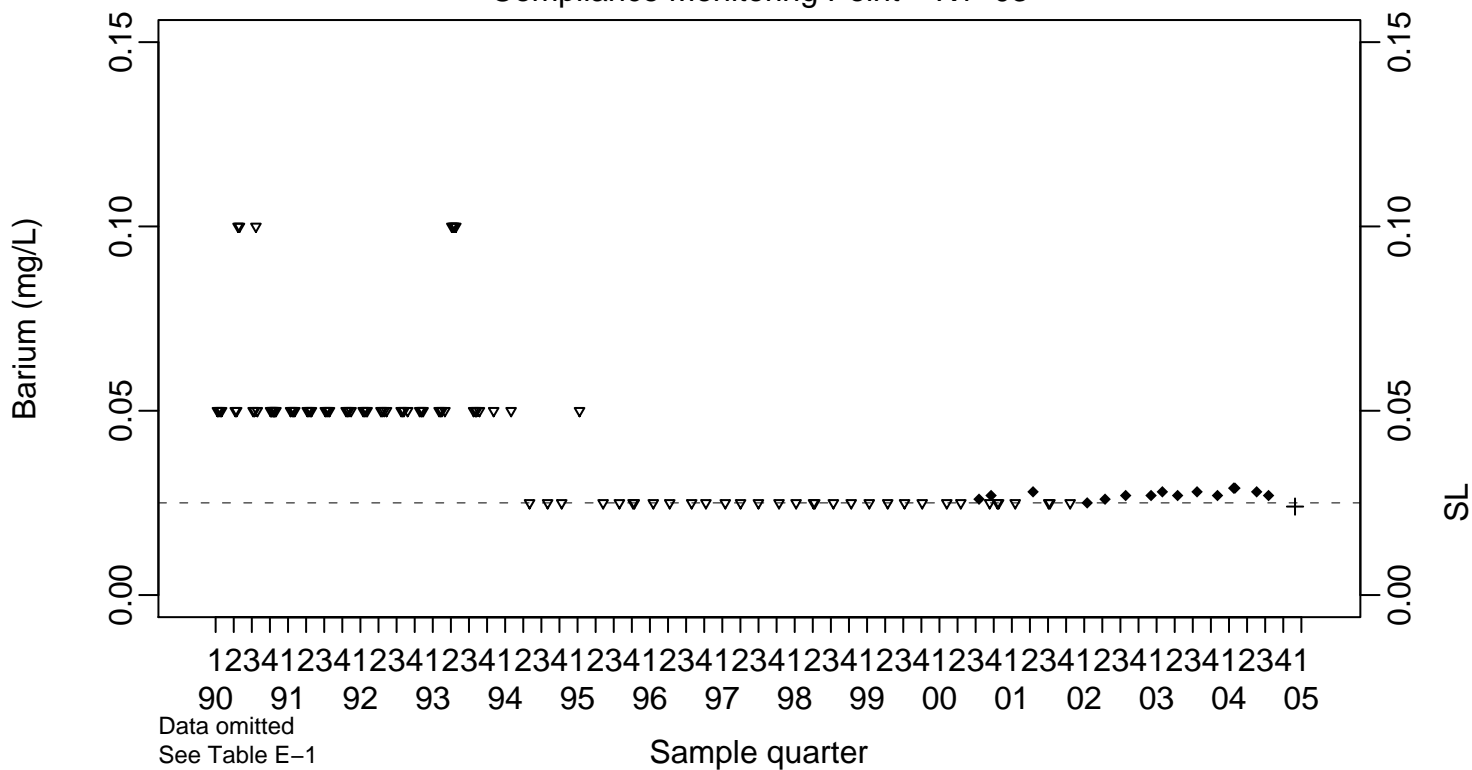
SL=0.025

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point K1-03

SL=0.025

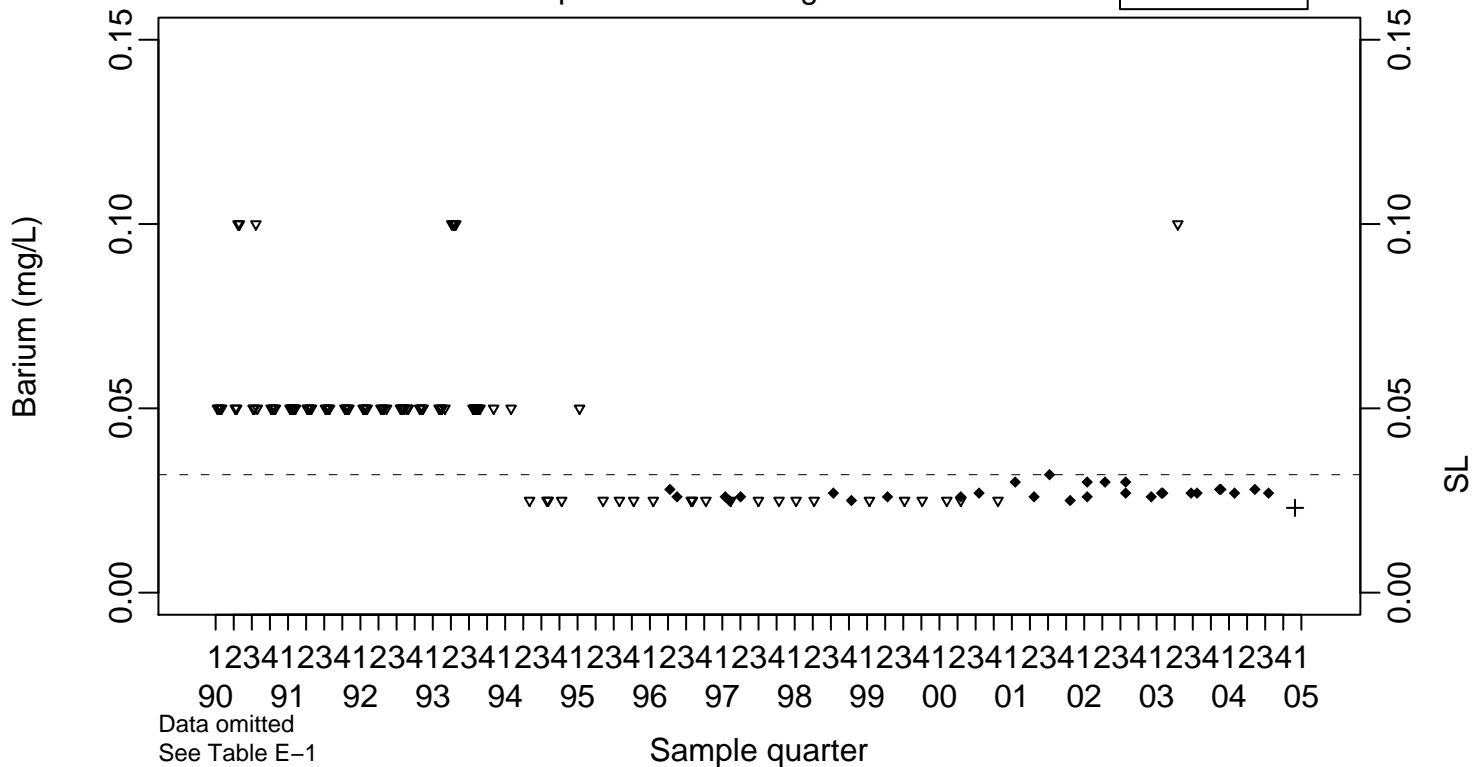


Pit 1 Area Barium (mg/L)

SL=0.032

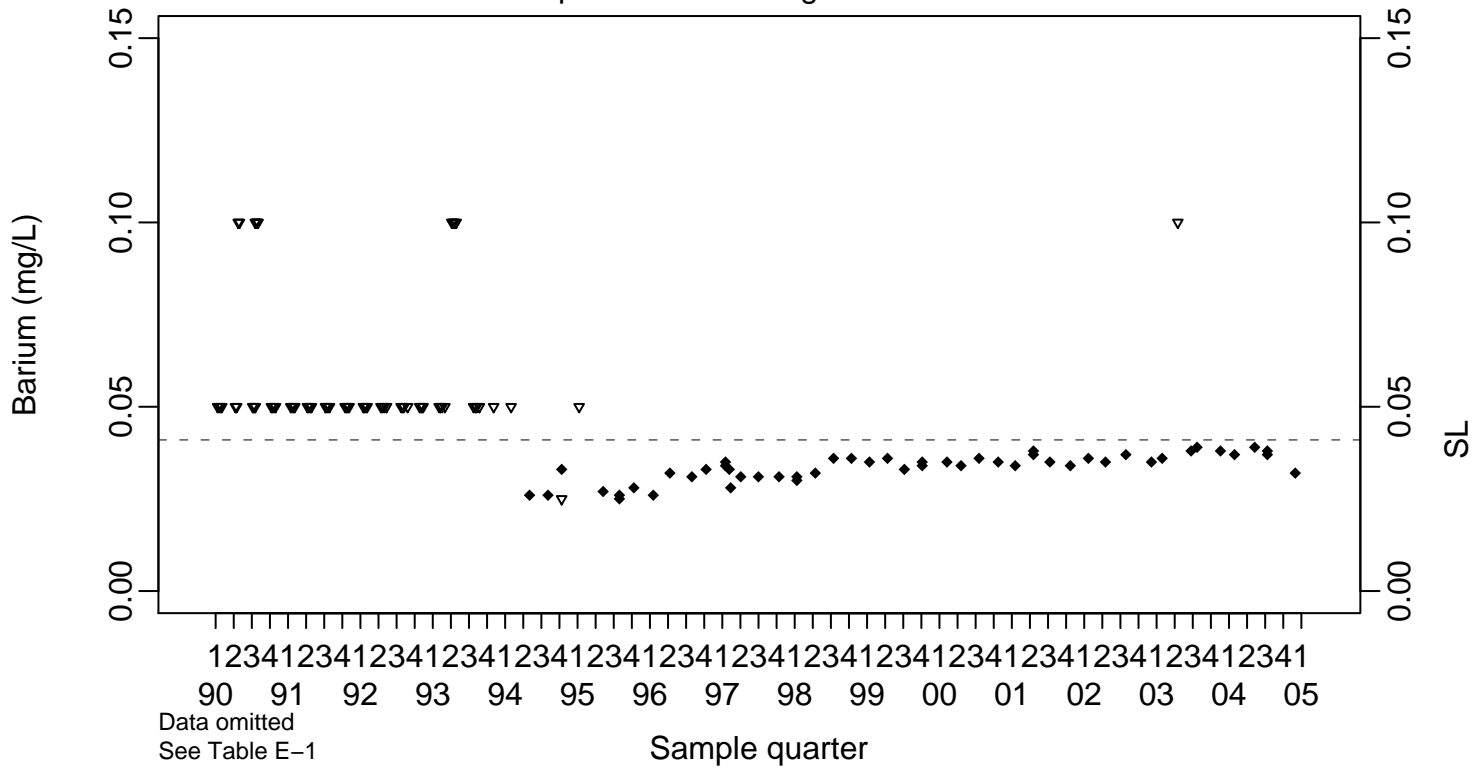
Compliance Monitoring Point K1-04

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.041

Compliance Monitoring Point K1-05

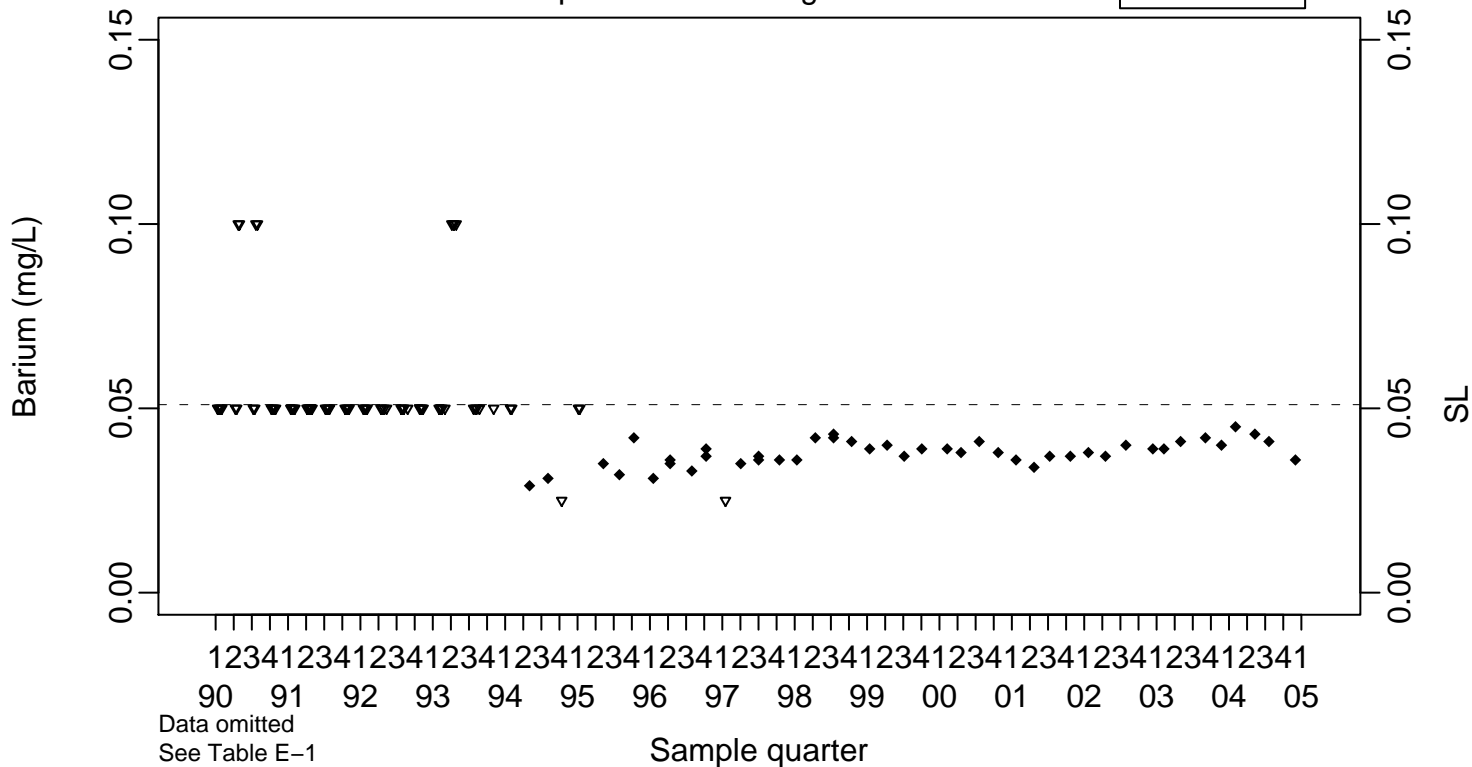


Pit 1 Area Barium (mg/L)

SL=0.051

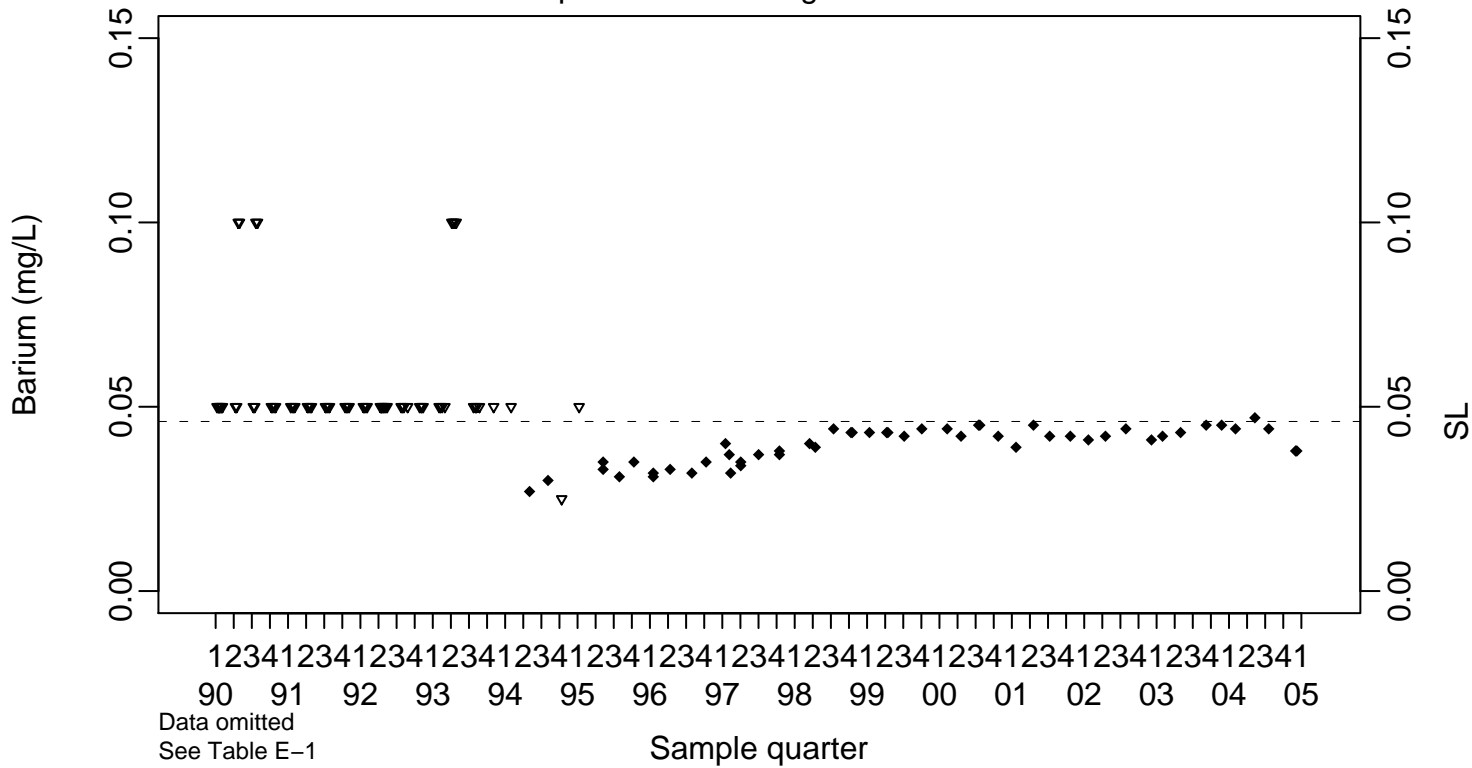
◆ Above RL
▽ Below RL

Compliance Monitoring Point K1-08



SL=0.046

Compliance Monitoring Point K1-09

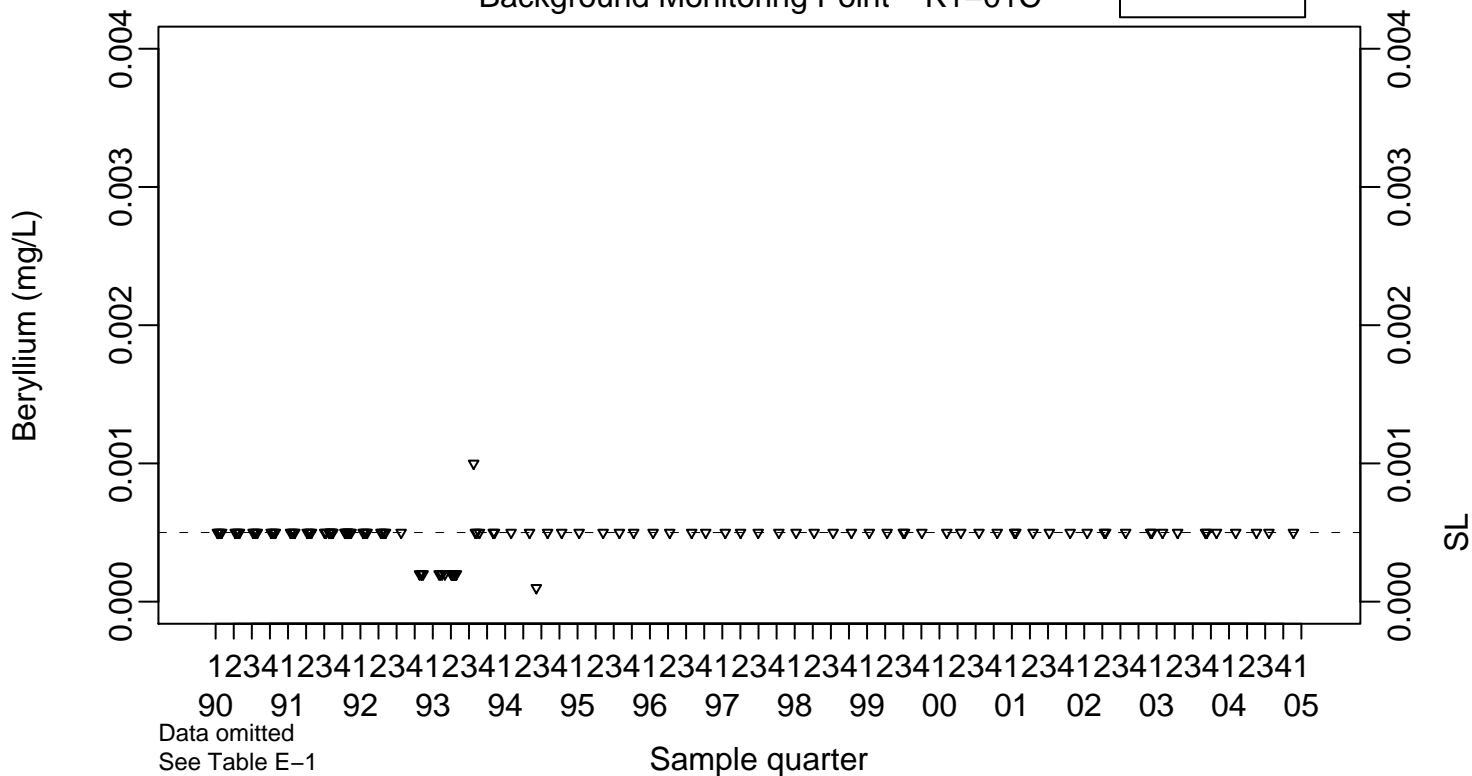


Pit 1 Area Beryllium (mg/L)

Background Monitoring Point K1-01C

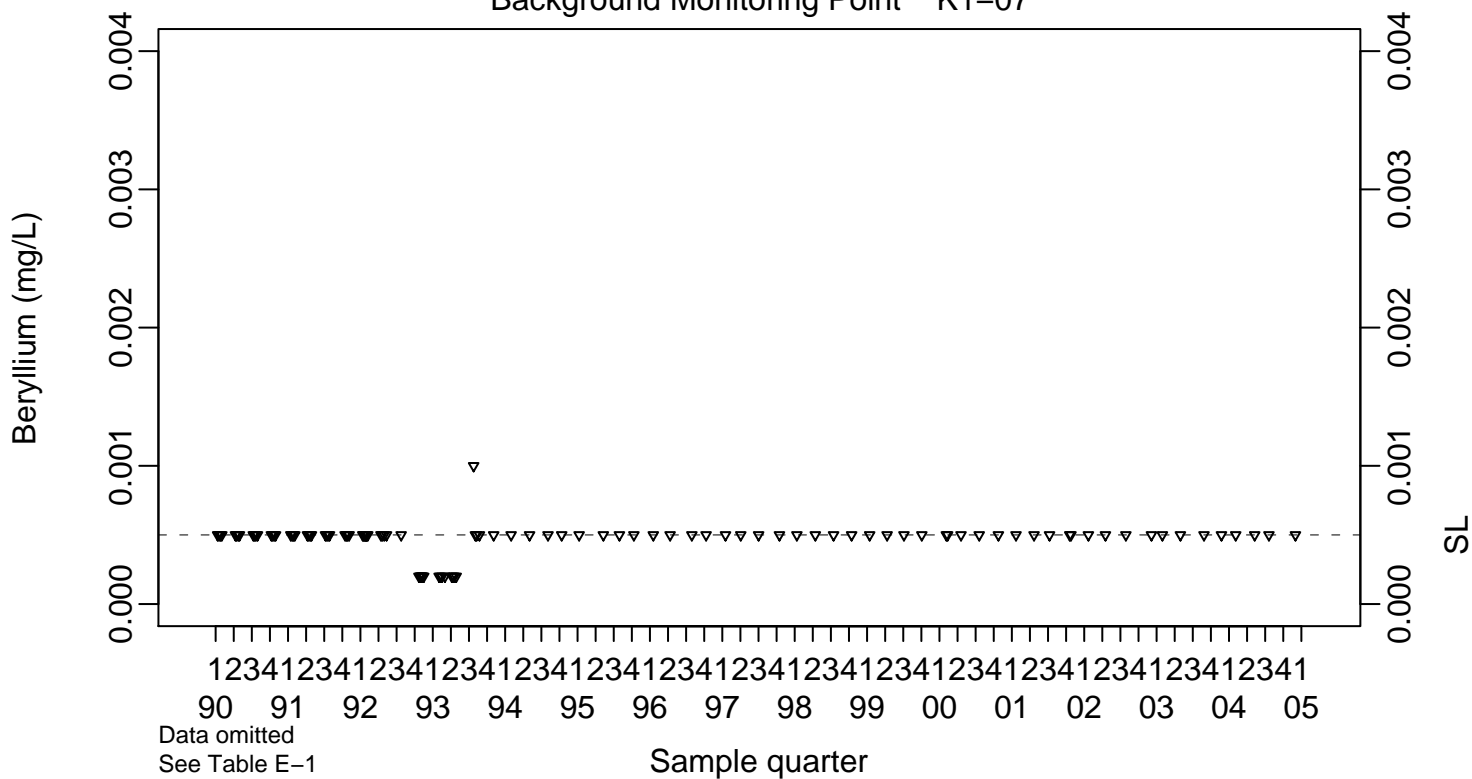
SL=5e-04

◆ Above RL
▽ Below RL



Background Monitoring Point K1-07

SL=5e-04

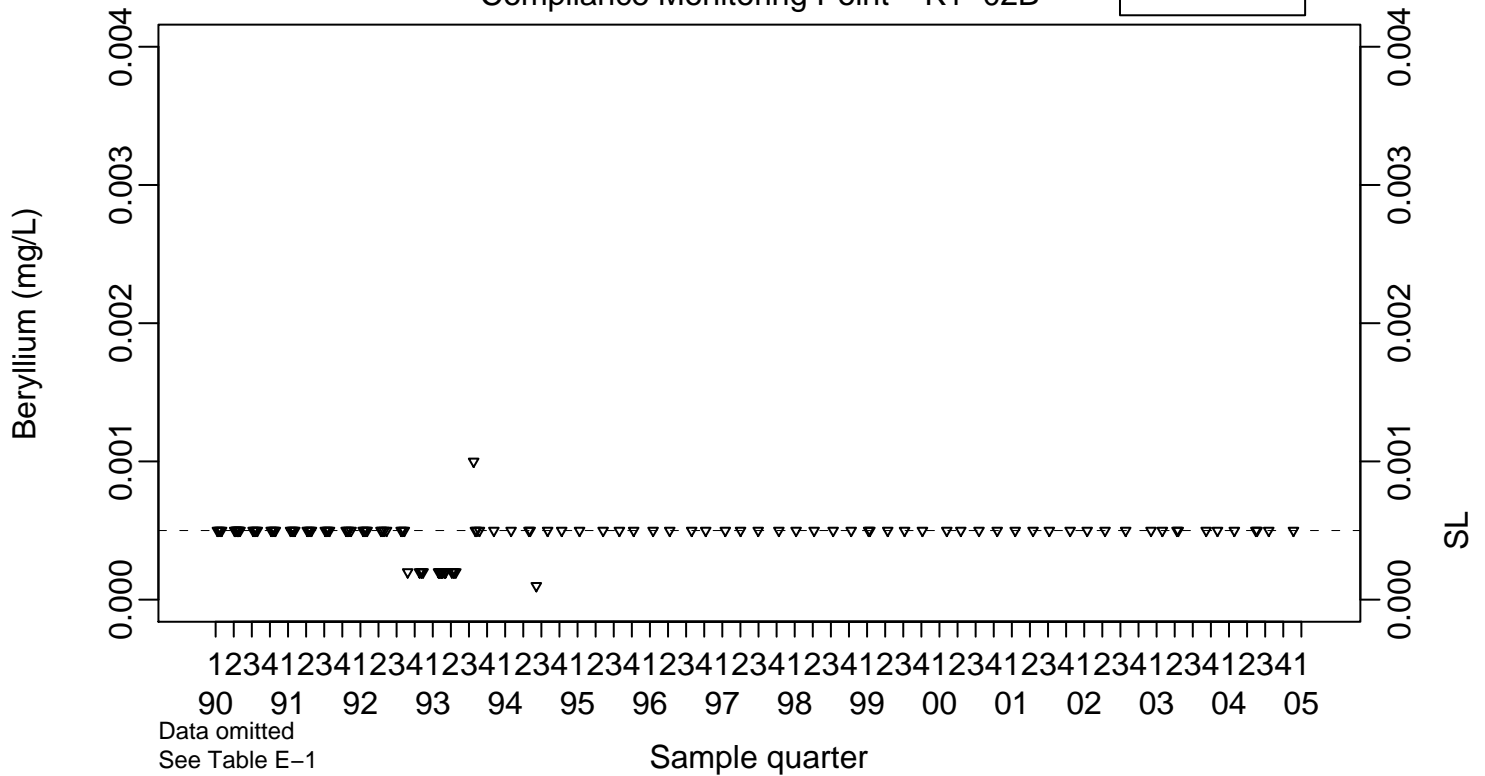


Pit 1 Area Beryllium (mg/L)

Compliance Monitoring Point K1-02B

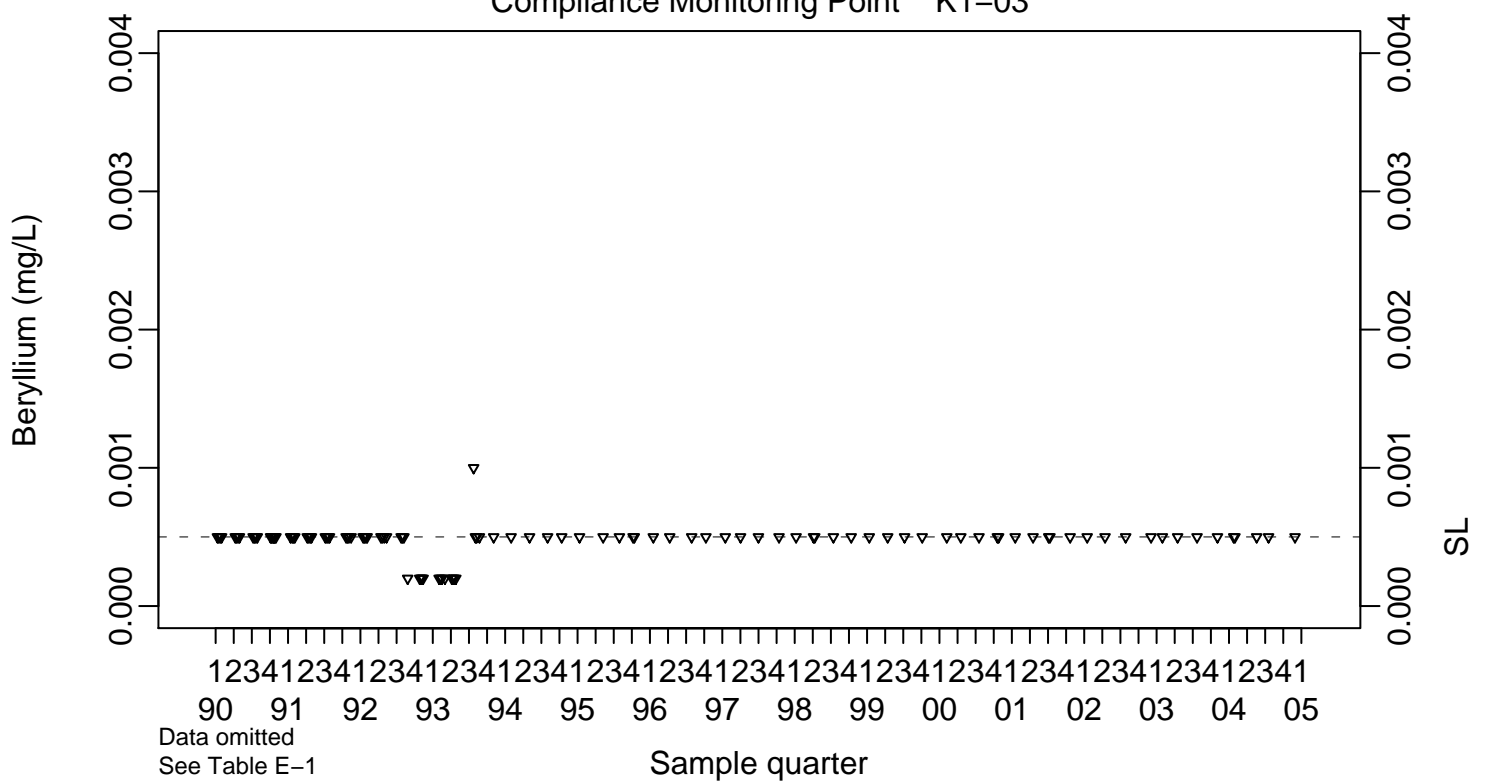
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-03

SL=5e-04

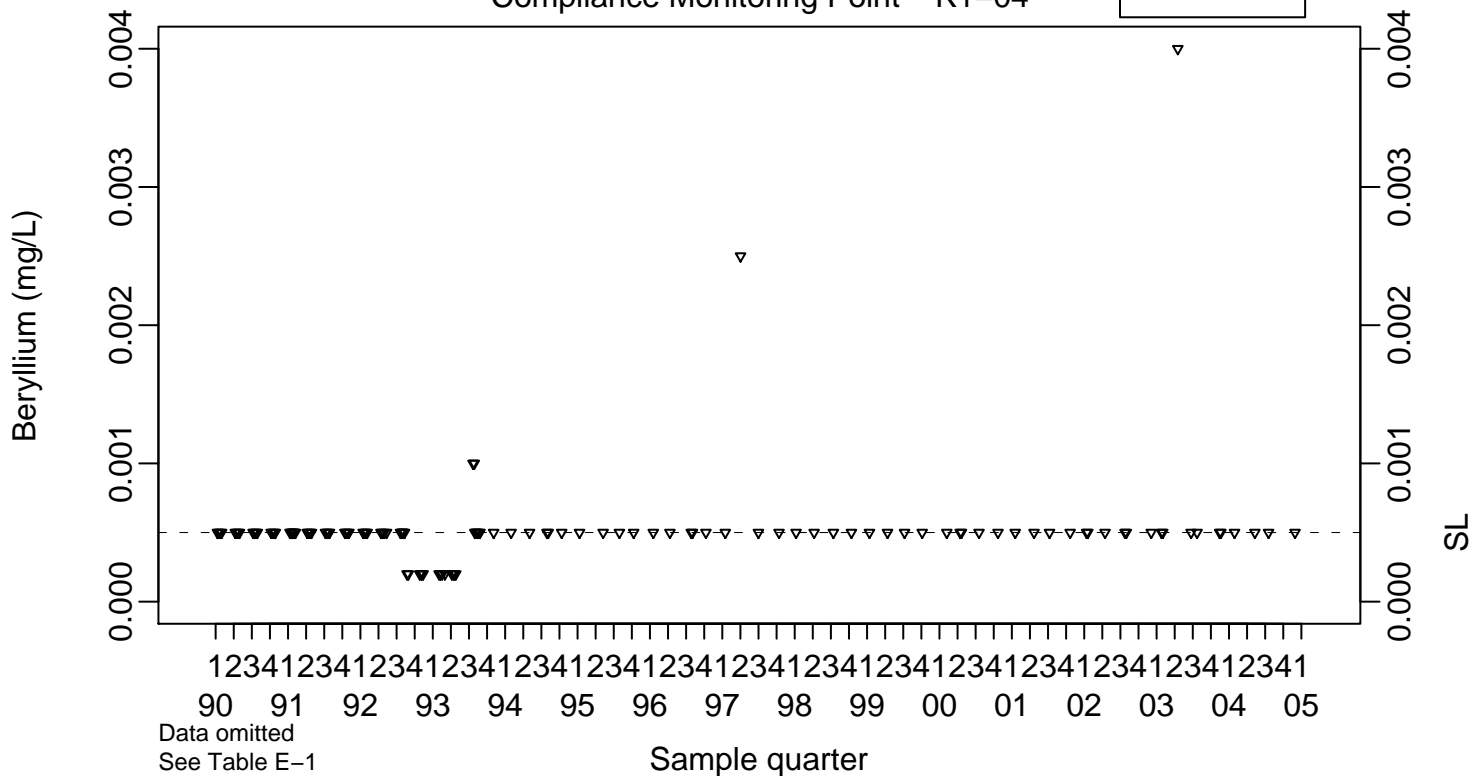


Pit 1 Area Beryllium (mg/L)

Compliance Monitoring Point K1-04

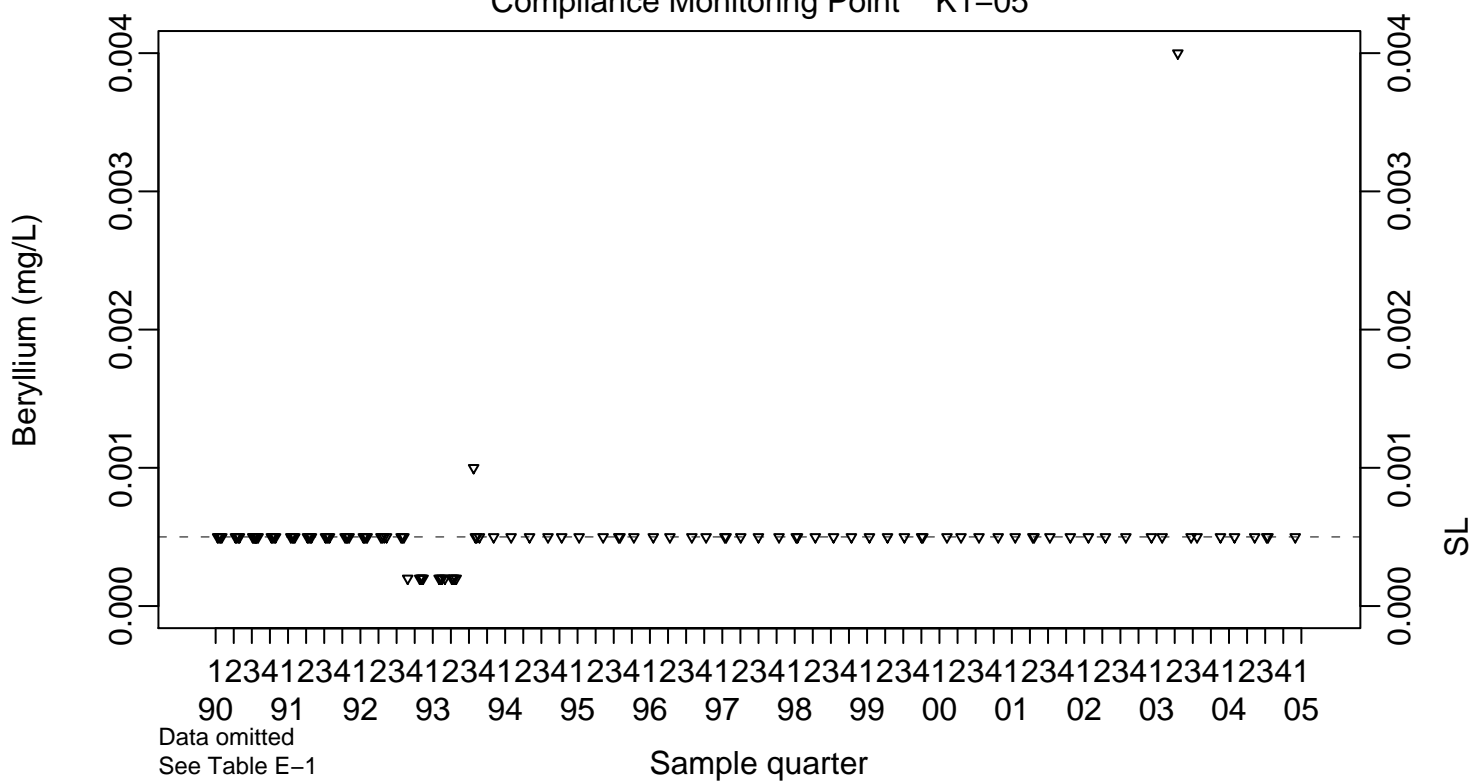
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-05

SL=5e-04

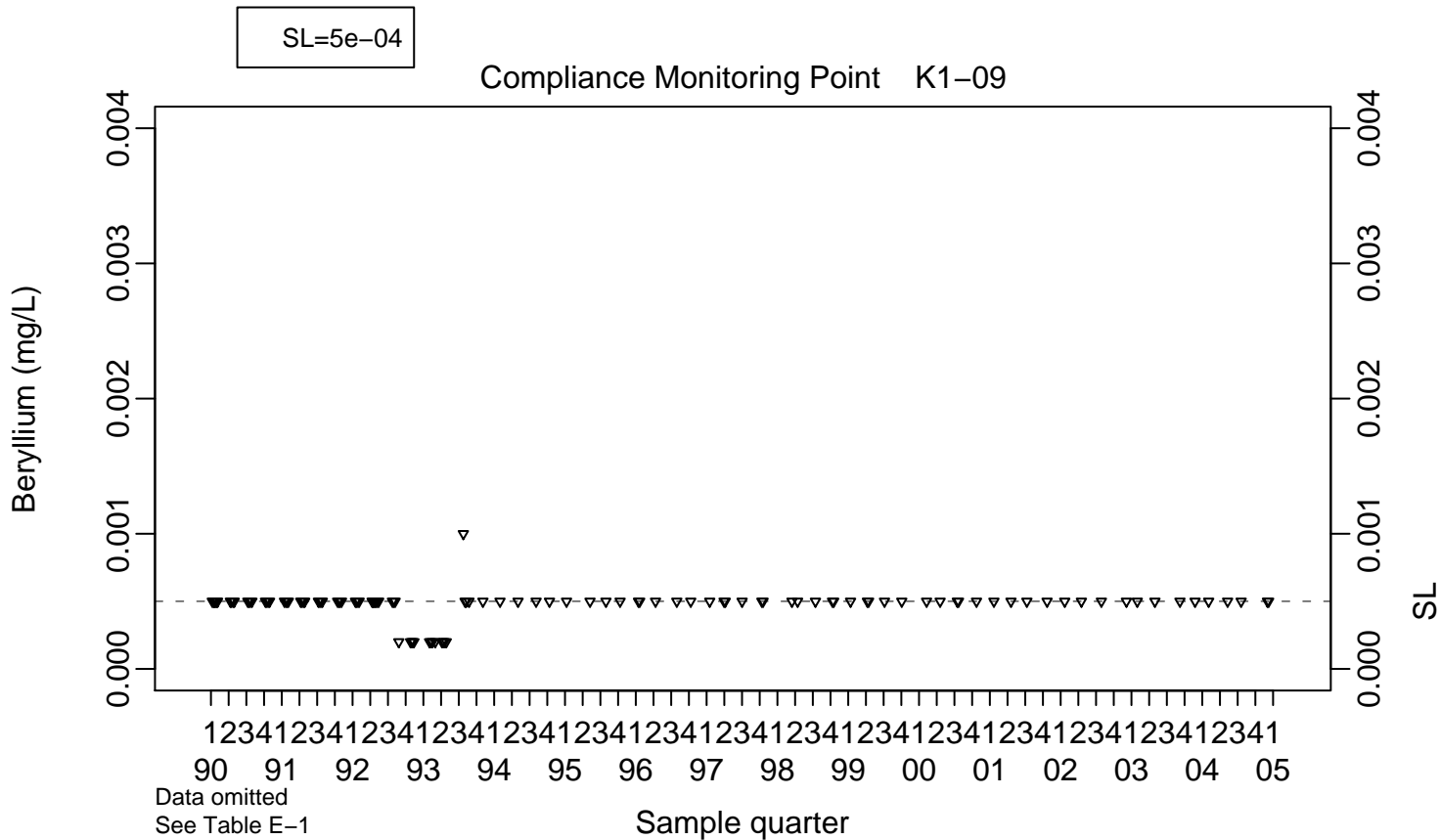
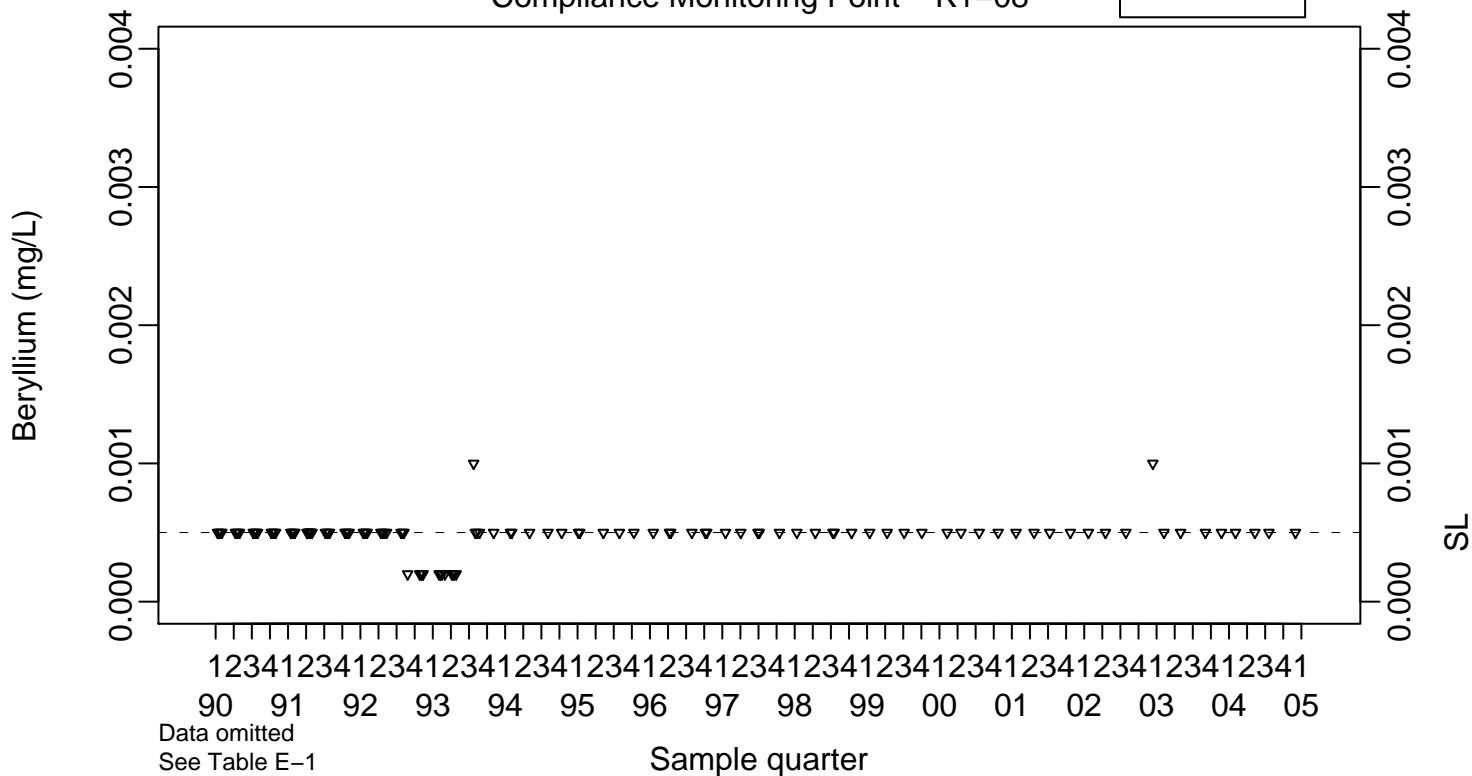


Pit 1 Area Beryllium (mg/L)

Compliance Monitoring Point K1-08

SL=5e-04

◆ Above RL
▽ Below RL

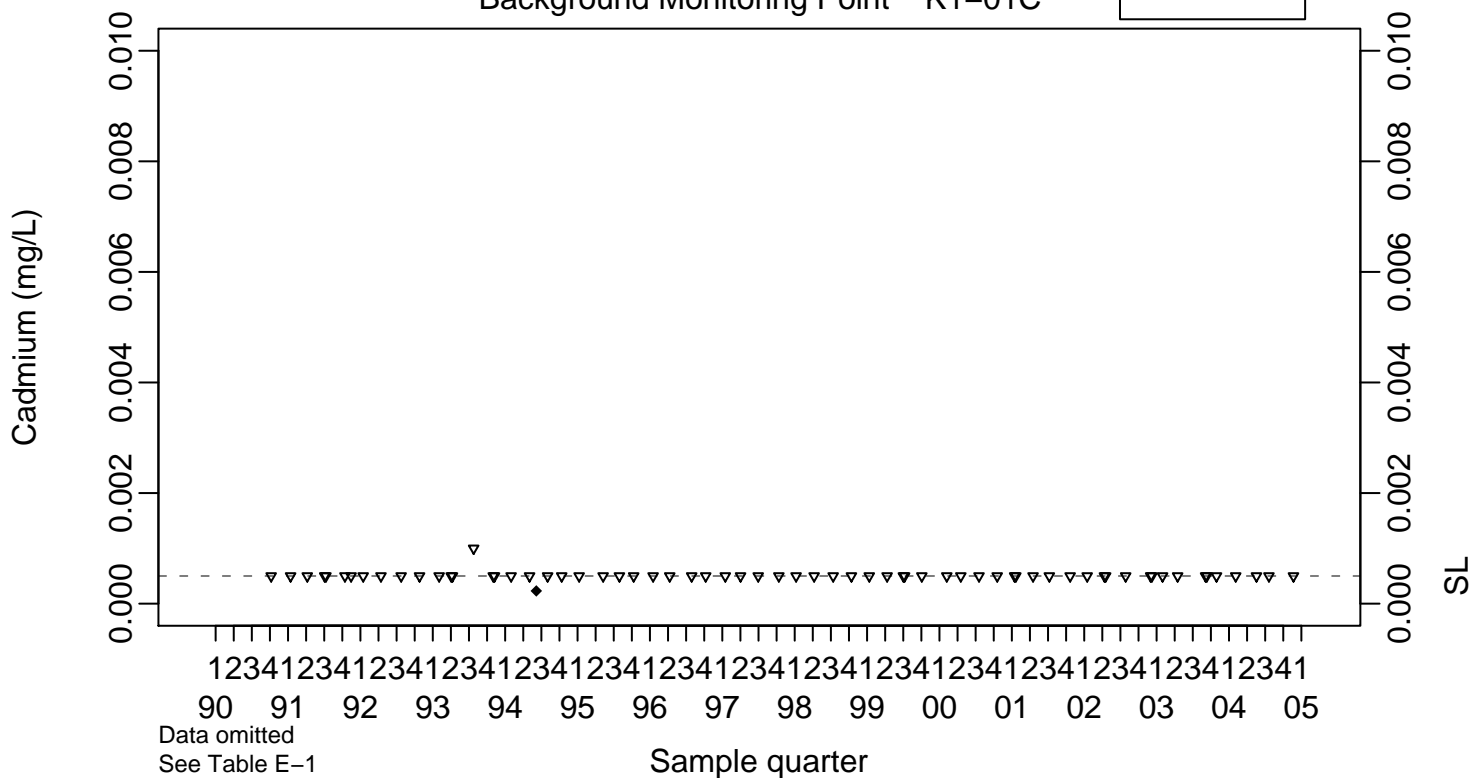


Pit 1 Area Cadmium (mg/L)

Background Monitoring Point K1-01C

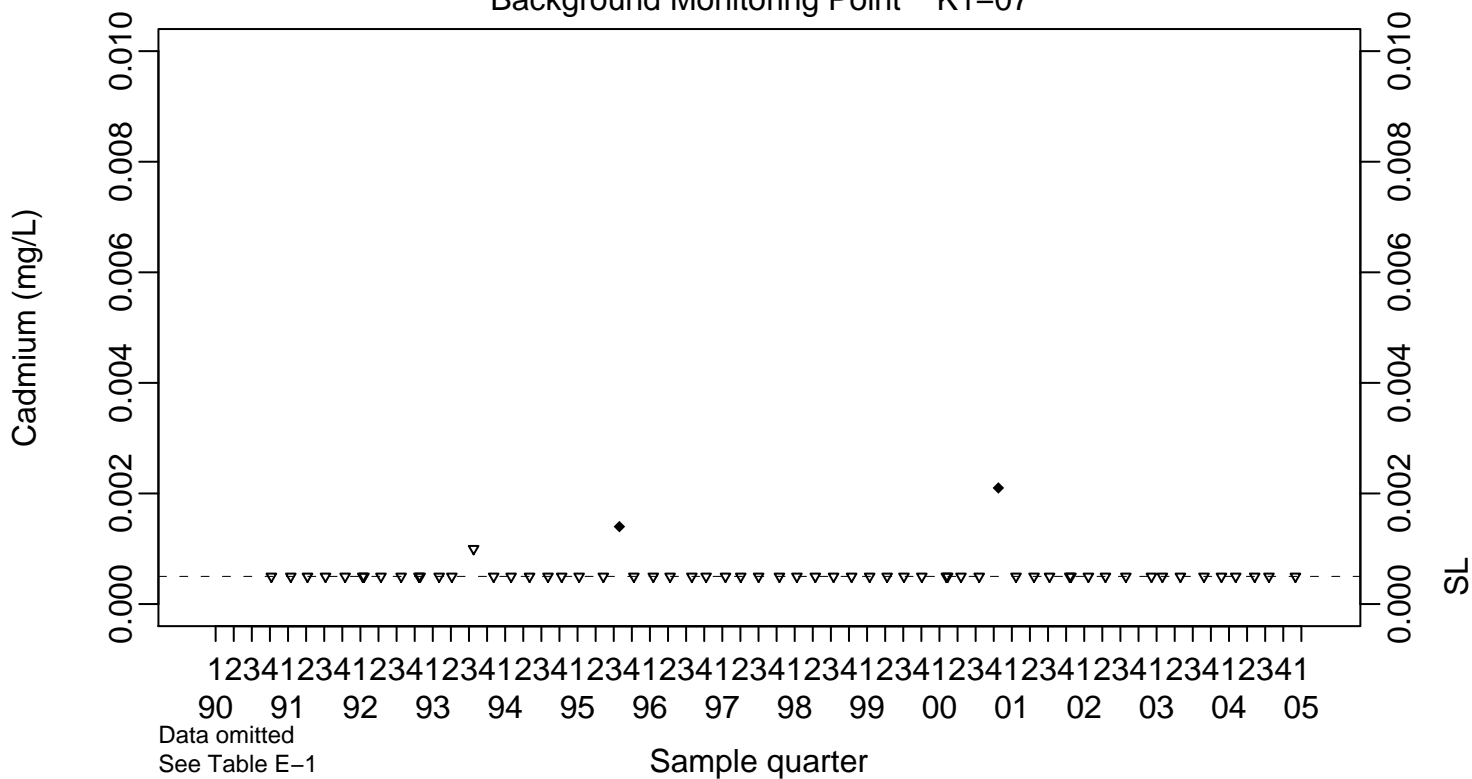
SL=5e-04

◆ Above RL
▽ Below RL



Background Monitoring Point K1-07

SL=5e-04

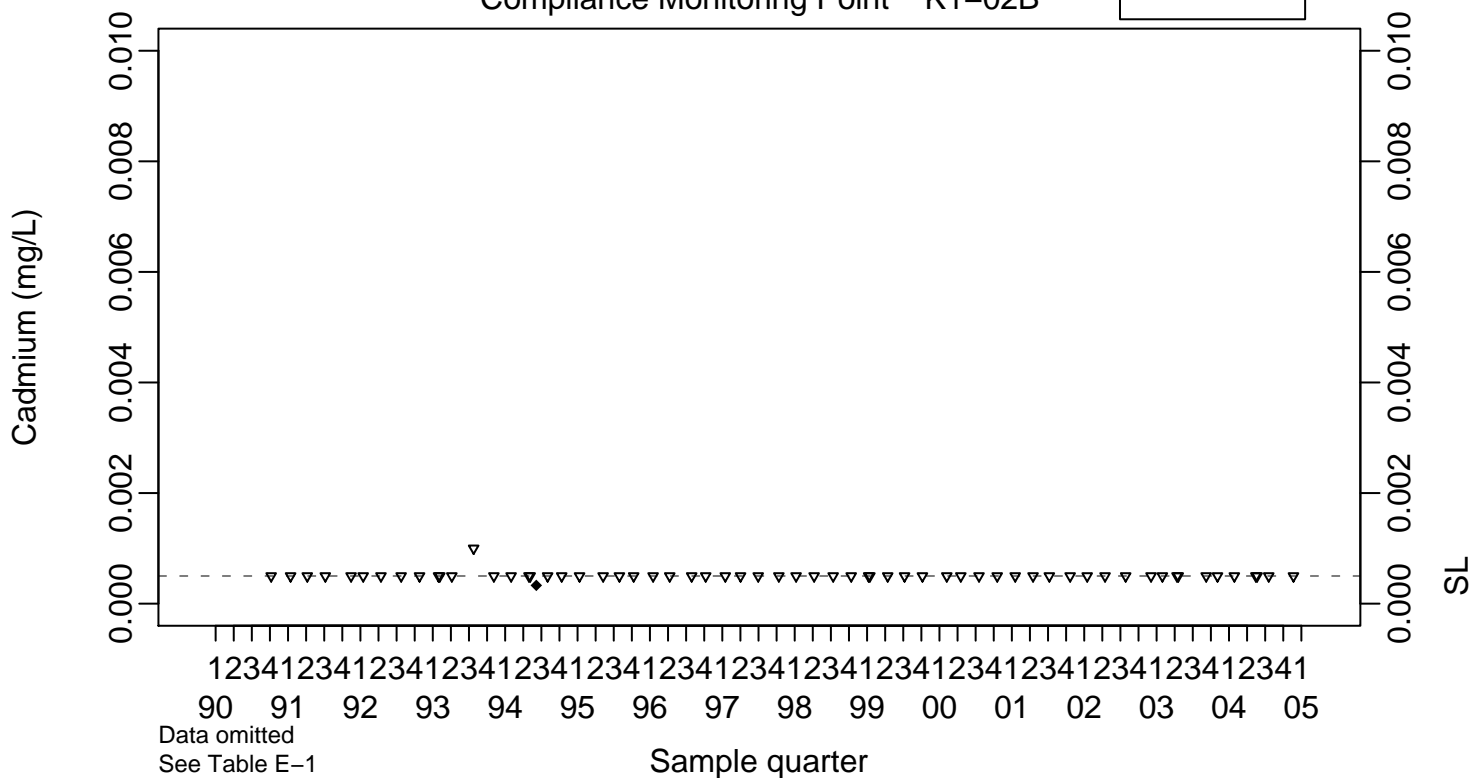


Pit 1 Area Cadmium (mg/L)

Compliance Monitoring Point K1-02B

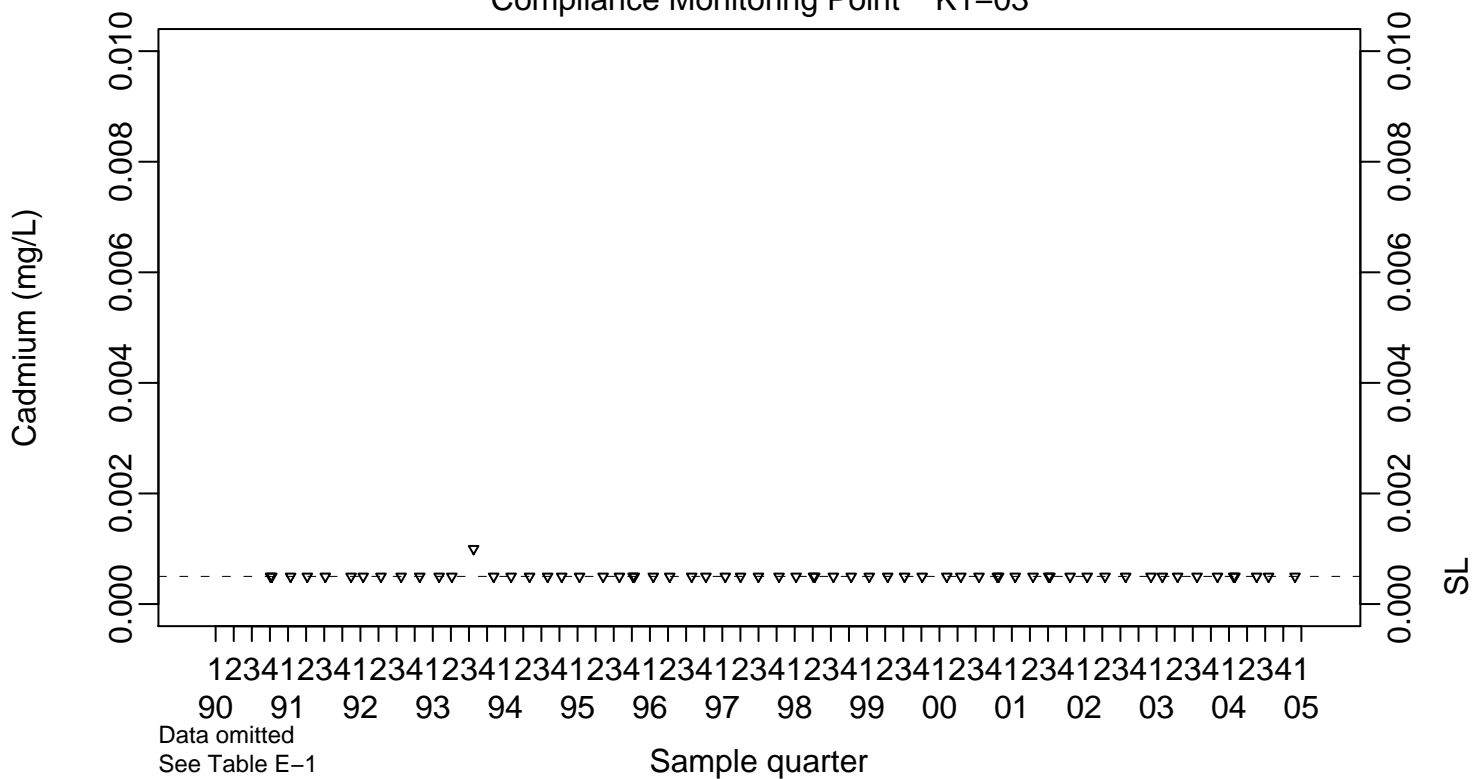
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-03

SL=5e-04

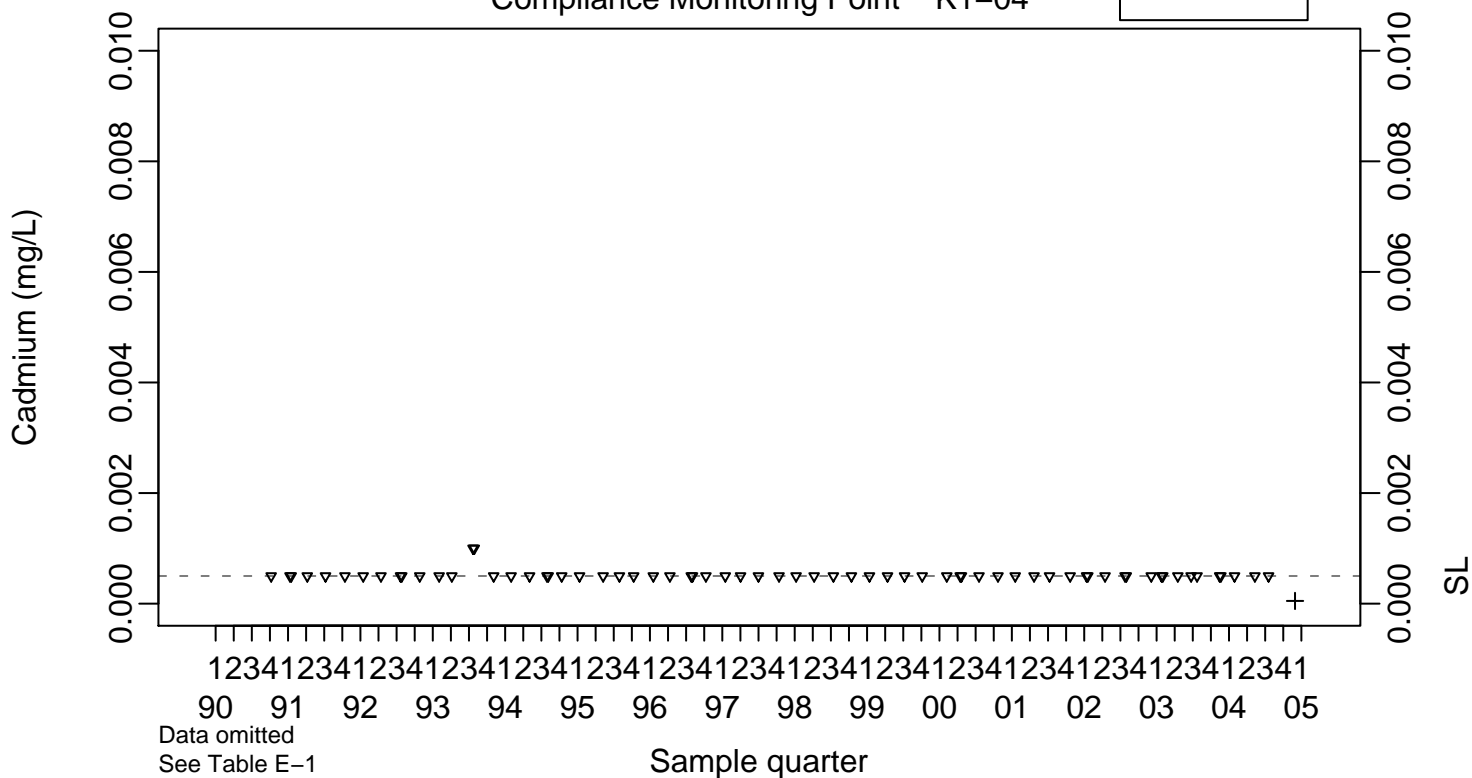


Pit 1 Area Cadmium (mg/L)

Compliance Monitoring Point K1-04

SL=5e-04

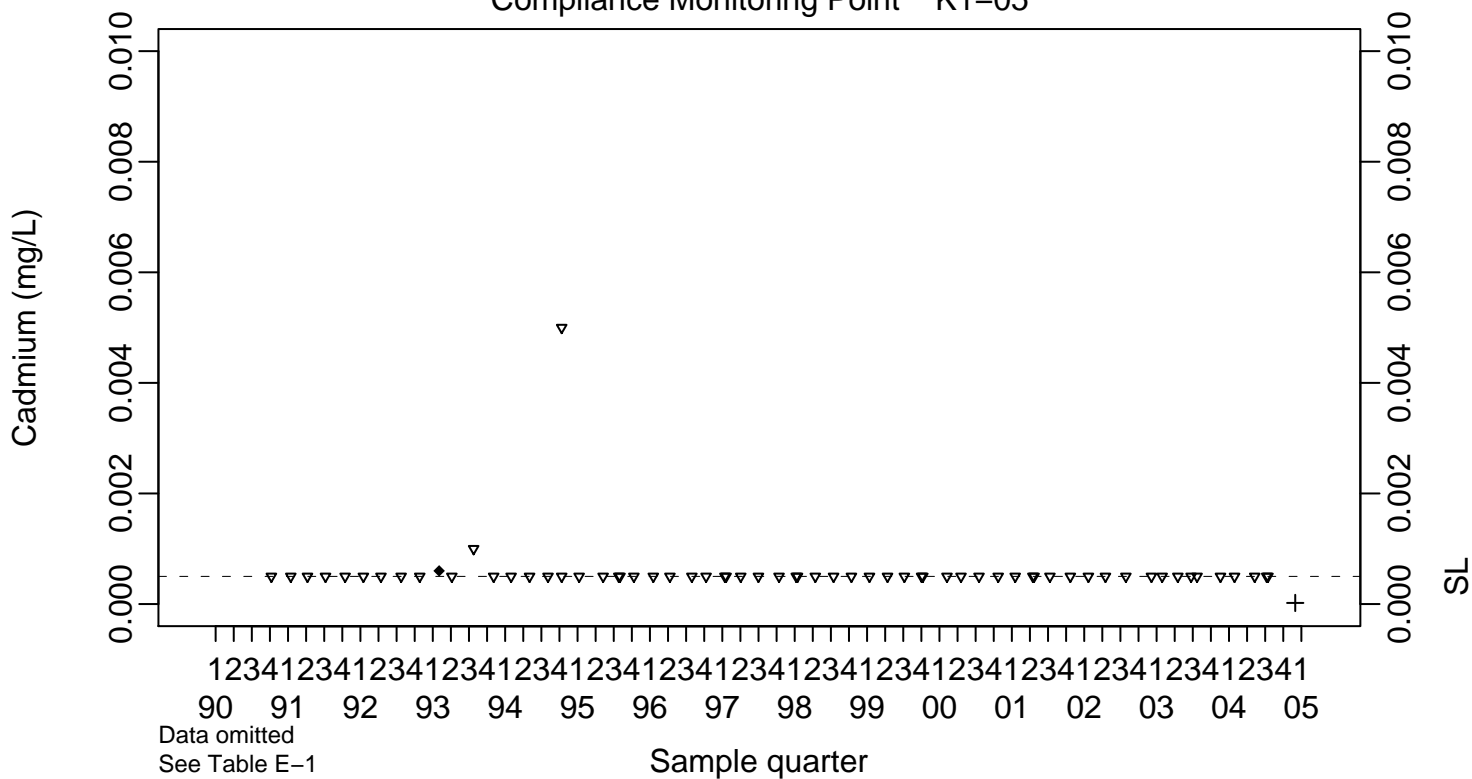
- ◆ Above RL
- ▽ Below RL
- + Estimated



Data omitted
See Table E-1

SL=5e-04

Compliance Monitoring Point K1-05



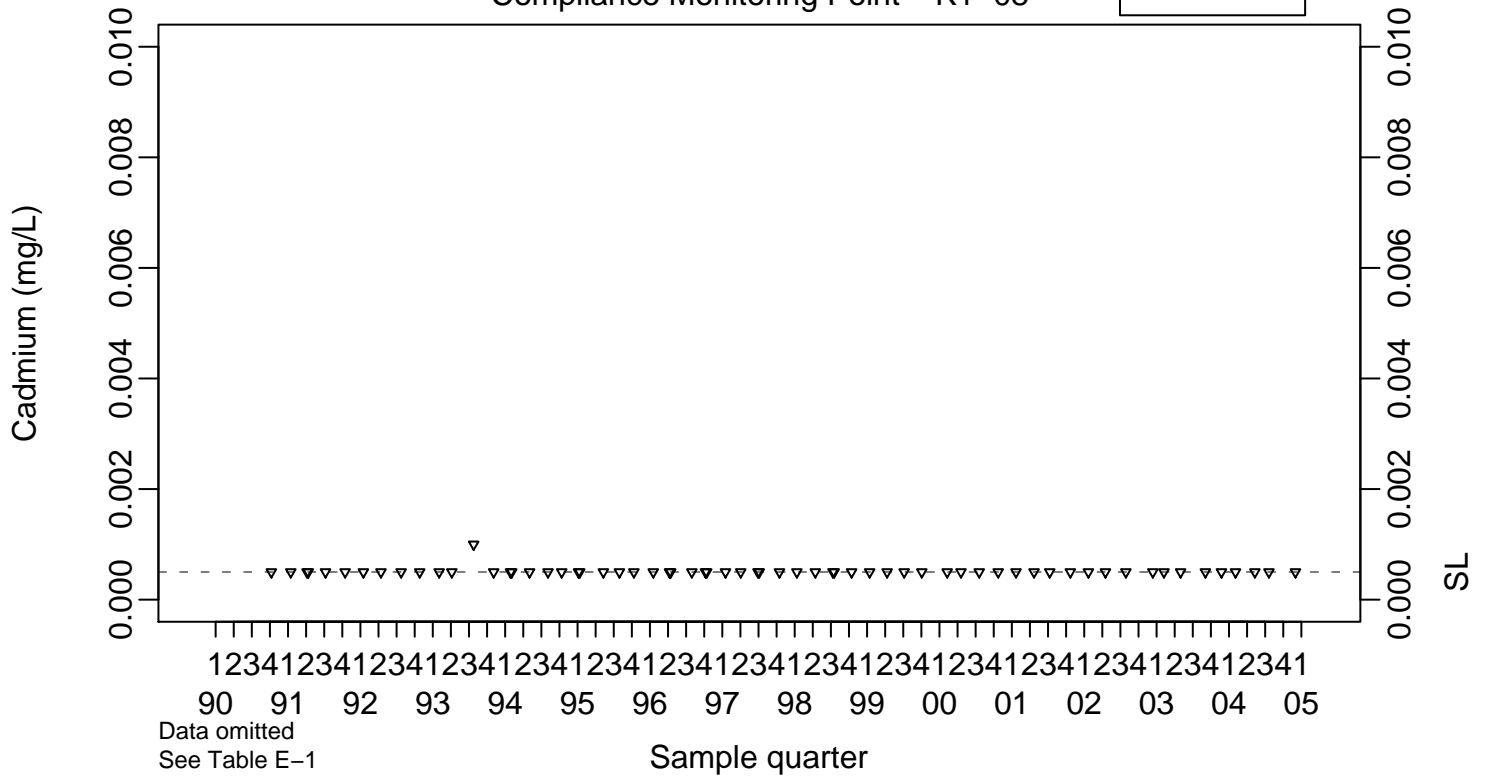
Data omitted
See Table E-1

Pit 1 Area Cadmium (mg/L)

Compliance Monitoring Point K1-08

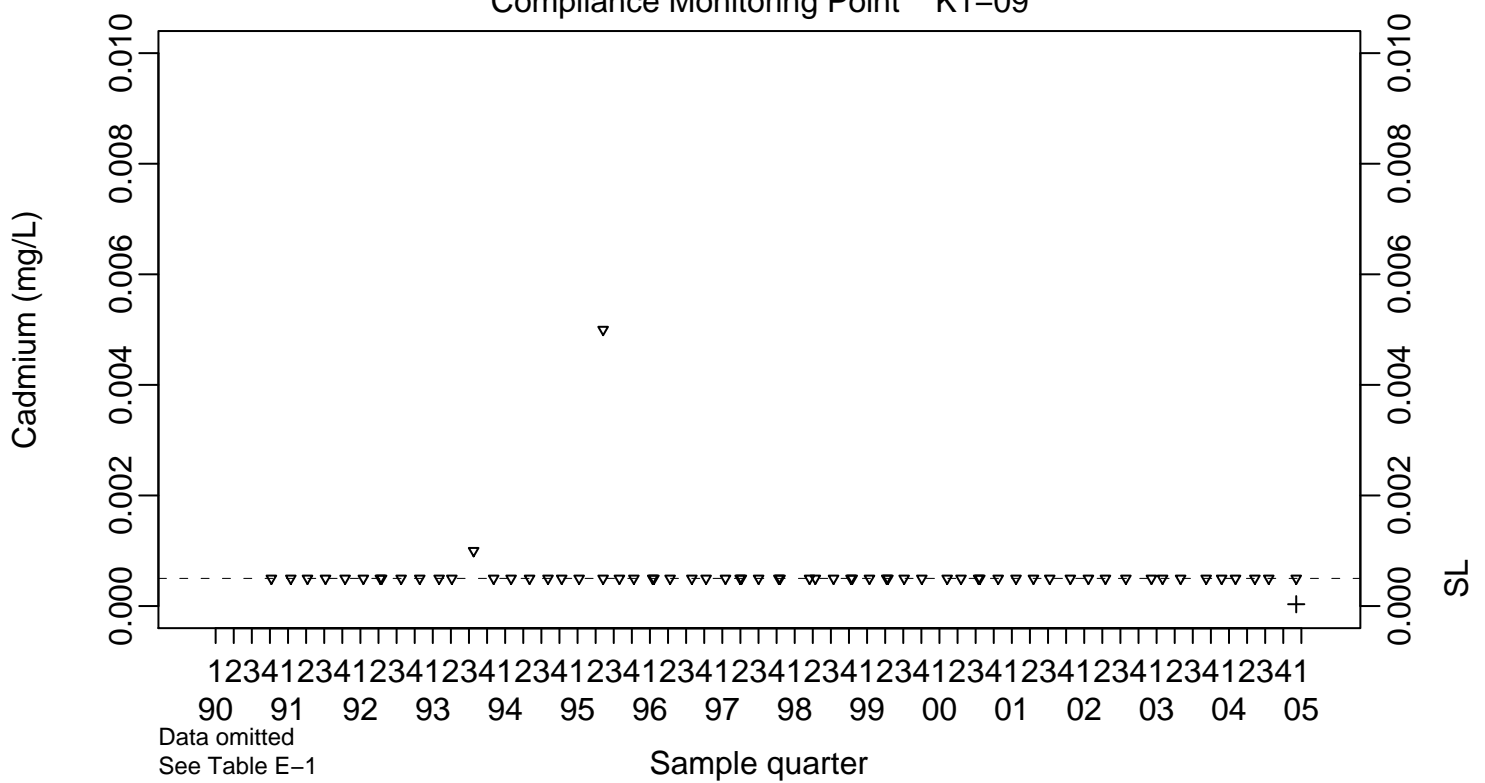
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-09

SL=5e-04

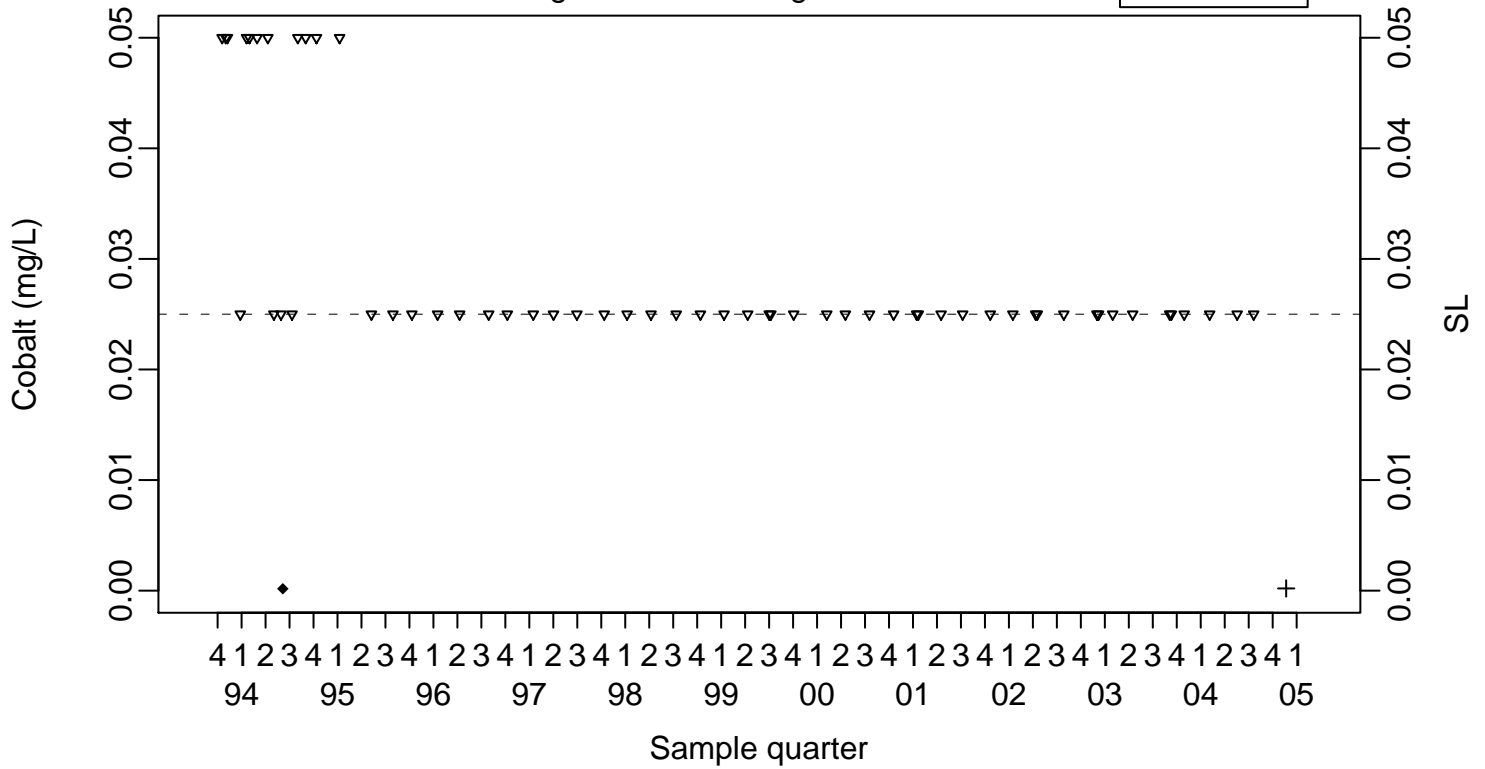


Pit 1 Area Cobalt (mg/L)

Background Monitoring Point K1-01C

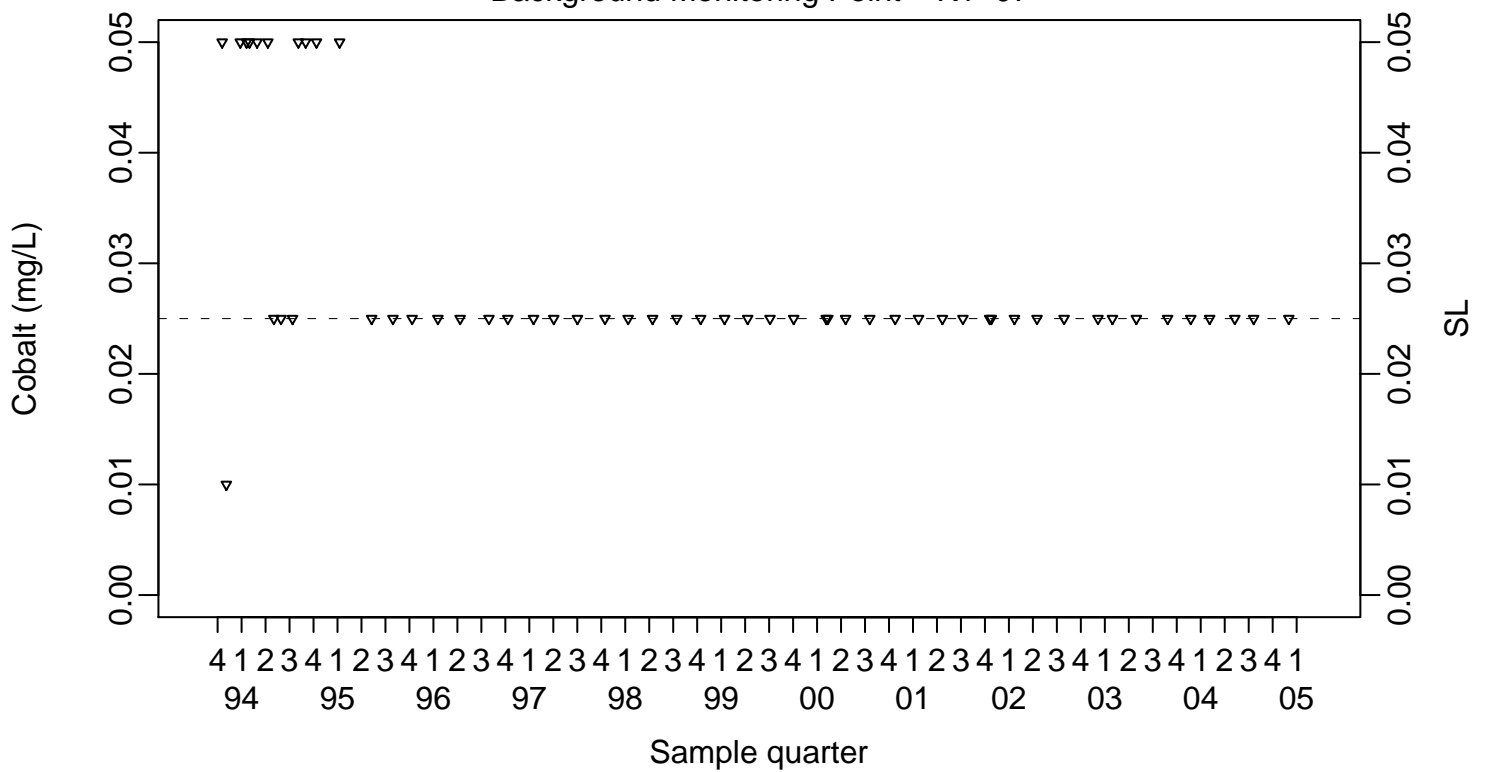
SL=0.025

- ◆ Above RL
- ▽ Below RL
- + Estimated



Background Monitoring Point K1-07

SL=0.025

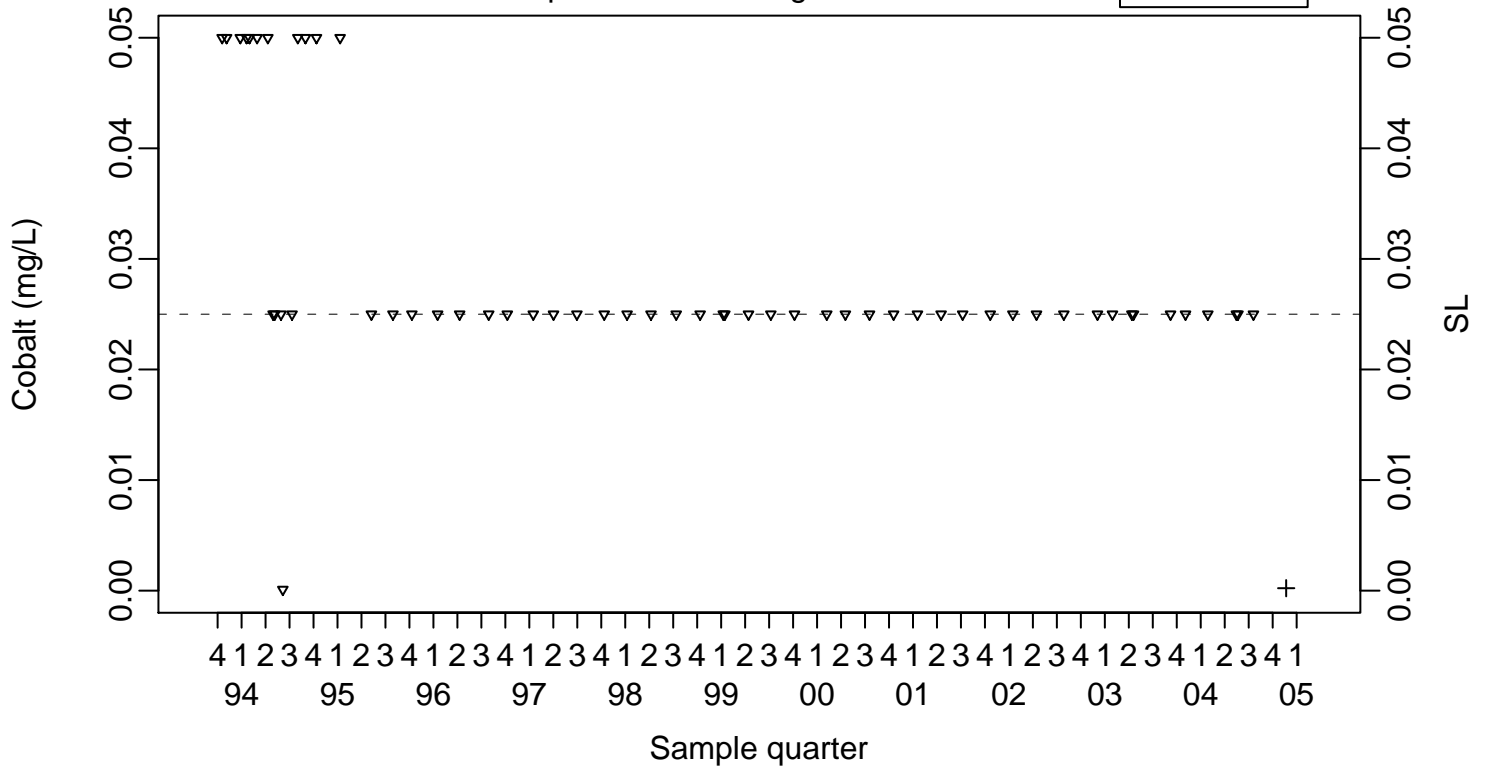


Pit 1 Area Cobalt (mg/L)

Compliance Monitoring Point K1-02B

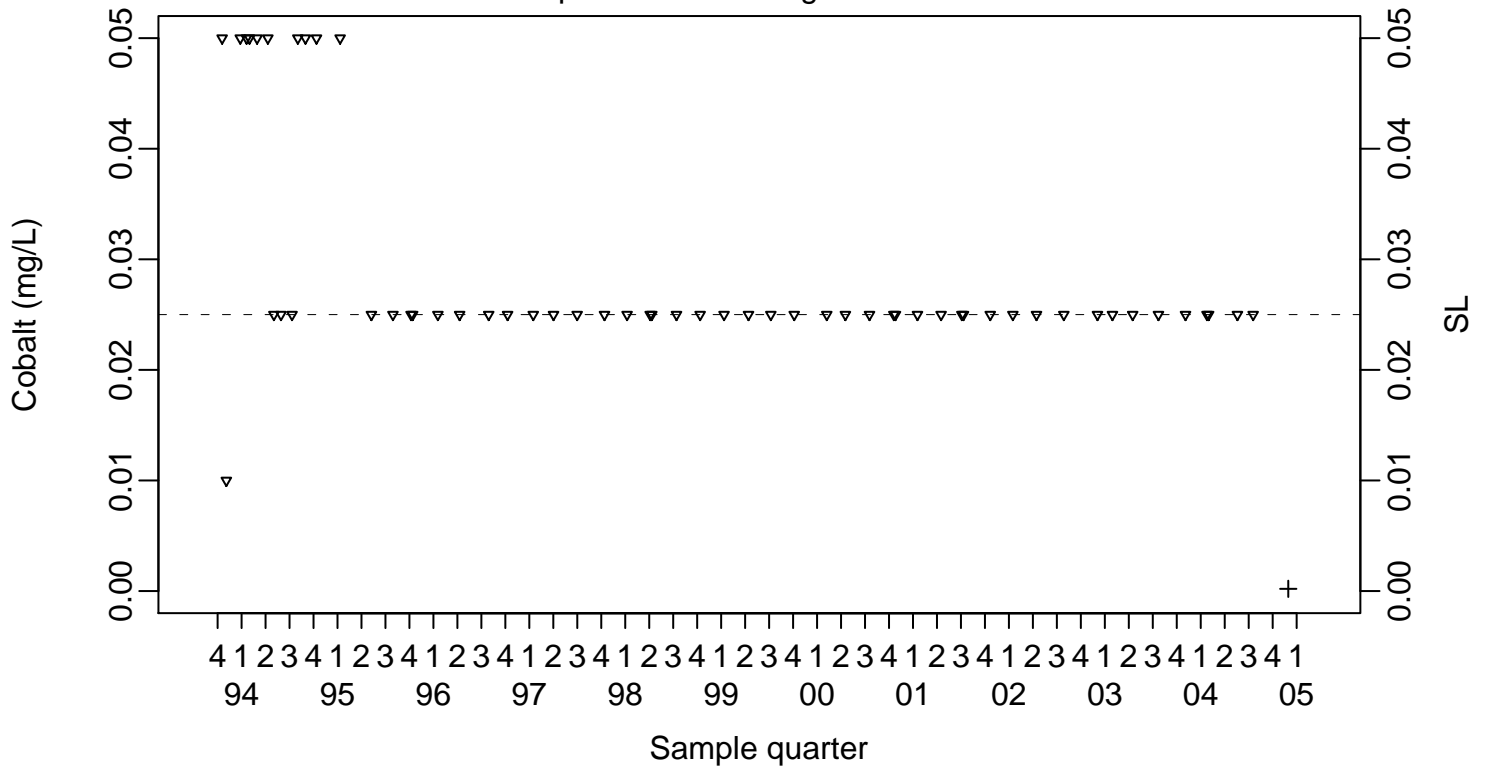
SL=0.025

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.025

Compliance Monitoring Point K1-03

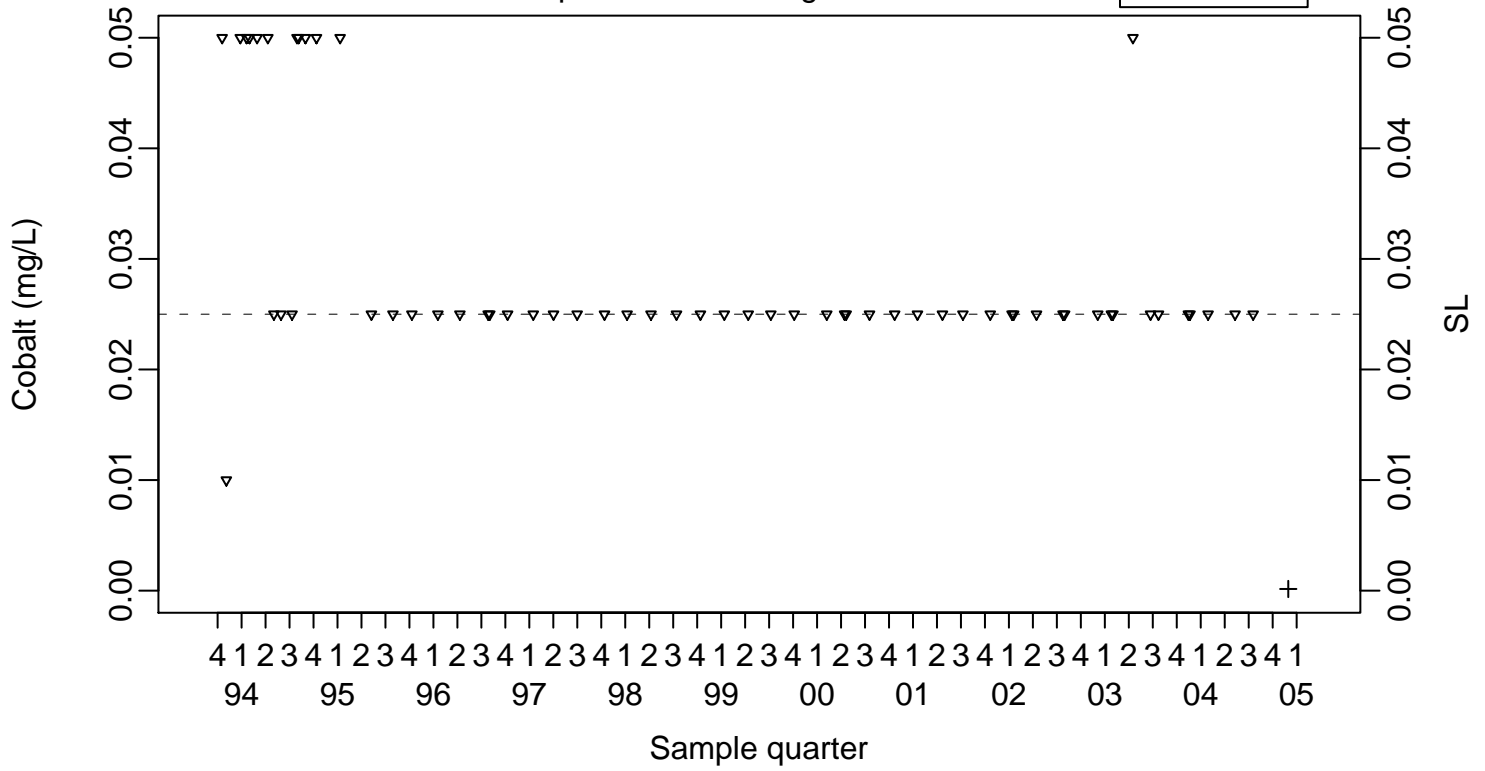


Pit 1 Area Cobalt (mg/L)

Compliance Monitoring Point K1-04

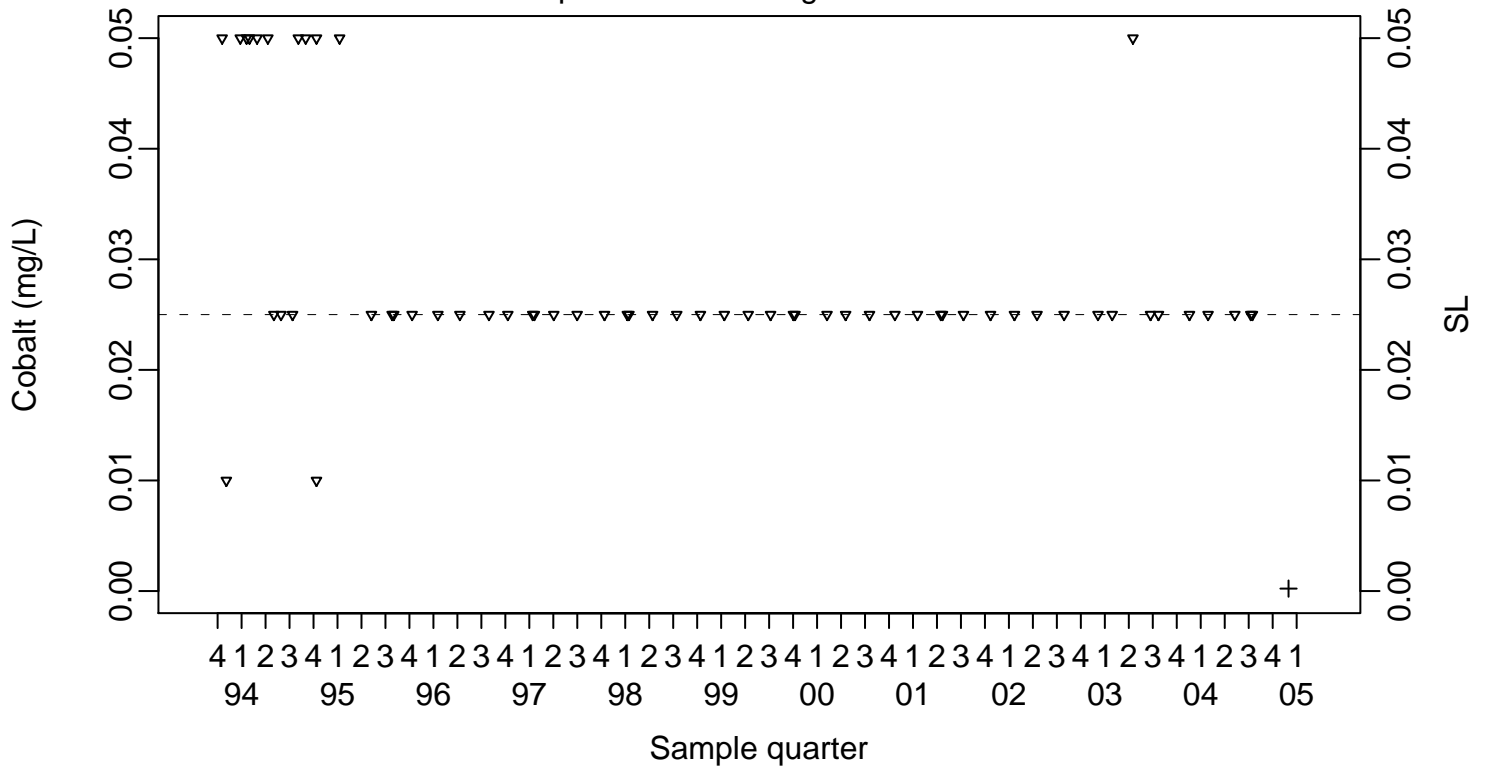
SL=0.025

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point K1-05

SL=0.025

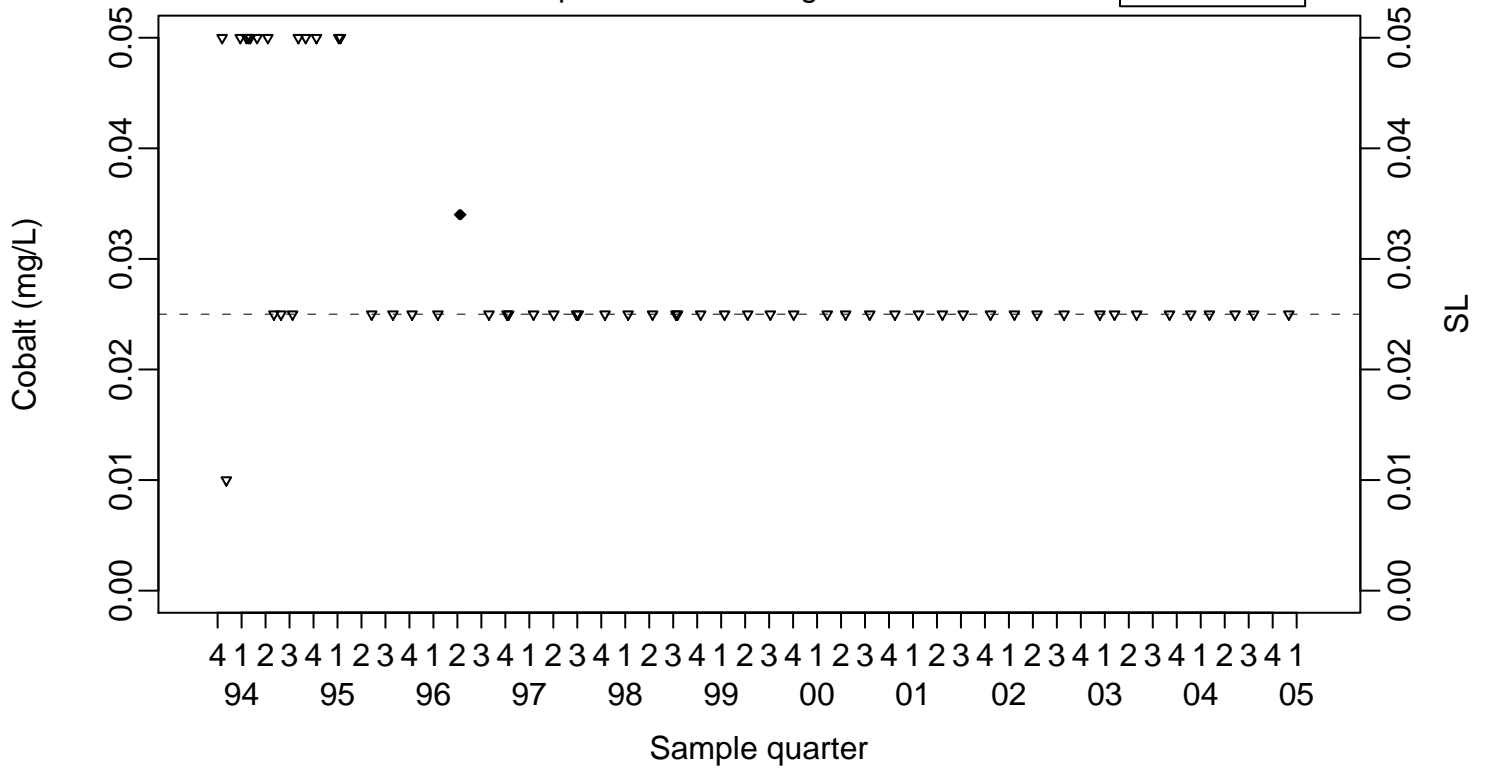


Pit 1 Area Cobalt (mg/L)

SL=0.025

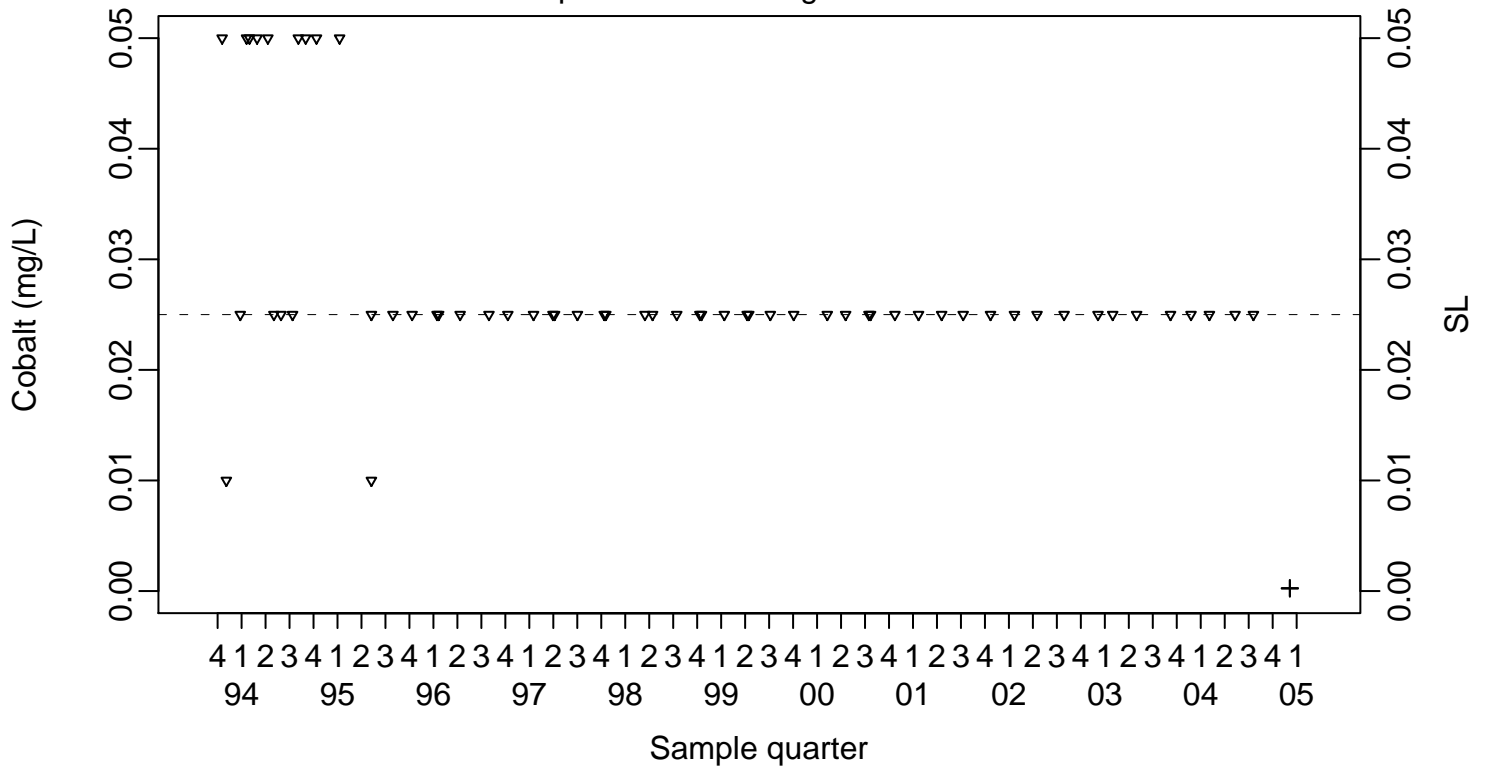
◆ Above RL
▽ Below RL

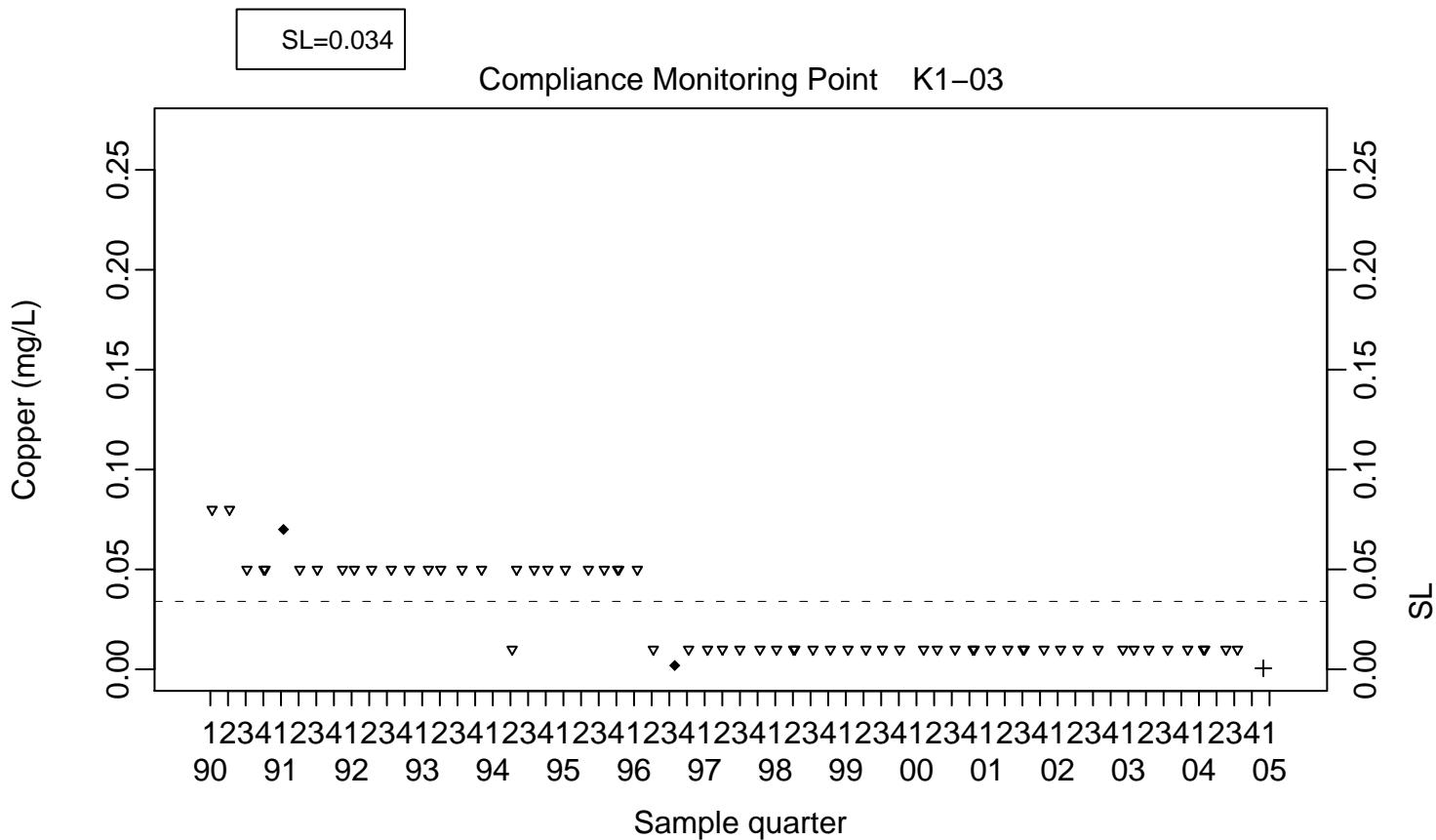
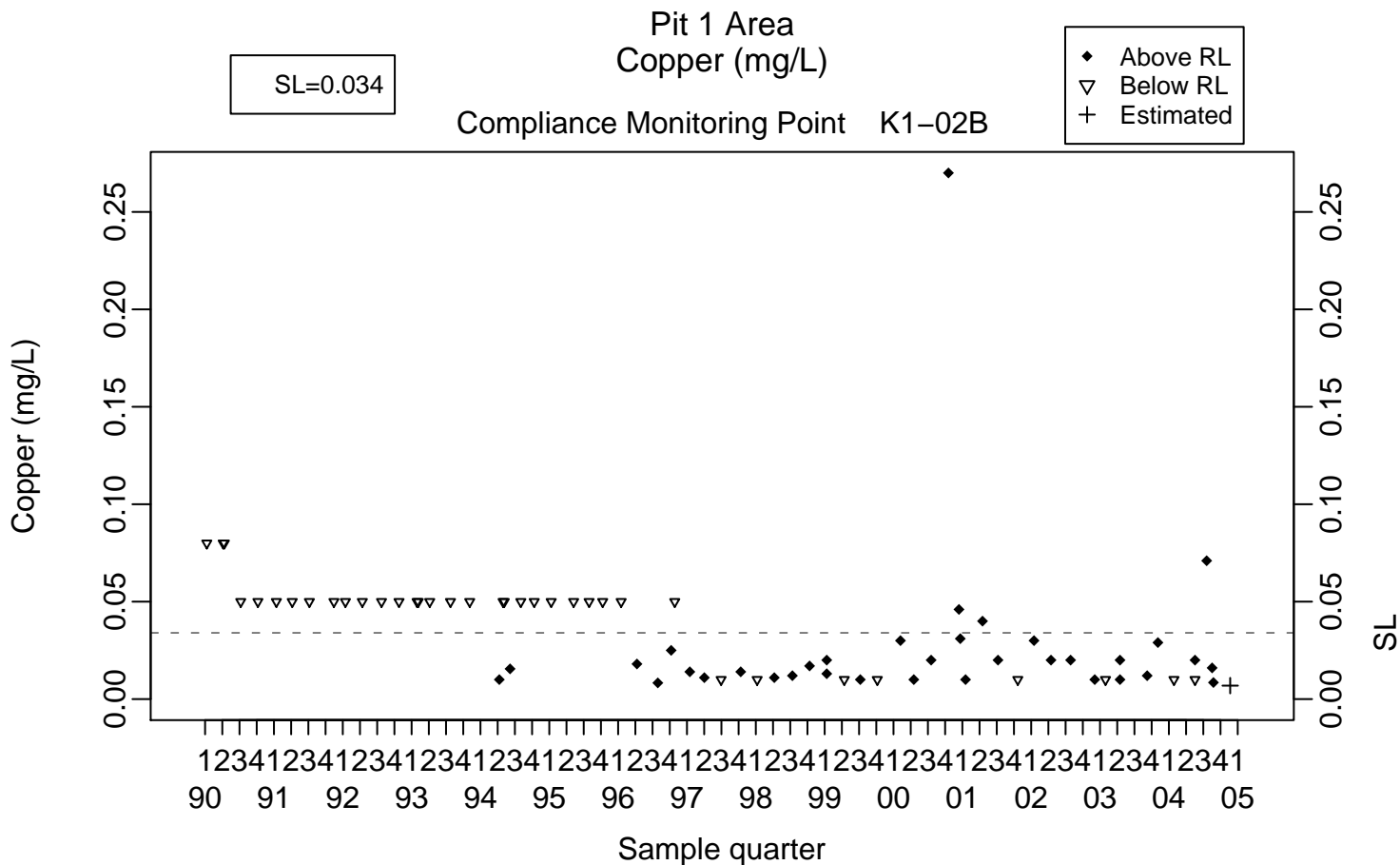
Compliance Monitoring Point K1-08



SL=0.025

Compliance Monitoring Point K1-09



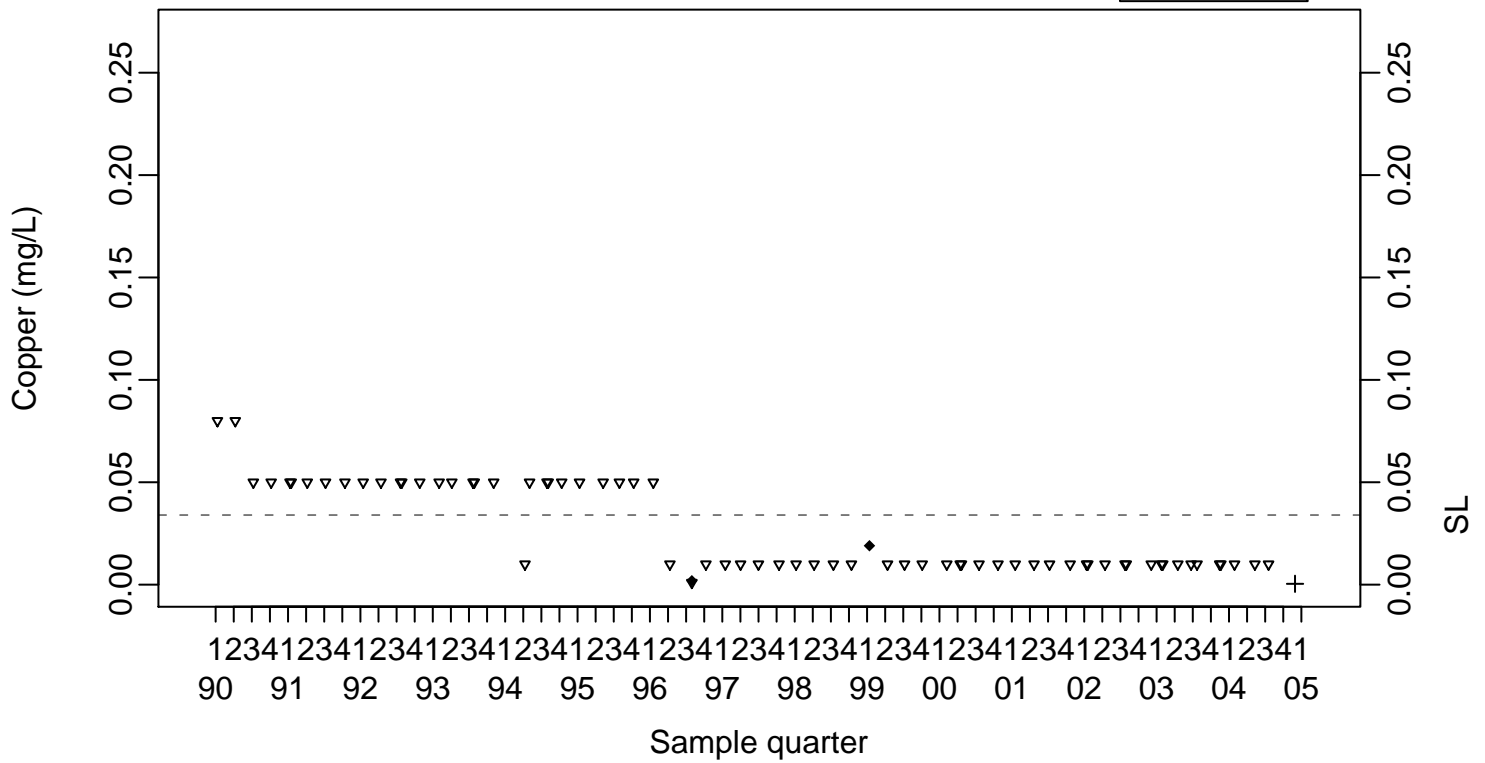


Pit 1 Area Copper (mg/L)

Compliance Monitoring Point K1-04

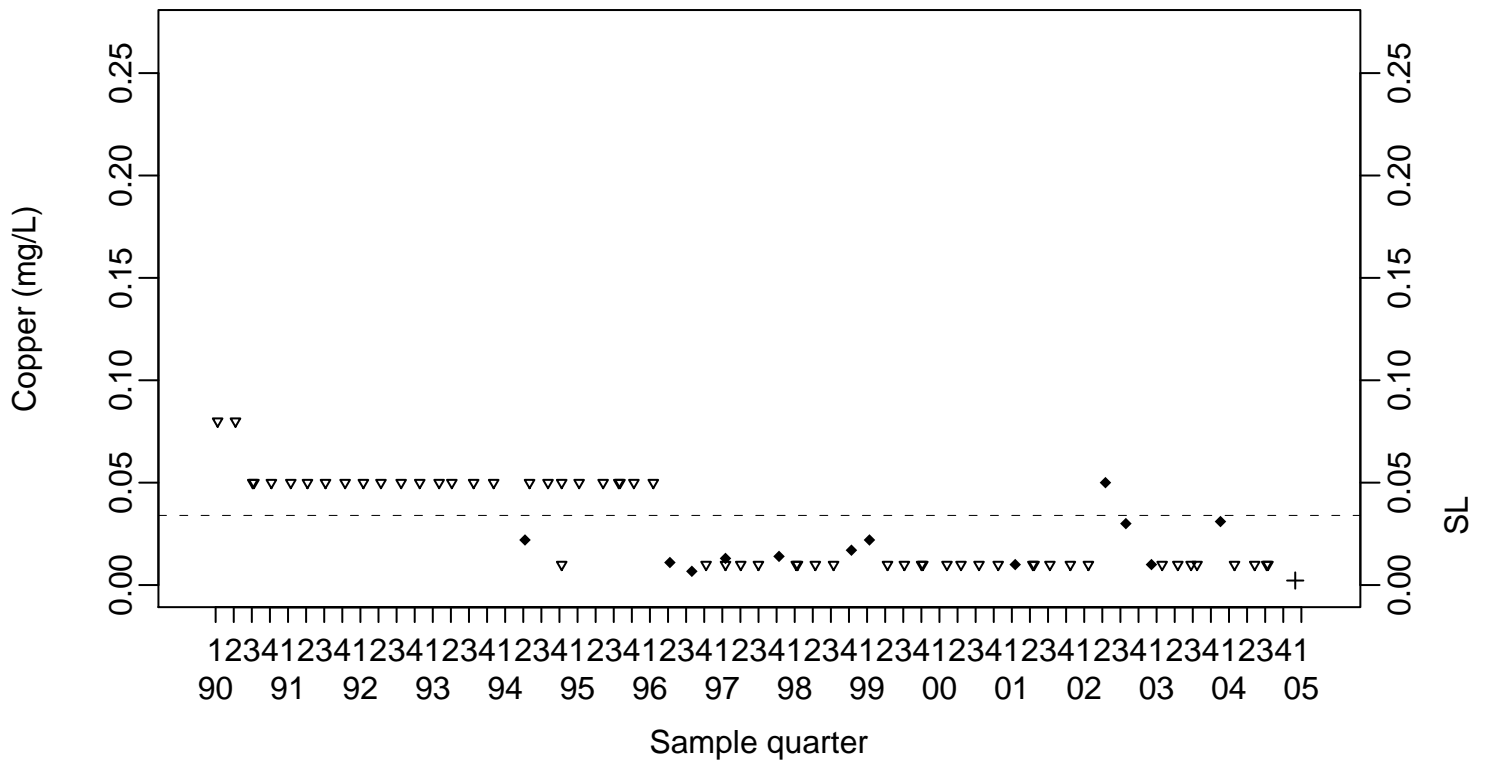
SL=0.034

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point K1-05

SL=0.034

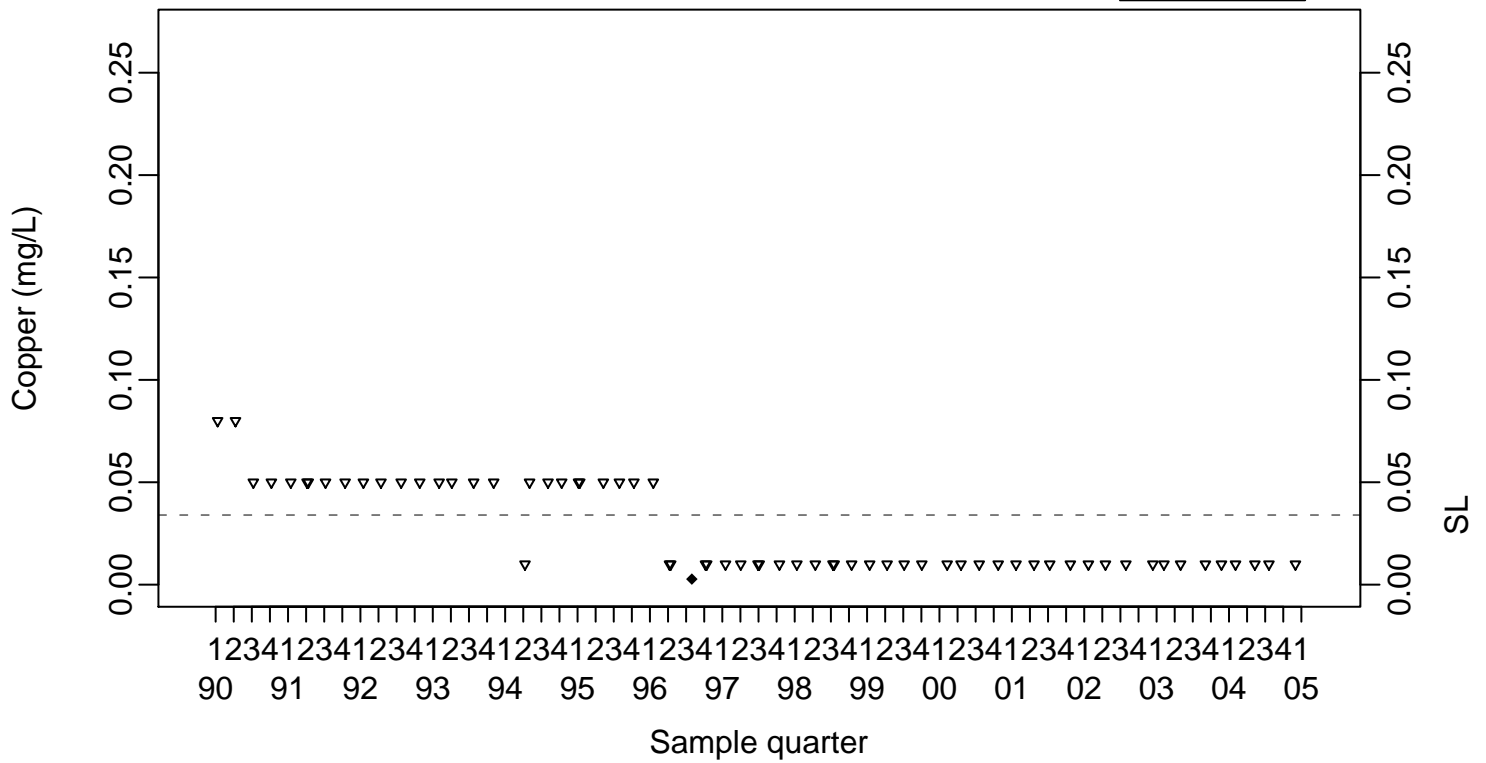


Pit 1 Area Copper (mg/L)

Compliance Monitoring Point K1-08

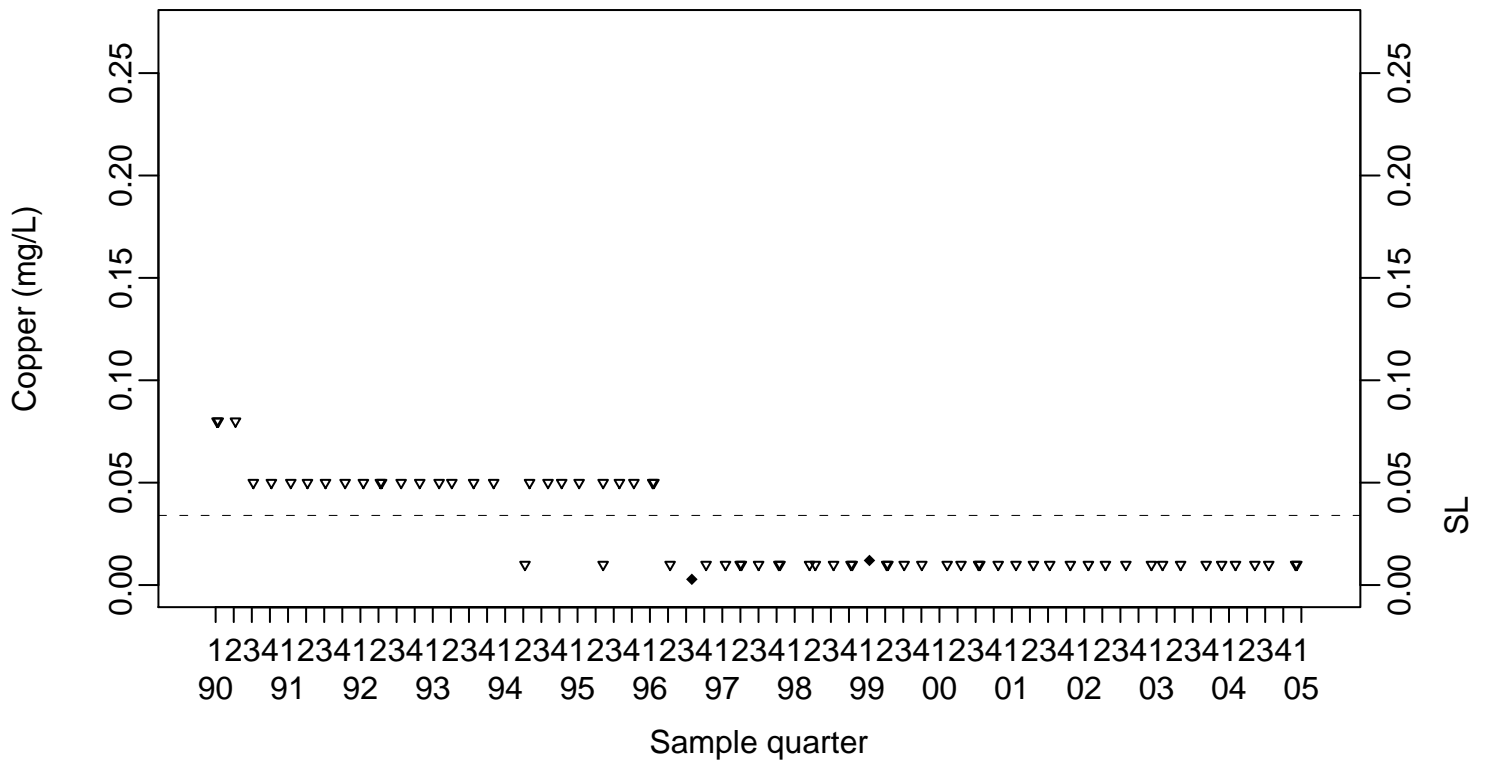
SL=0.034

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-09

SL=0.034

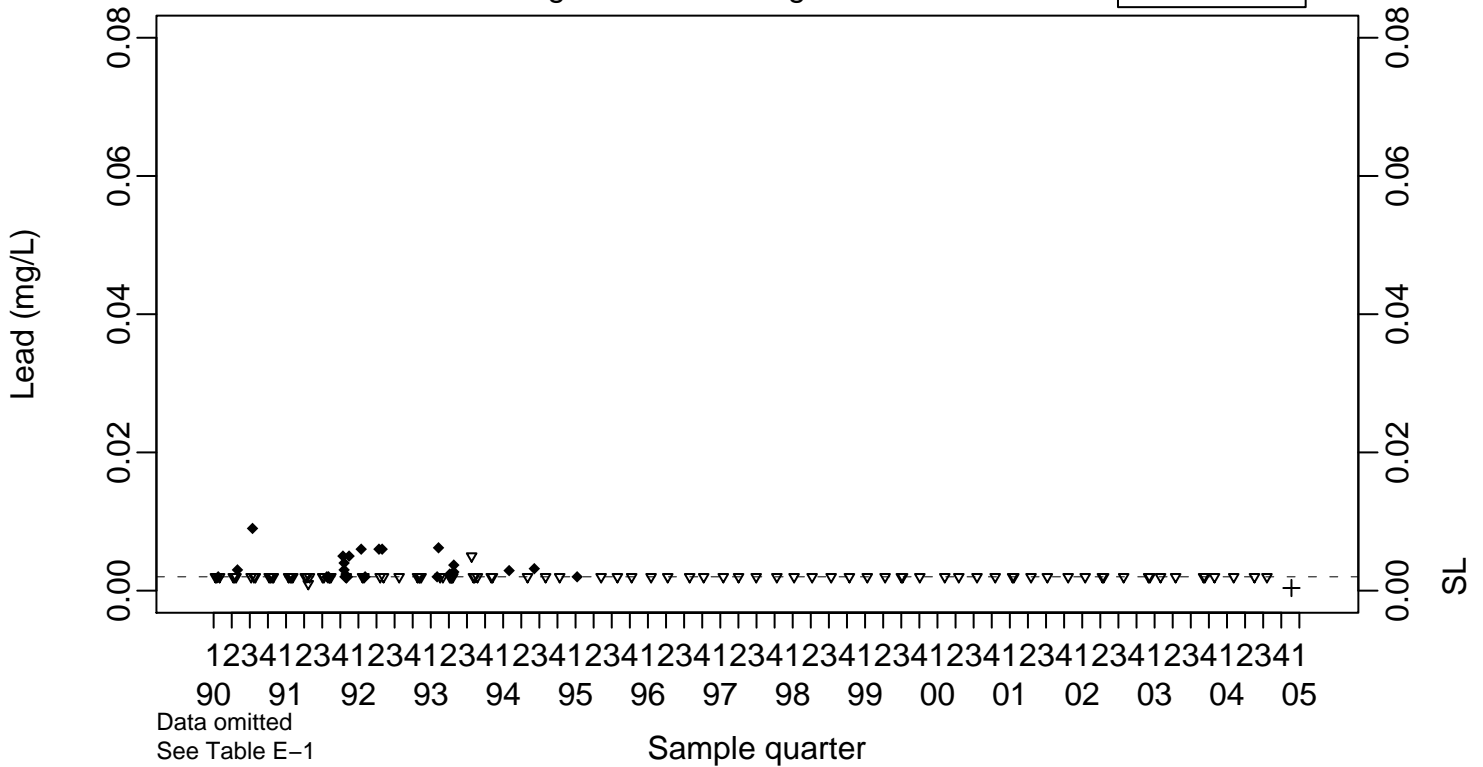


Pit 1 Area Lead (mg/L)

SL=0.002

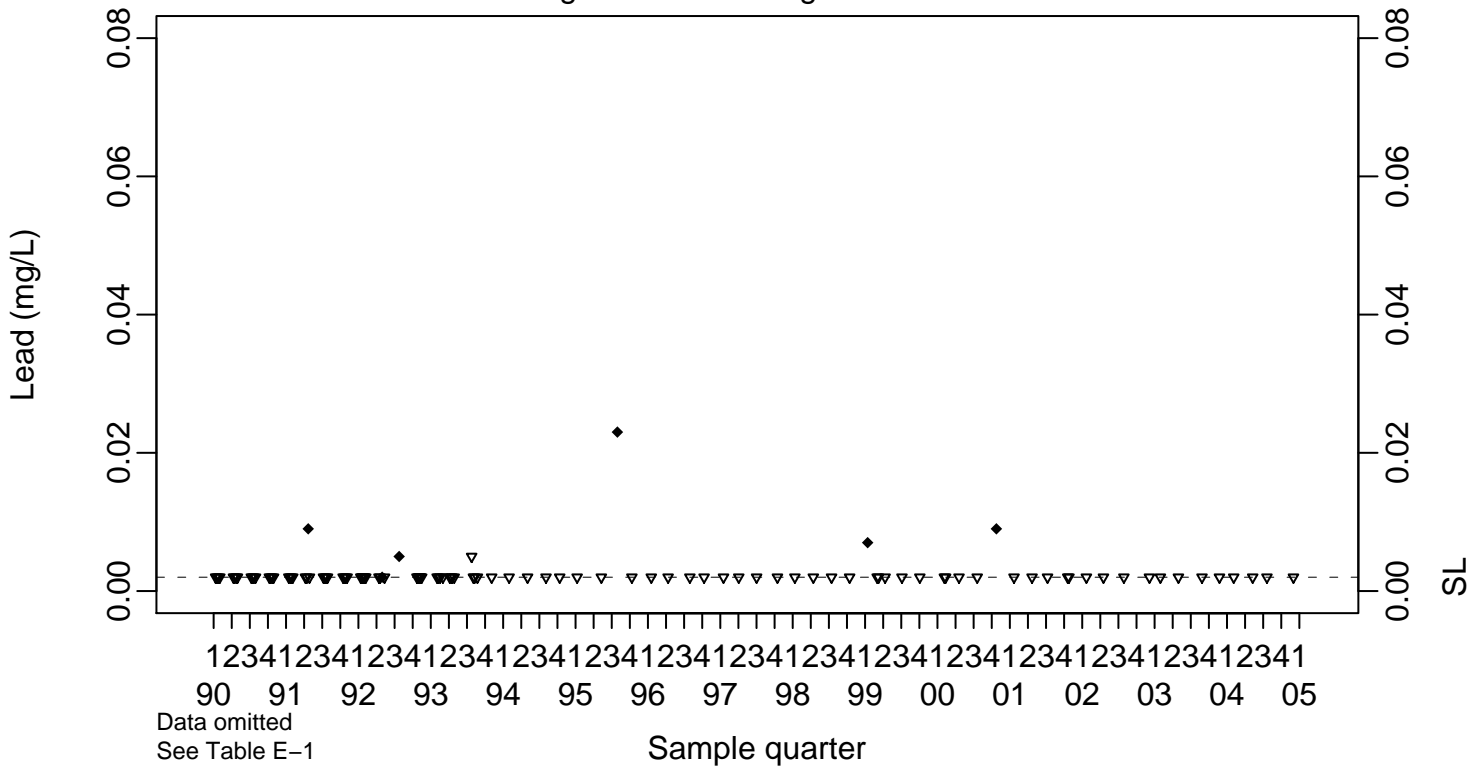
- ◆ Above RL
- ▽ Below RL
- + Estimated

Background Monitoring Point K1-01C



SL=0.002

Background Monitoring Point K1-07

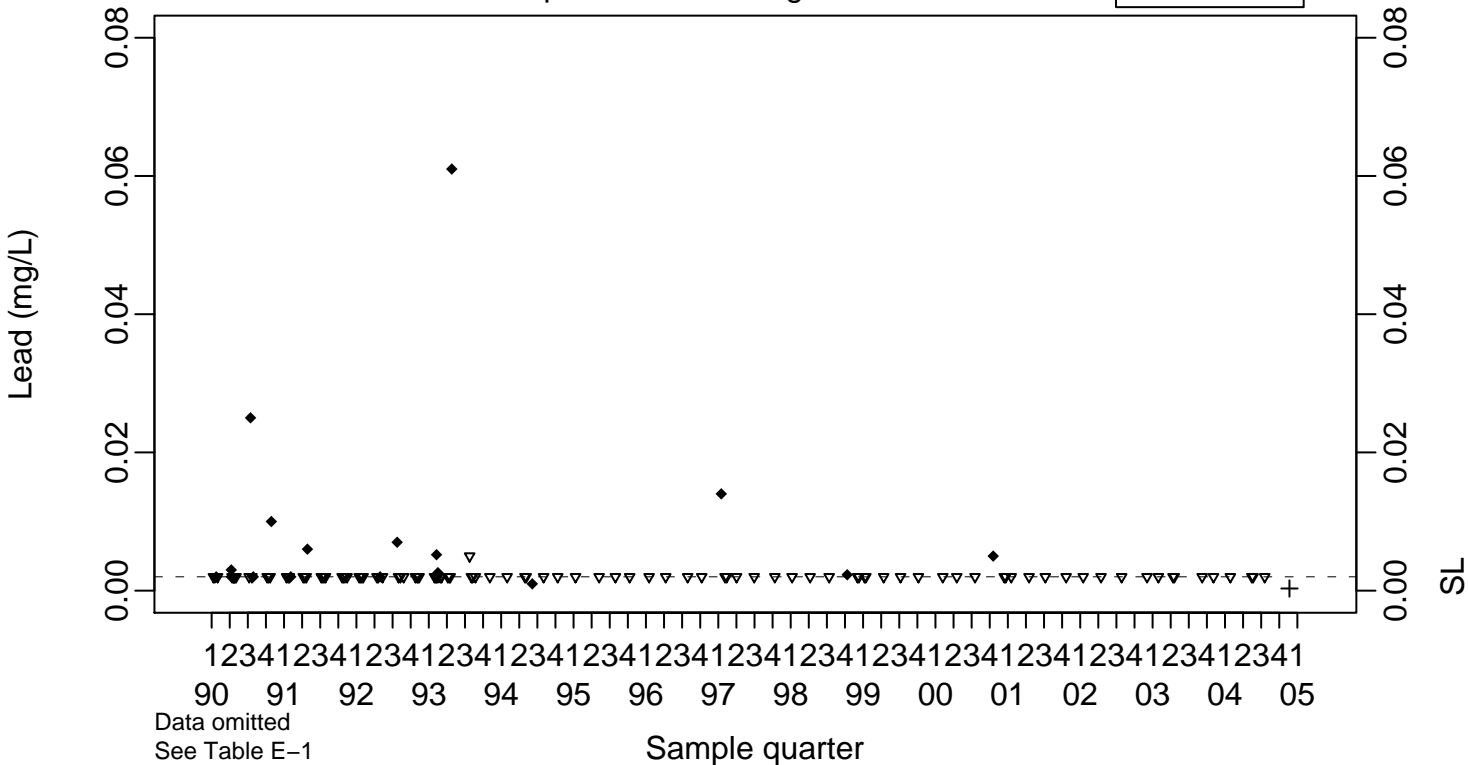


Pit 1 Area Lead (mg/L)

Compliance Monitoring Point K1-02B

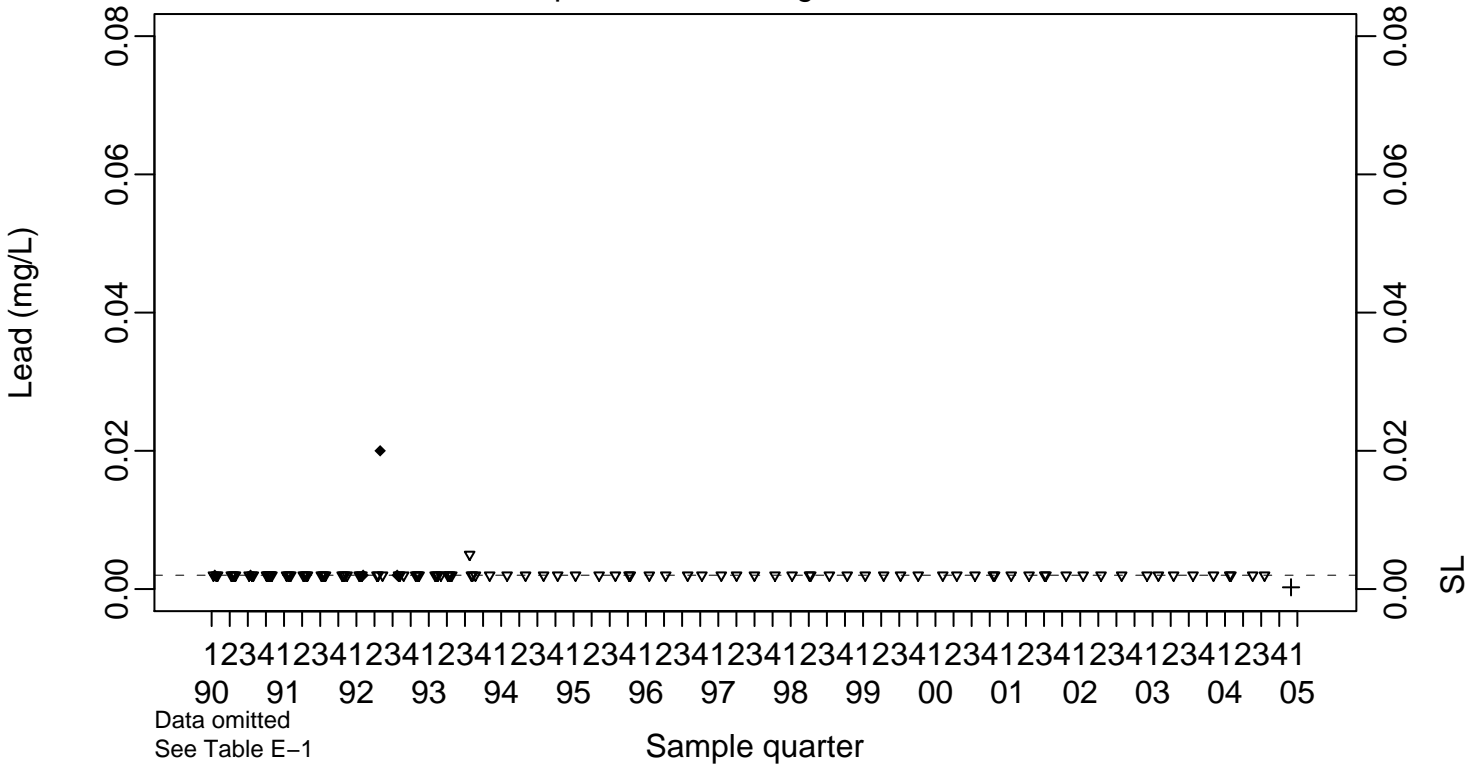
SL=0.002

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.002

Compliance Monitoring Point K1-03

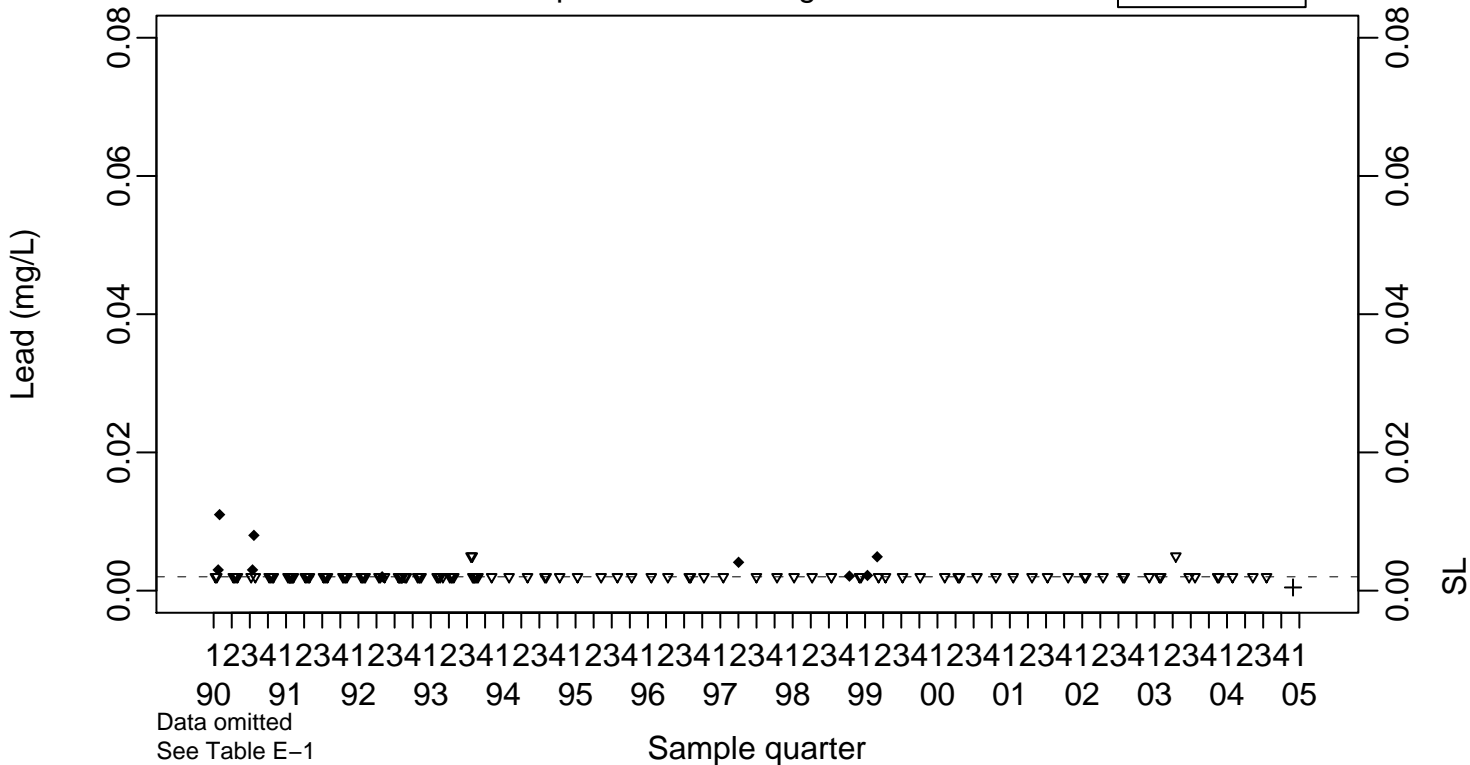


Pit 1 Area Lead (mg/L)

Compliance Monitoring Point K1-04

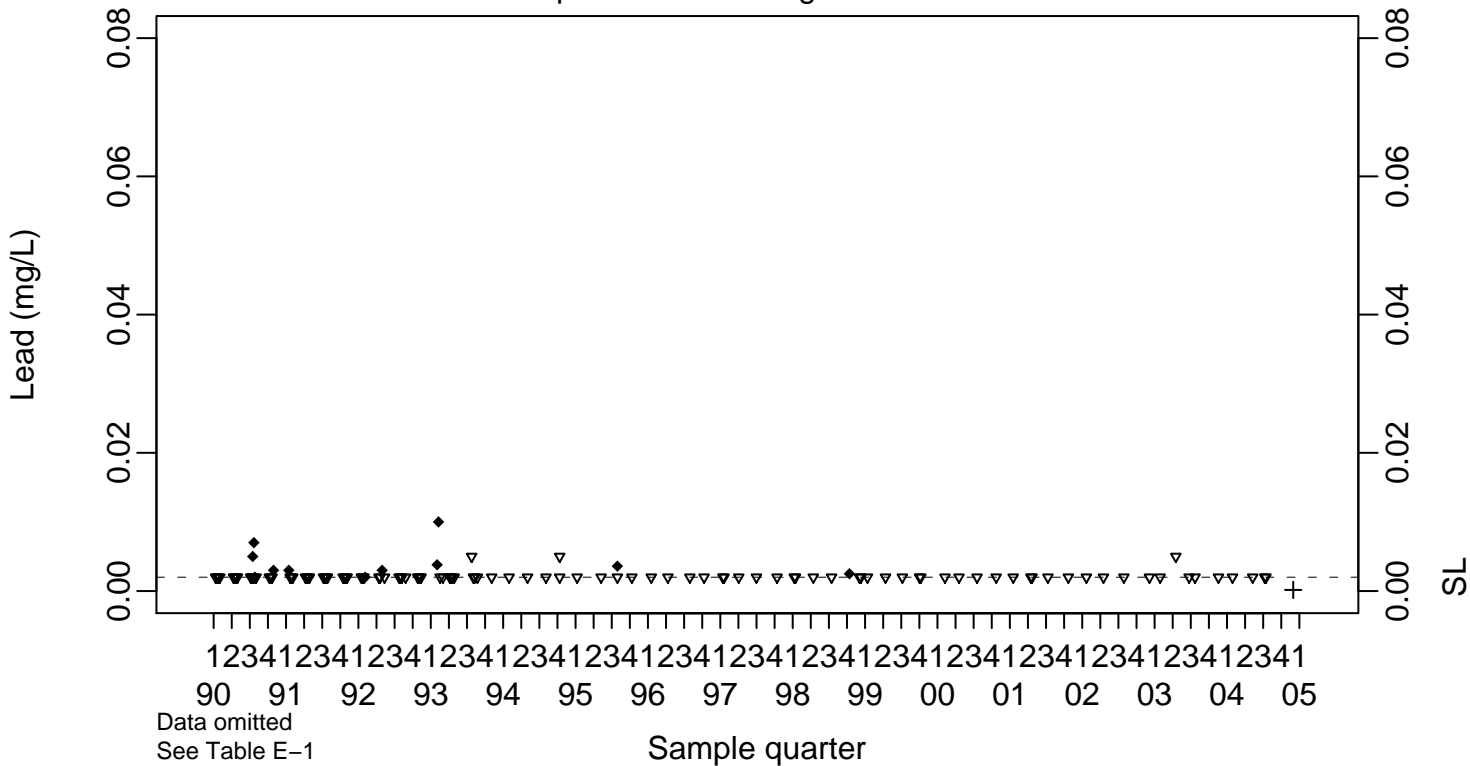
SL=0.002

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.002

Compliance Monitoring Point K1-05

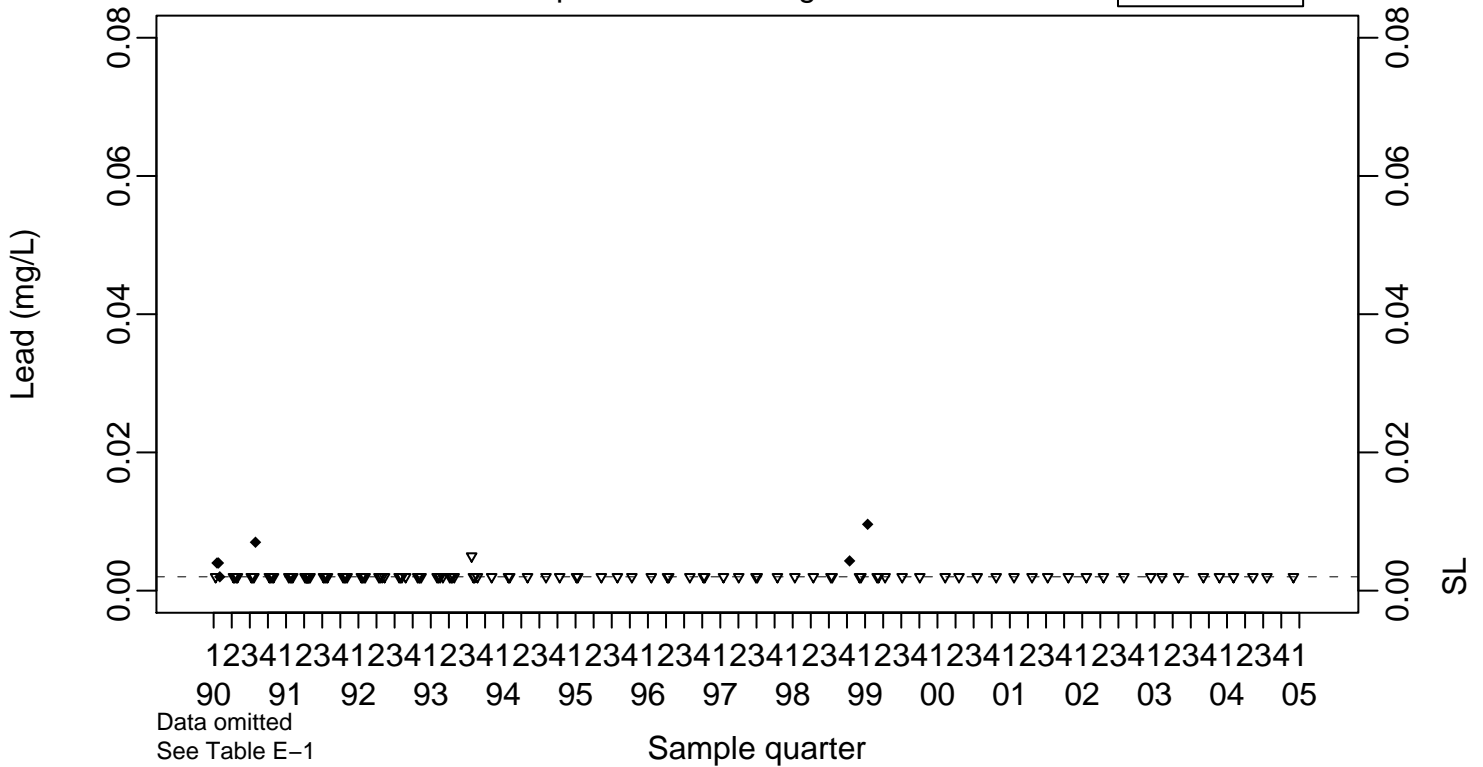


Pit 1 Area Lead (mg/L)

Compliance Monitoring Point K1-08

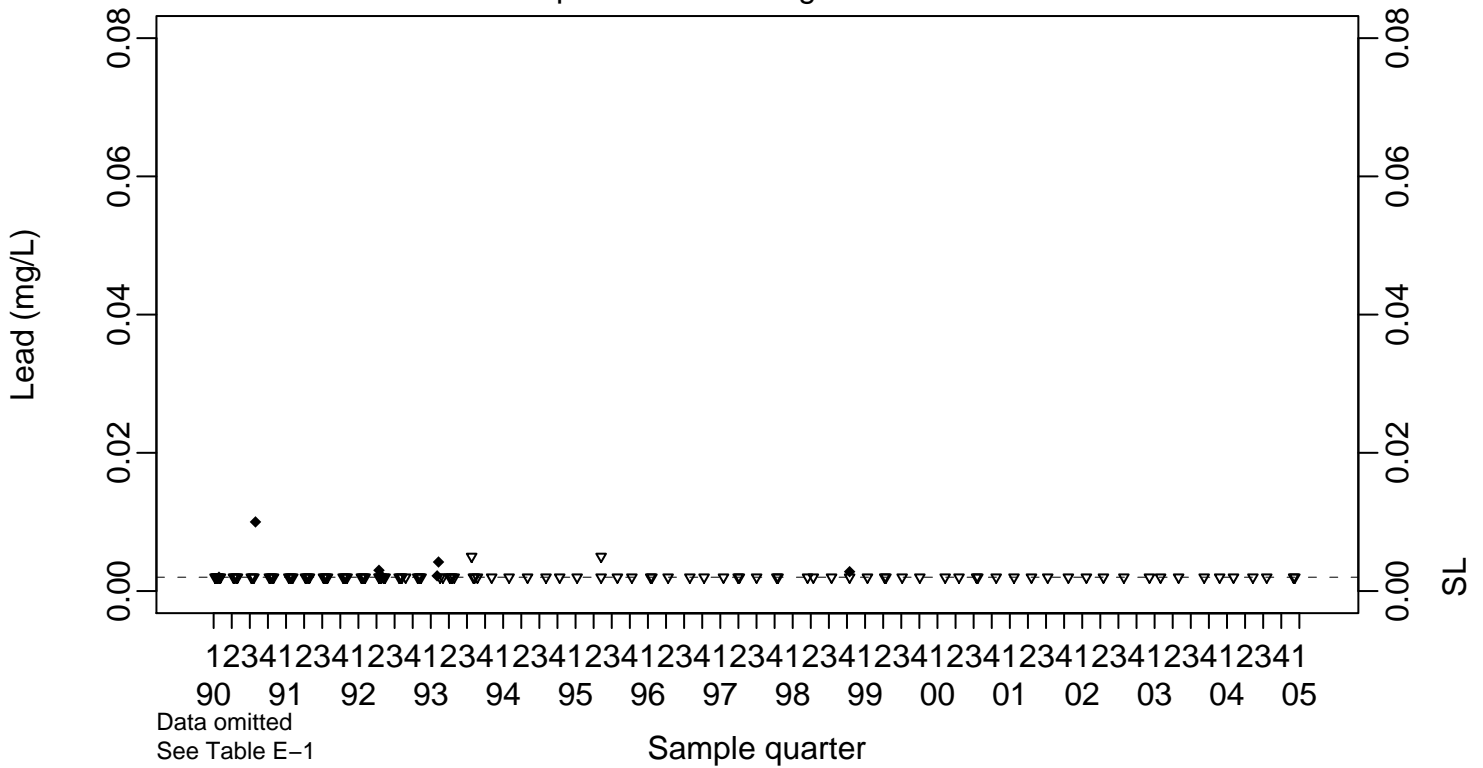
SL=0.002

◆ Above RL
▽ Below RL



SL=0.002

Compliance Monitoring Point K1-09

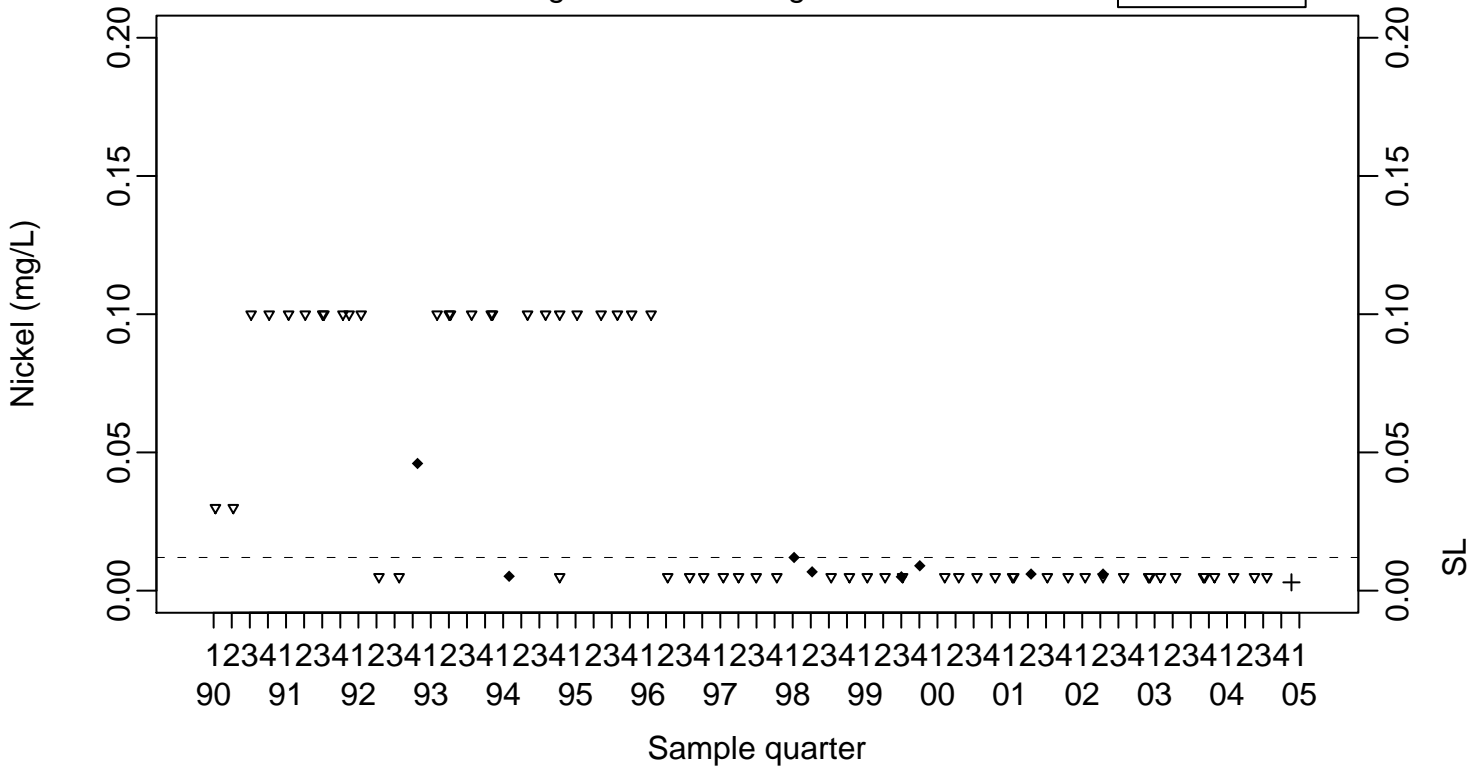


Pit 1 Area Nickel (mg/L)

Background Monitoring Point K1-01C

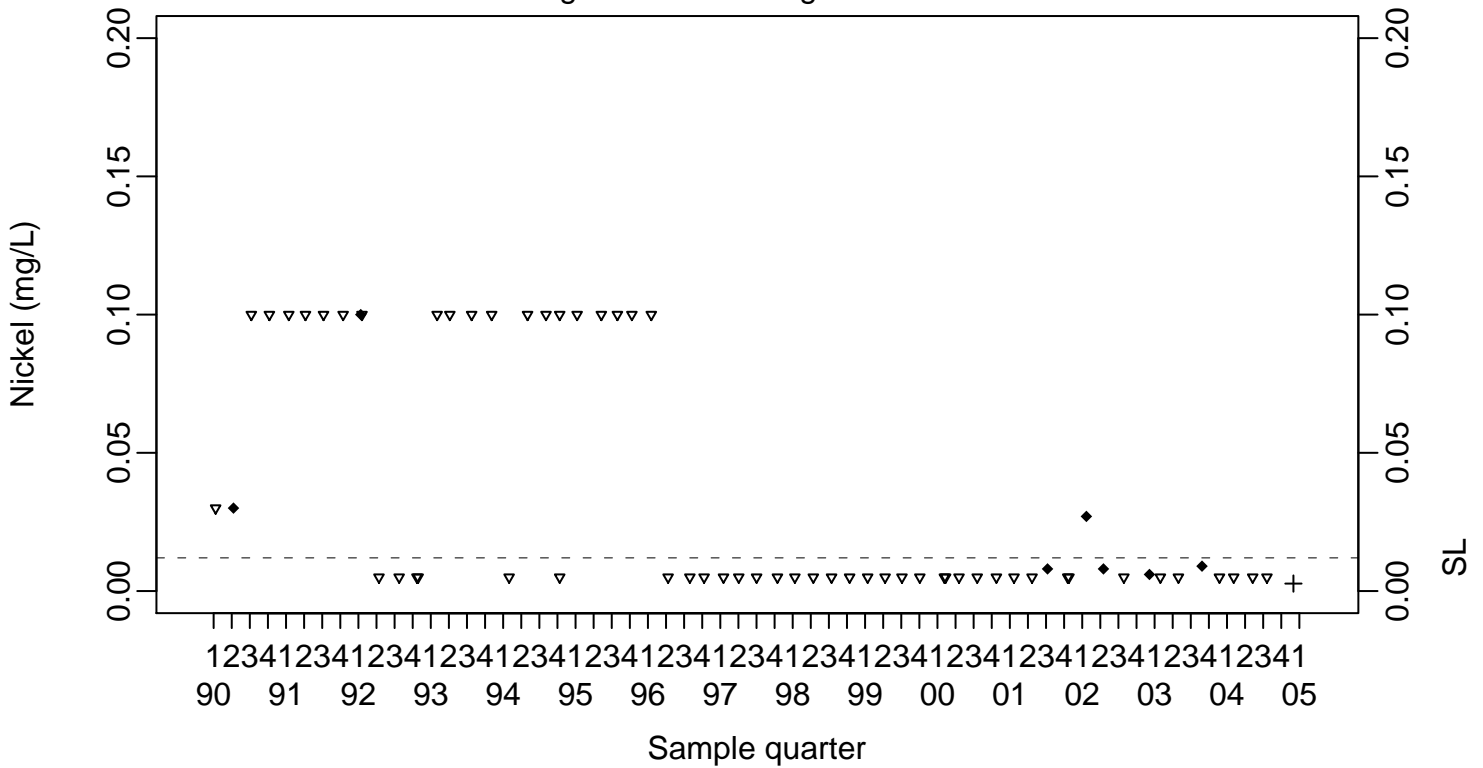
SL=0.012

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.012

Background Monitoring Point K1-07

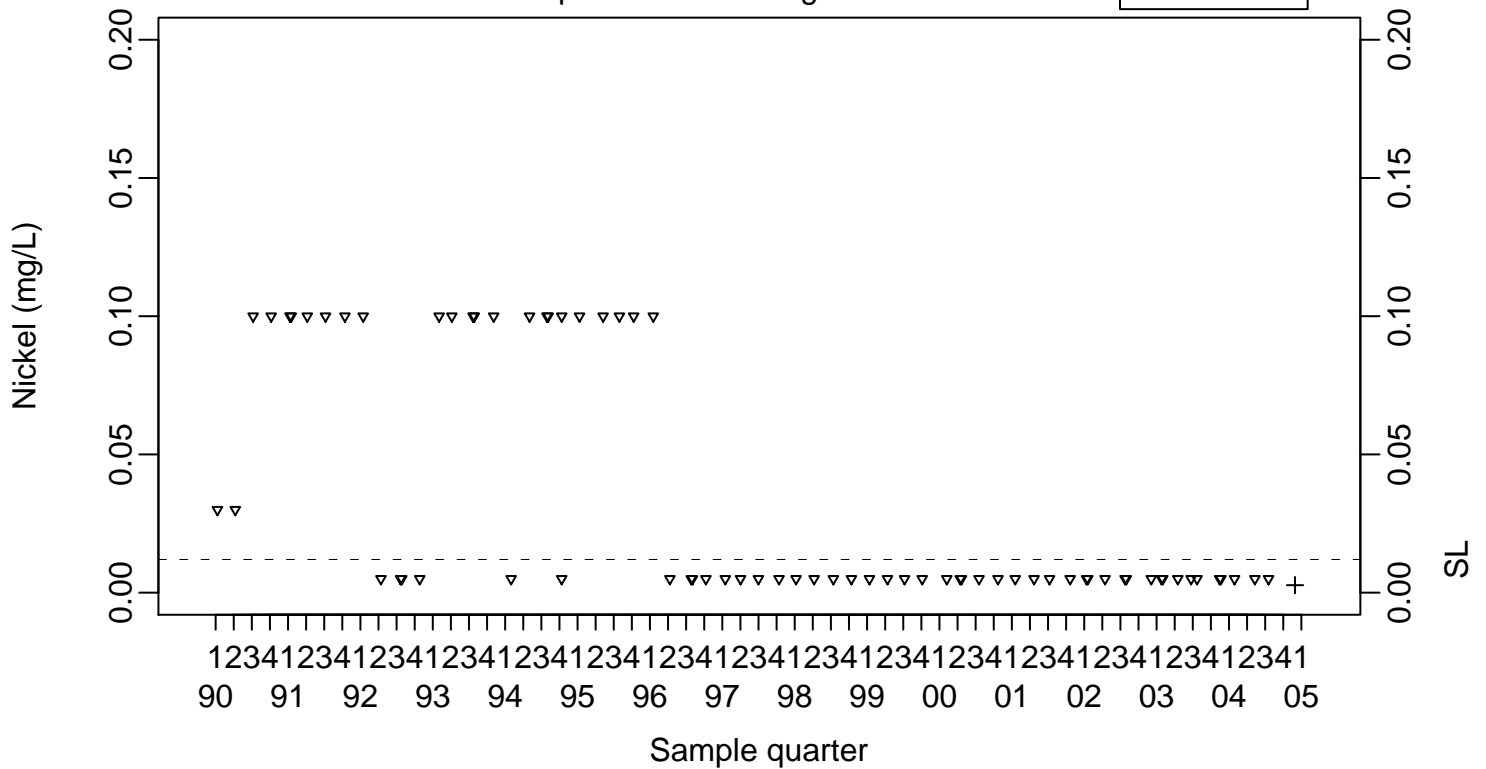


Pit 1 Area
Nickel (mg/L)

SL=0.012

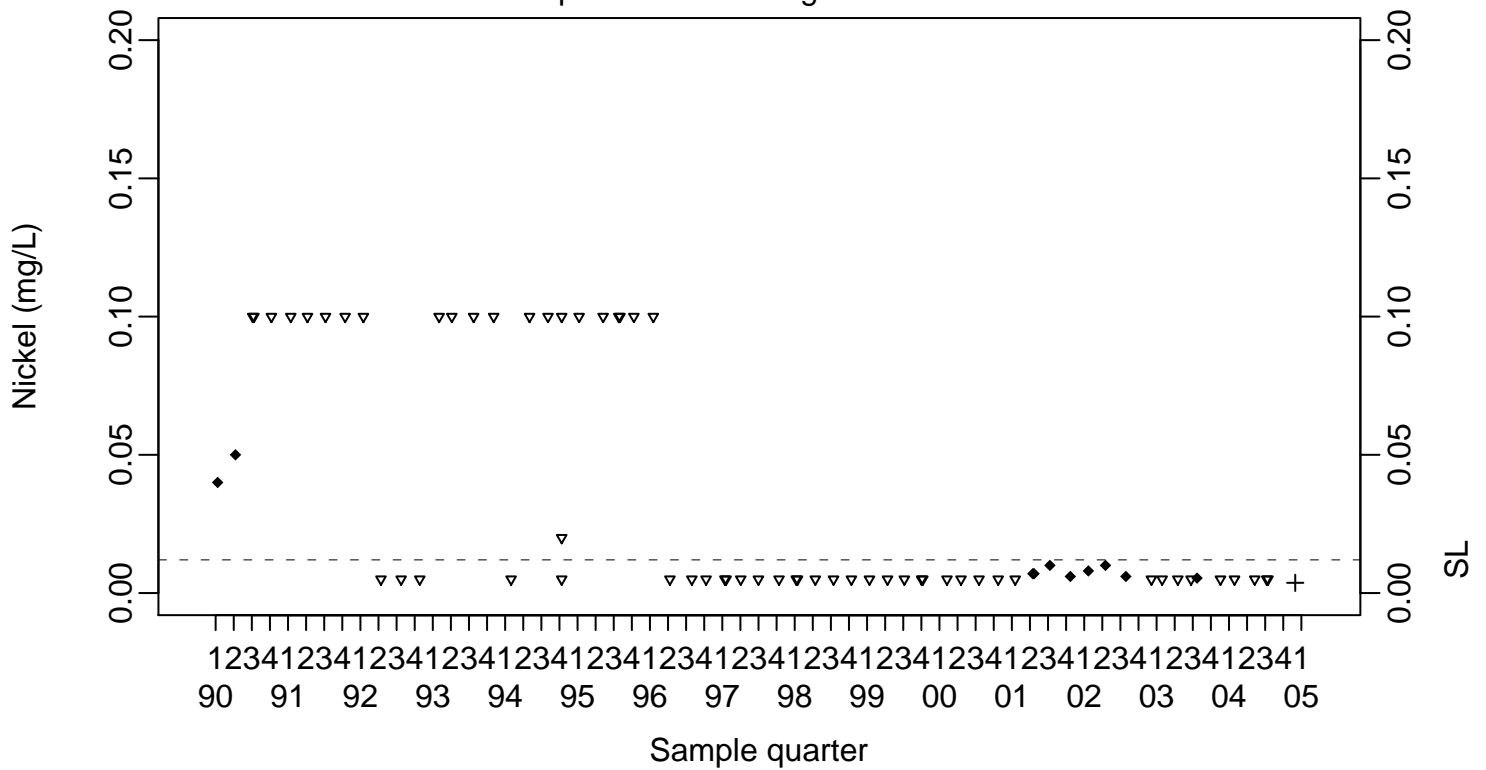
Compliance Monitoring Point K1-04

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.012

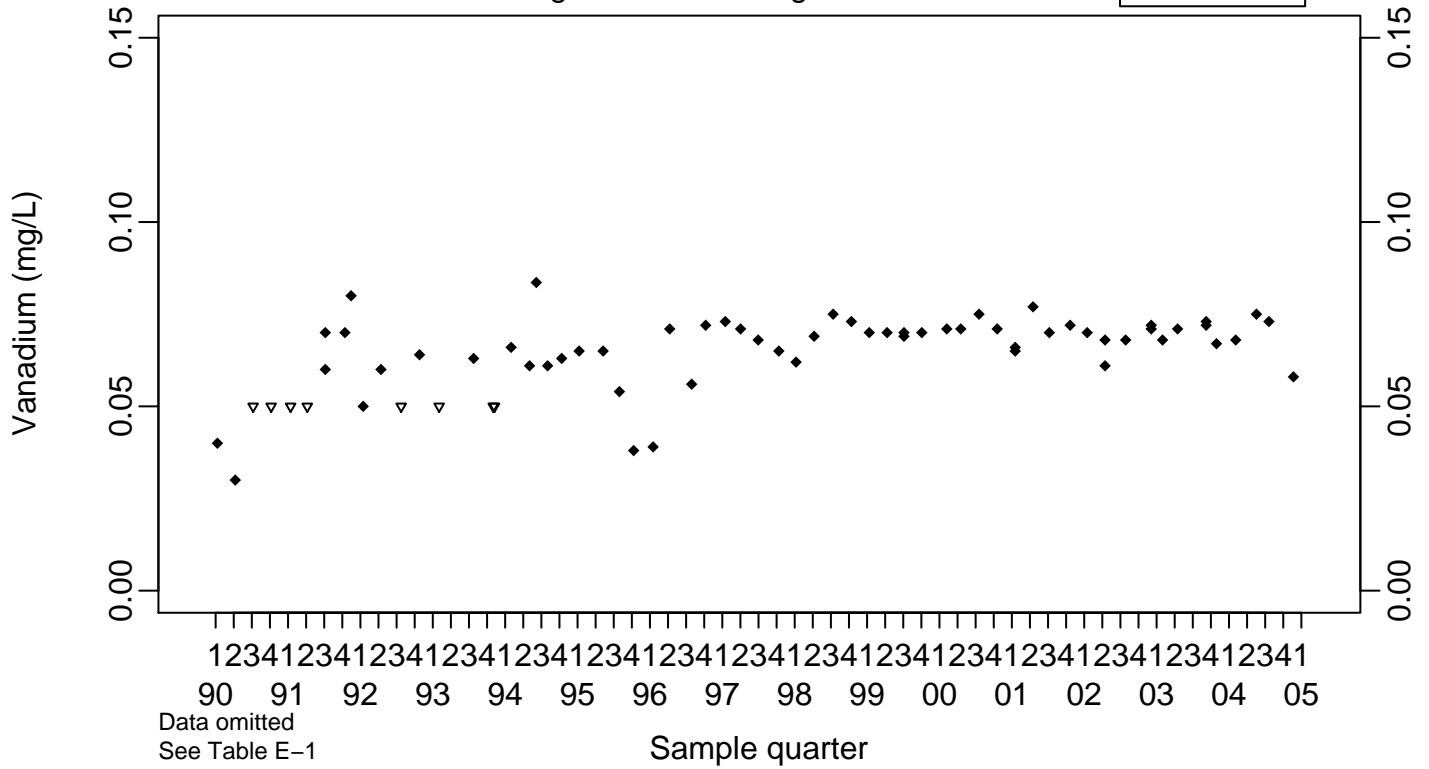
Compliance Monitoring Point K1-05



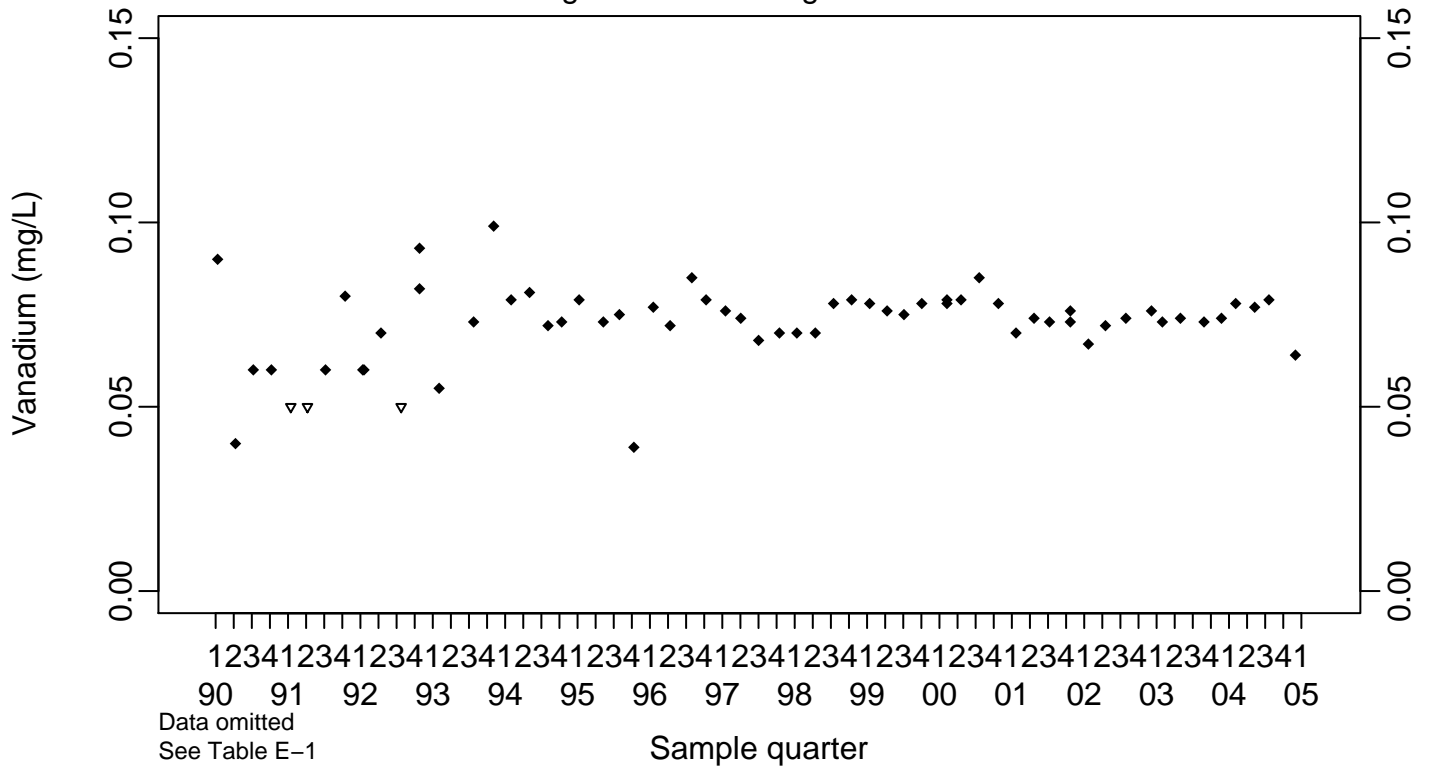
Pit 1 Area Vanadium (mg/L)

Background Monitoring Point K1-01C

◆ Above RL
▽ Below RL



Background Monitoring Point K1-07

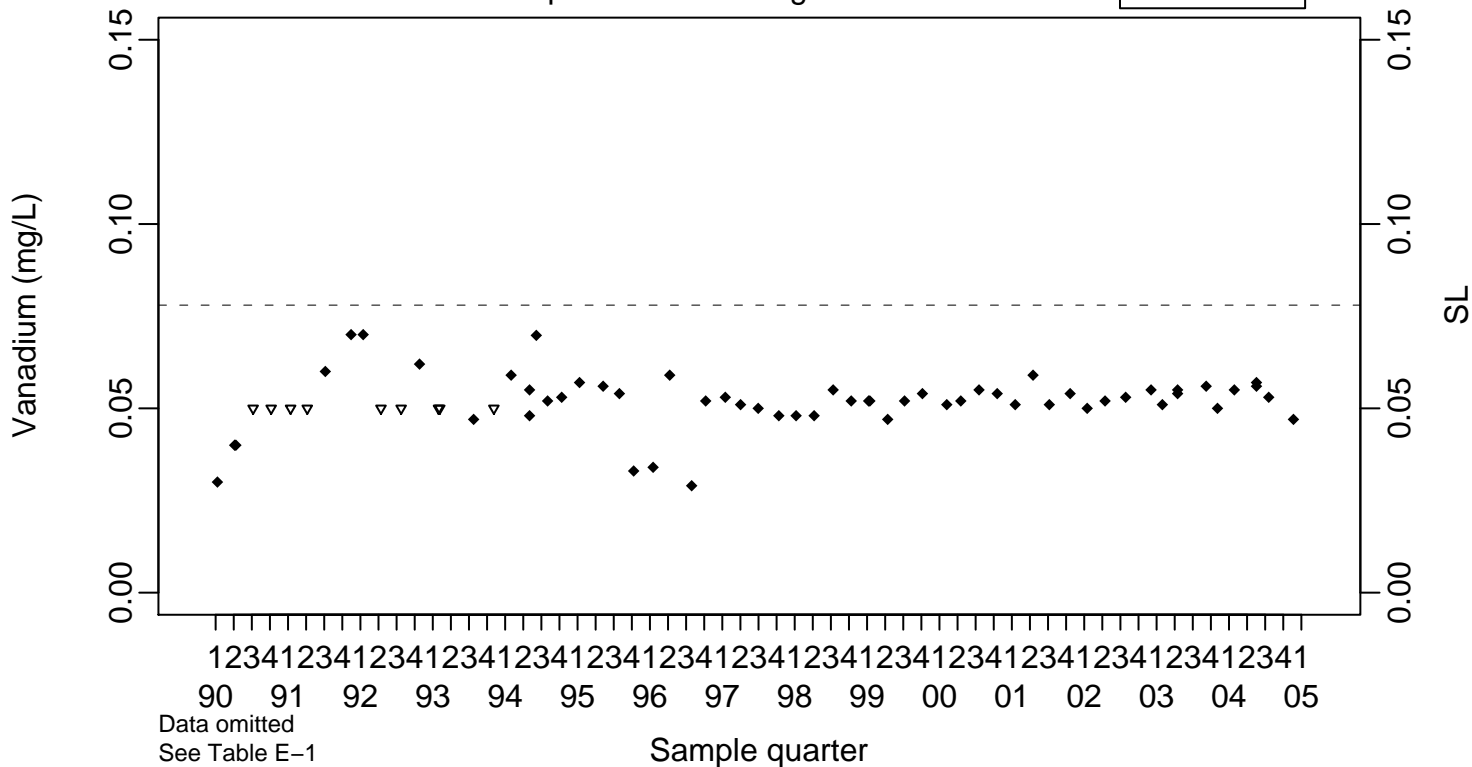


Pit 1 Area
Vanadium (mg/L)

SL=0.078

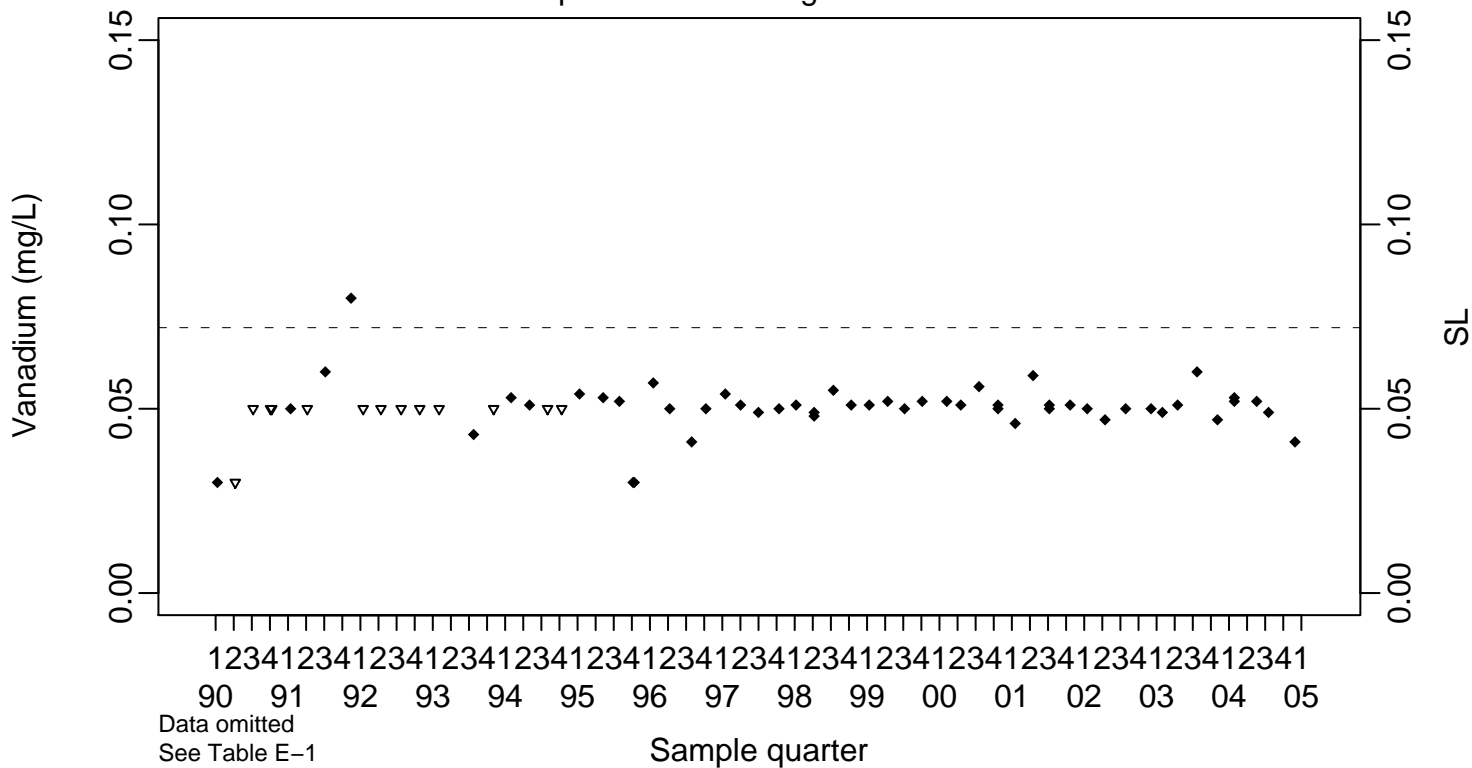
Compliance Monitoring Point K1-02B

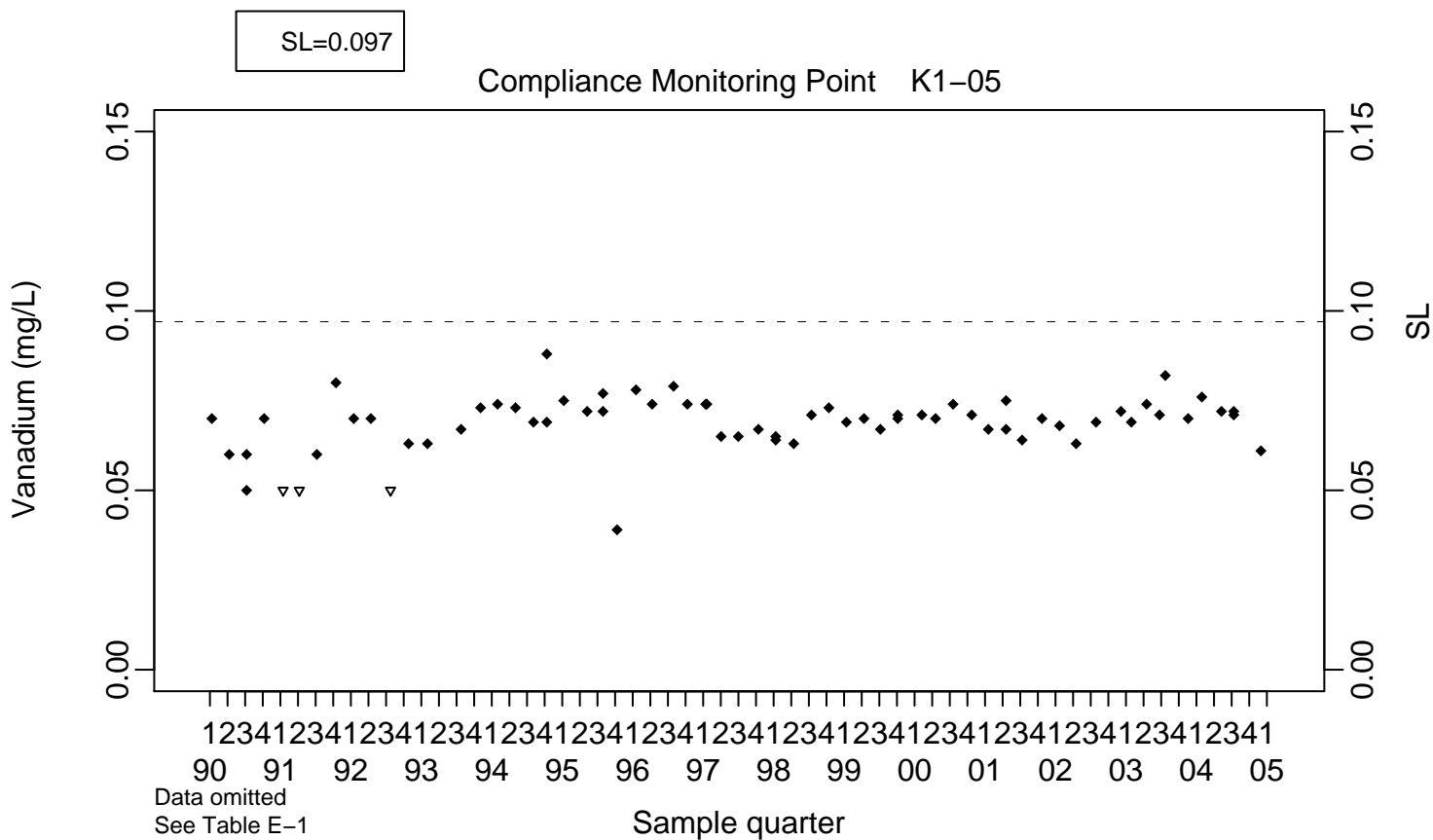
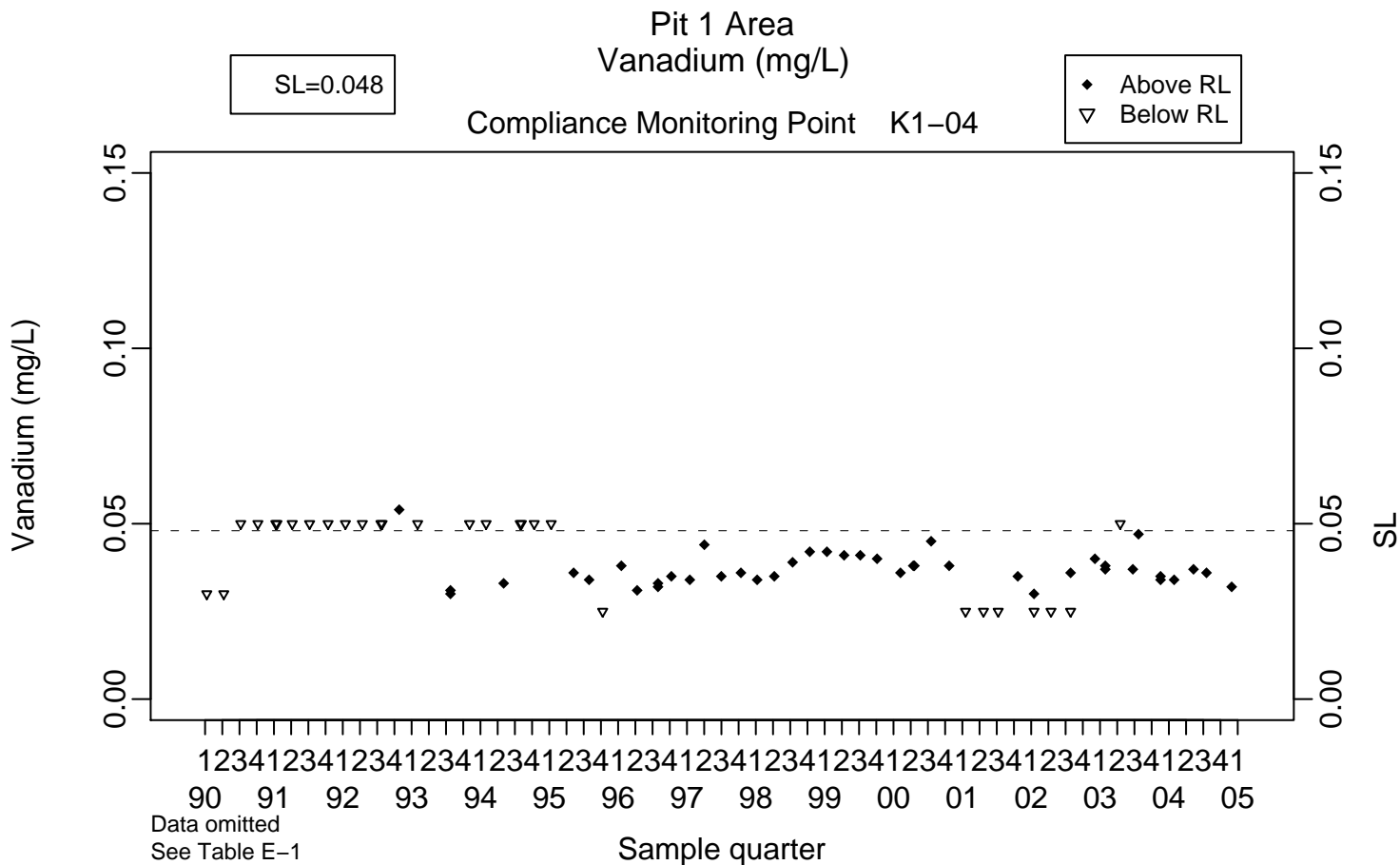
◆ Above RL
▽ Below RL



SL=0.072

Compliance Monitoring Point K1-03



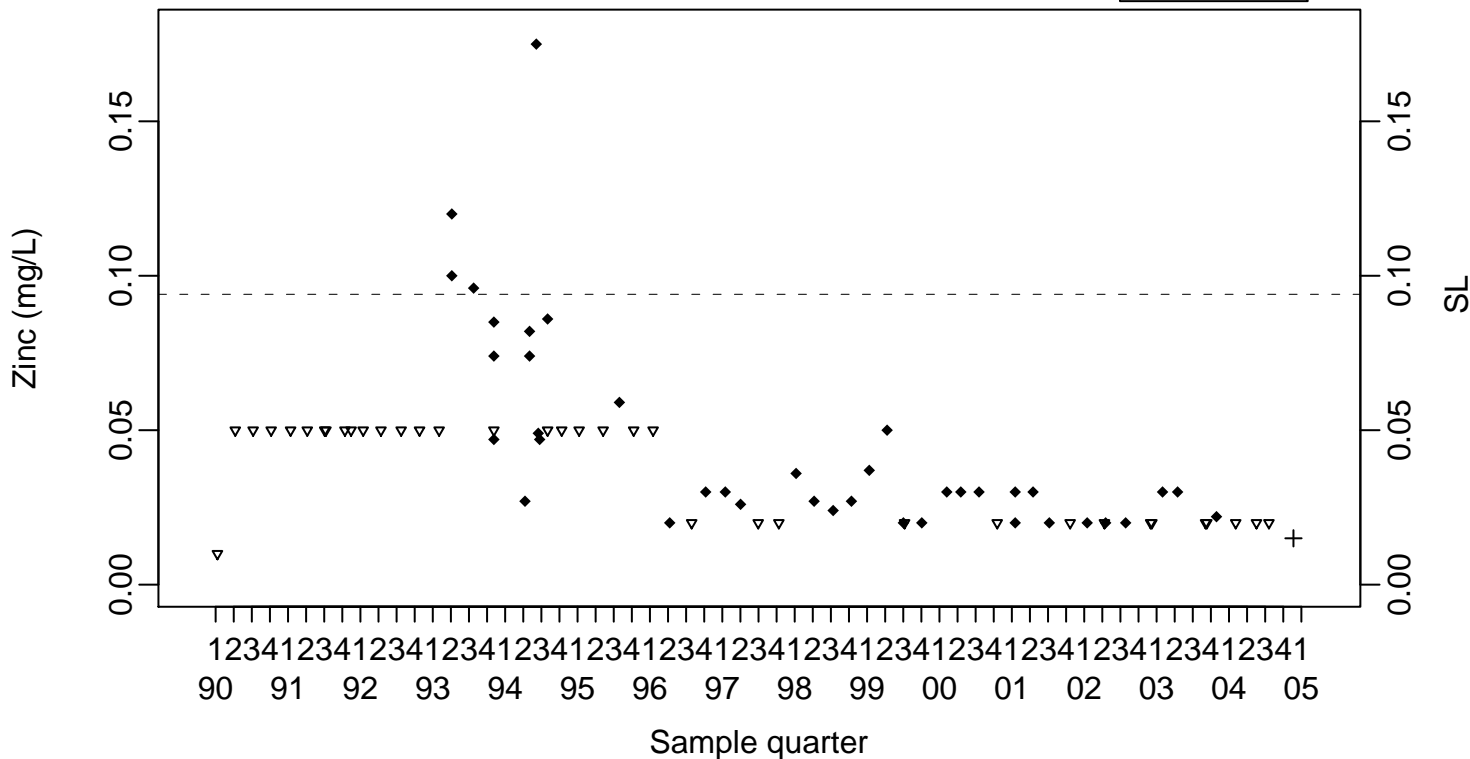


Pit 1 Area Zinc (mg/L)

SL=0.094

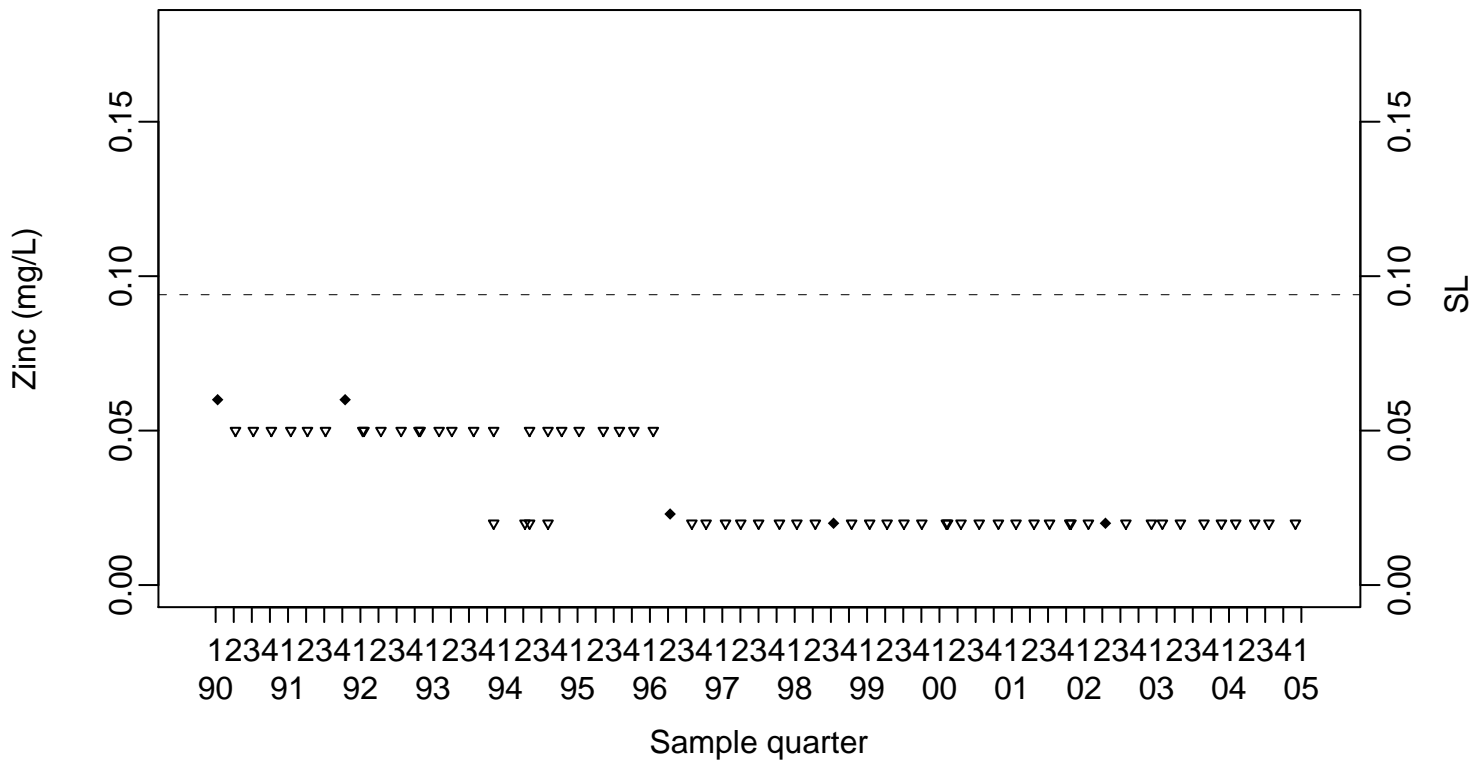
- ◆ Above RL
- ▽ Below RL
- + Estimated

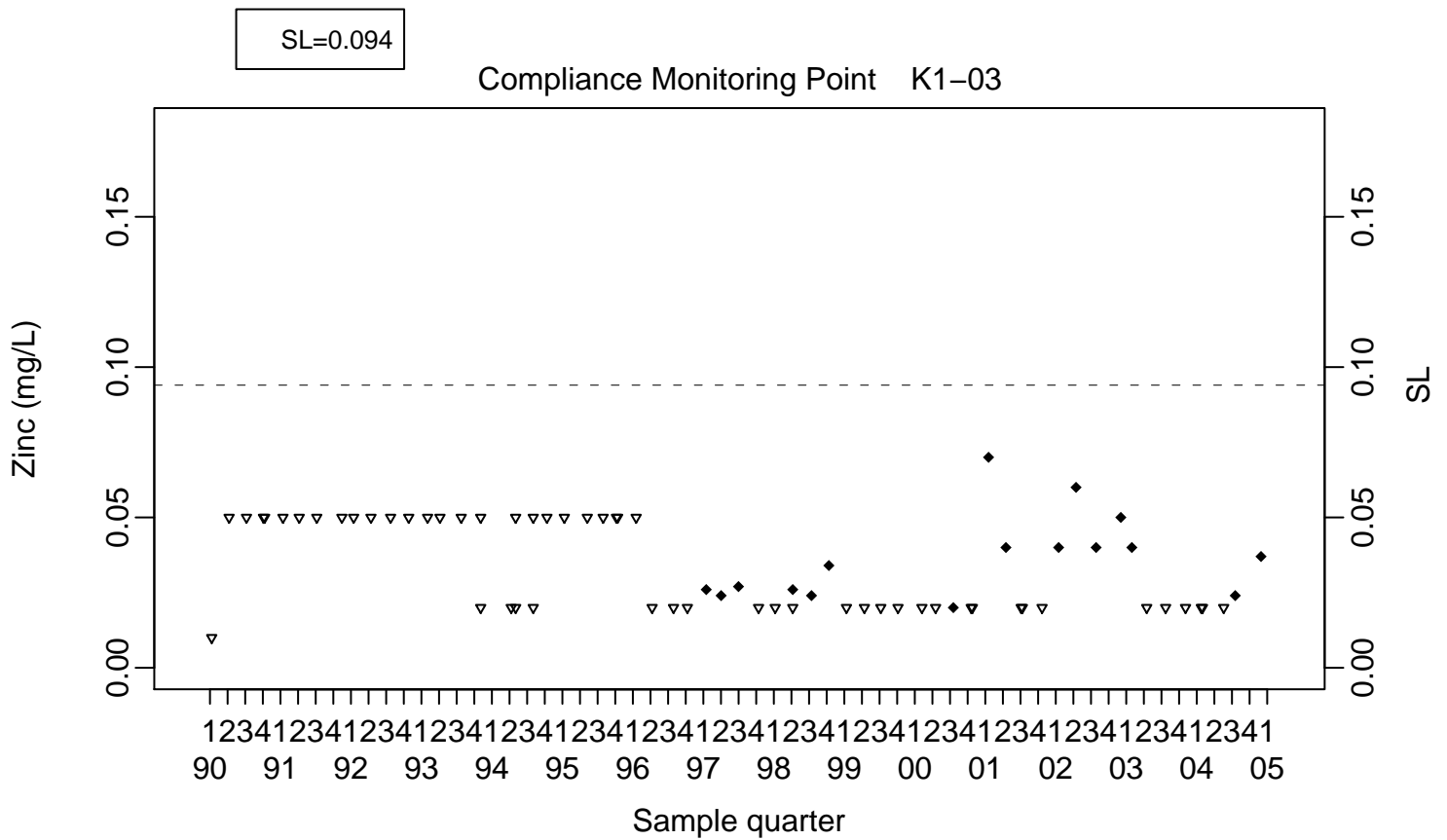
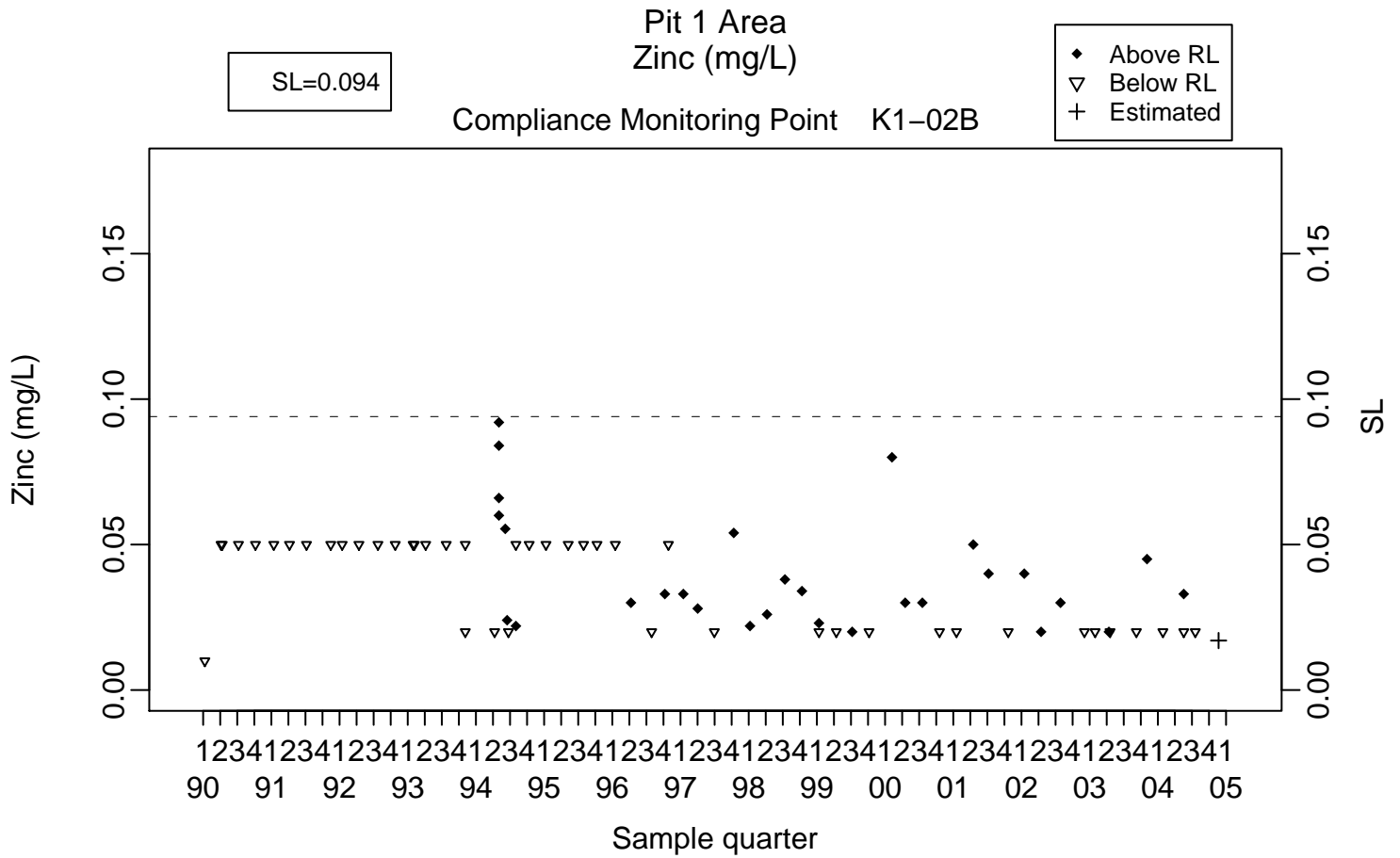
Background Monitoring Point K1-01C



SL=0.094

Background Monitoring Point K1-07



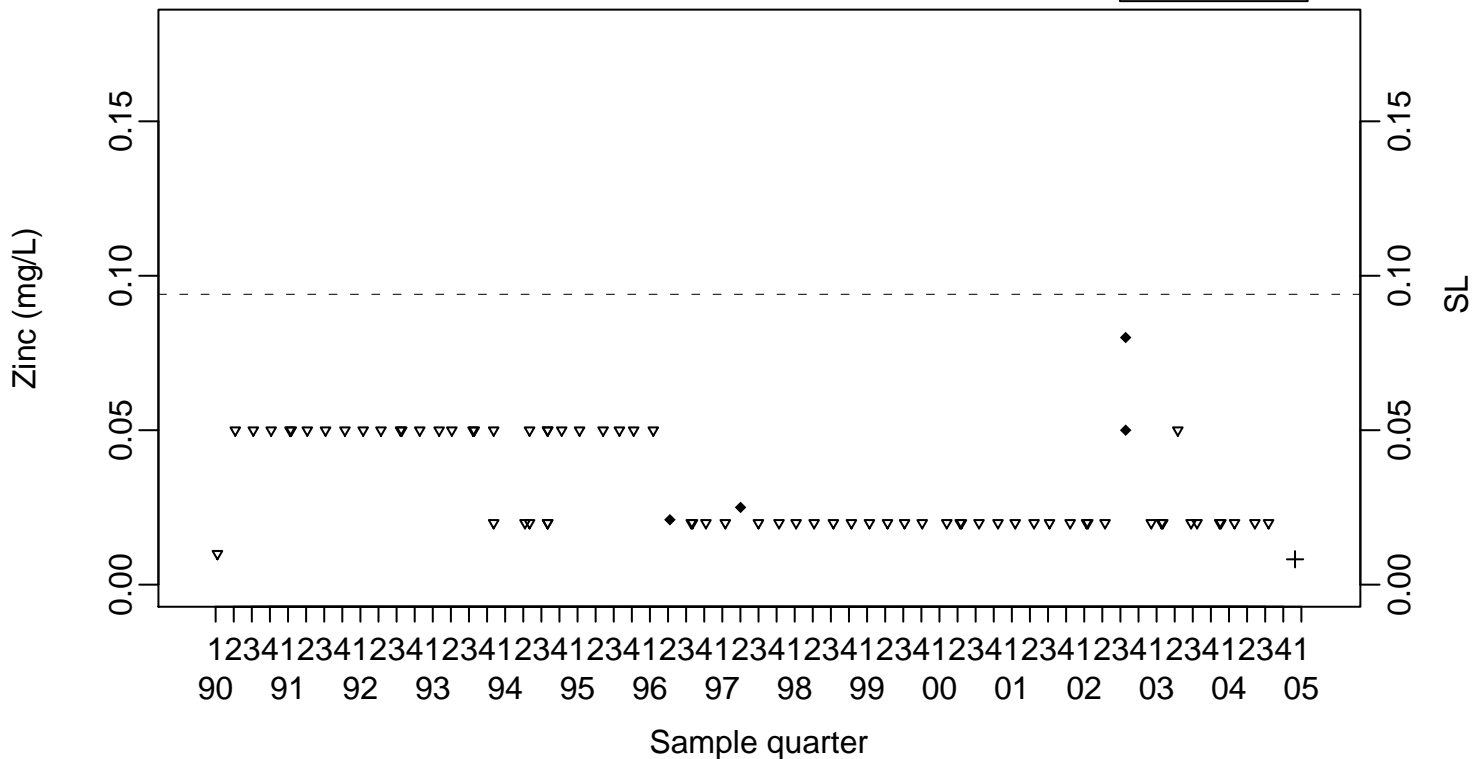


Pit 1 Area Zinc (mg/L)

SL=0.094

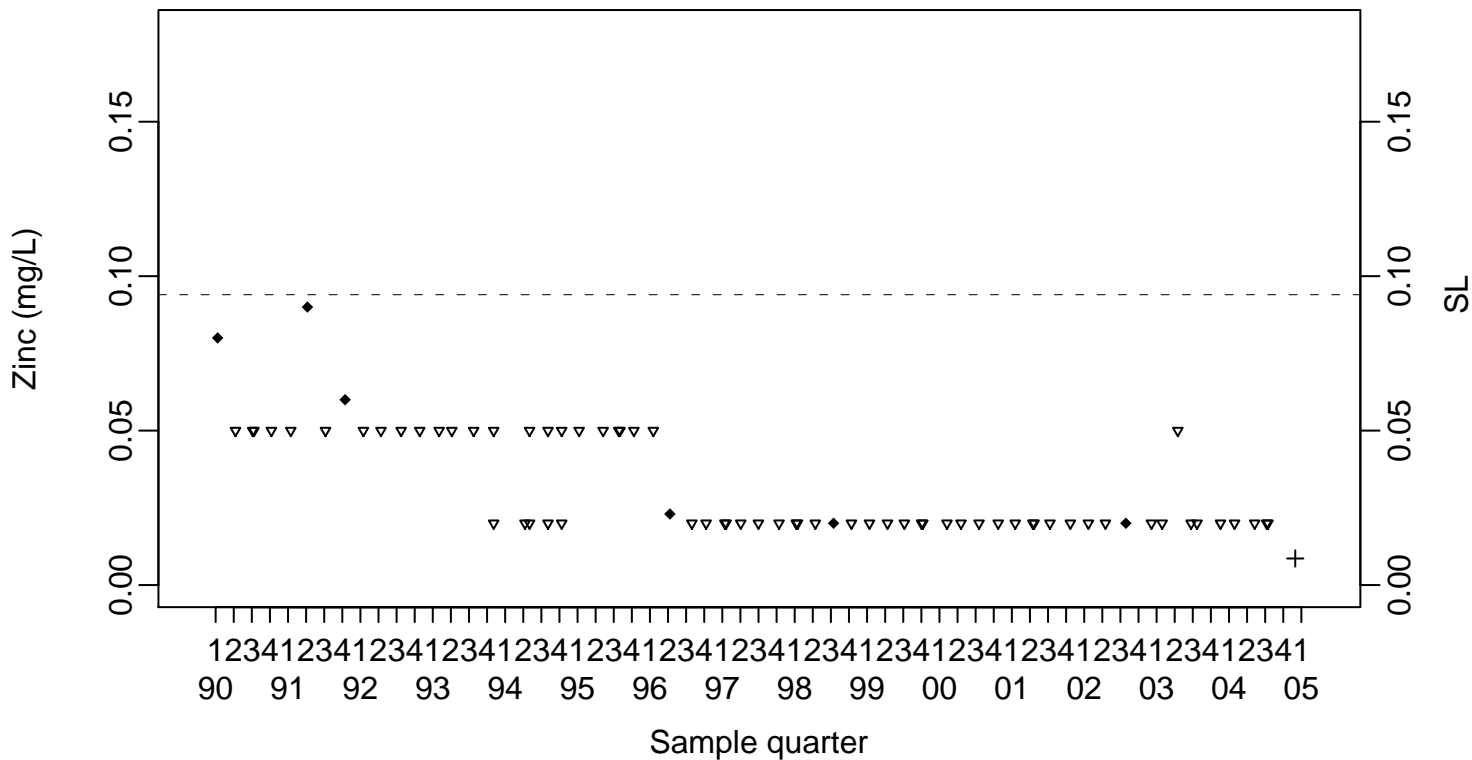
Compliance Monitoring Point K1-04

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.094

Compliance Monitoring Point K1-05

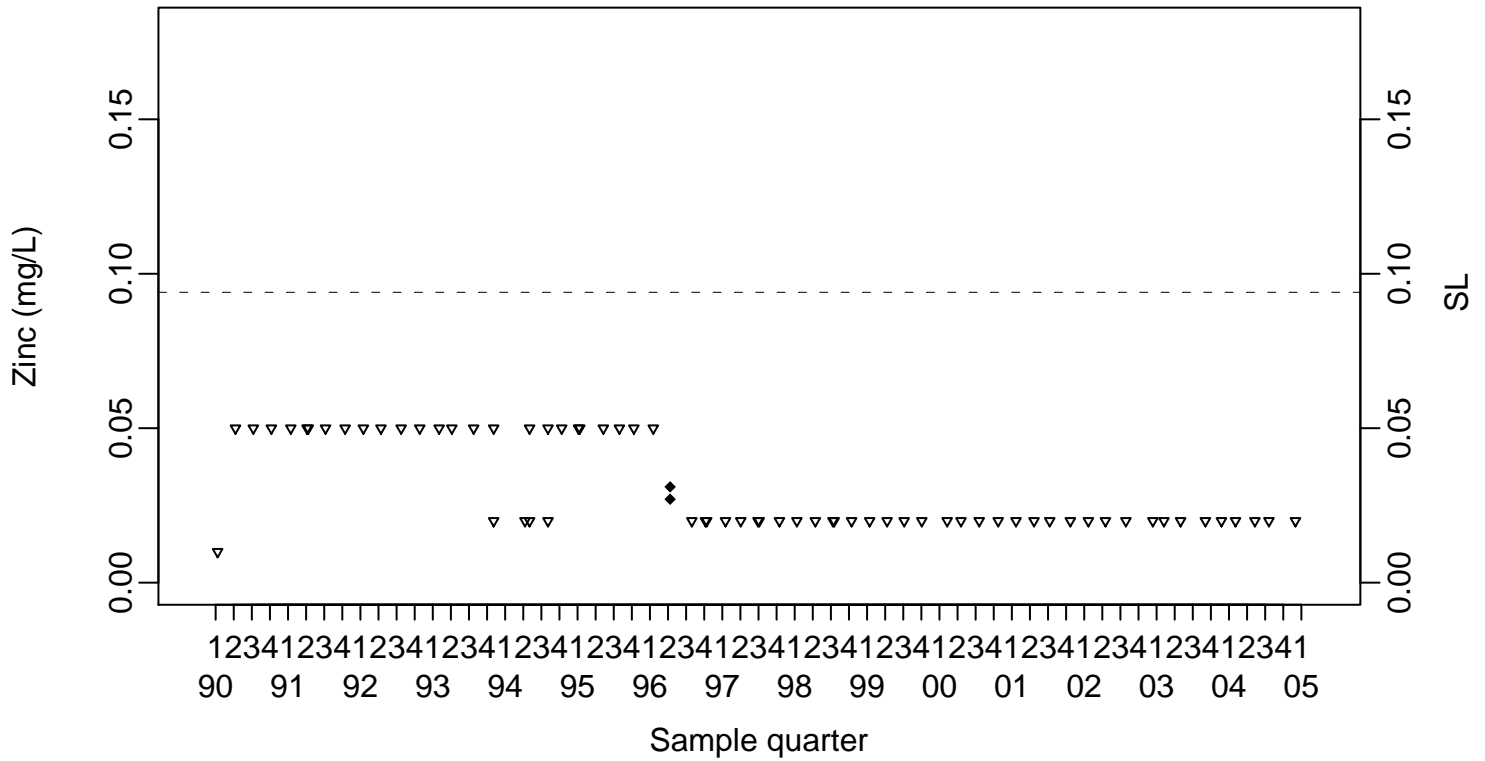


Pit 1 Area Zinc (mg/L)

SL=0.094

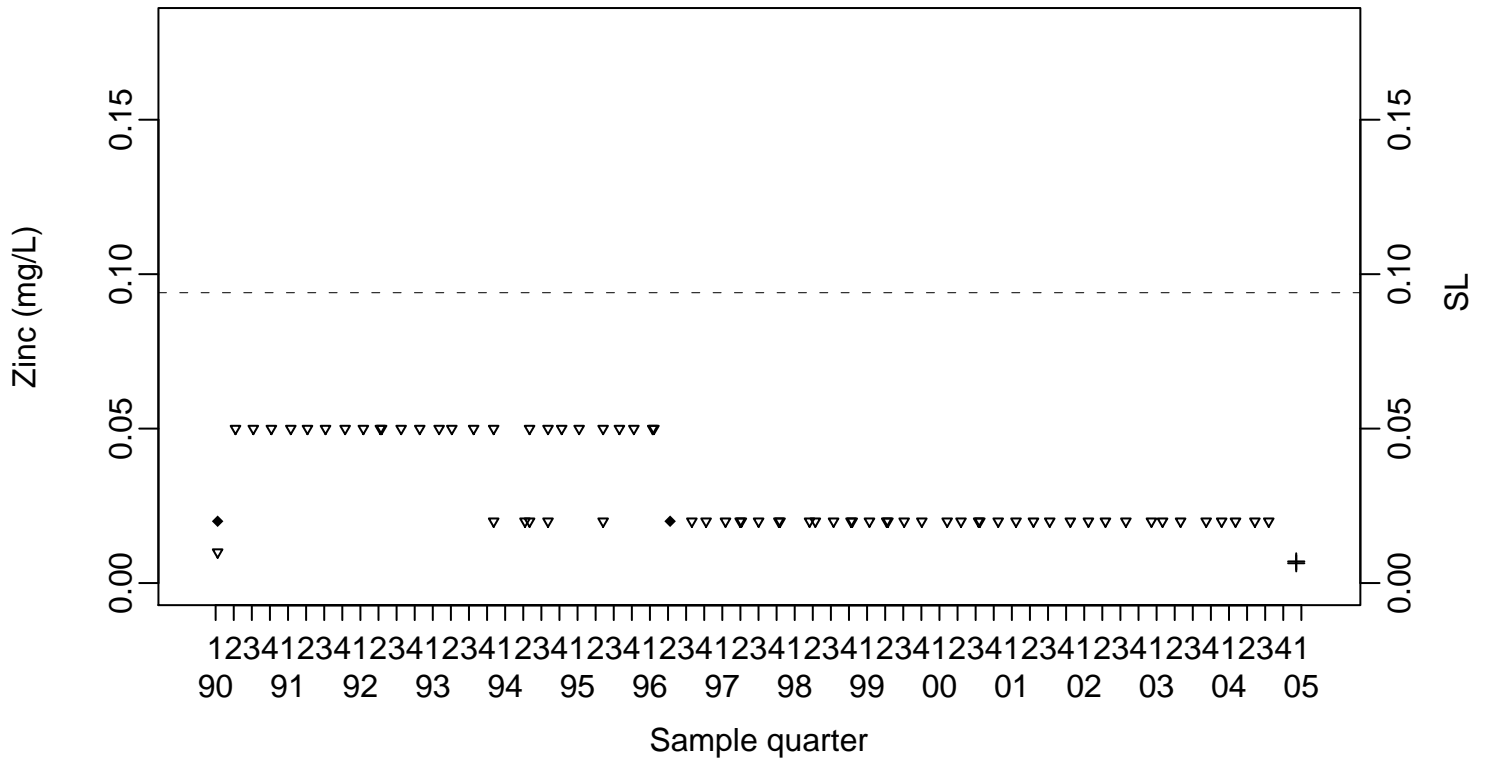
Compliance Monitoring Point K1-08

◆ Above RL
▽ Below RL



SL=0.094

Compliance Monitoring Point K1-09

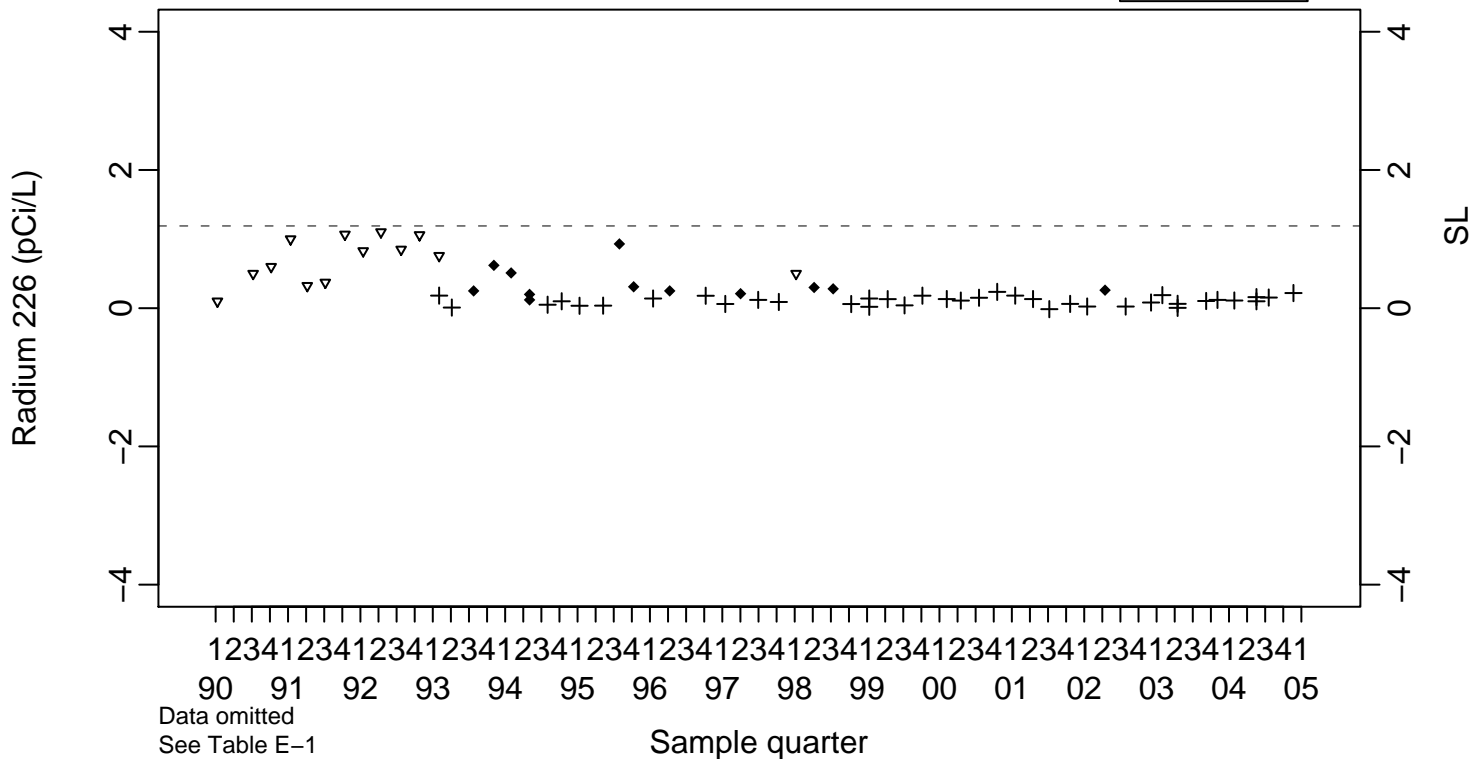


Pit 1 Area Radium 226 (pCi/L)

Compliance Monitoring Point K1-02B

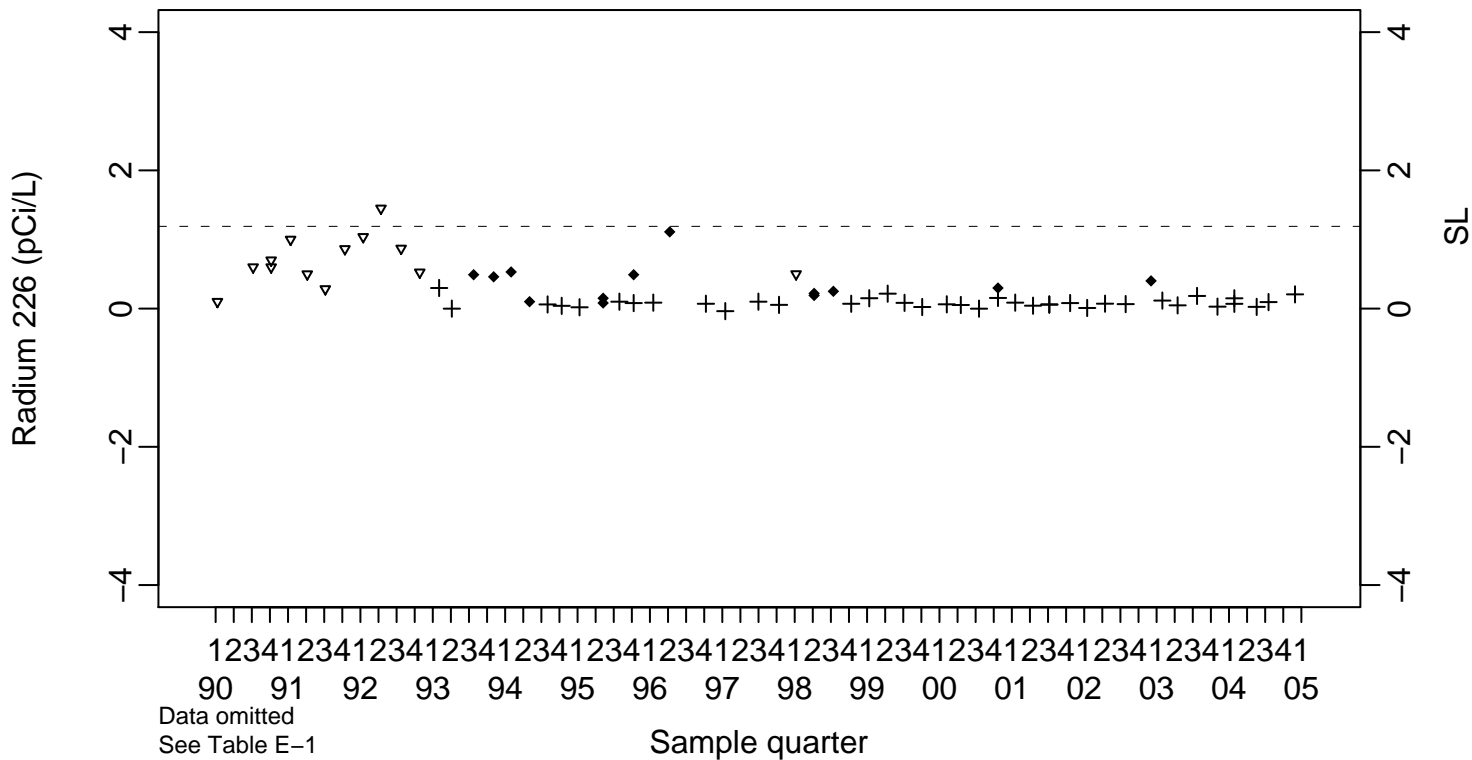
SL=1.19

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=1.19

Compliance Monitoring Point K1-03

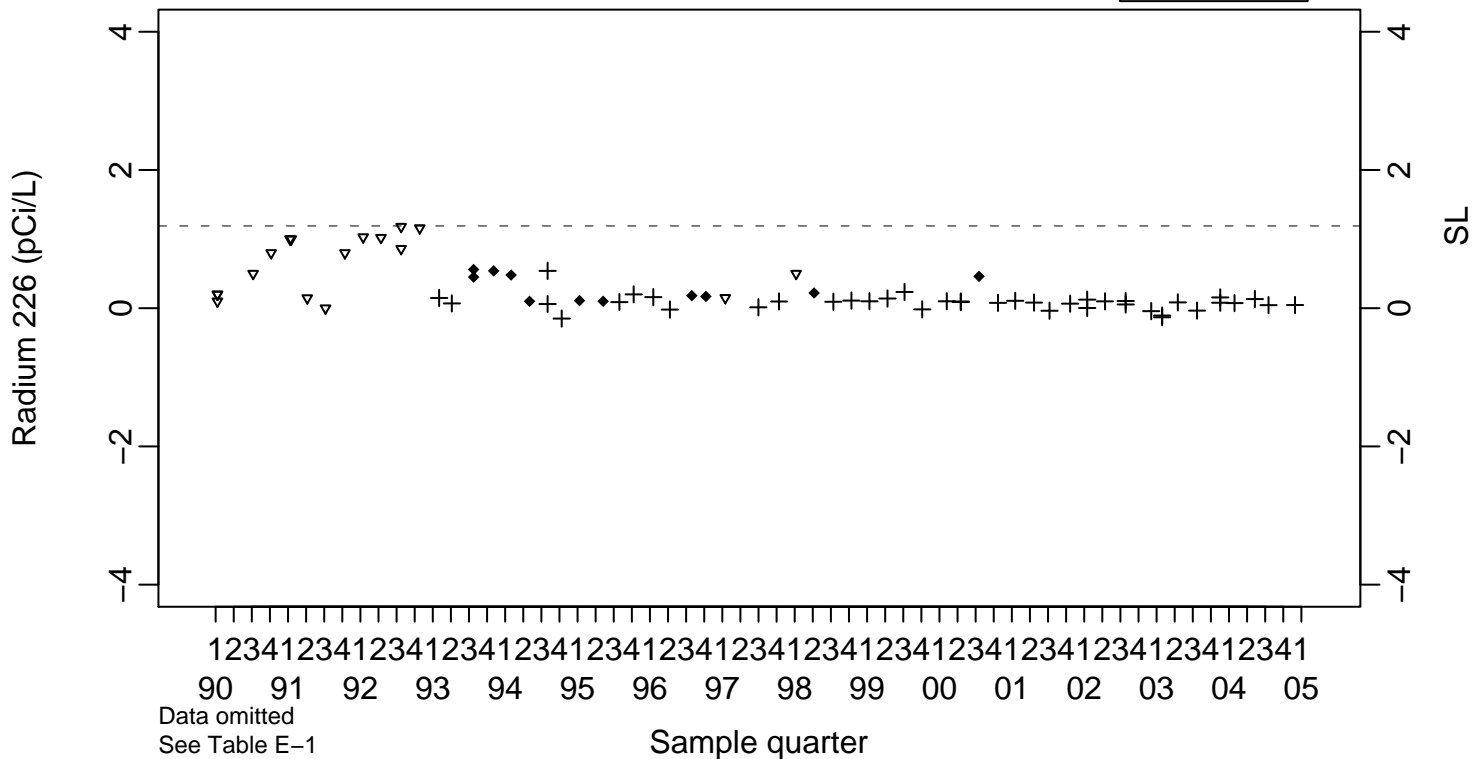


Pit 1 Area Radium 226 (pCi/L)

Compliance Monitoring Point K1-04

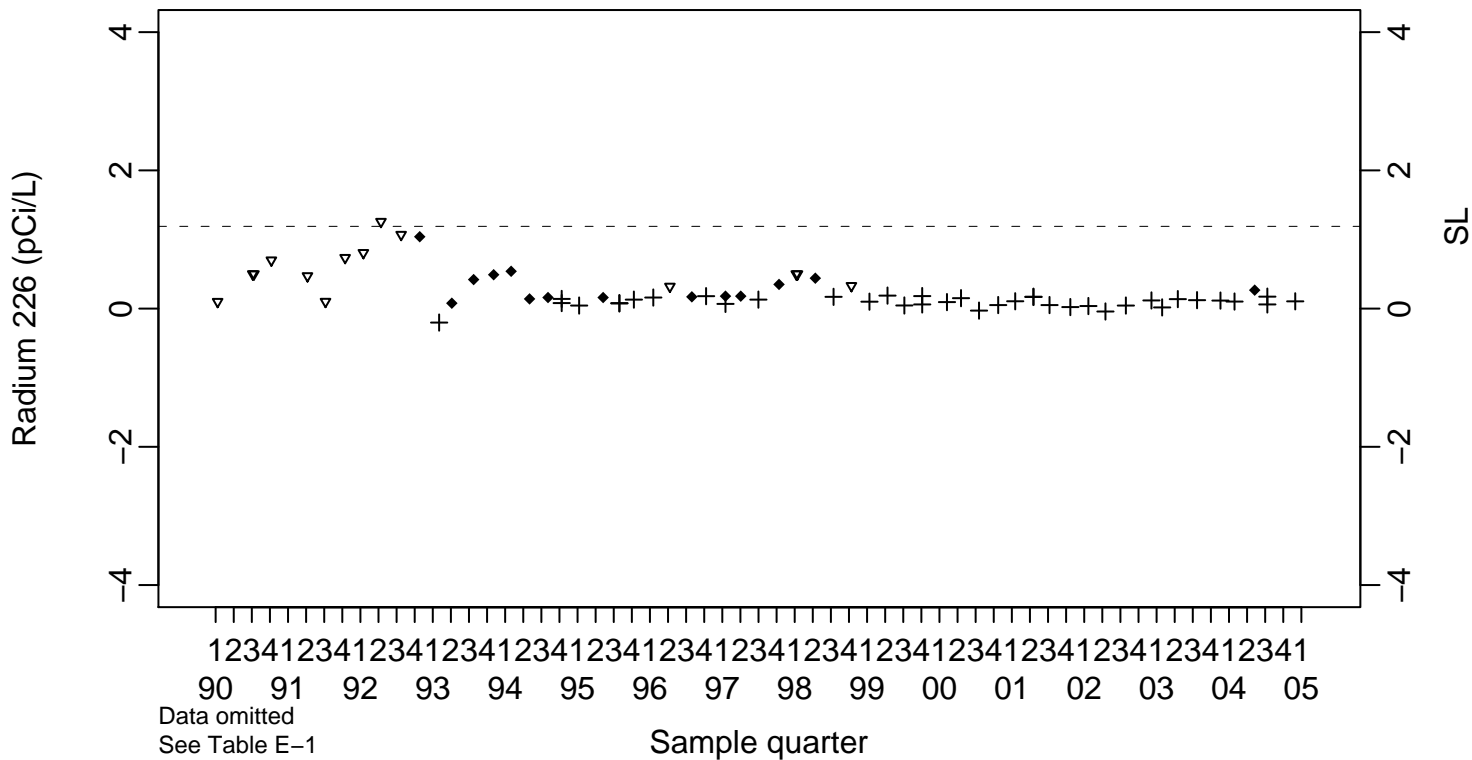
SL=1.19

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=1.19

Compliance Monitoring Point K1-05

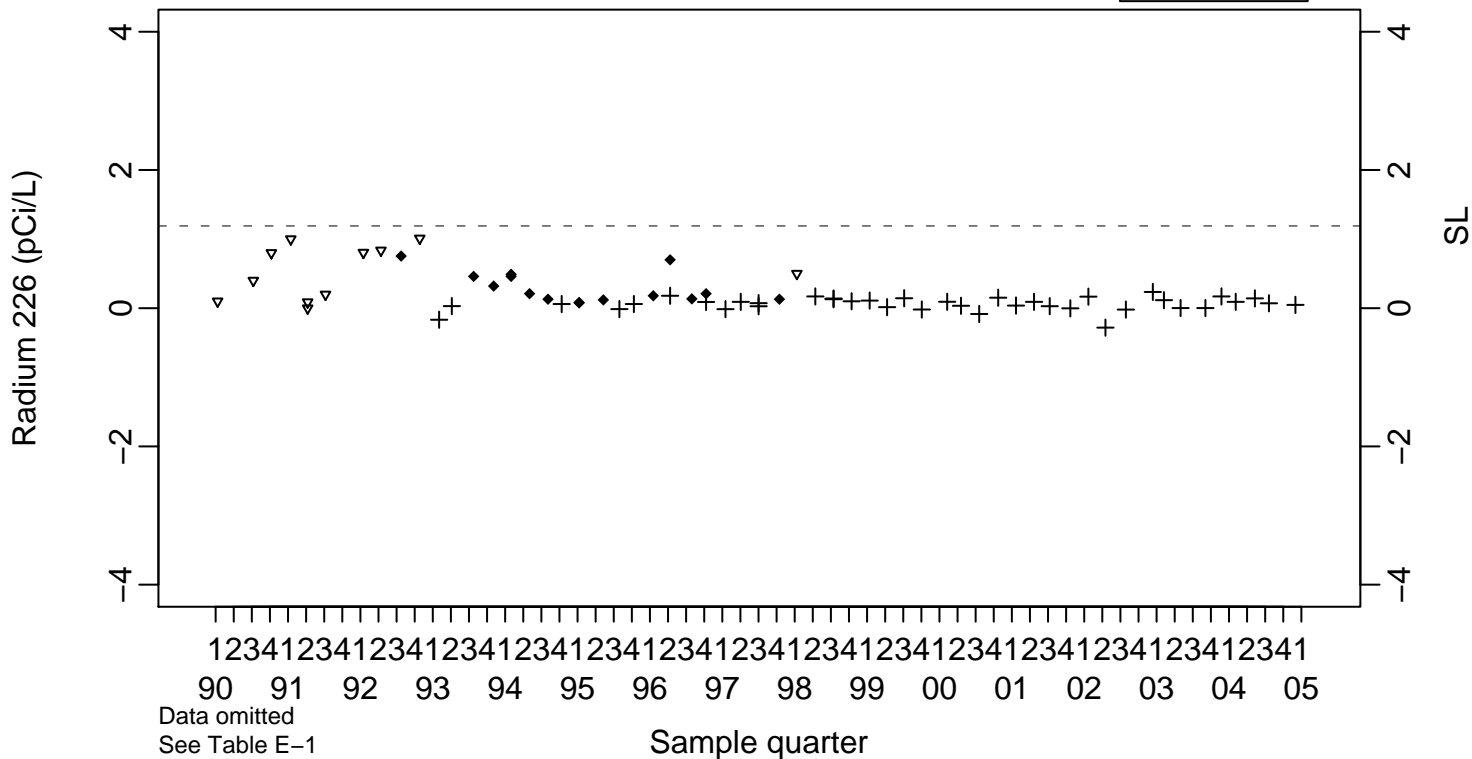


Pit 1 Area Radium 226 (pCi/L)

Compliance Monitoring Point K1-08

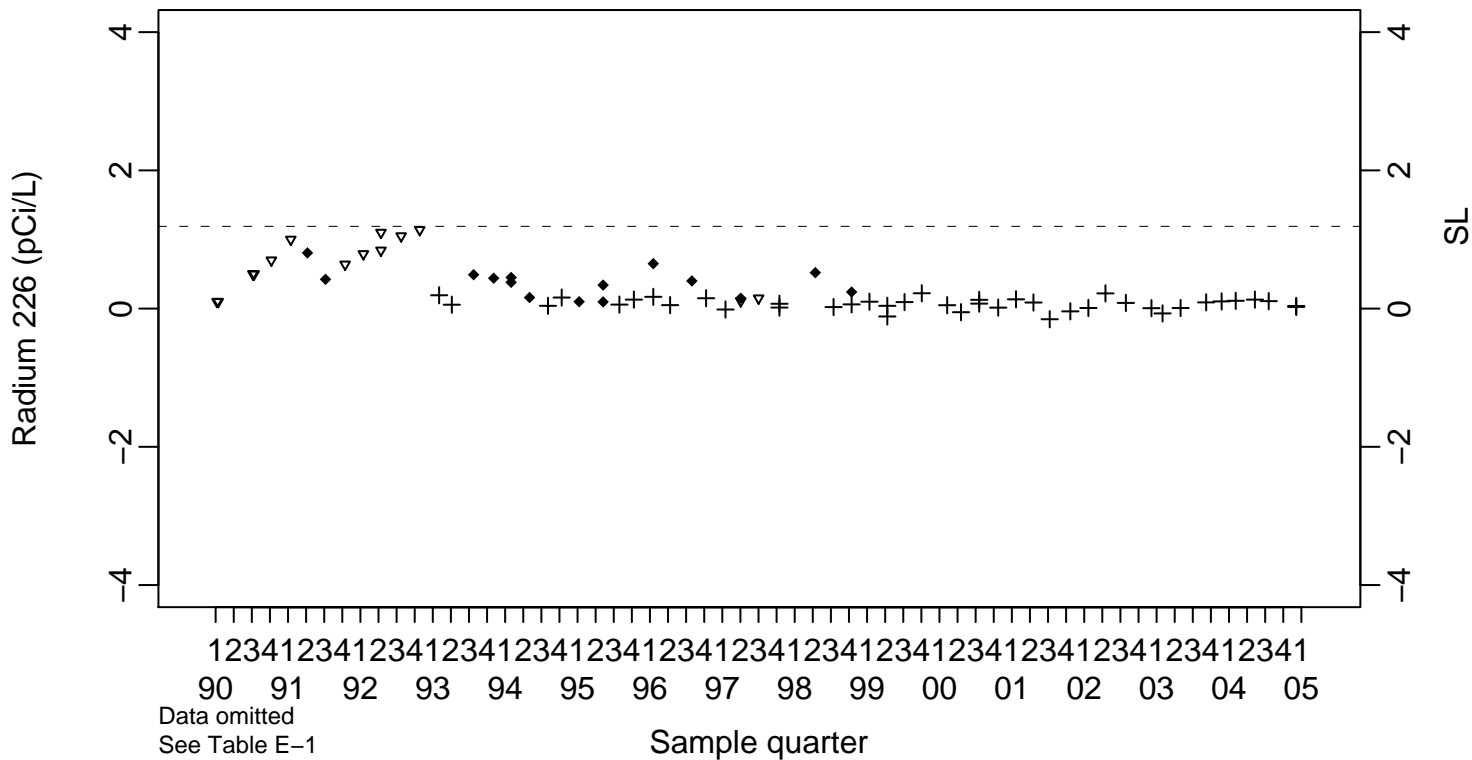
SL=1.19

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=1.19

Compliance Monitoring Point K1-09

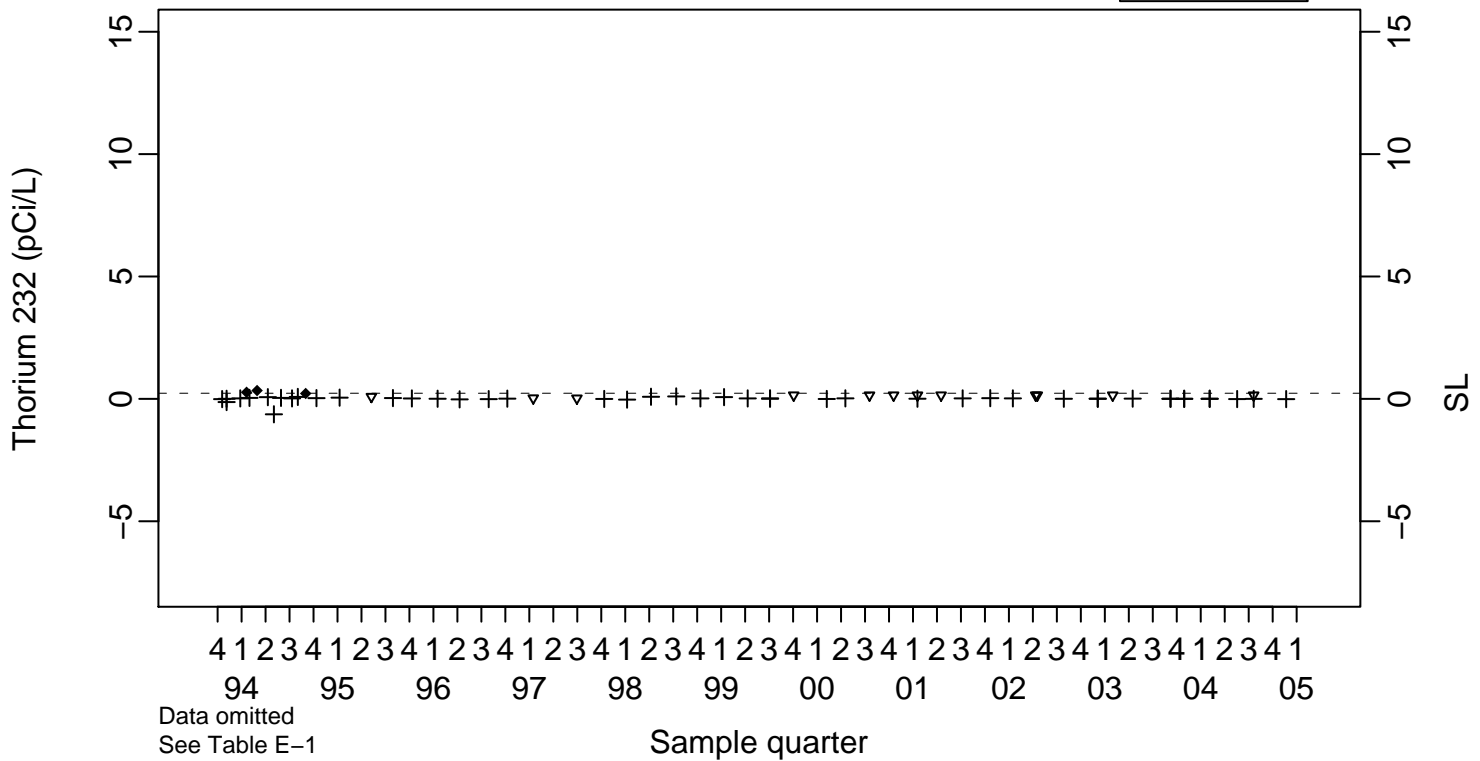


Pit 1 Area Thorium 232 (pCi/L)

Background Monitoring Point K1-01C

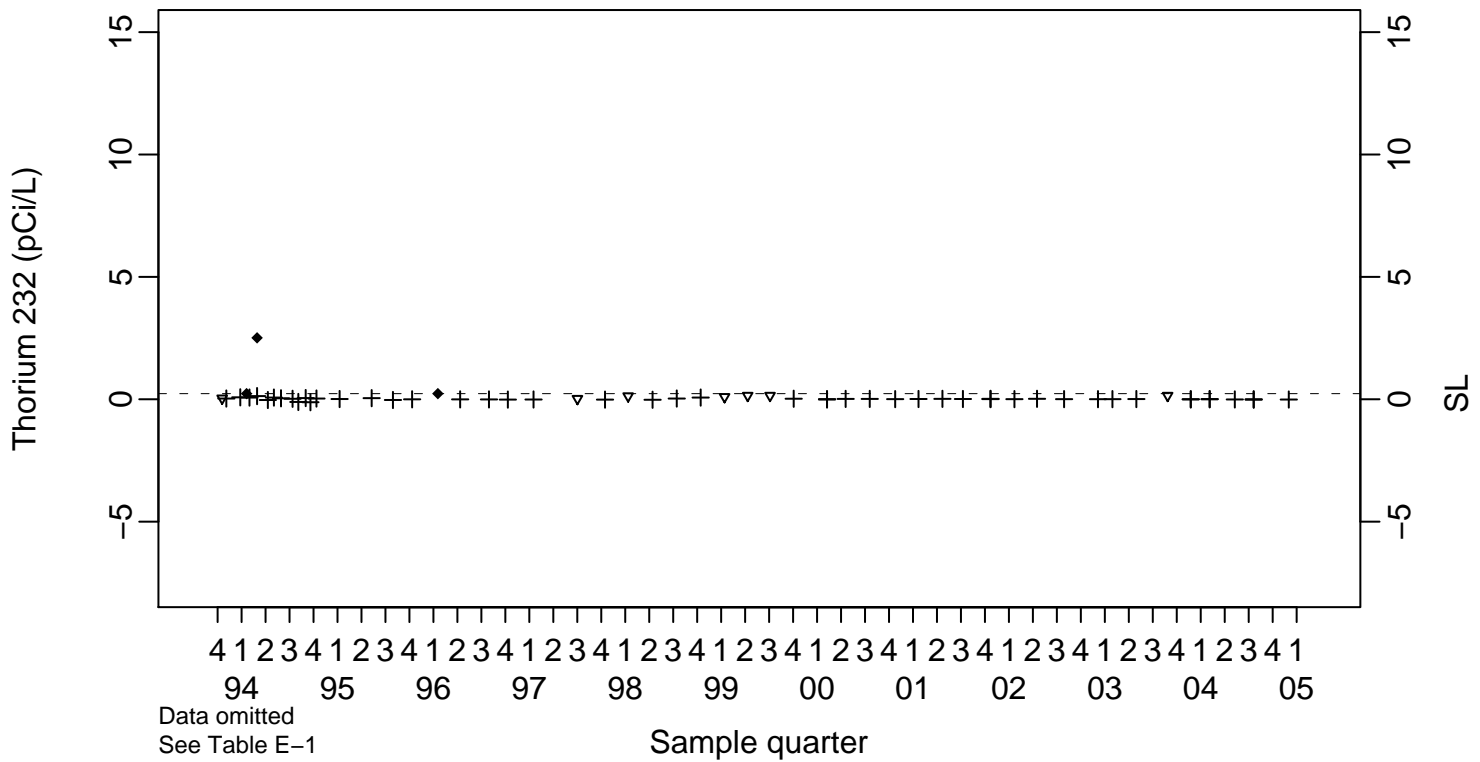
SL=0.23

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.23

Background Monitoring Point K1-07

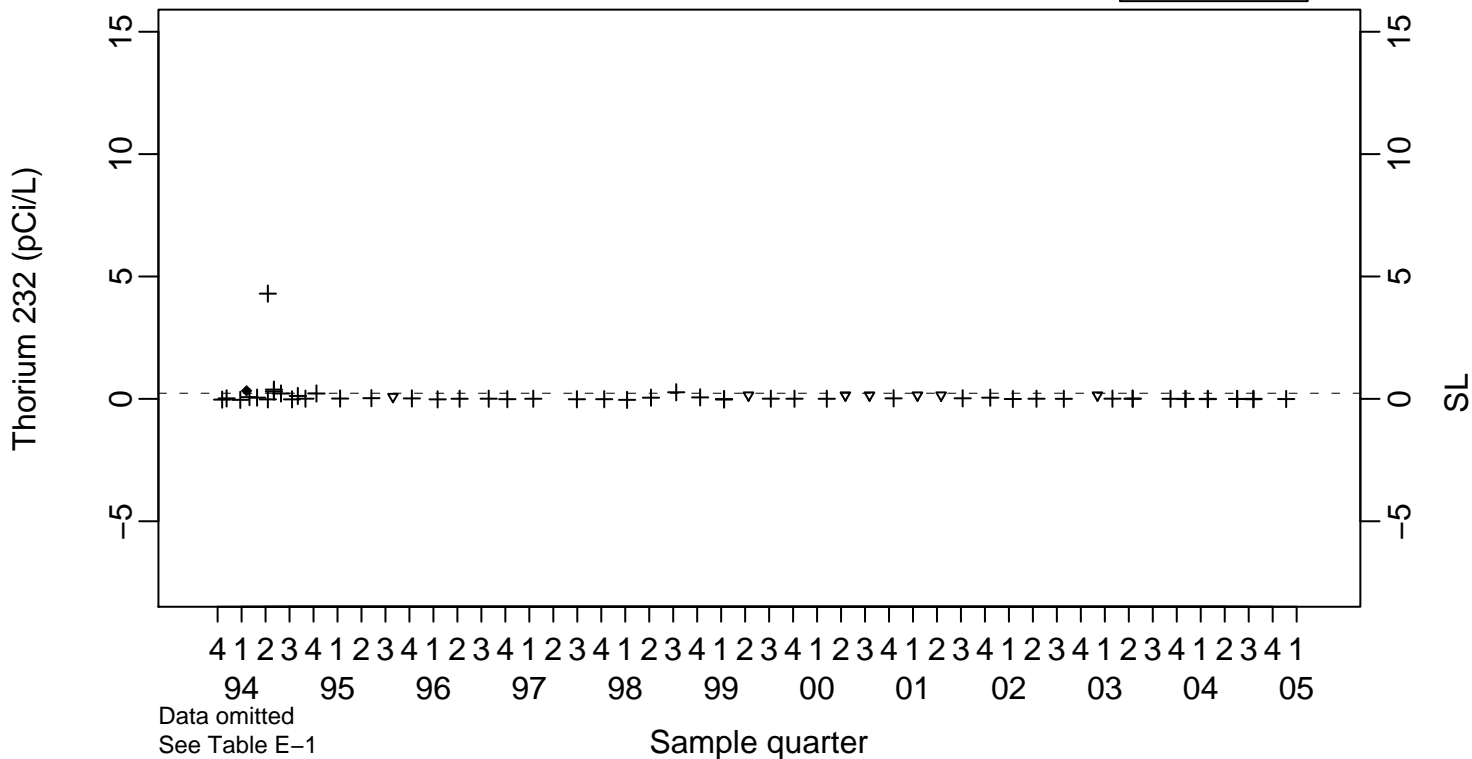


Pit 1 Area Thorium 232 (pCi/L)

Compliance Monitoring Point K1-02B

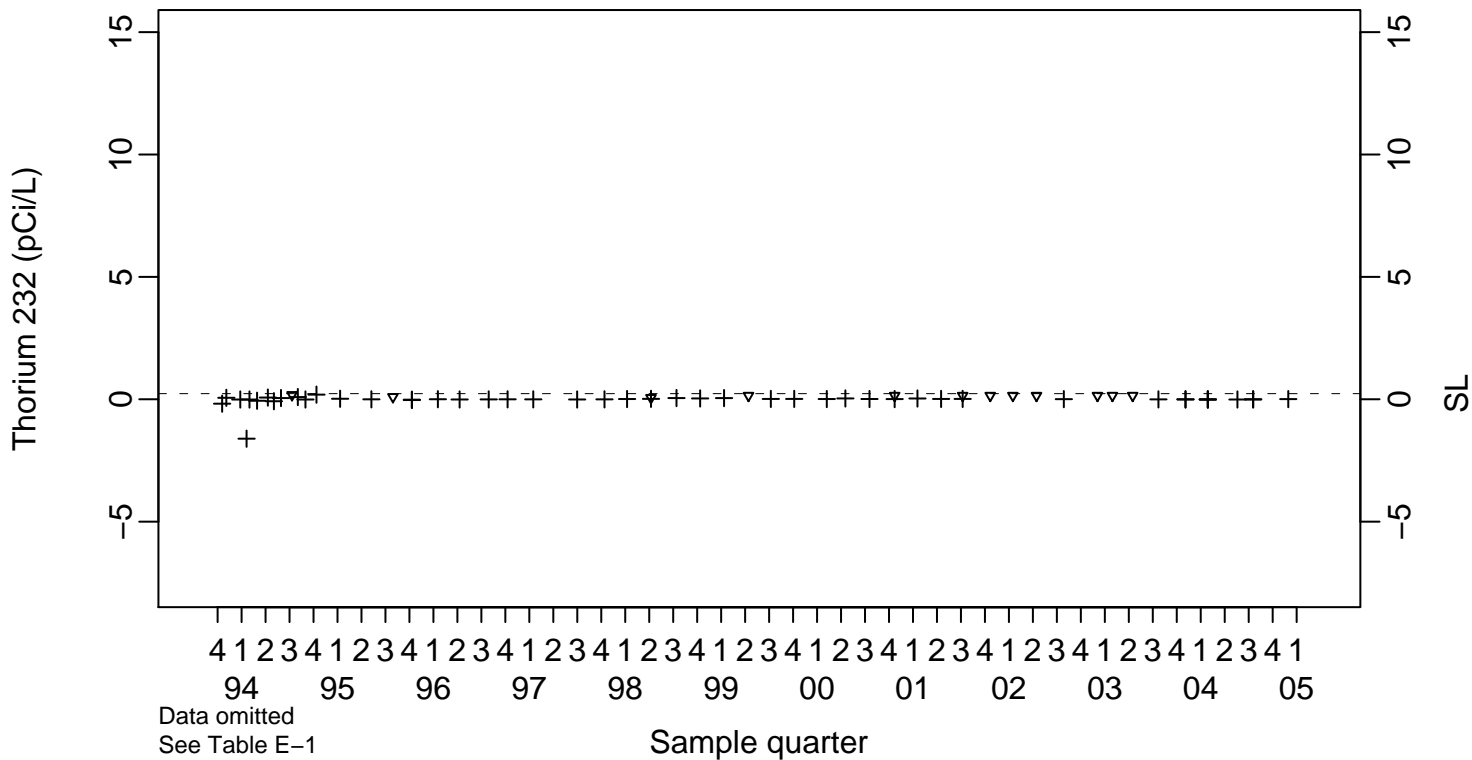
SL=0.23

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.23

Compliance Monitoring Point K1-03

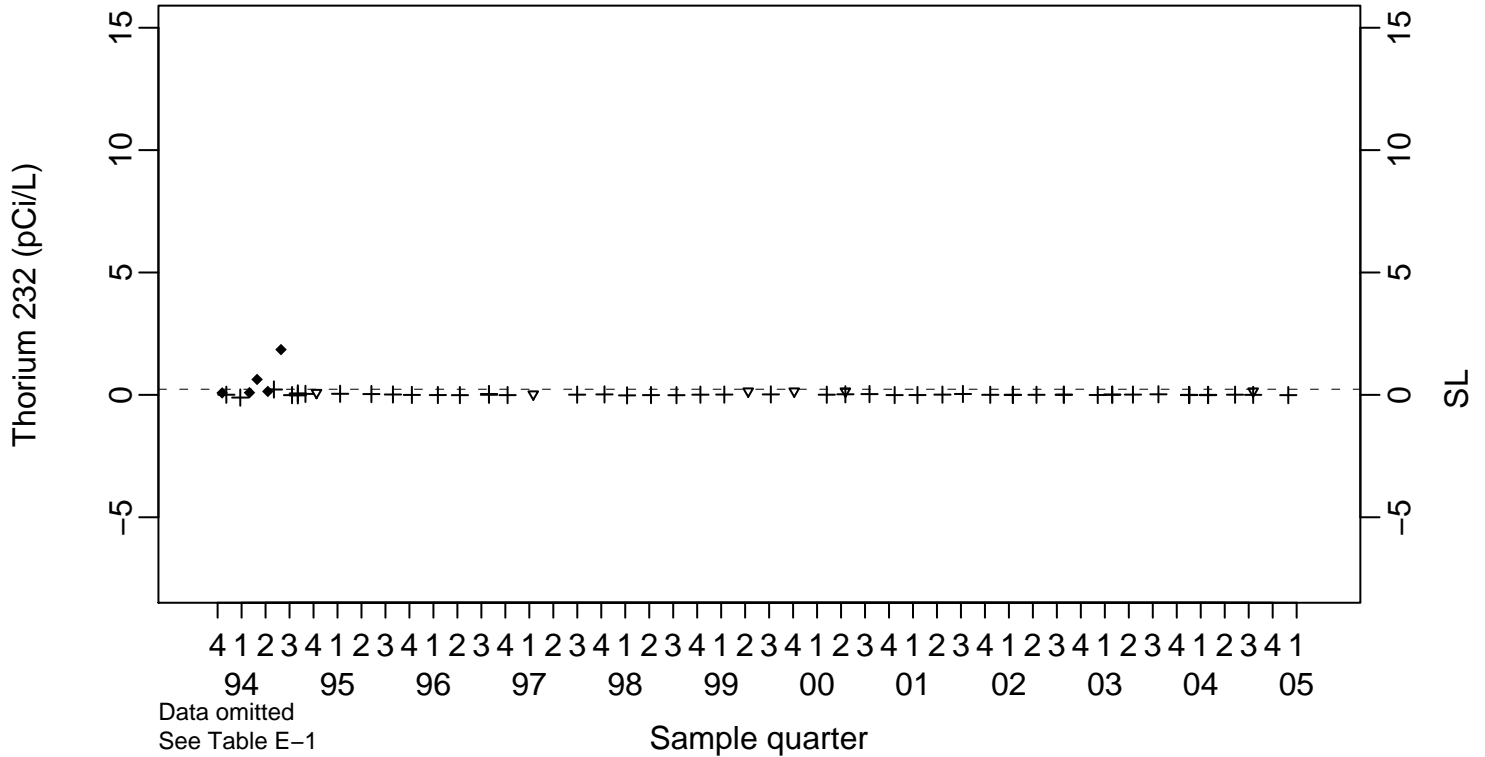


Pit 1 Area
Thorium 232 (pCi/L)

Compliance Monitoring Point K1-04

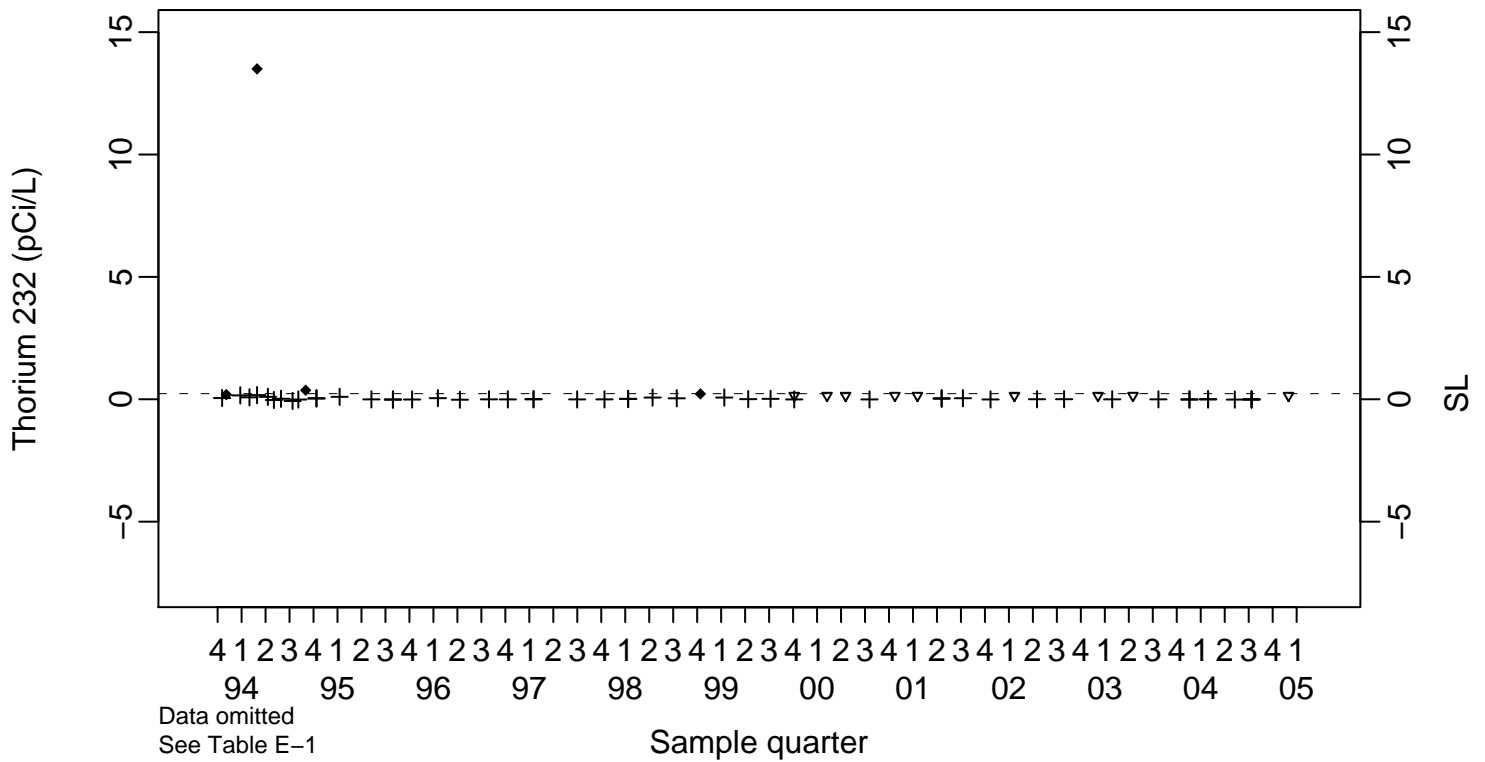
SL=0.23

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.23

Compliance Monitoring Point K1-05

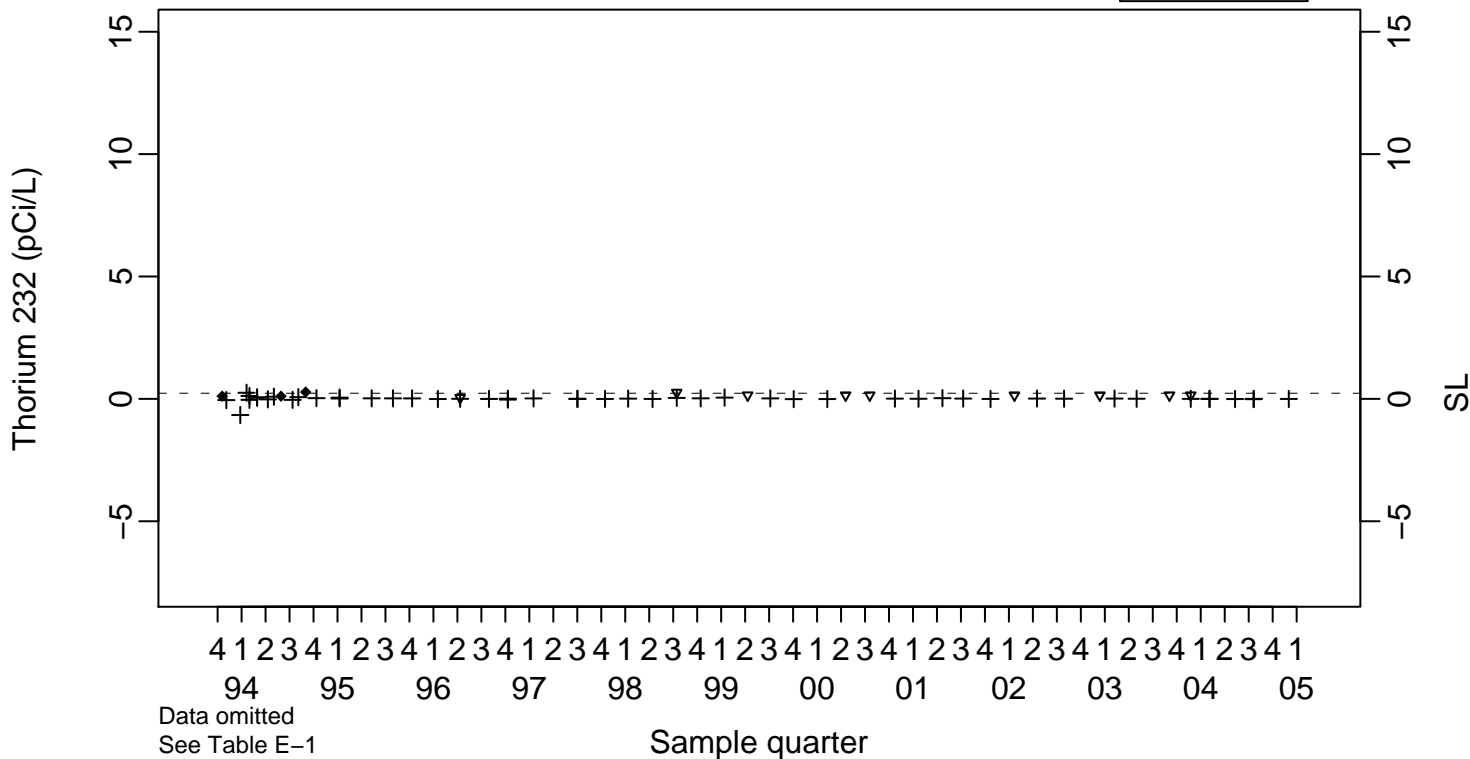


Pit 1 Area Thorium 232 (pCi/L)

Compliance Monitoring Point K1-08

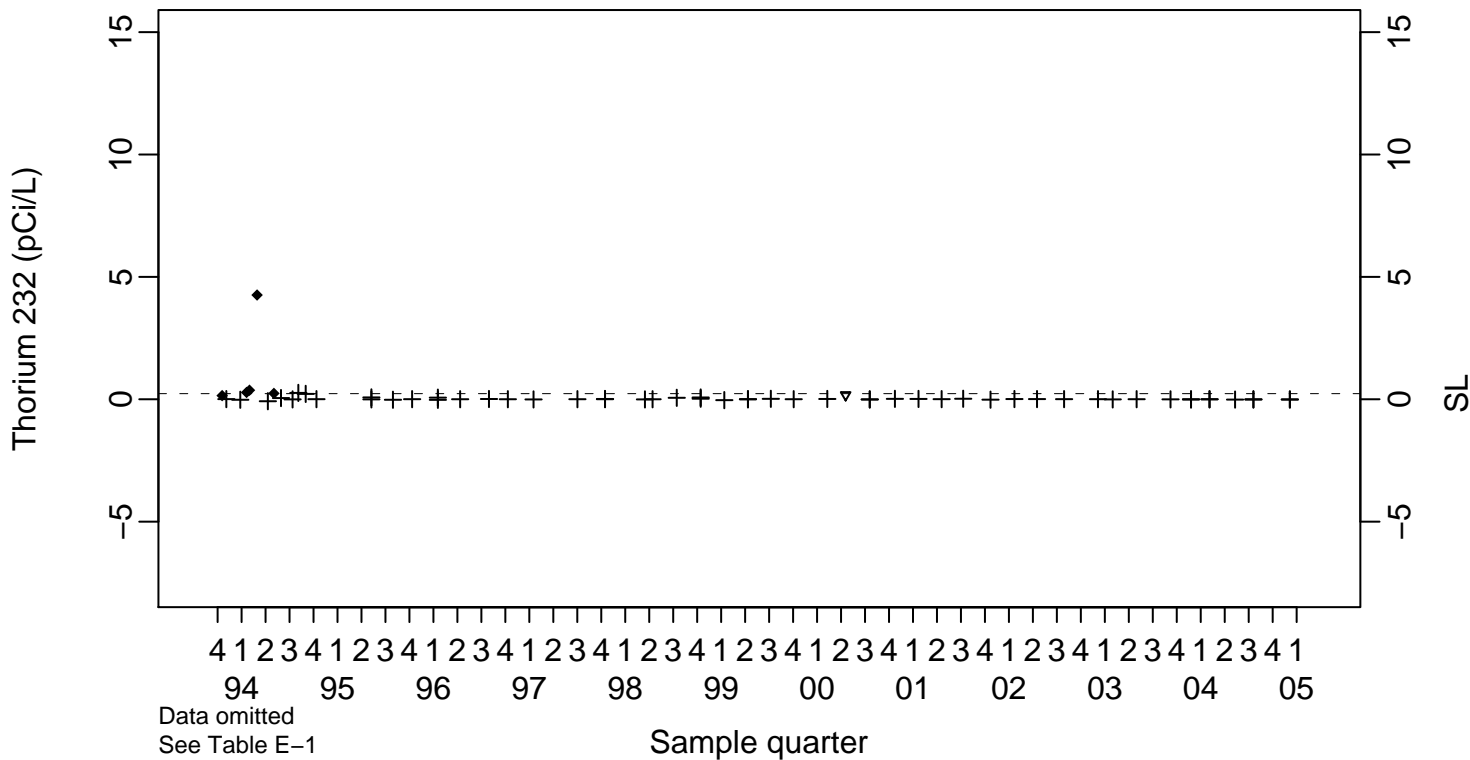
SL=0.23

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.23

Compliance Monitoring Point K1-09

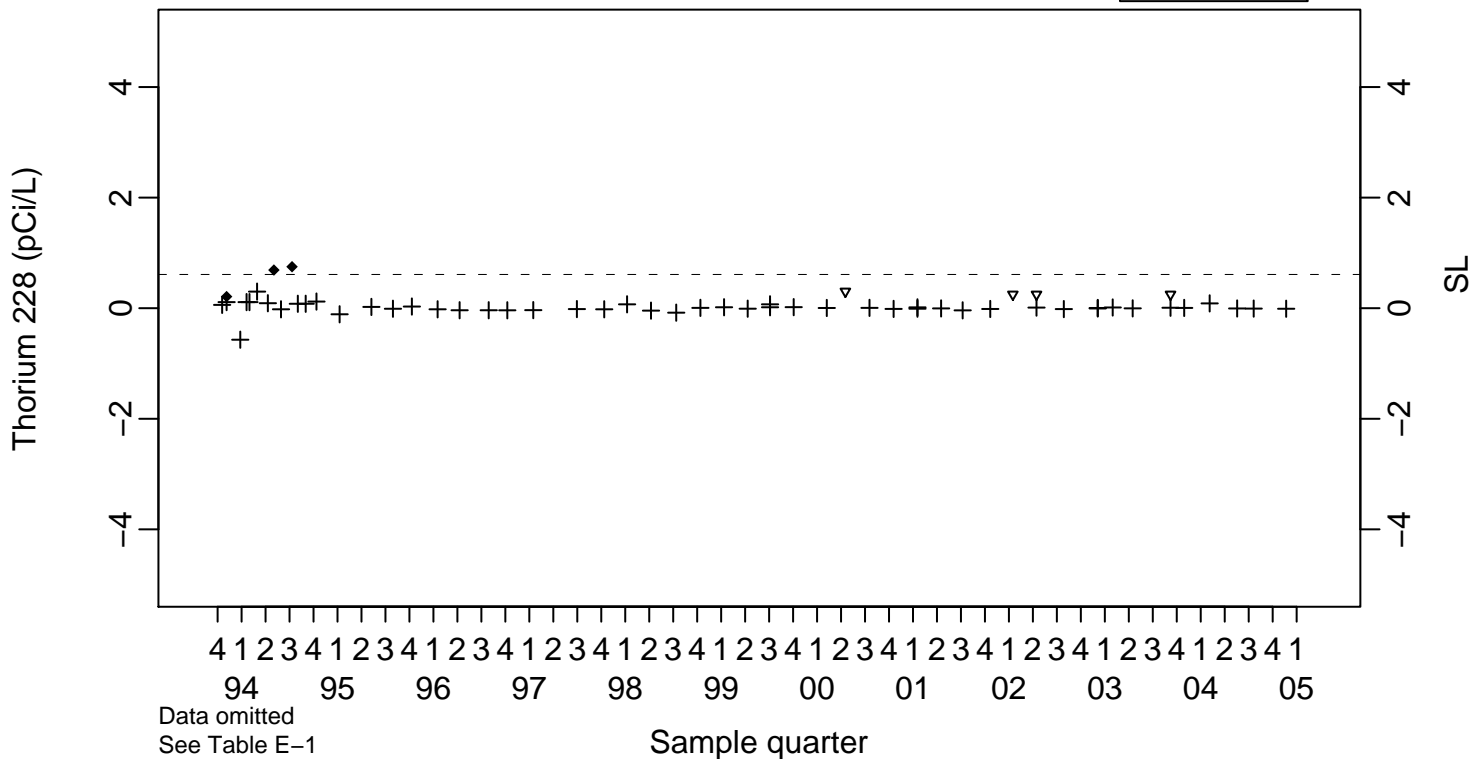


Pit 1 Area Thorium 228 (pCi/L)

Background Monitoring Point K1-01C

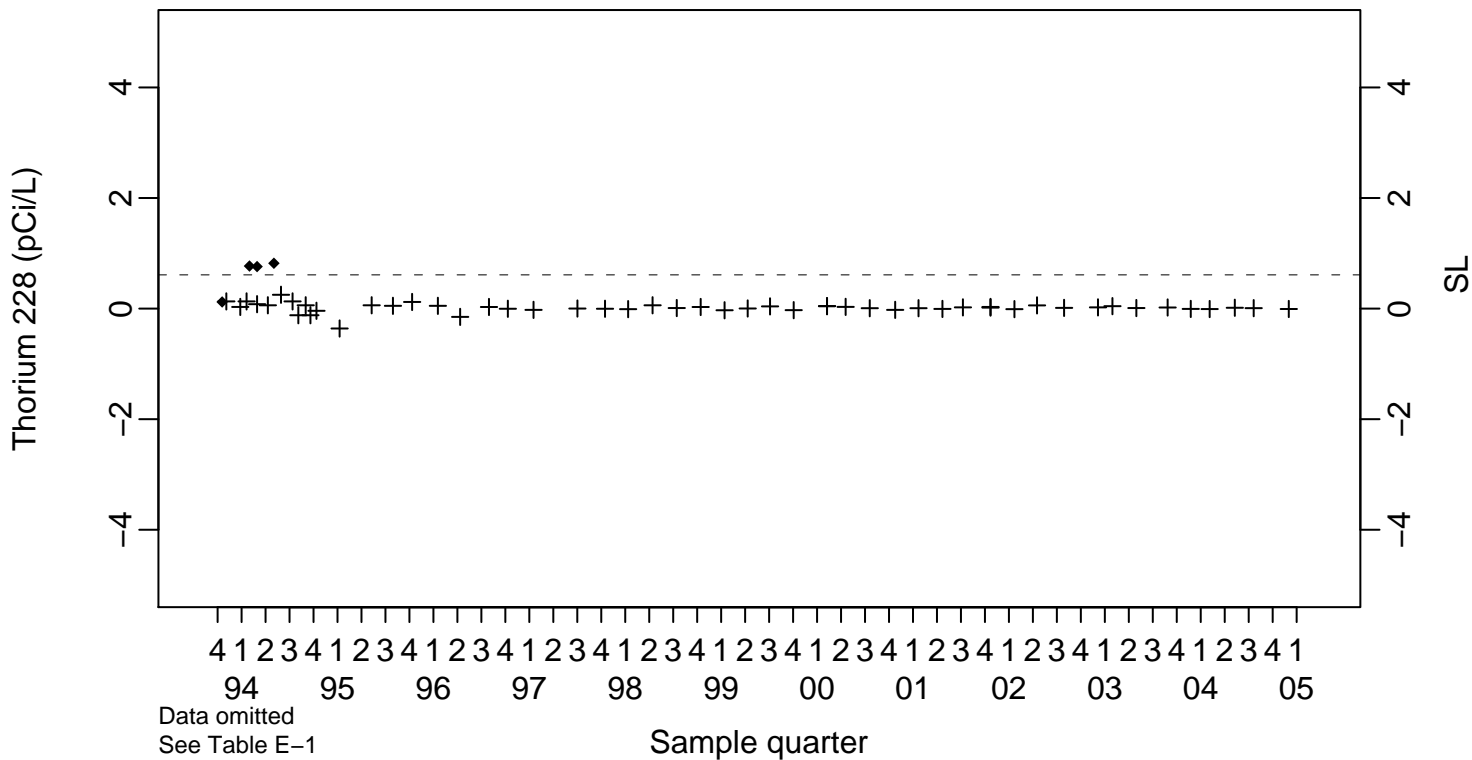
SL=0.61

- ◆ Above RL
- ▽ Below RL
- + Estimated



Background Monitoring Point K1-07

SL=0.61

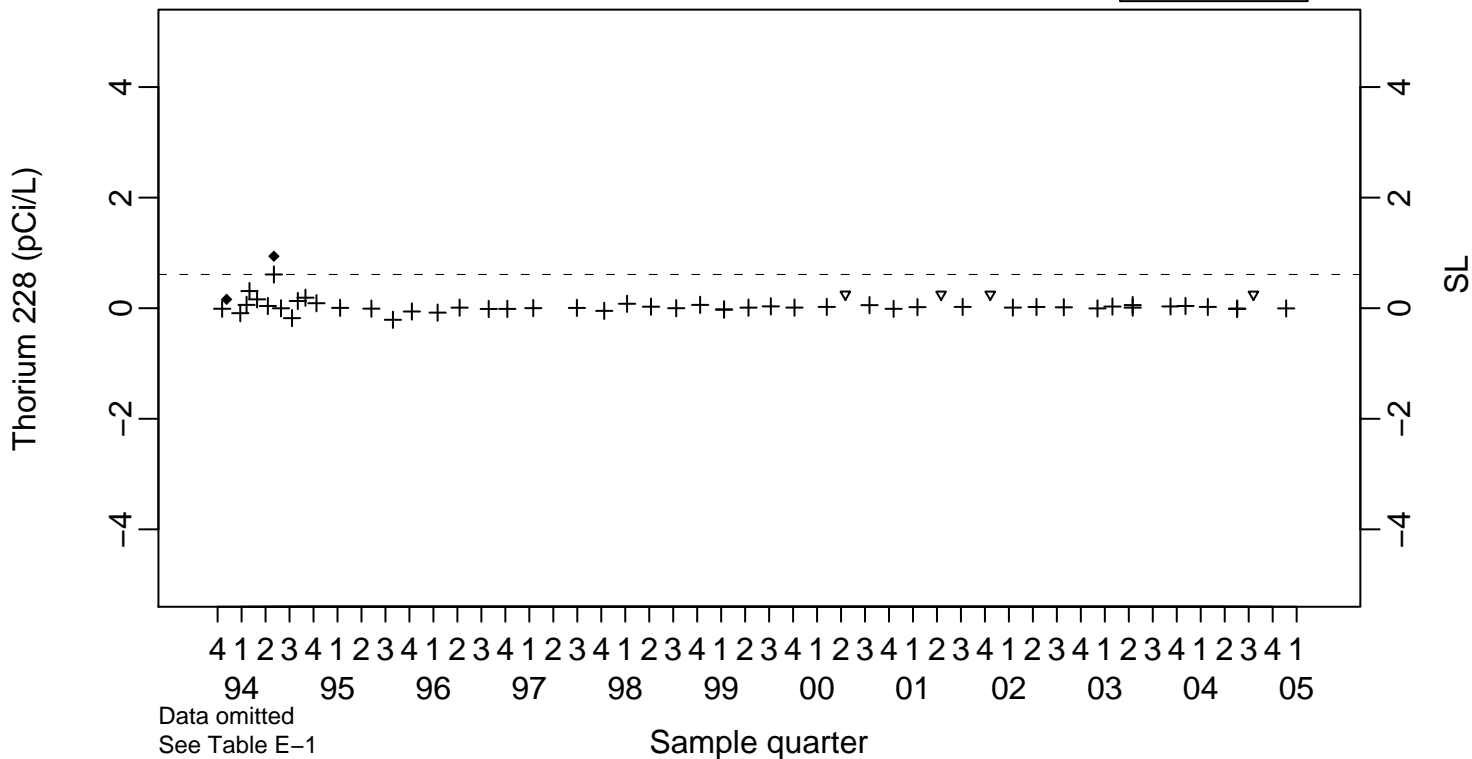


Pit 1 Area Thorium 228 (pCi/L)

Compliance Monitoring Point K1-02B

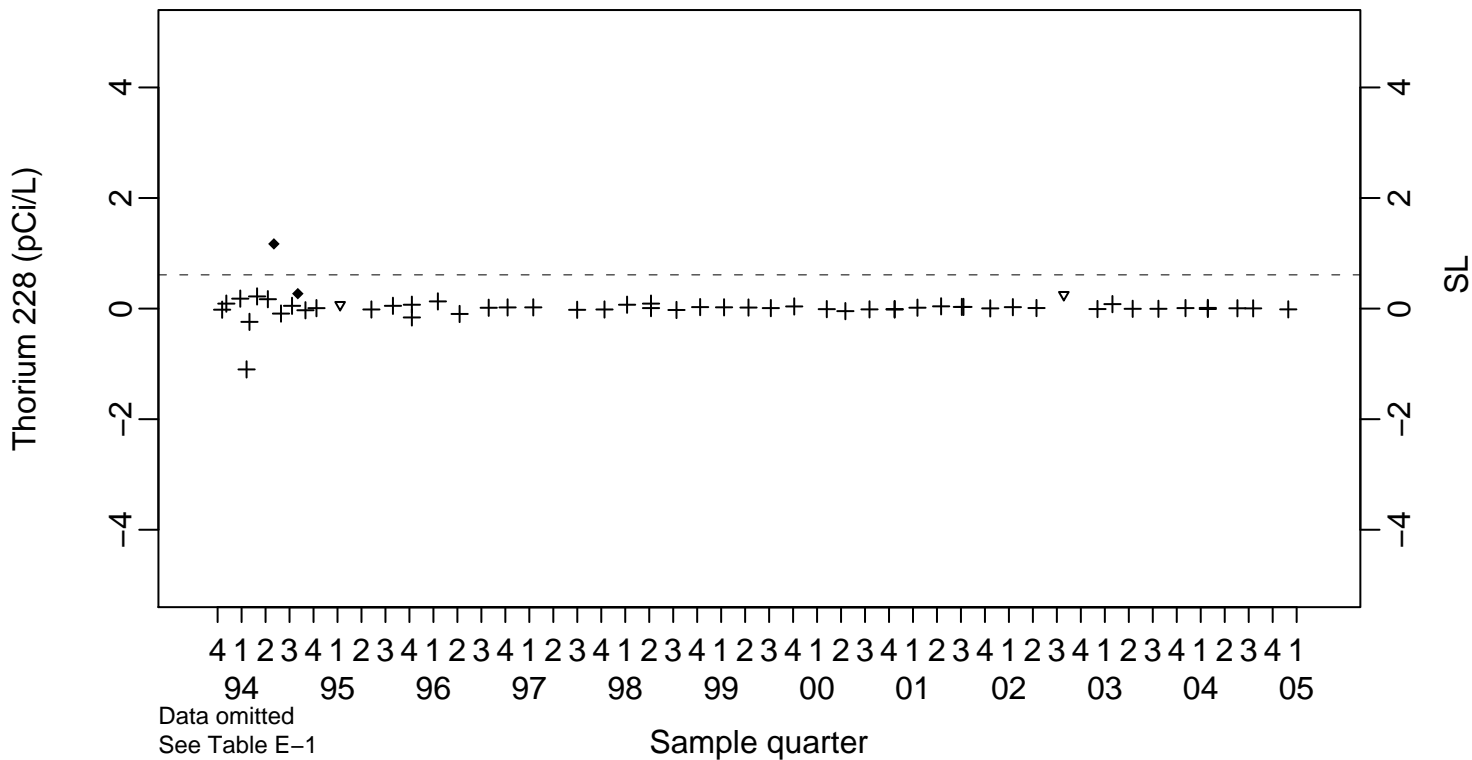
SL=0.61

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.61

Compliance Monitoring Point K1-03

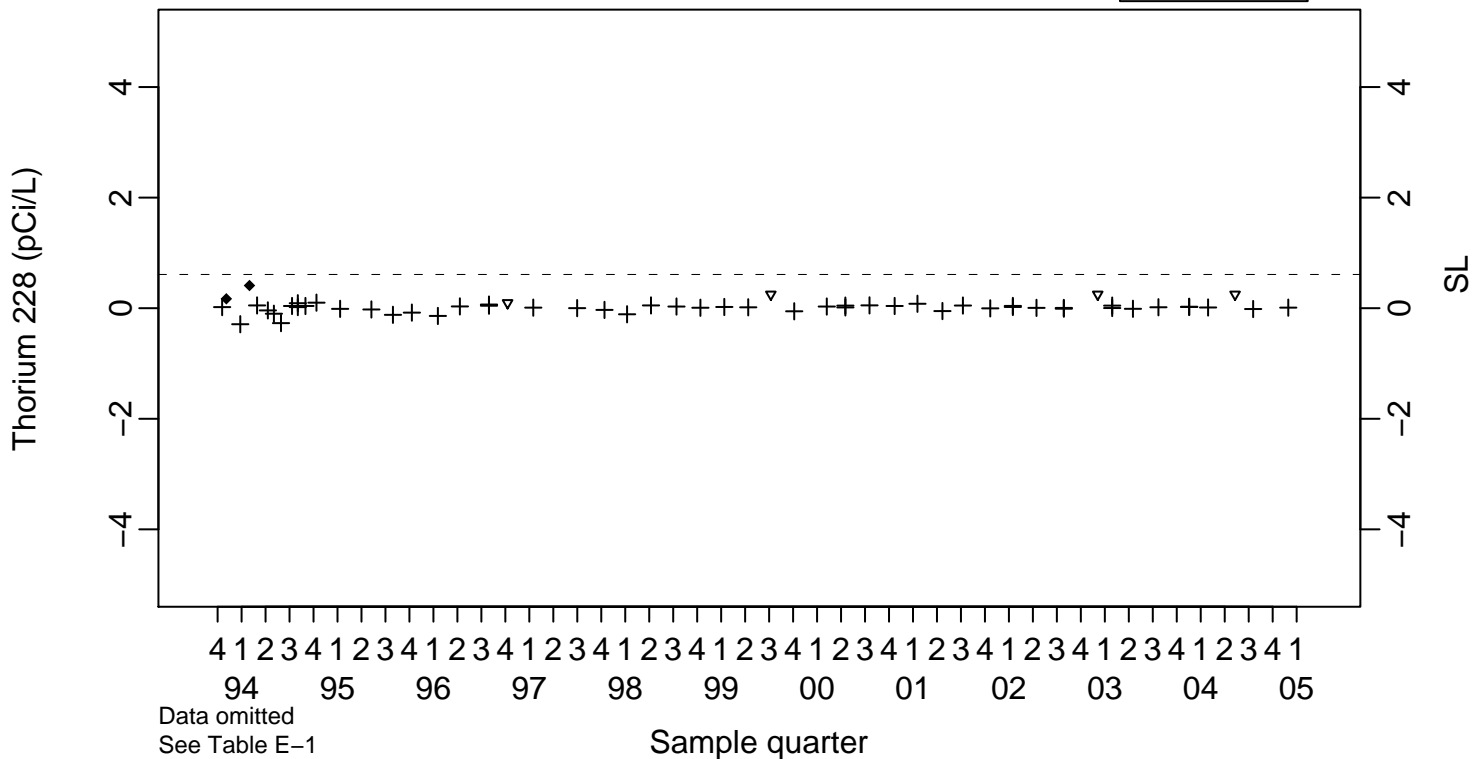


Pit 1 Area Thorium 228 (pCi/L)

Compliance Monitoring Point K1-04

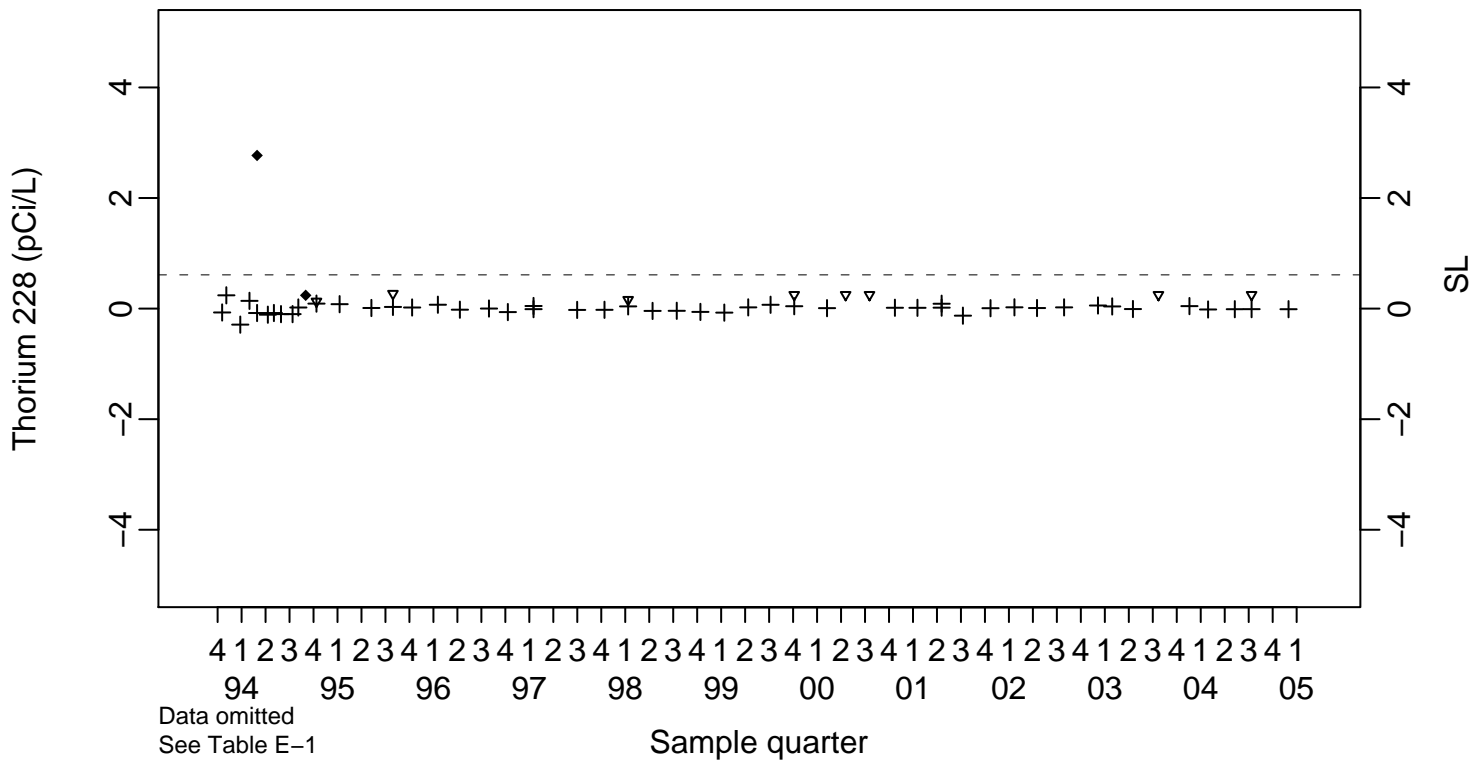
SL=0.61

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.61

Compliance Monitoring Point K1-05

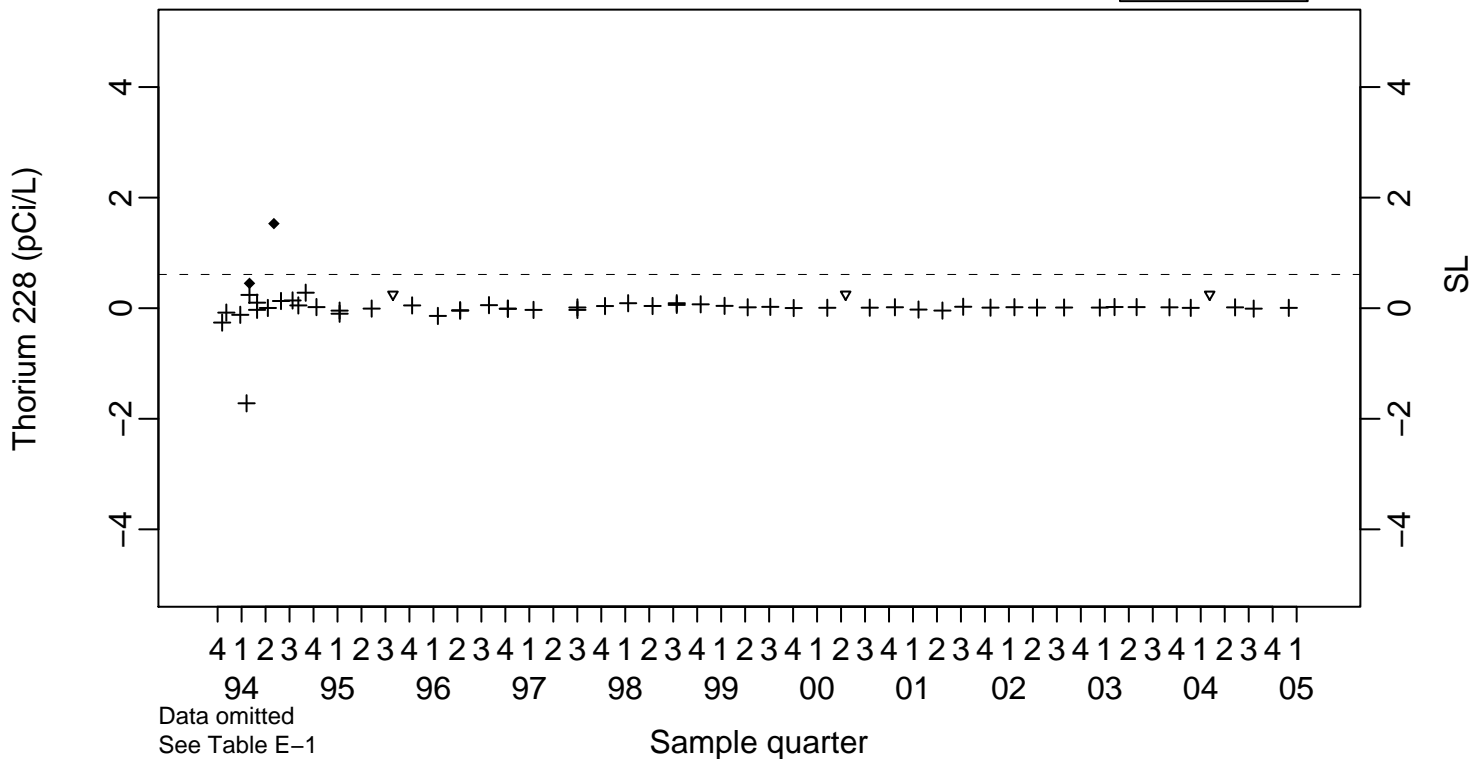


Pit 1 Area Thorium 228 (pCi/L)

Compliance Monitoring Point K1-08

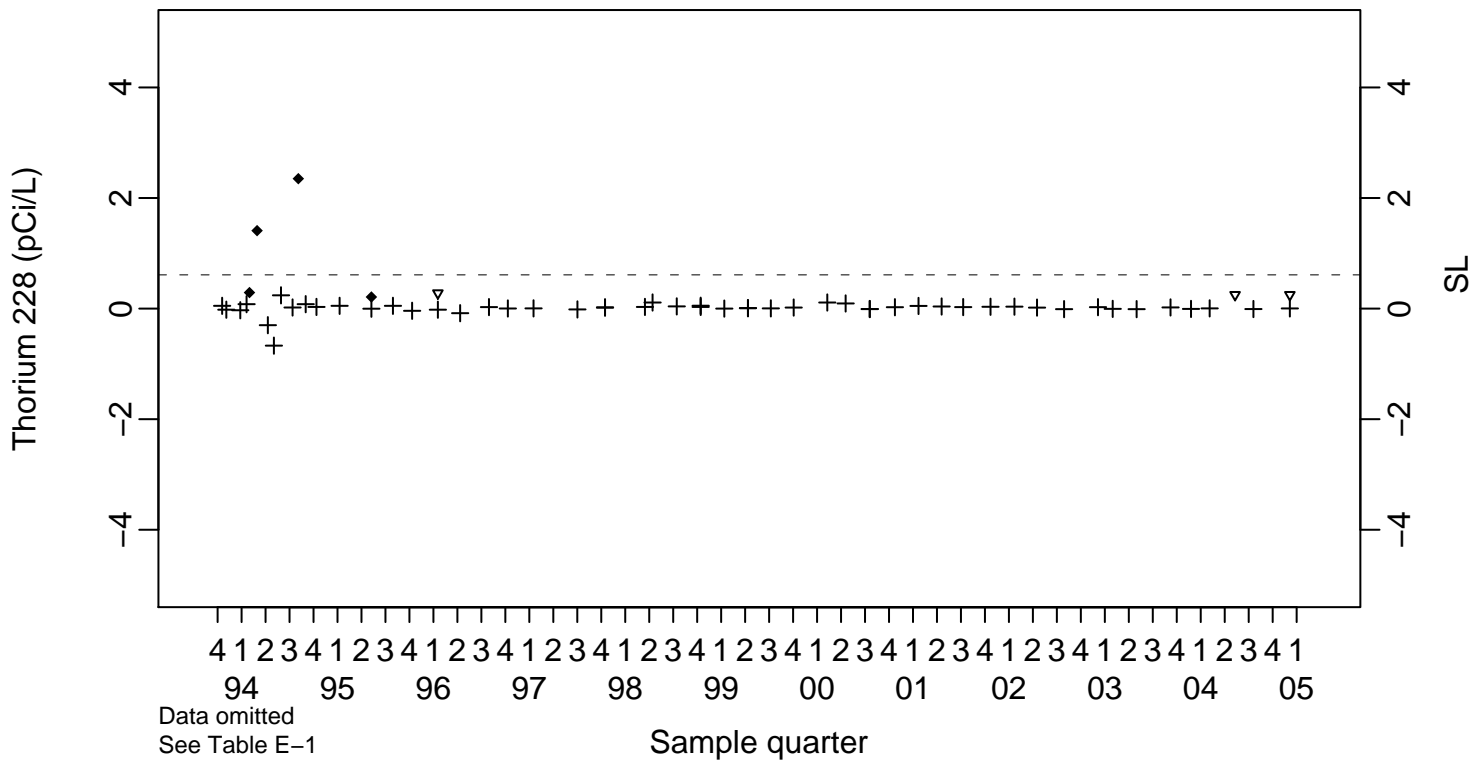
SL=0.61

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.61

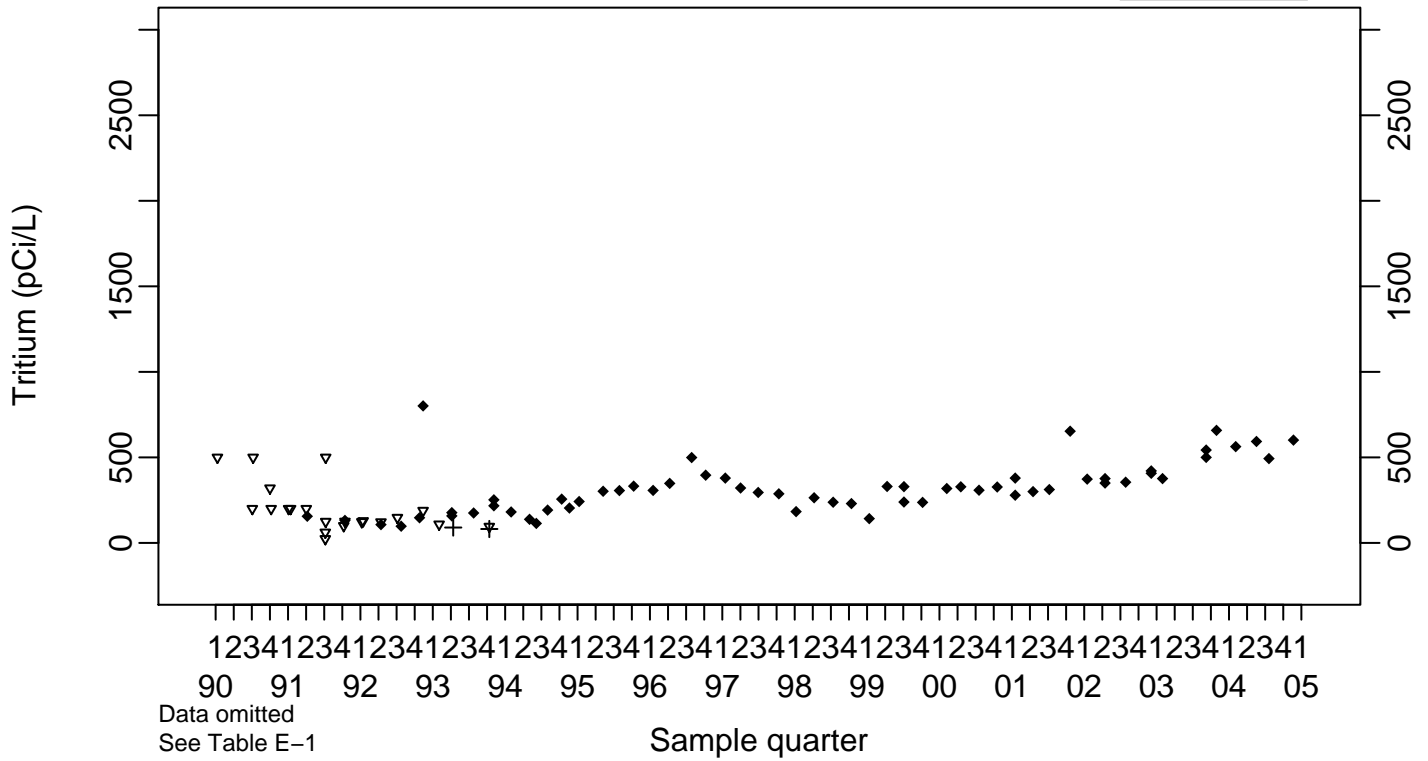
Compliance Monitoring Point K1-09



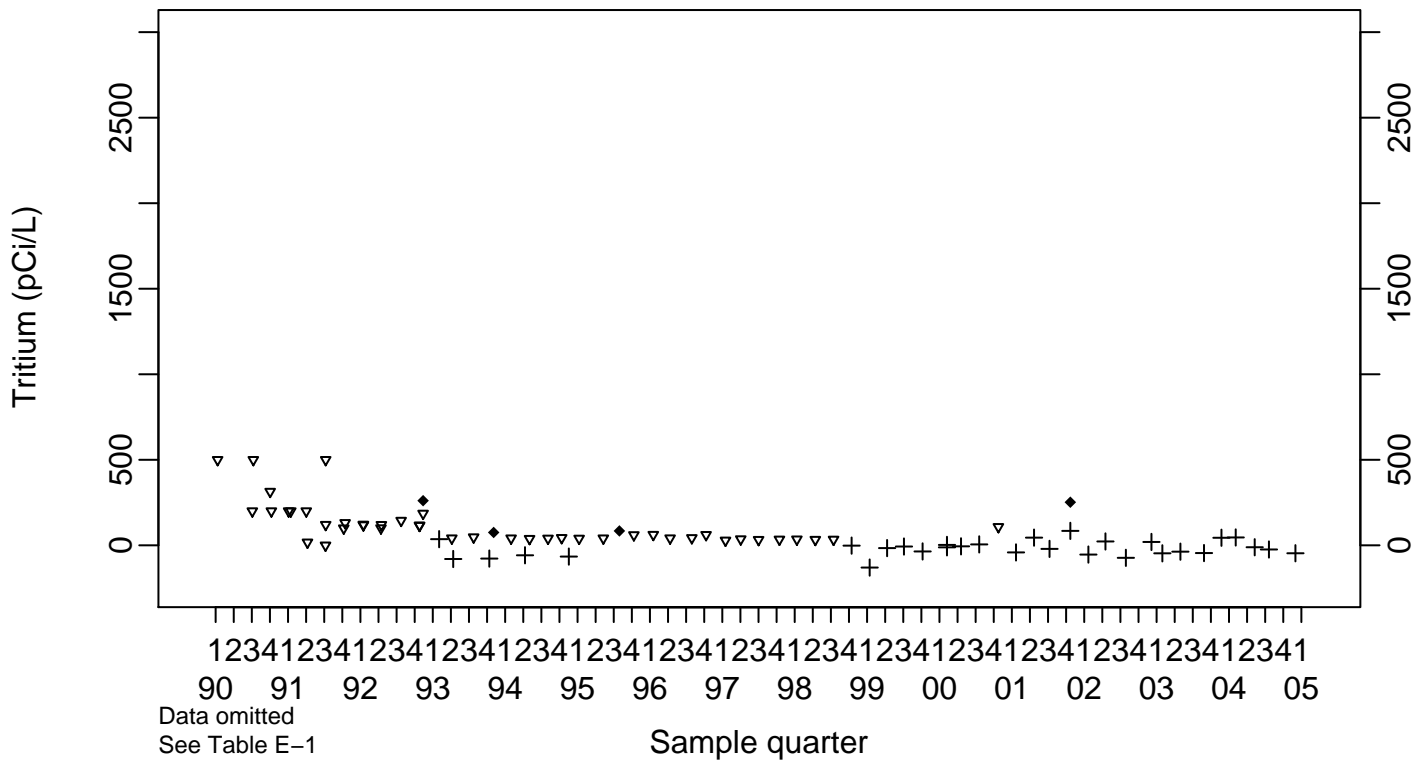
Pit 1 Area Tritium (pCi/L)

Background Monitoring Point K1-01C

- ◆ Above RL
- ▽ Below RL
- + Estimated



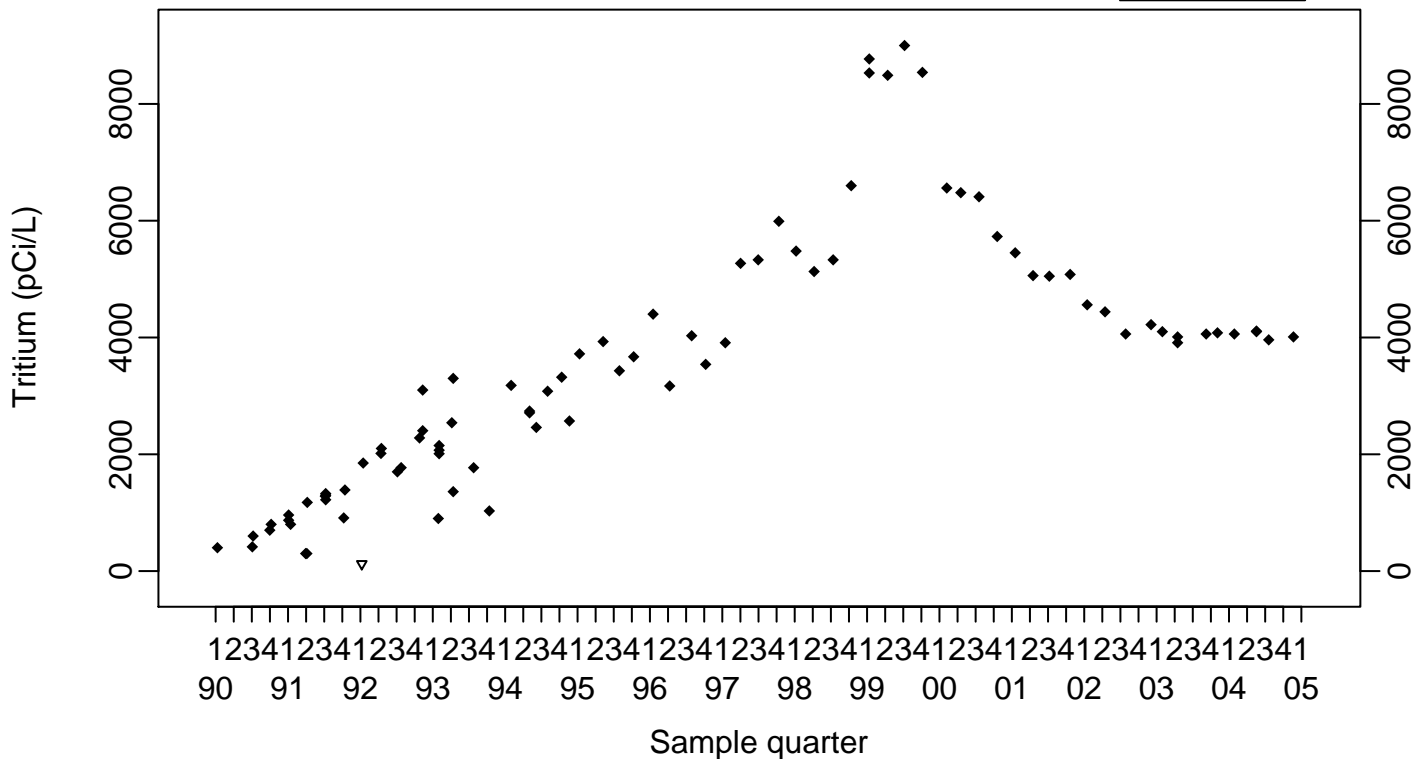
Background Monitoring Point K1-07



Pit 1 Area Tritium (pCi/L)

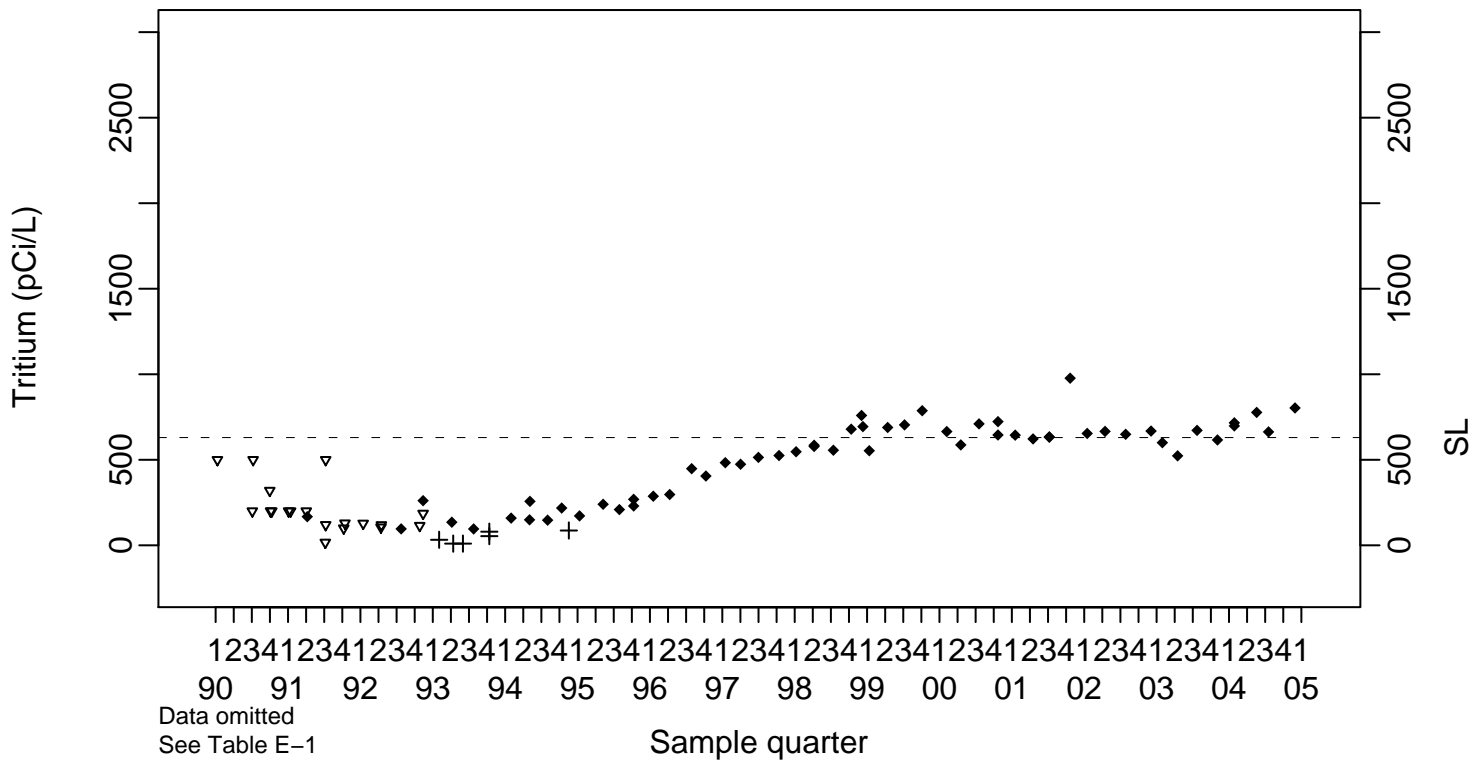
Compliance Monitoring Point K1-02B

◆ Above RL
▽ Below RL



SL=630

Compliance Monitoring Point K1-03



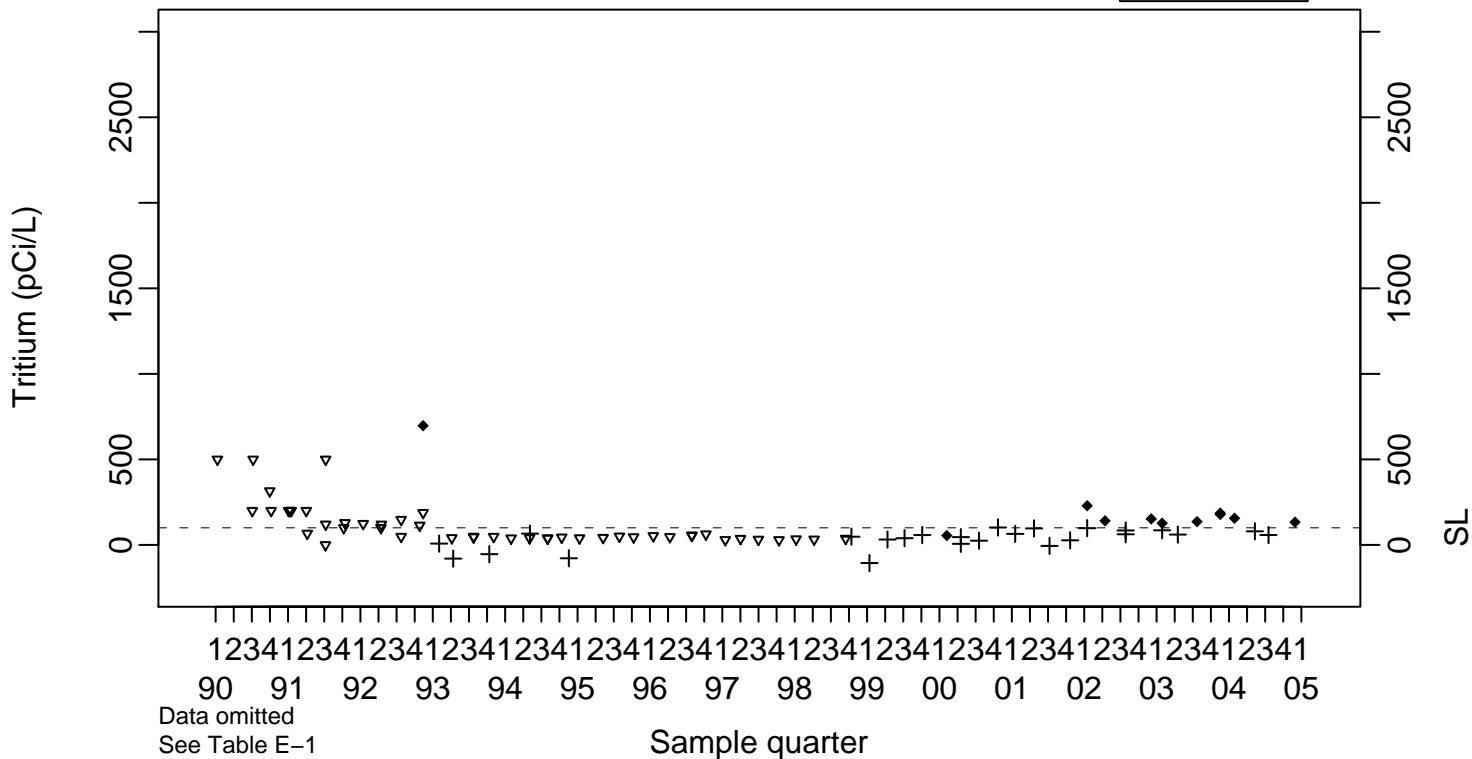
Data omitted
See Table E-1

Pit 1 Area Tritium (pCi/L)

Compliance Monitoring Point K1-04

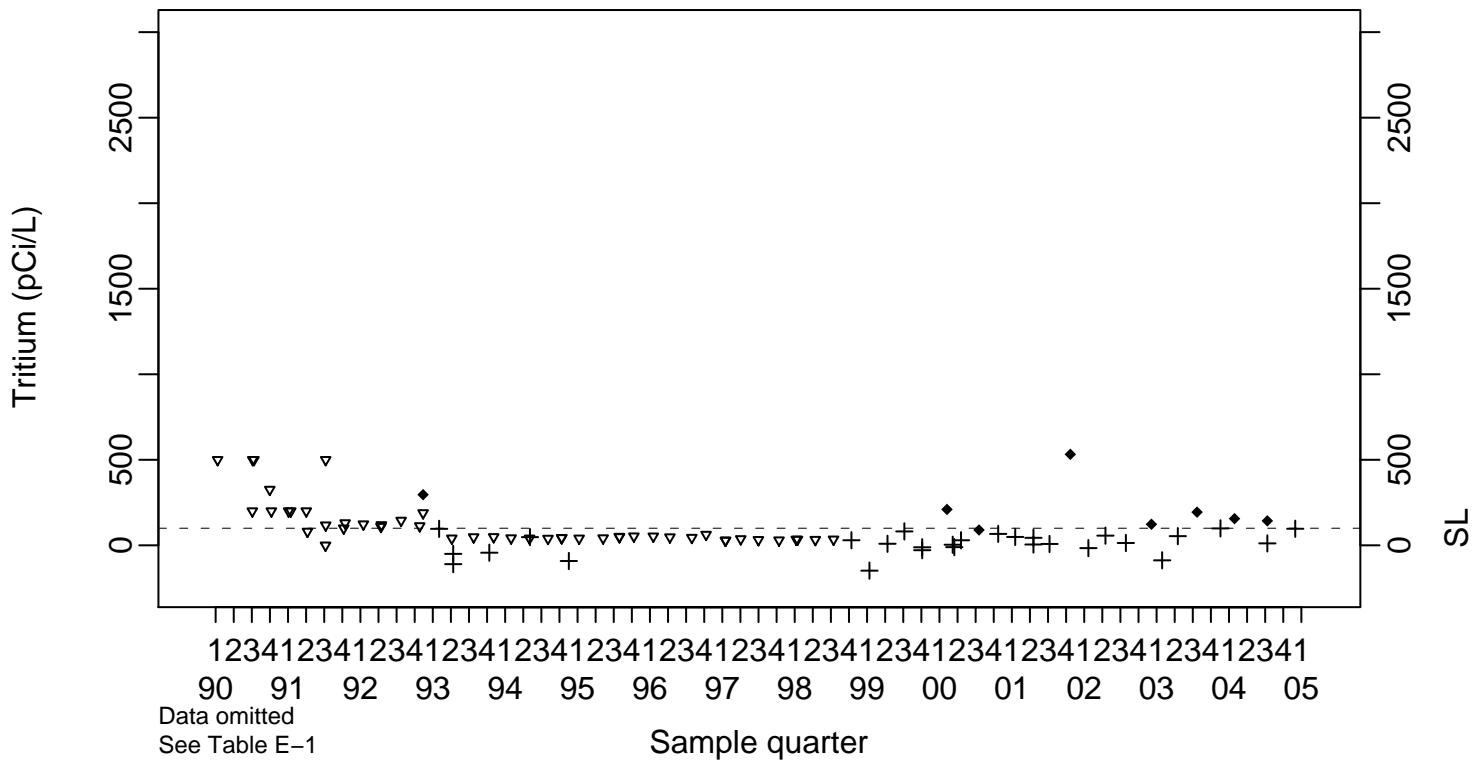
SL=100

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=100

Compliance Monitoring Point K1-05

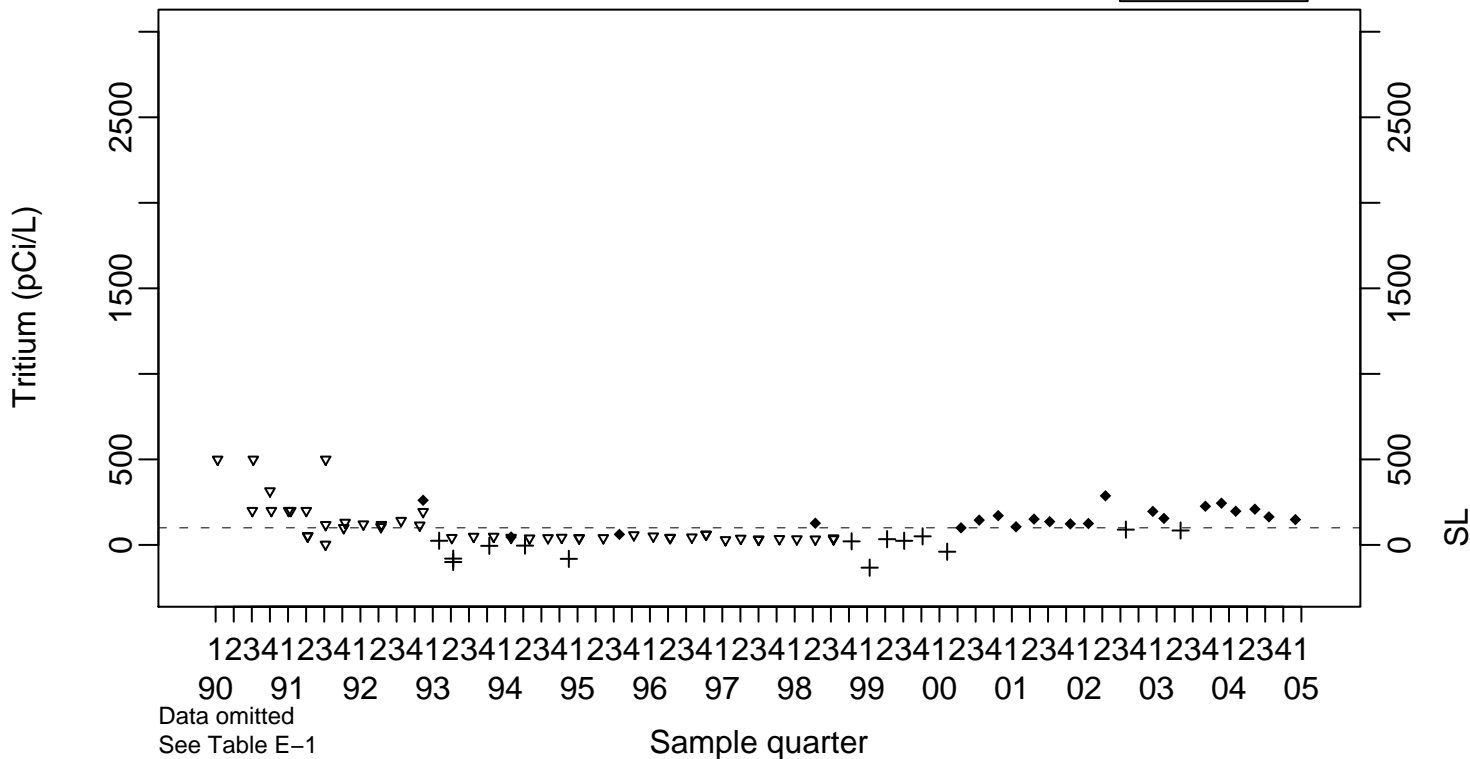


Pit 1 Area Tritium (pCi/L)

Compliance Monitoring Point K1-08

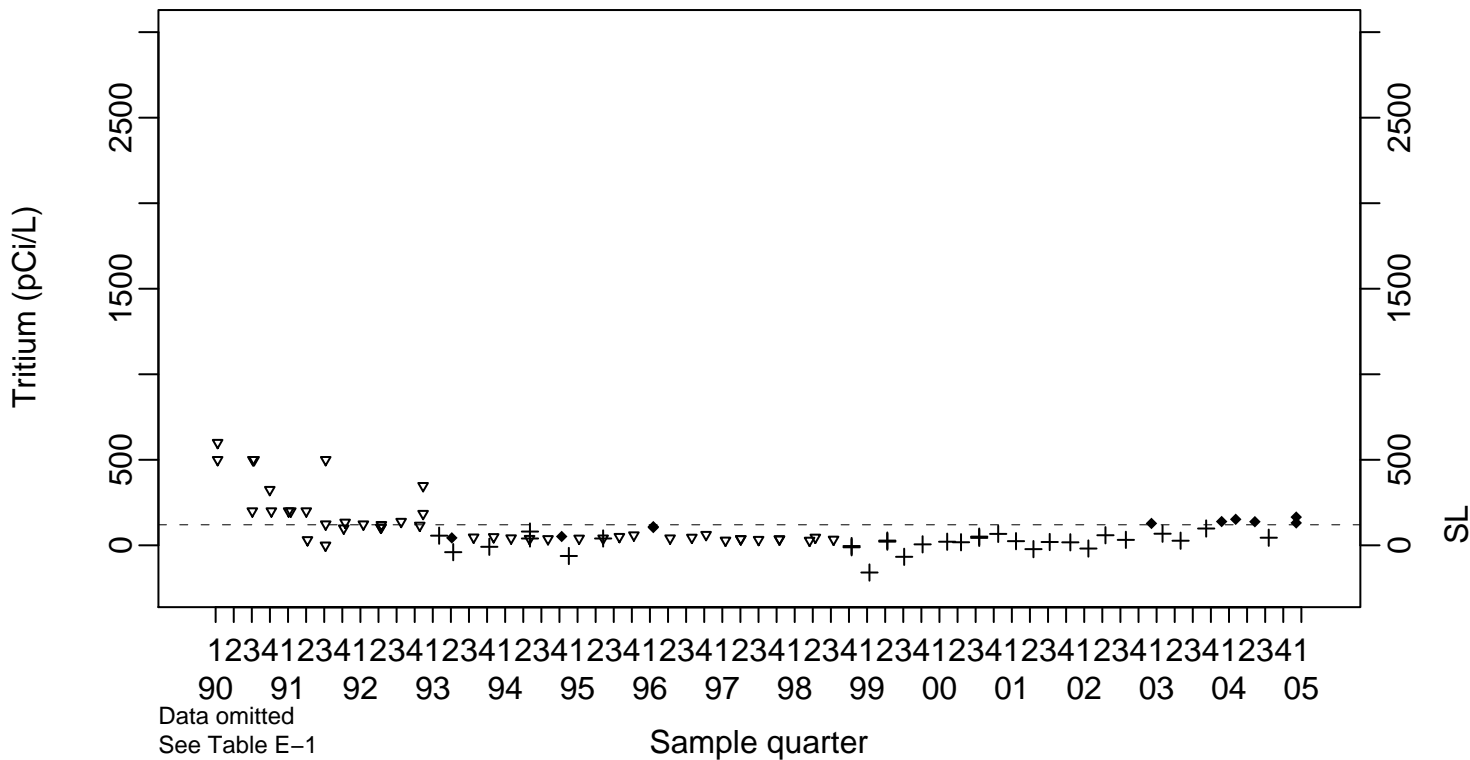
SL=100

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=120

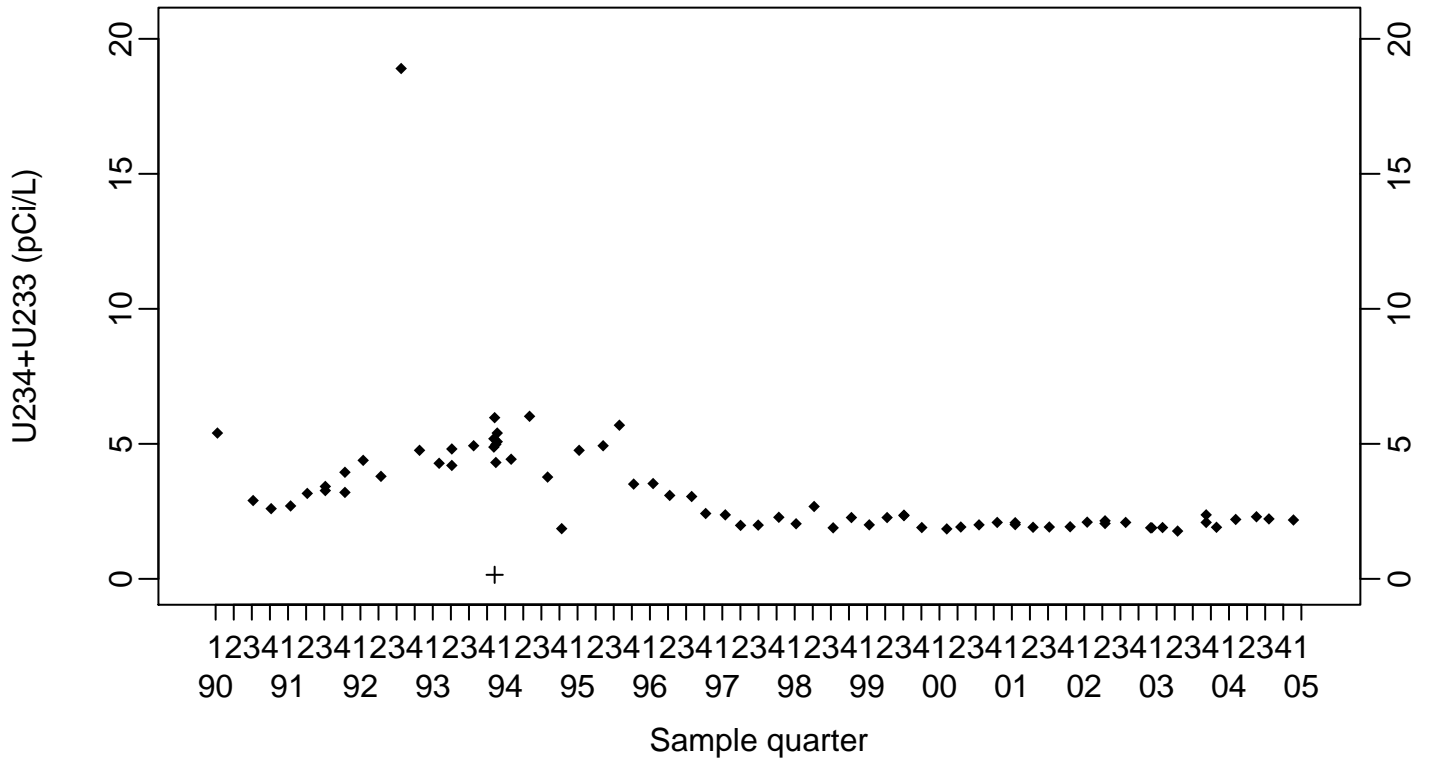
Compliance Monitoring Point K1-09



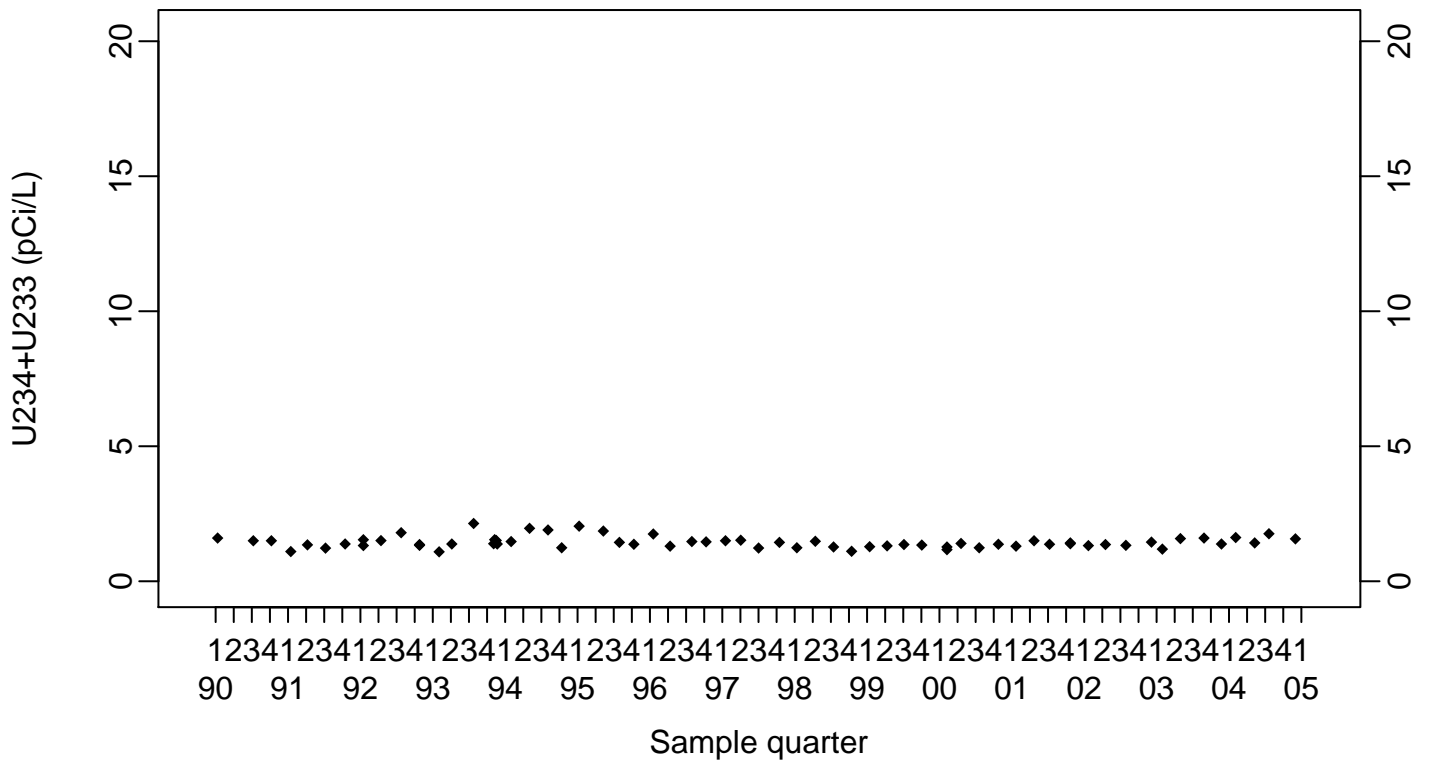
Pit 1 Area
U234+U233 (pCi/L)

Background Monitoring Point K1-01C

◆ Above RL
+ Estimated



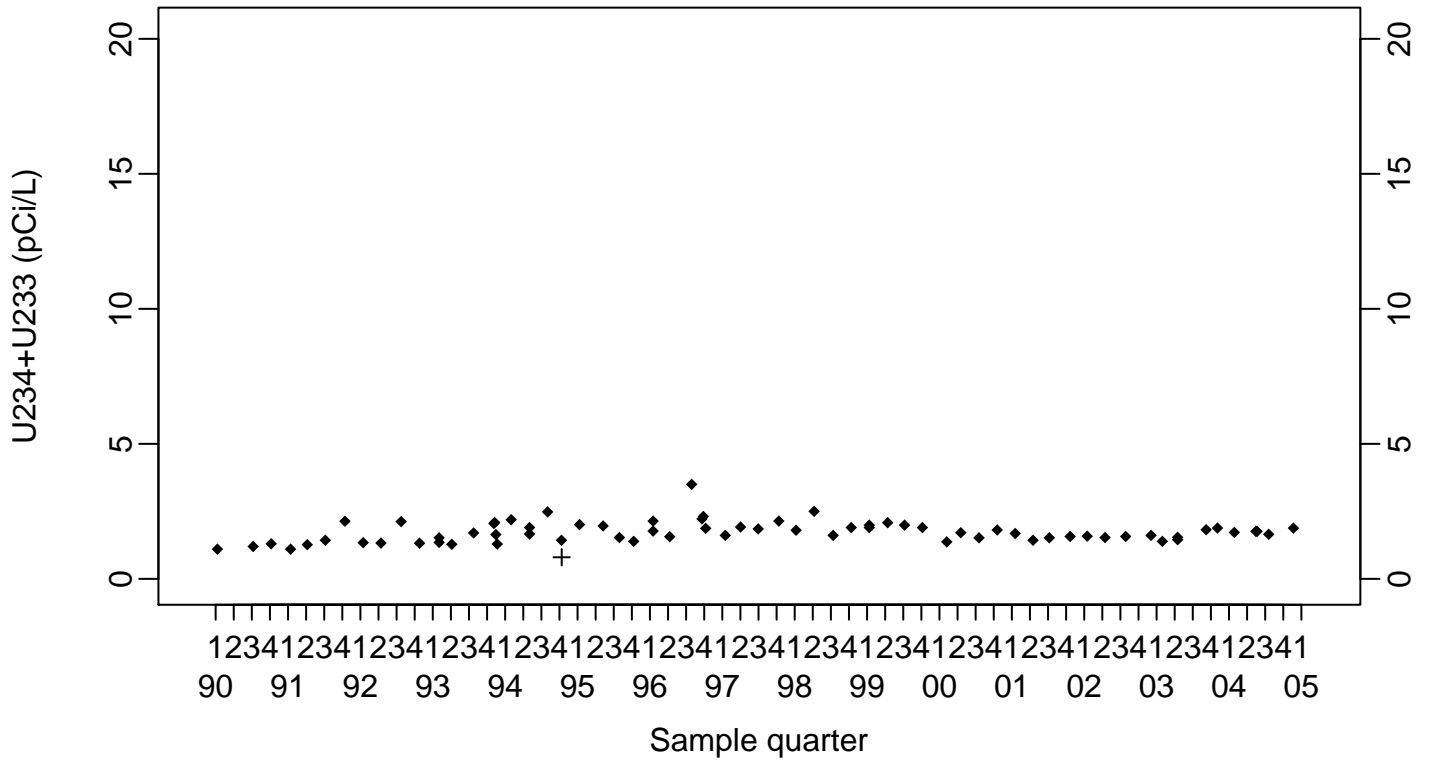
Background Monitoring Point K1-07



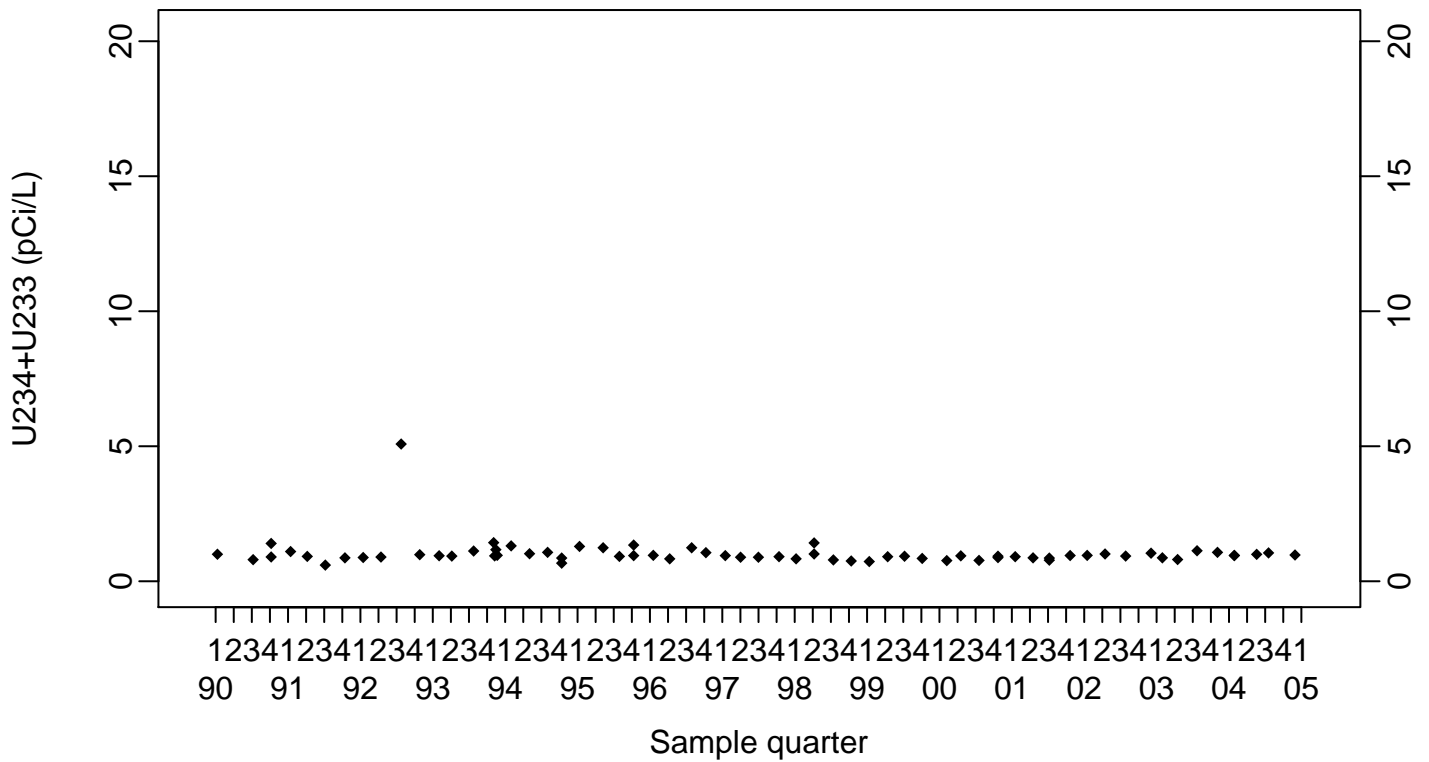
Pit 1 Area
U234+U233 (pCi/L)

Compliance Monitoring Point K1-02B

◆ Above RL
+ Estimated



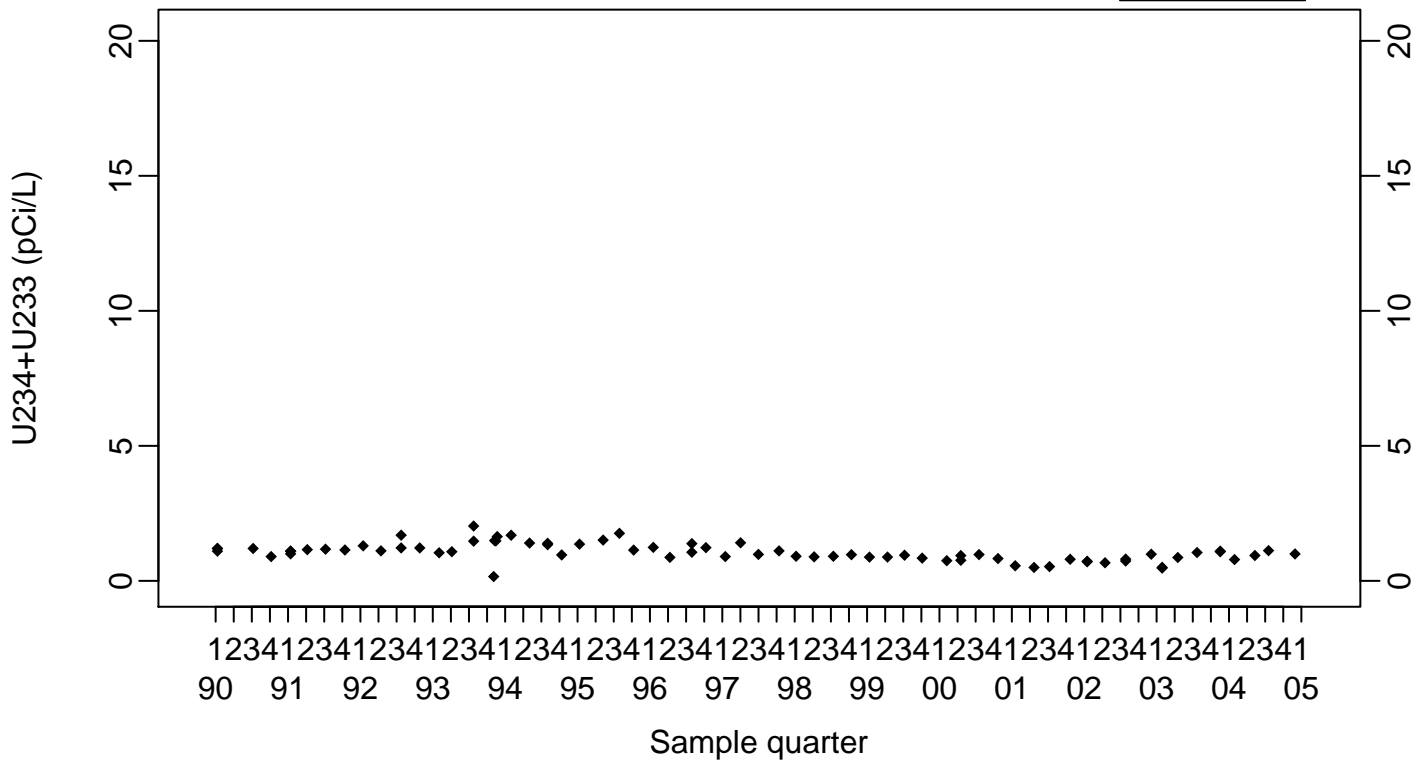
Compliance Monitoring Point K1-03



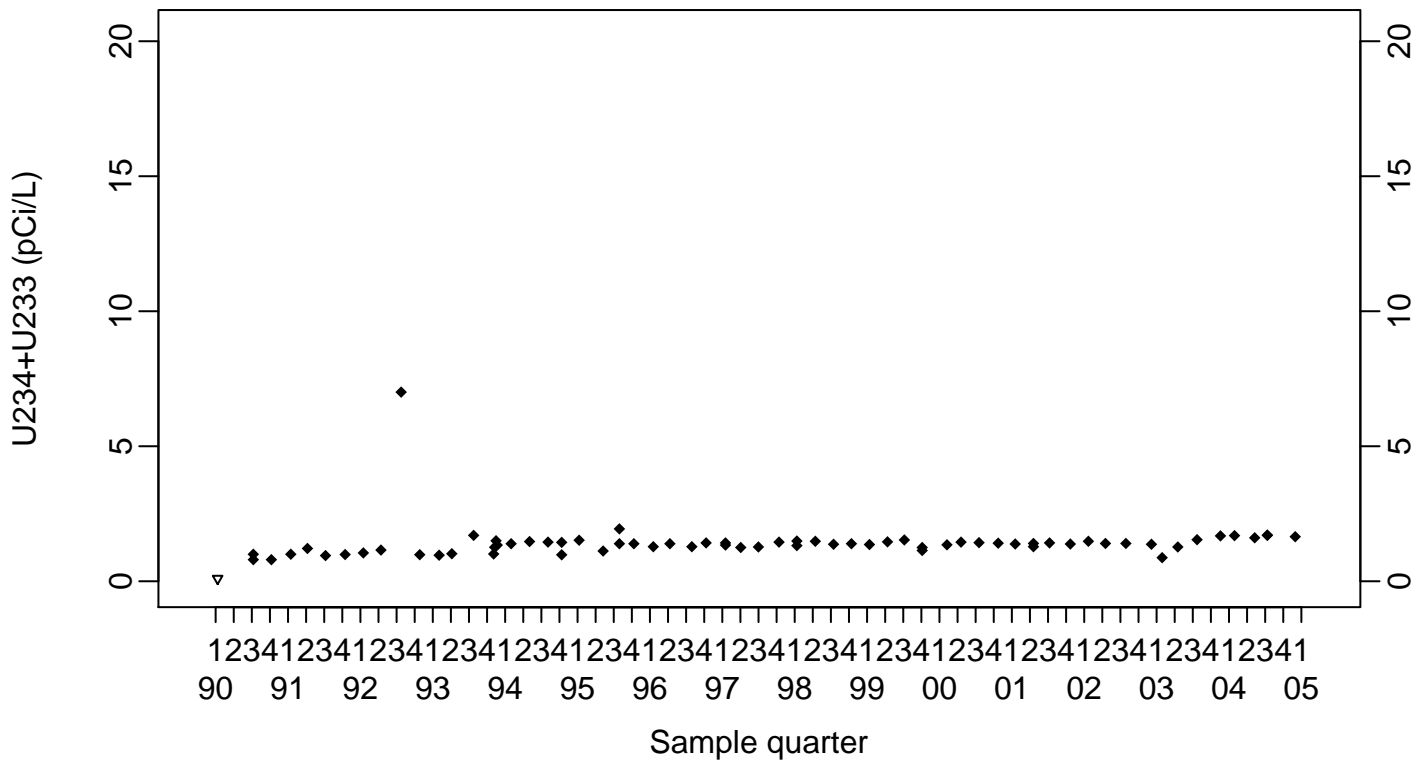
Pit 1 Area
U234+U233 (pCi/L)

Compliance Monitoring Point K1-04

◆ Above RL
▽ Below RL



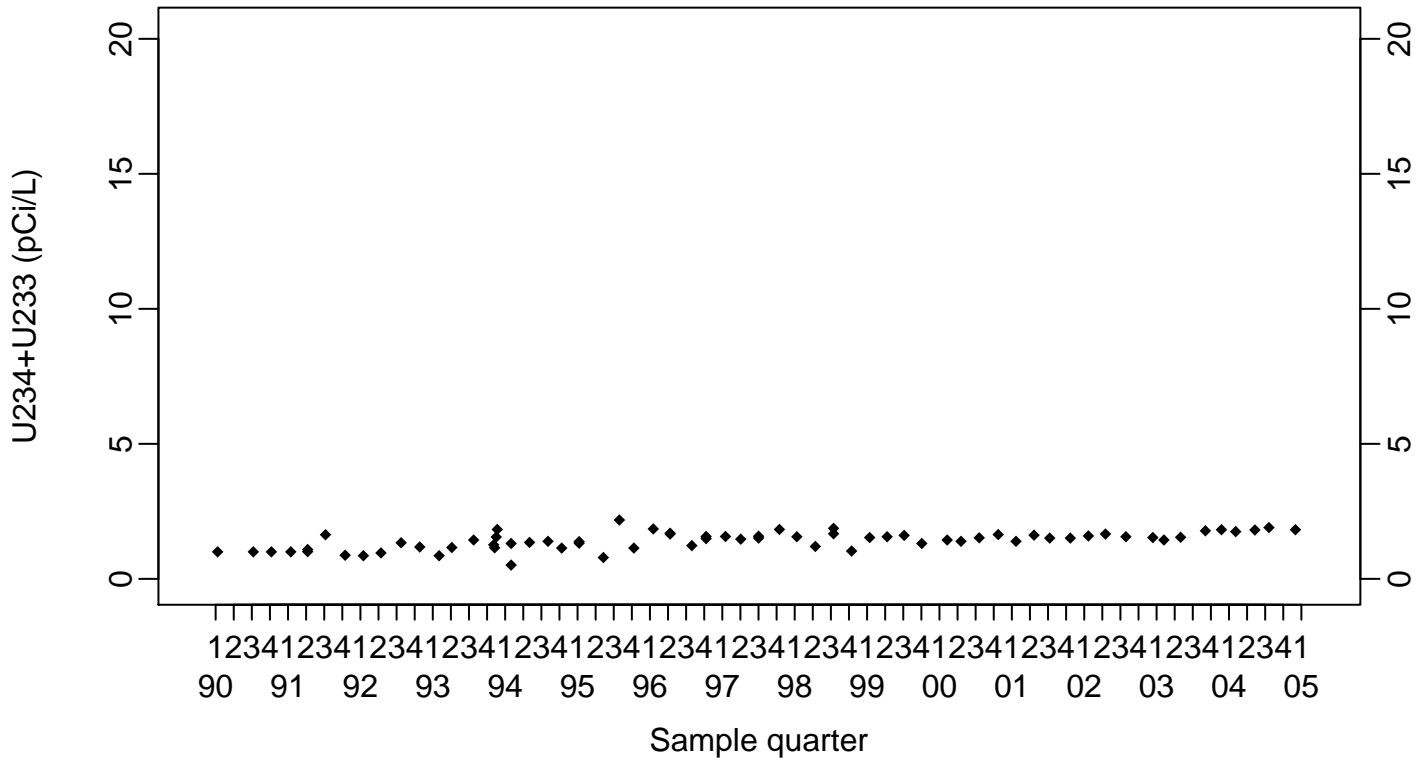
Compliance Monitoring Point K1-05



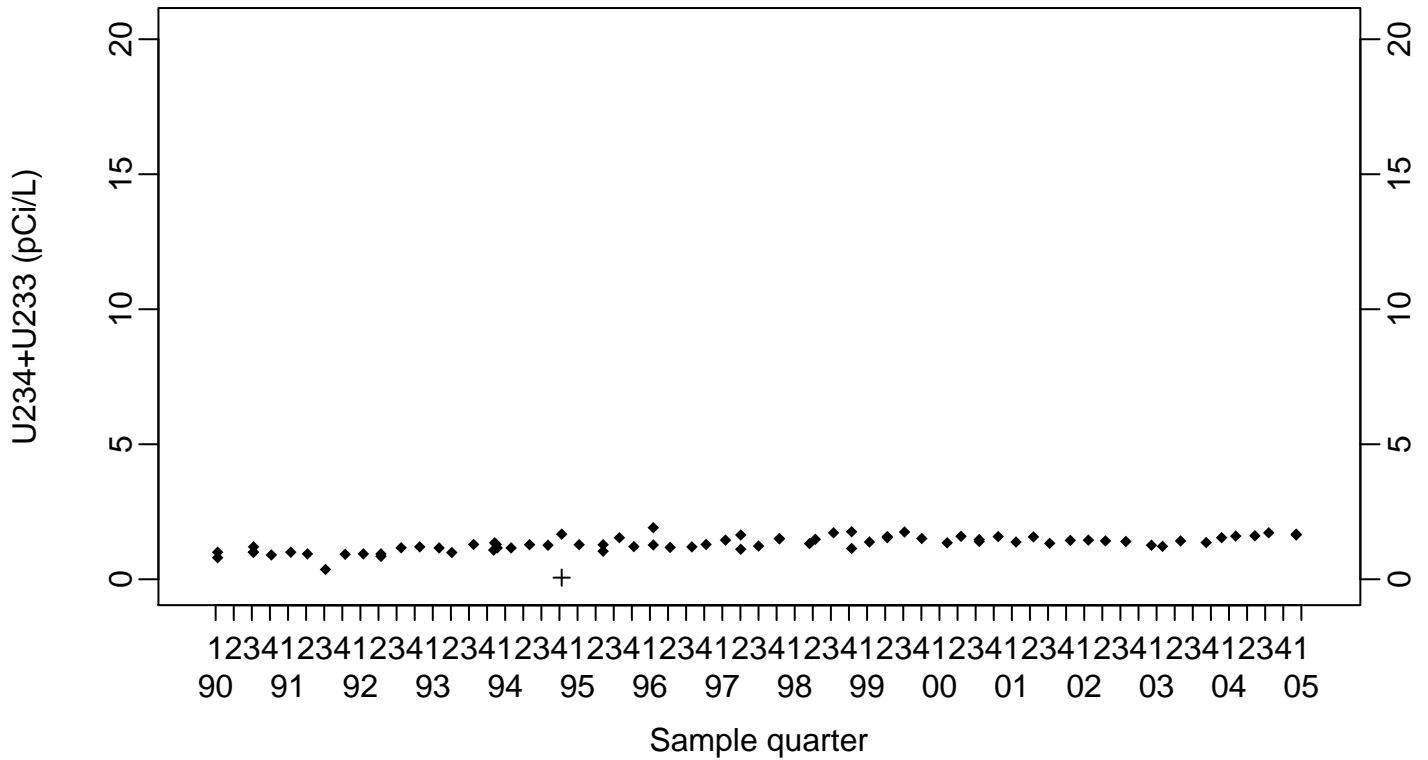
Pit 1 Area U234+U233 (pCi/L)

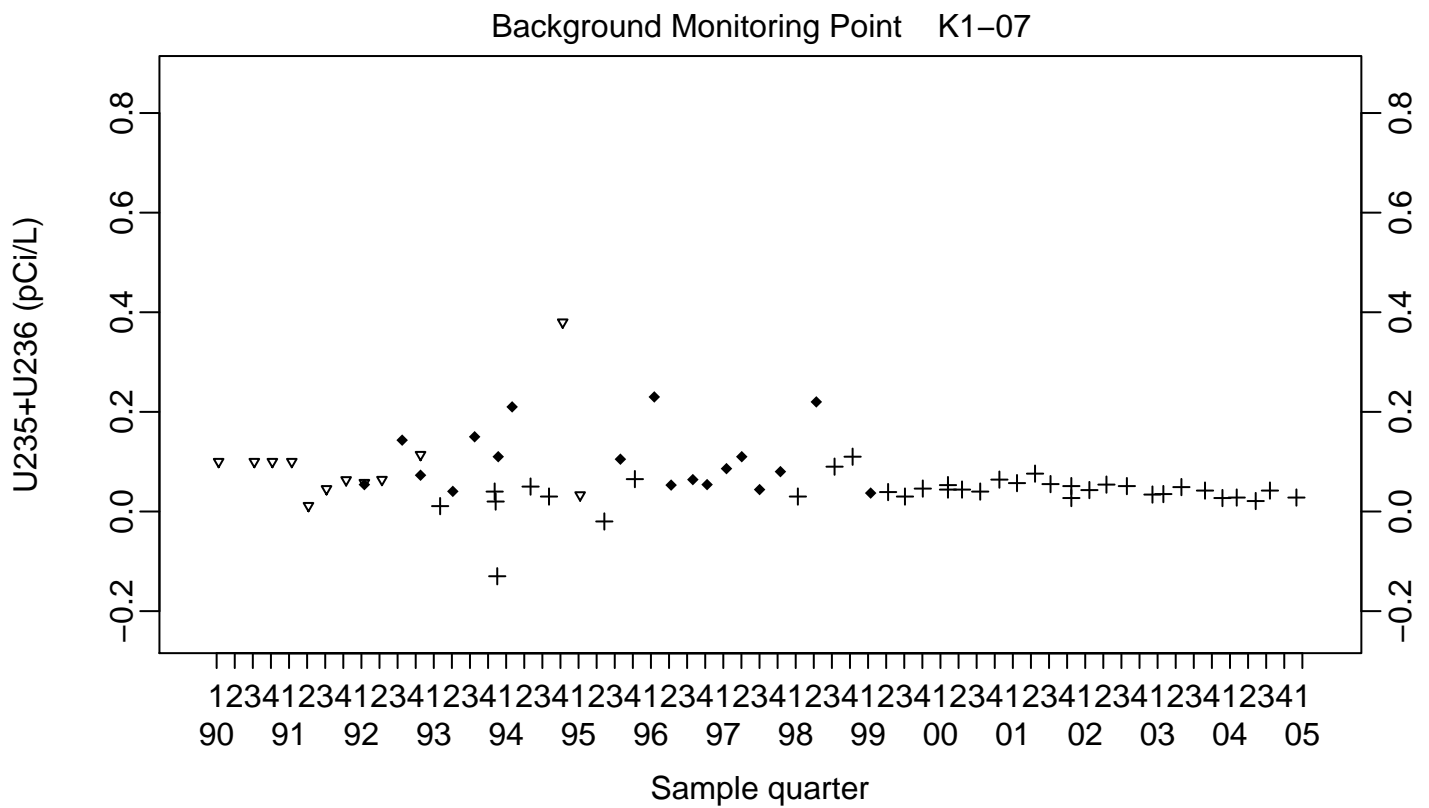
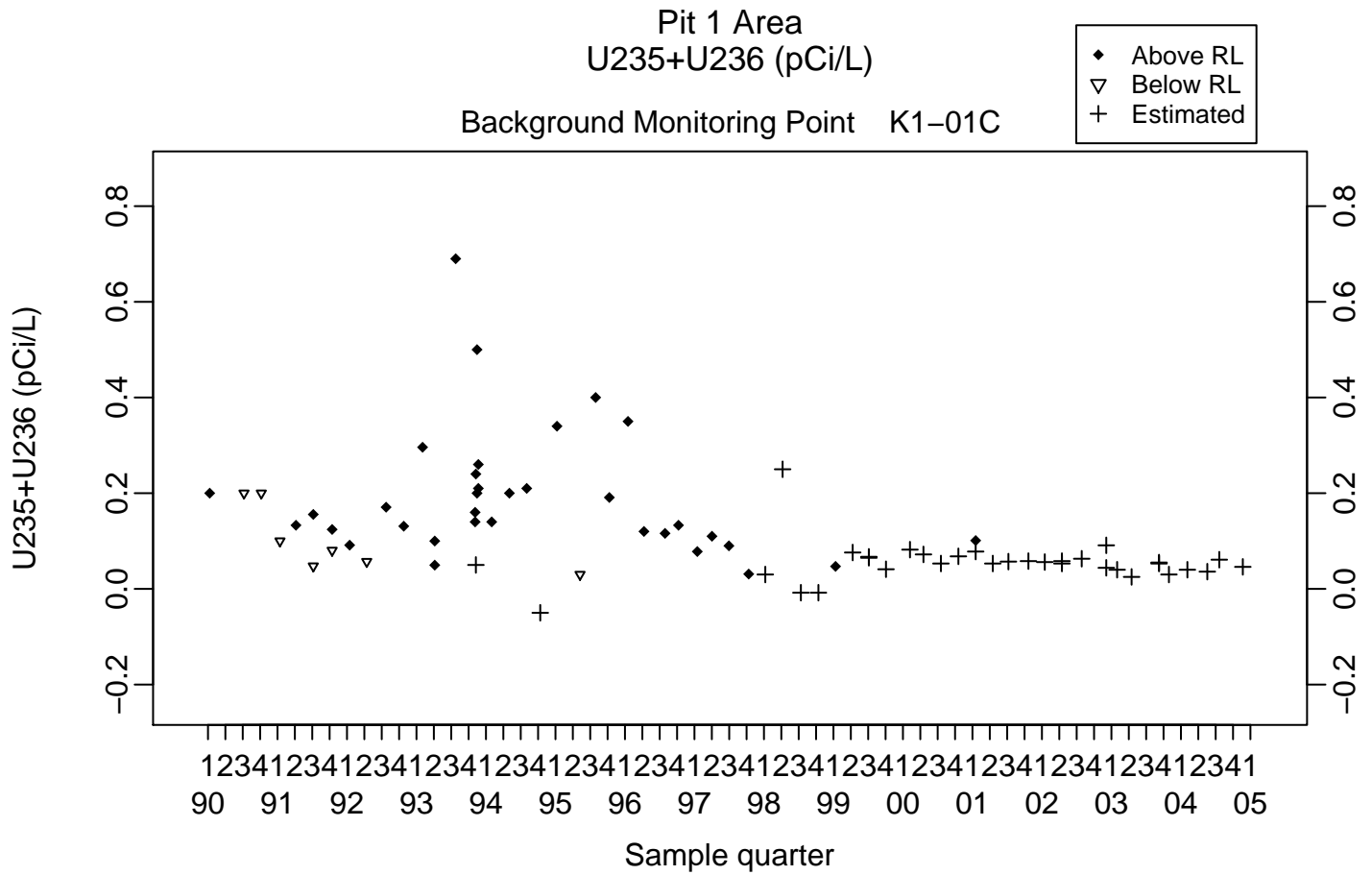
Compliance Monitoring Point K1-08

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-09

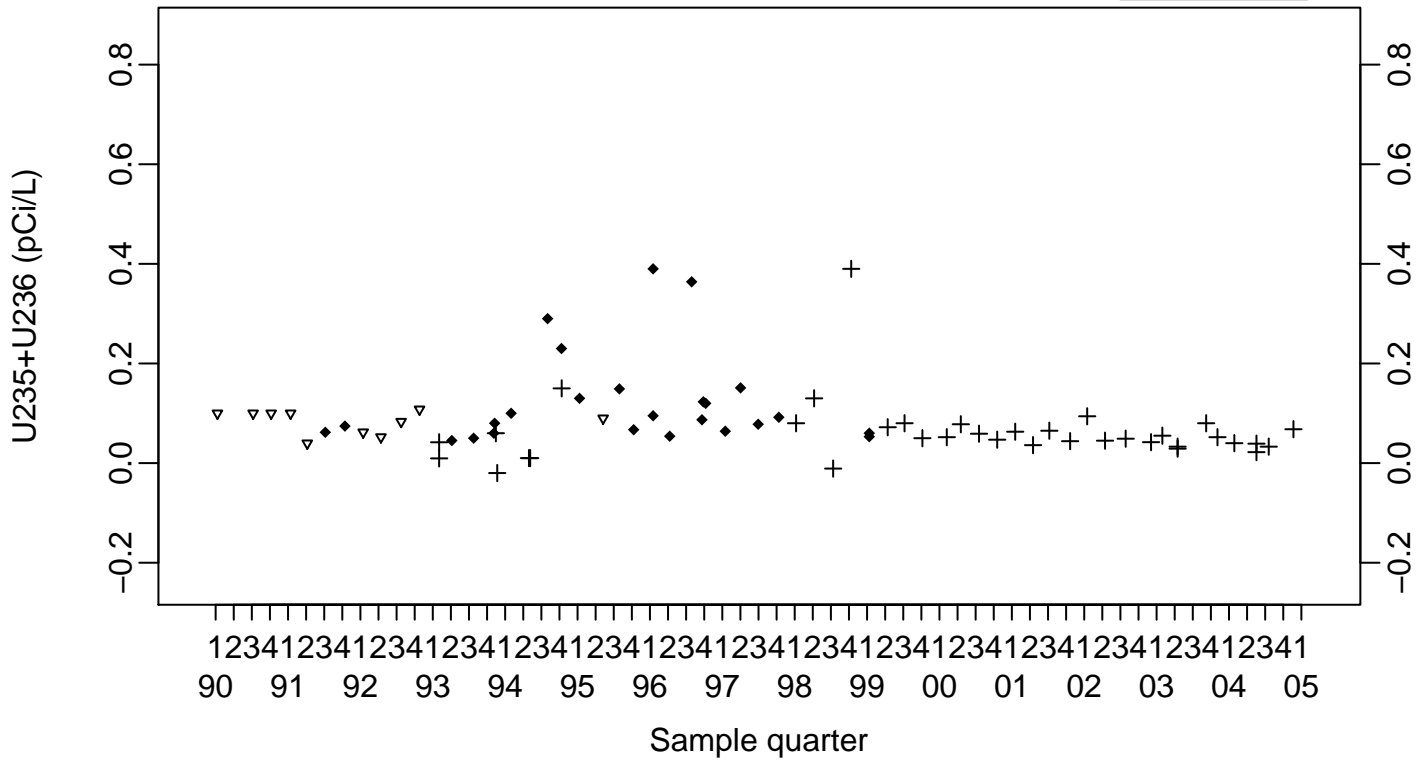




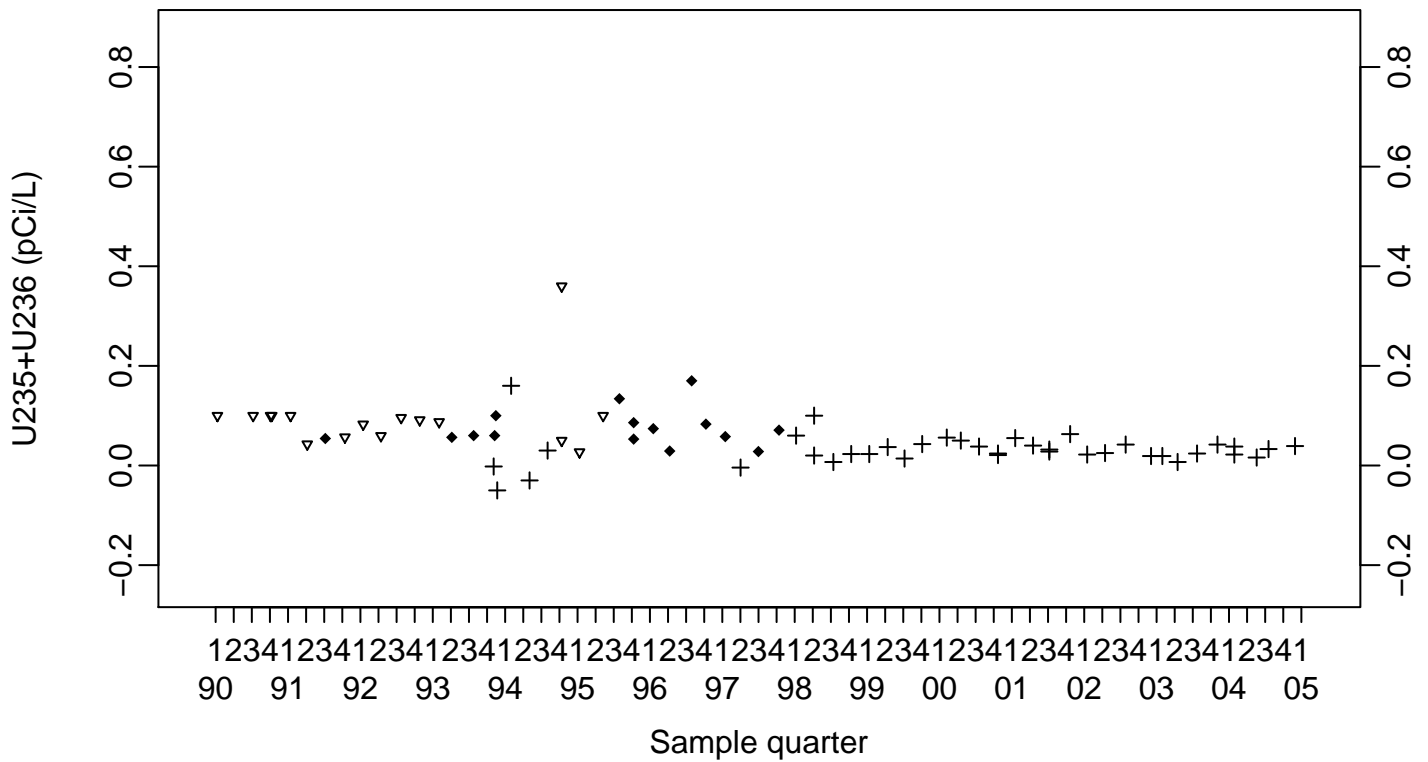
Pit 1 Area U235+U236 (pCi/L)

Compliance Monitoring Point K1-02B

- ◆ Above RL
- ▽ Below RL
- + Estimated



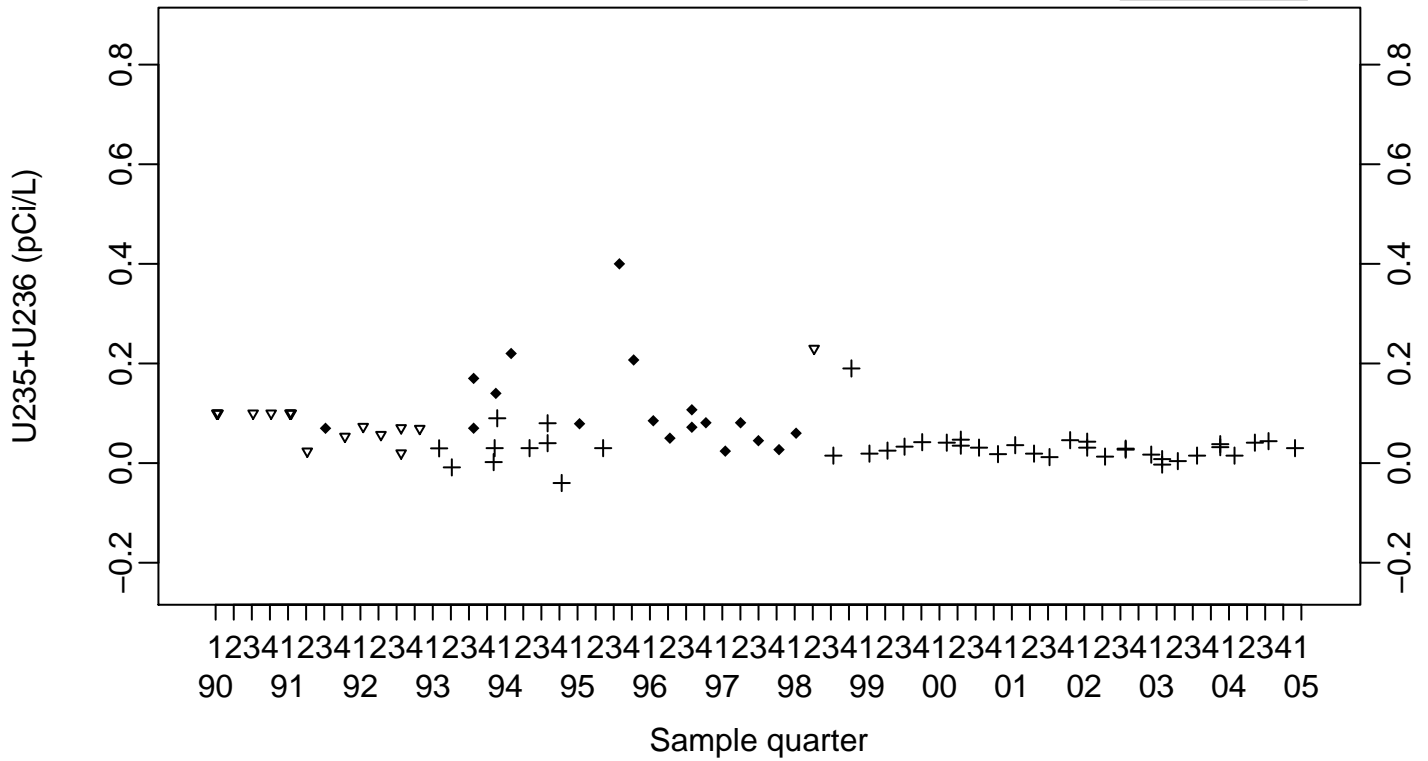
Compliance Monitoring Point K1-03



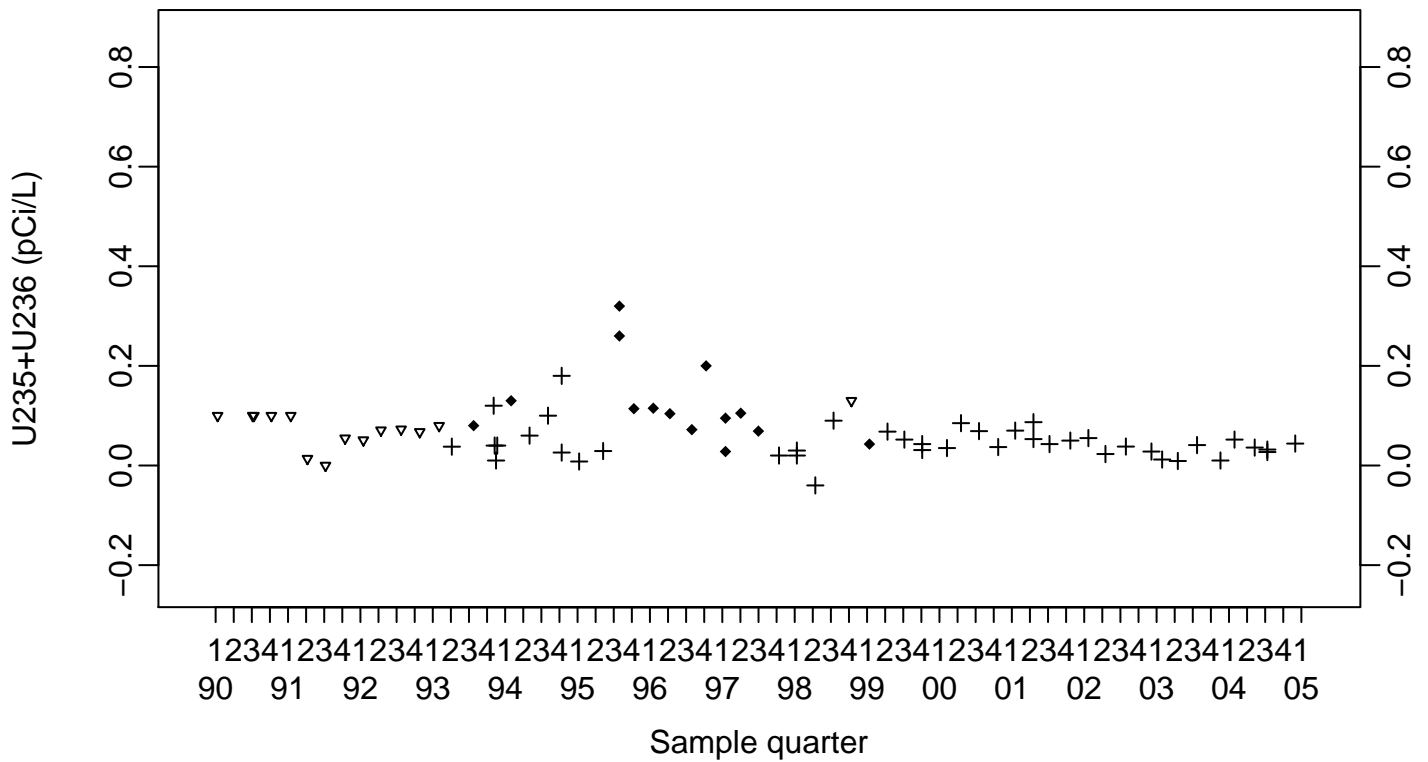
Pit 1 Area
U235+U236 (pCi/L)

Compliance Monitoring Point K1-04

- ◆ Above RL
- ▽ Below RL
- + Estimated



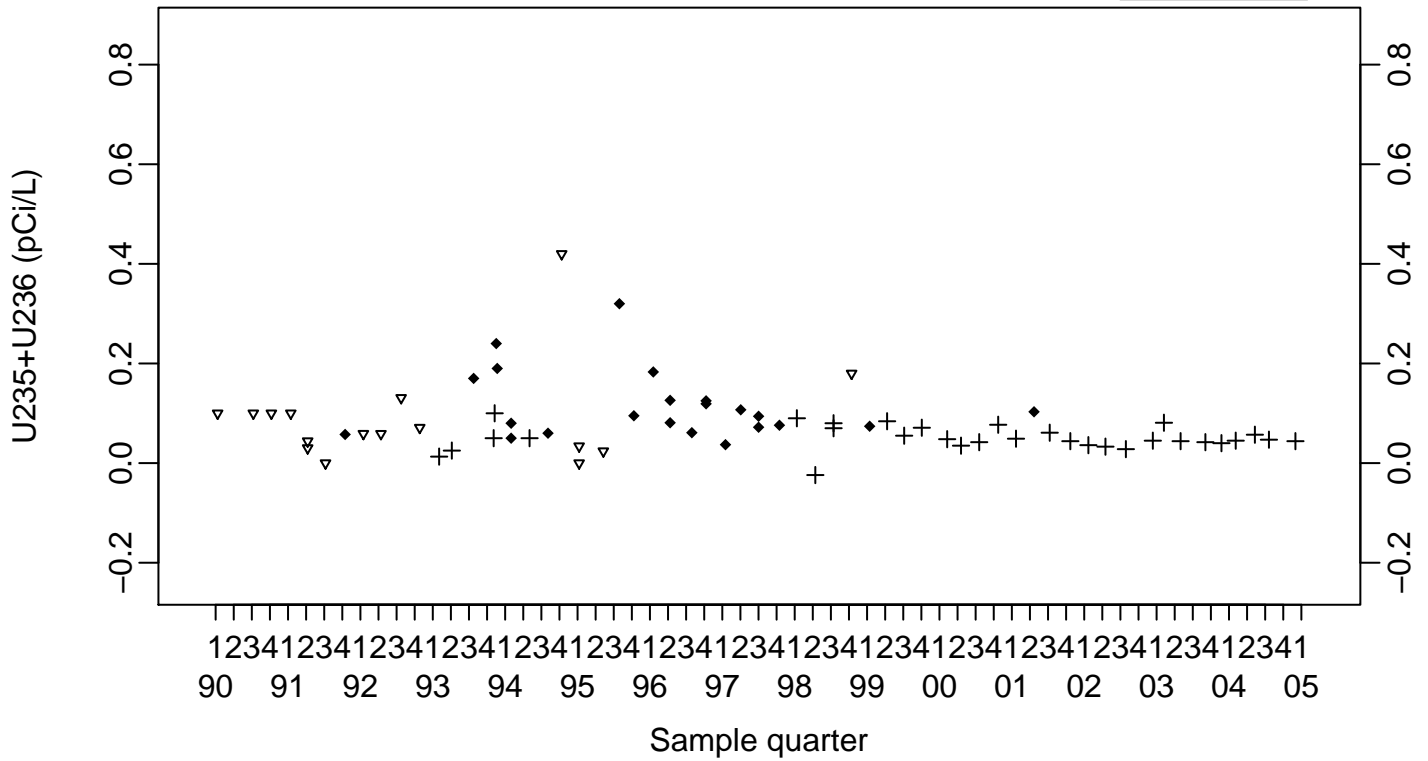
Compliance Monitoring Point K1-05



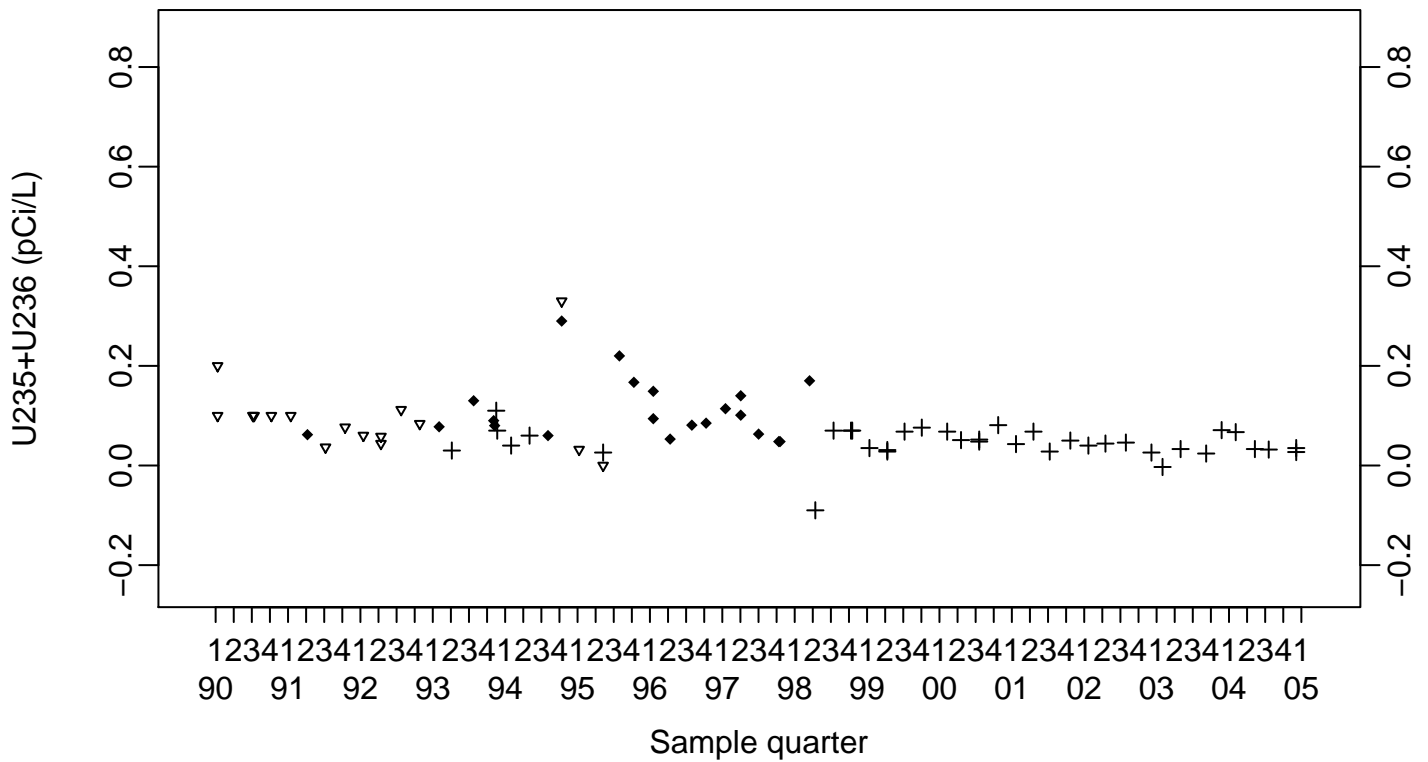
Pit 1 Area U235+U236 (pCi/L)

Compliance Monitoring Point K1-08

- ◆ Above RL
- ▽ Below RL
- + Estimated



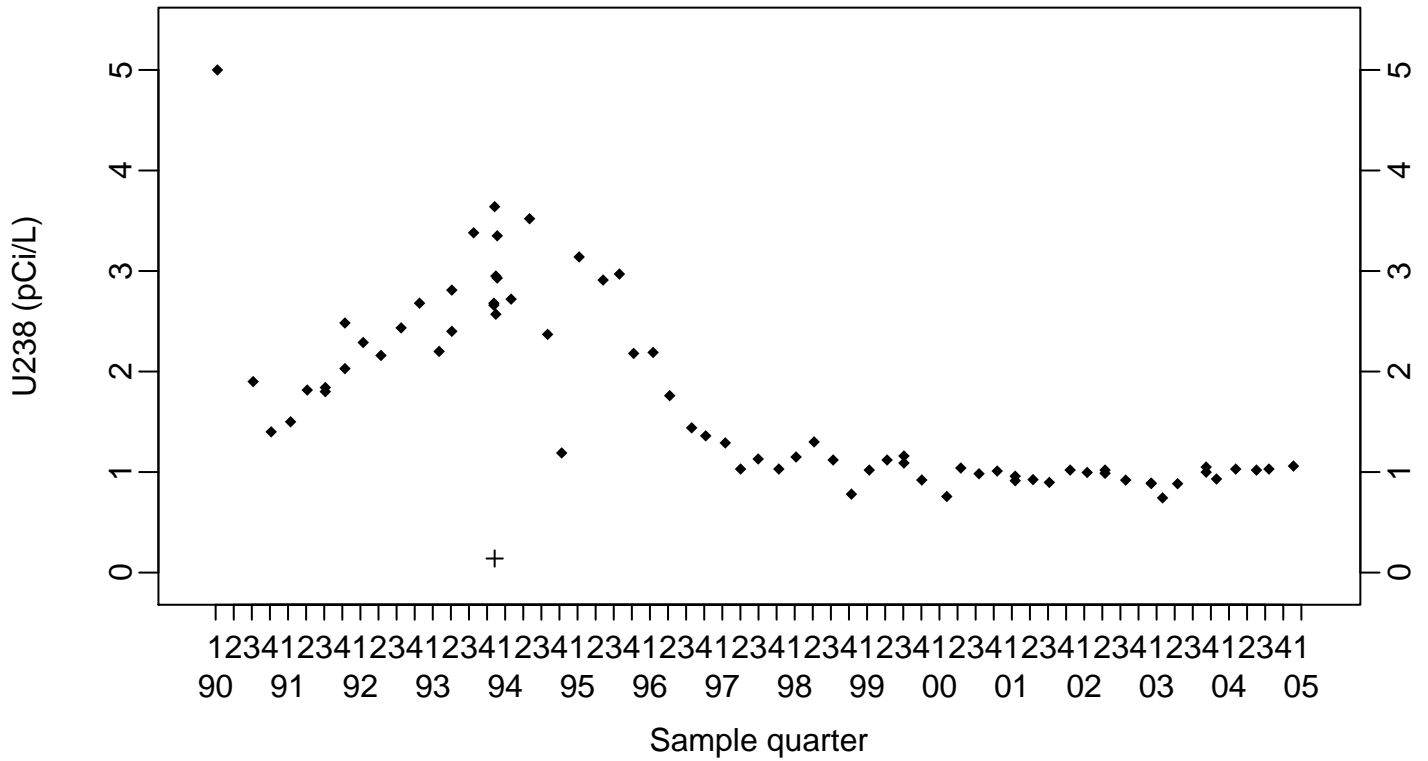
Compliance Monitoring Point K1-09



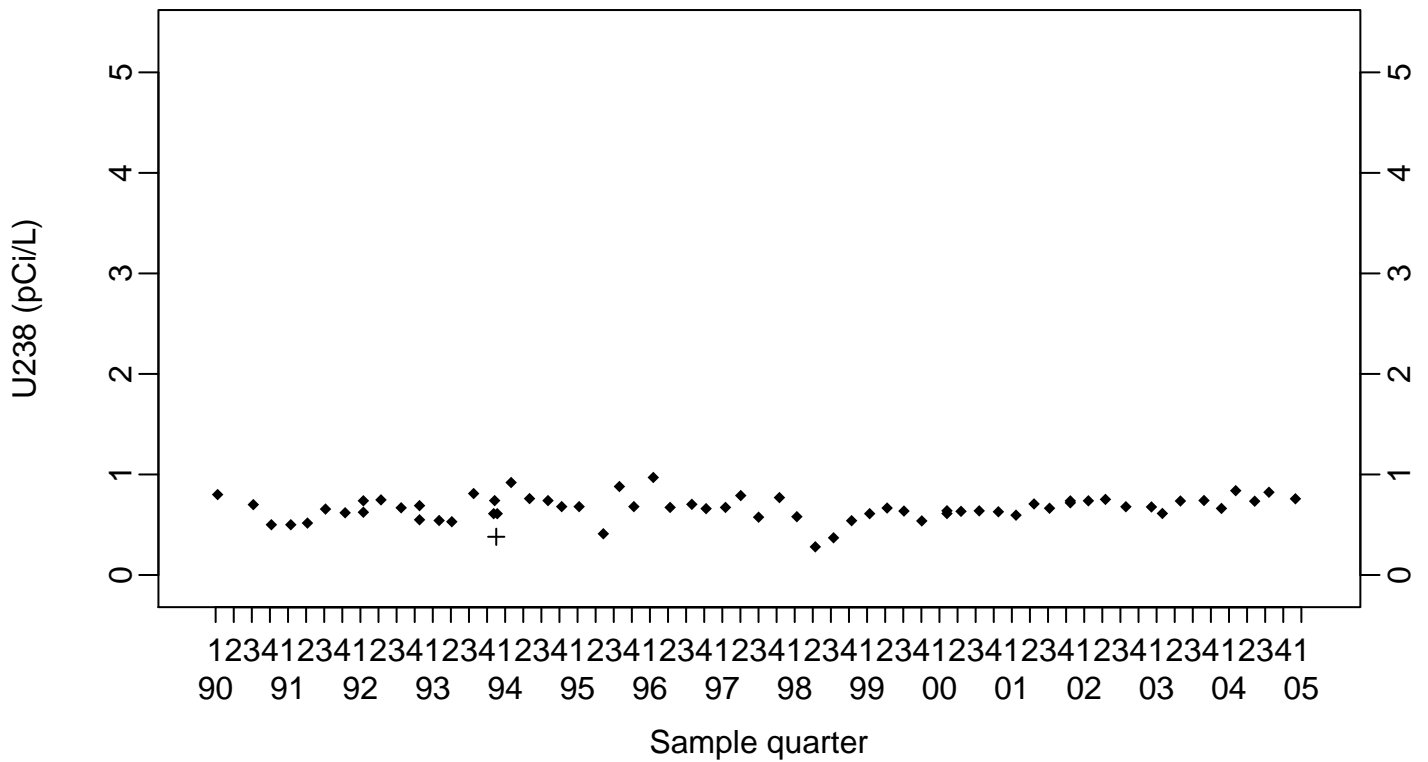
Pit 1 Area U238 (pCi/L)

Background Monitoring Point K1-01C

◆ Above RL
+ Estimated



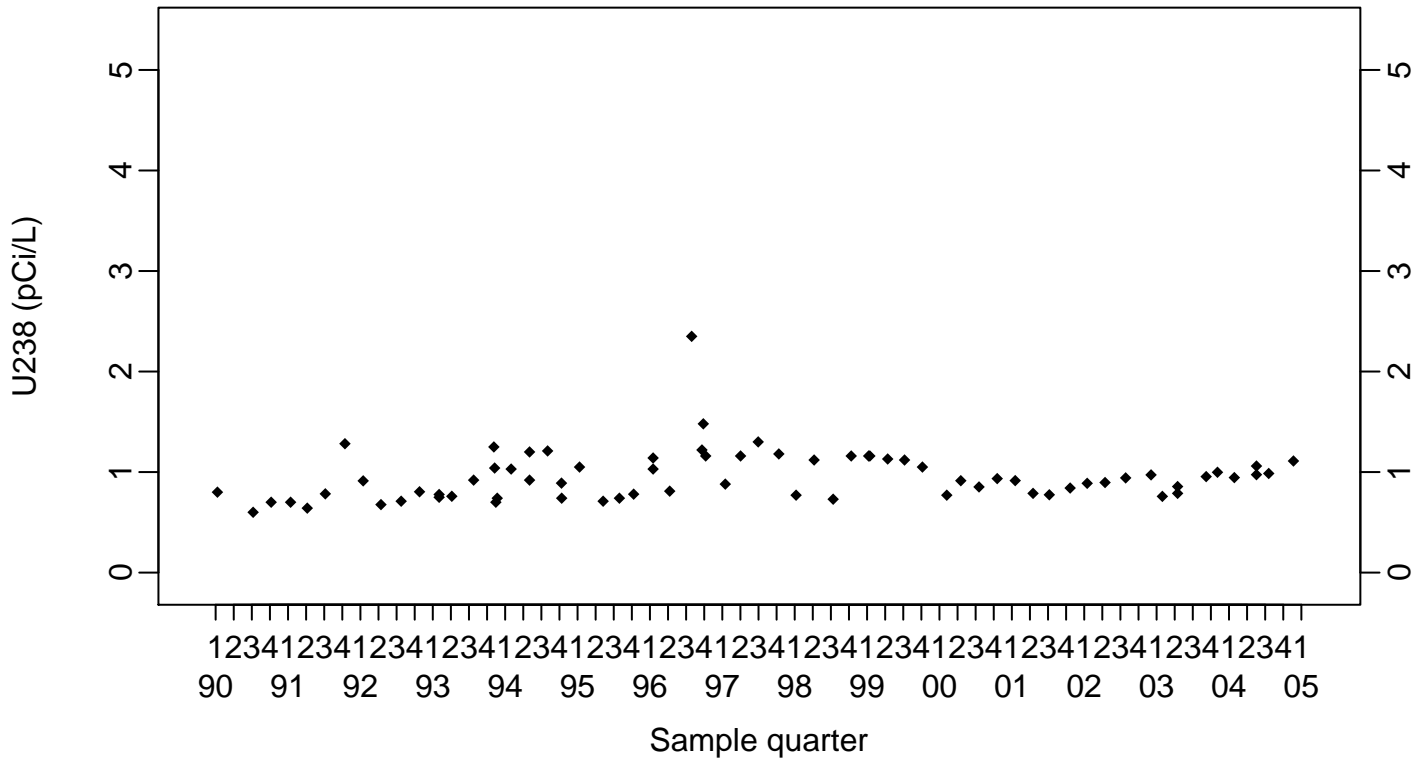
Background Monitoring Point K1-07



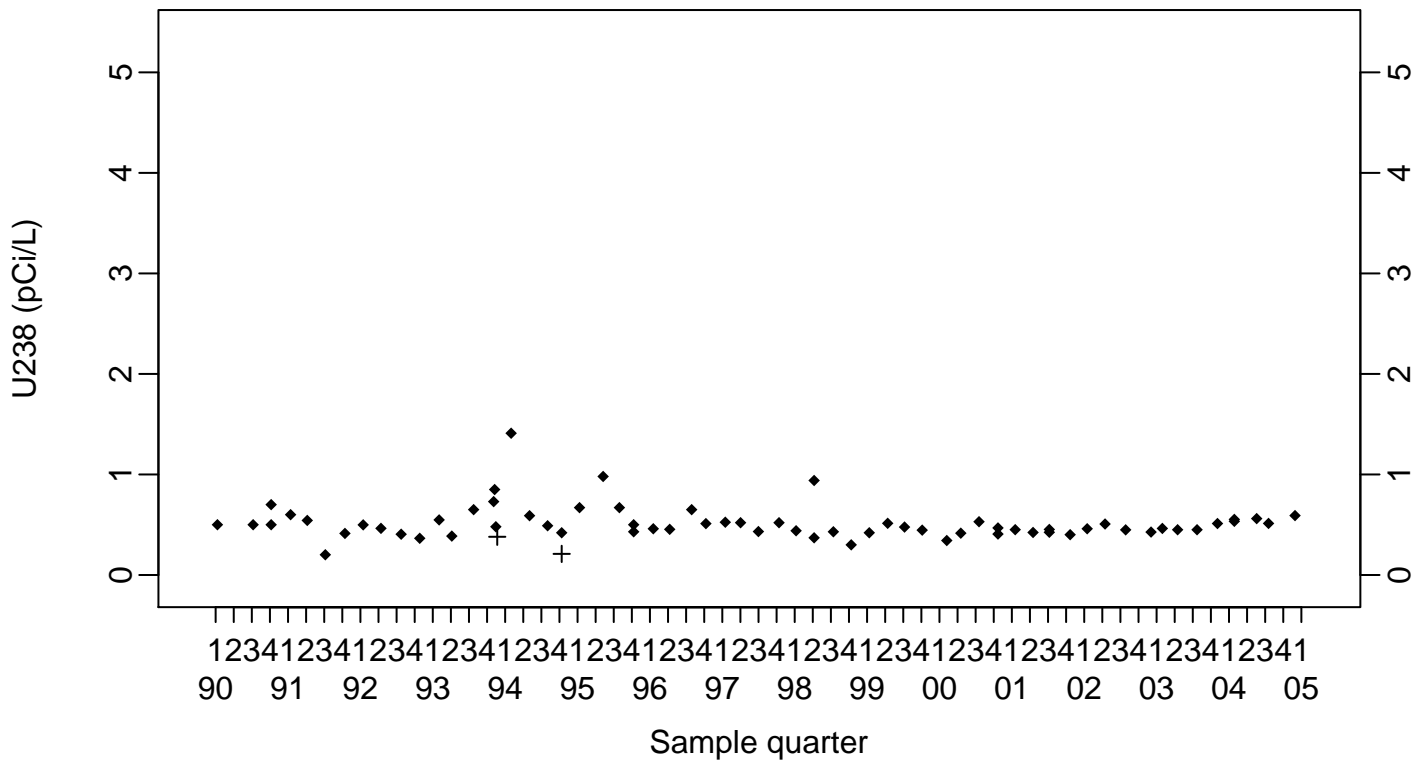
Pit 1 Area U238 (pCi/L)

Compliance Monitoring Point K1-02B

◆ Above RL
▽ Below RL



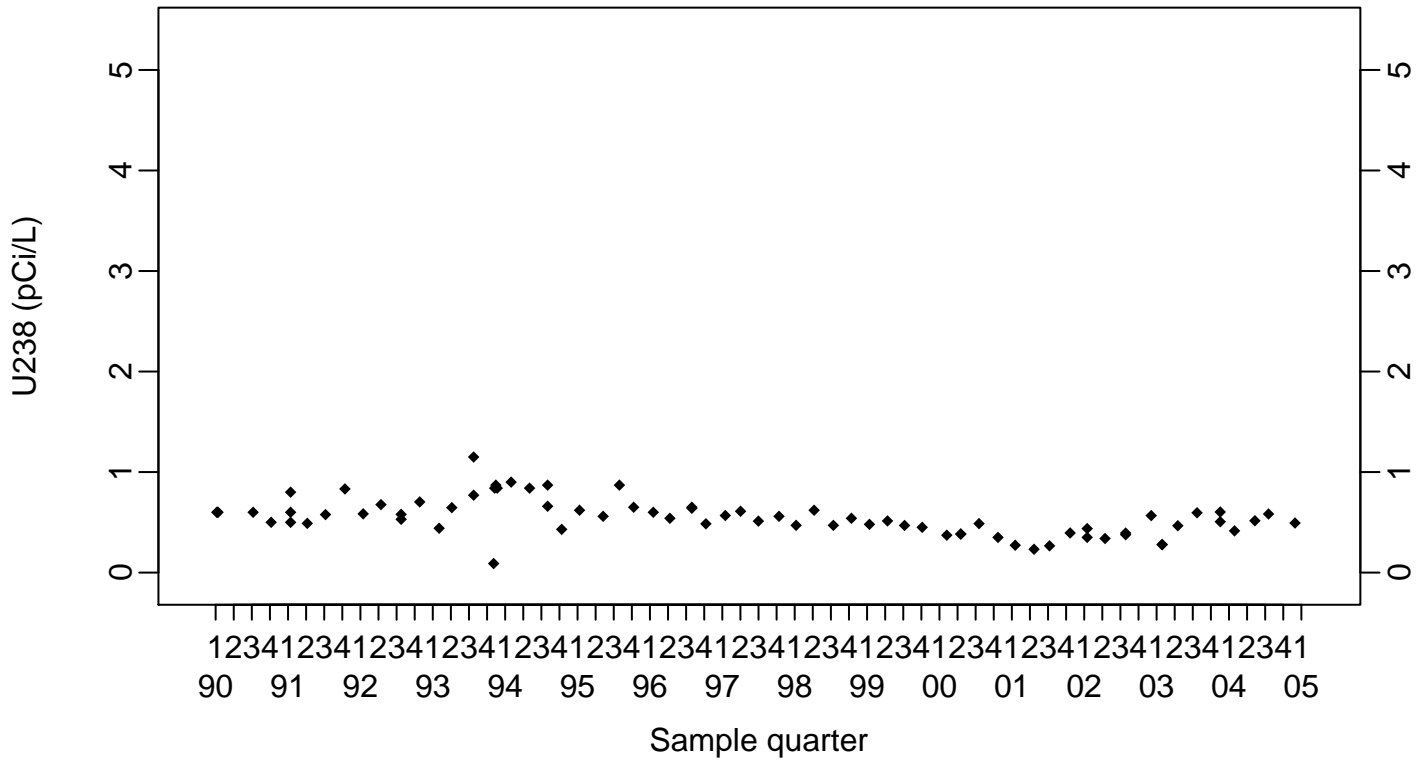
Compliance Monitoring Point K1-03



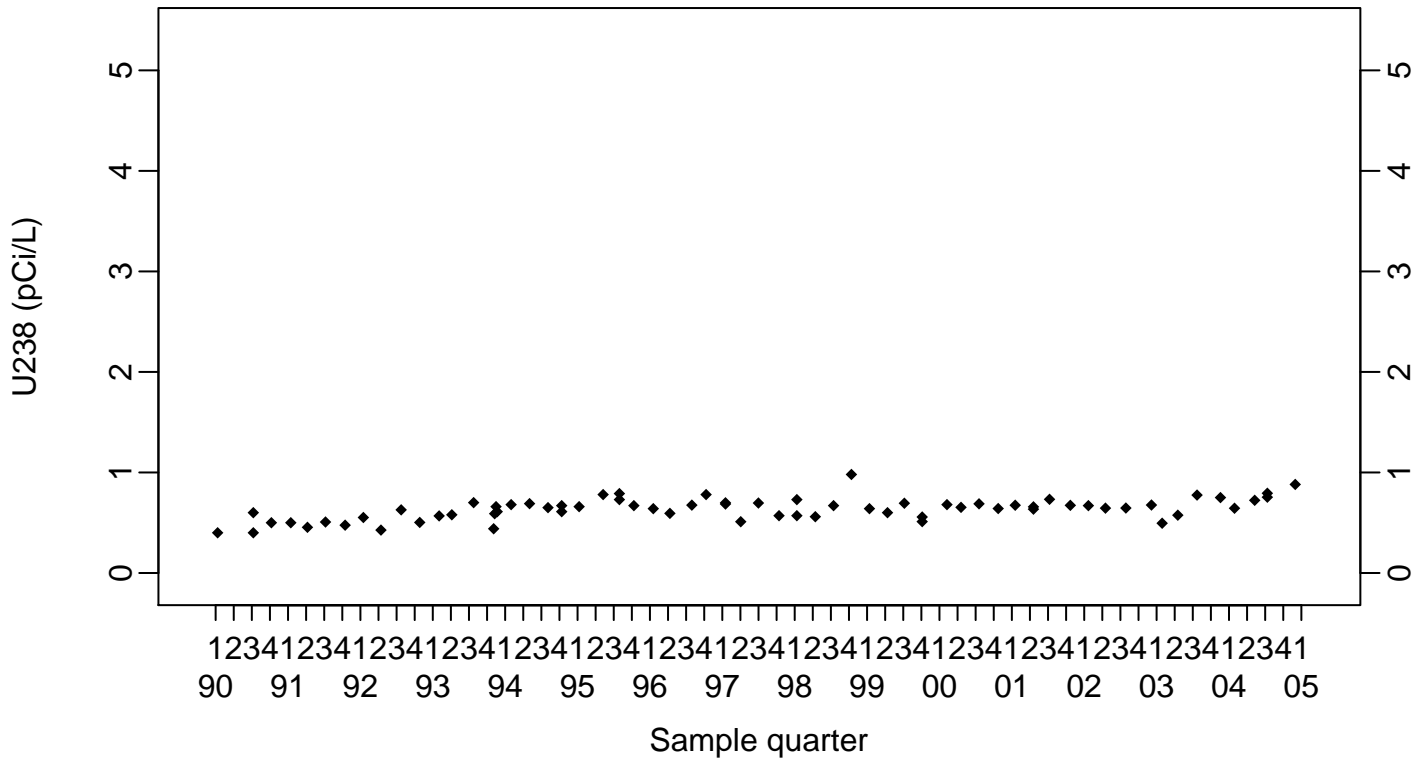
Pit 1 Area
U238 (pCi/L)

Compliance Monitoring Point K1-04

◆ Above RL
▽ Below RL



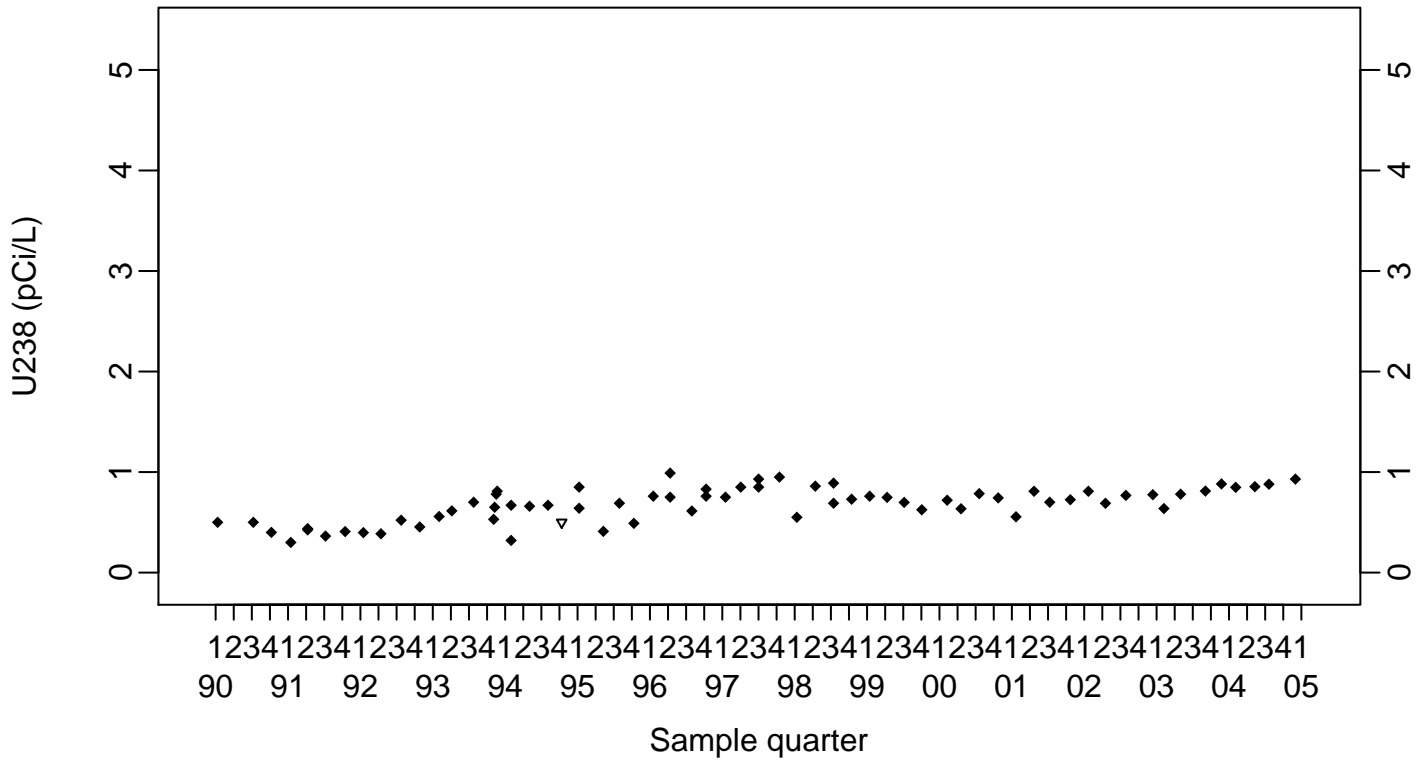
Compliance Monitoring Point K1-05



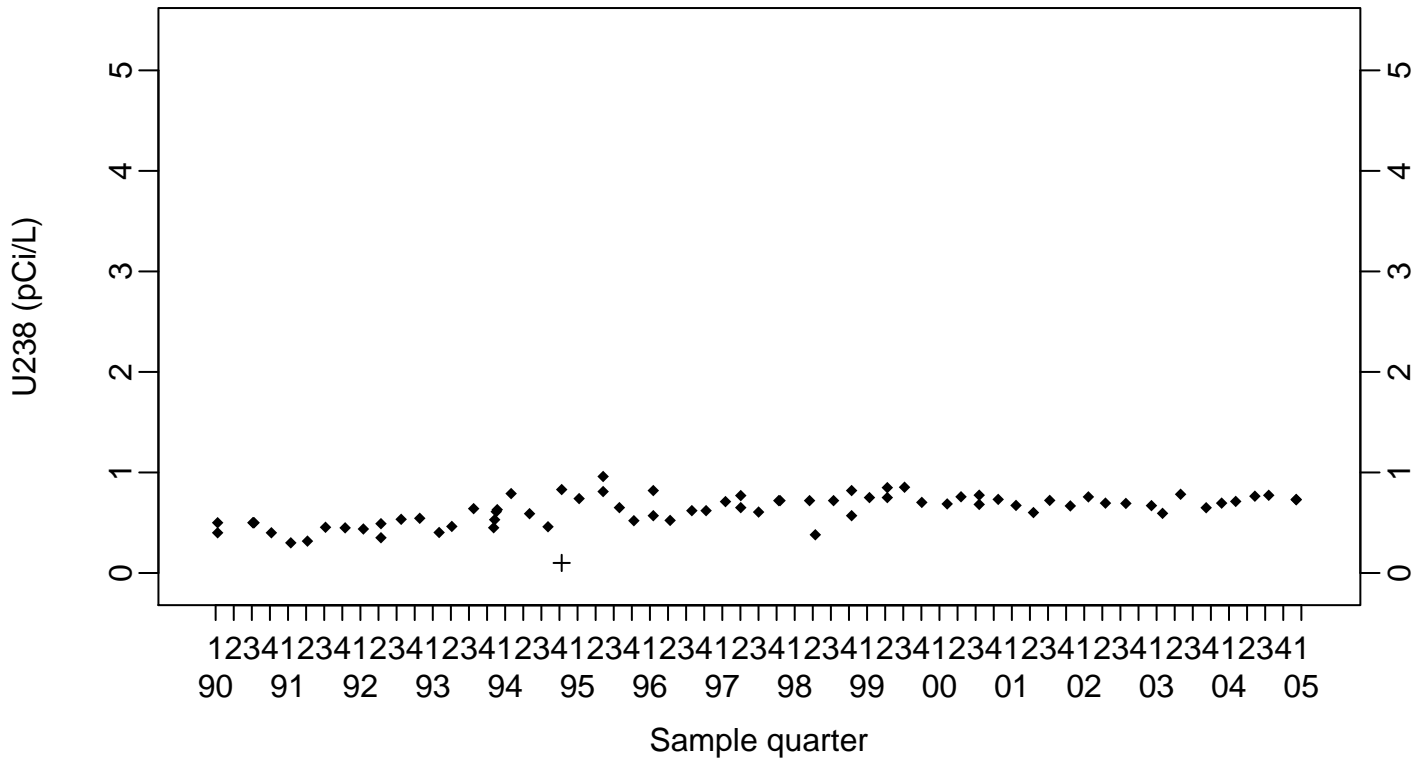
Pit 1 Area U238 (pCi/L)

Compliance Monitoring Point K1-08

◆ Above RL
▽ Below RL



Compliance Monitoring Point K1-09

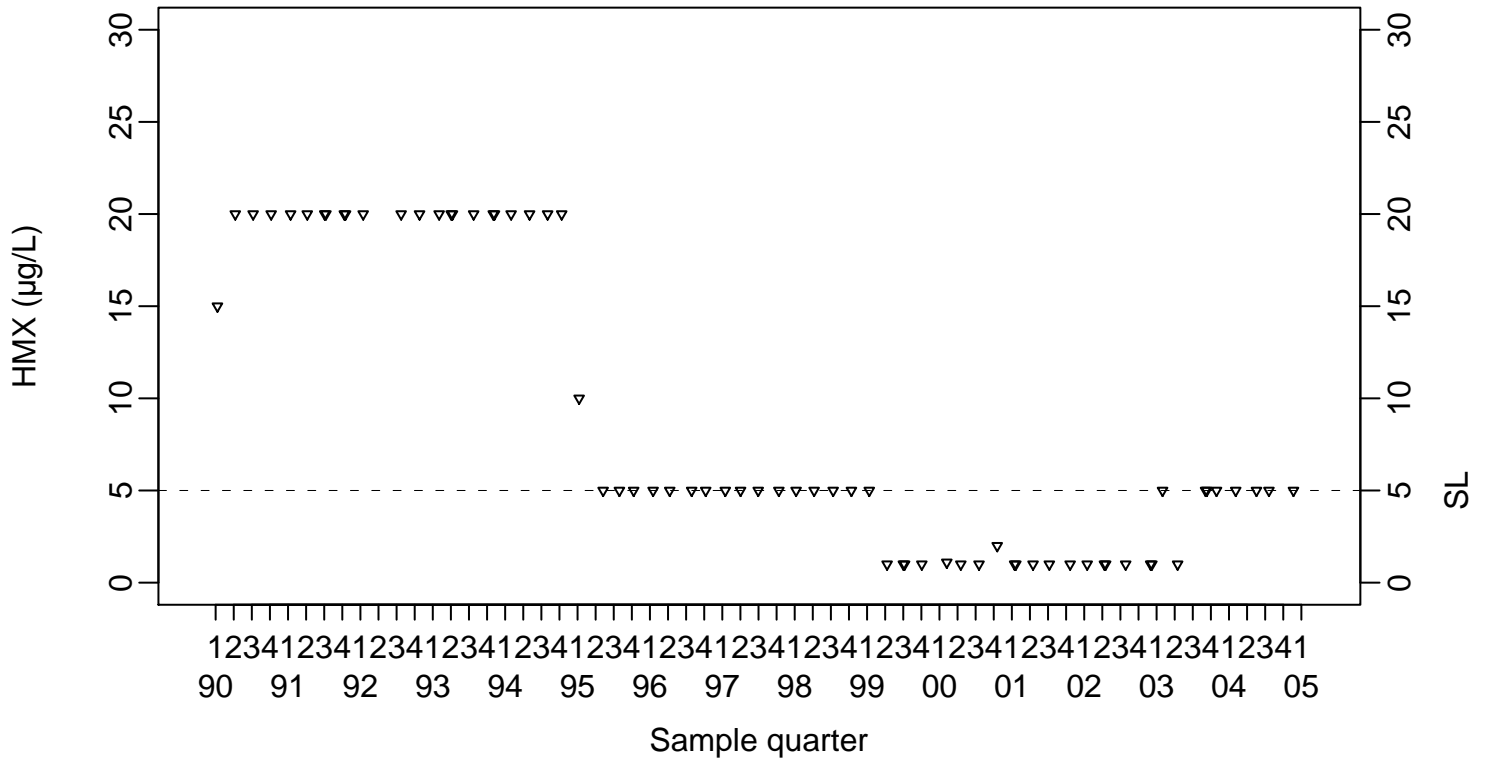


Pit 1 Area
HMX ($\mu\text{g/L}$)

Background Monitoring Point K1-01C

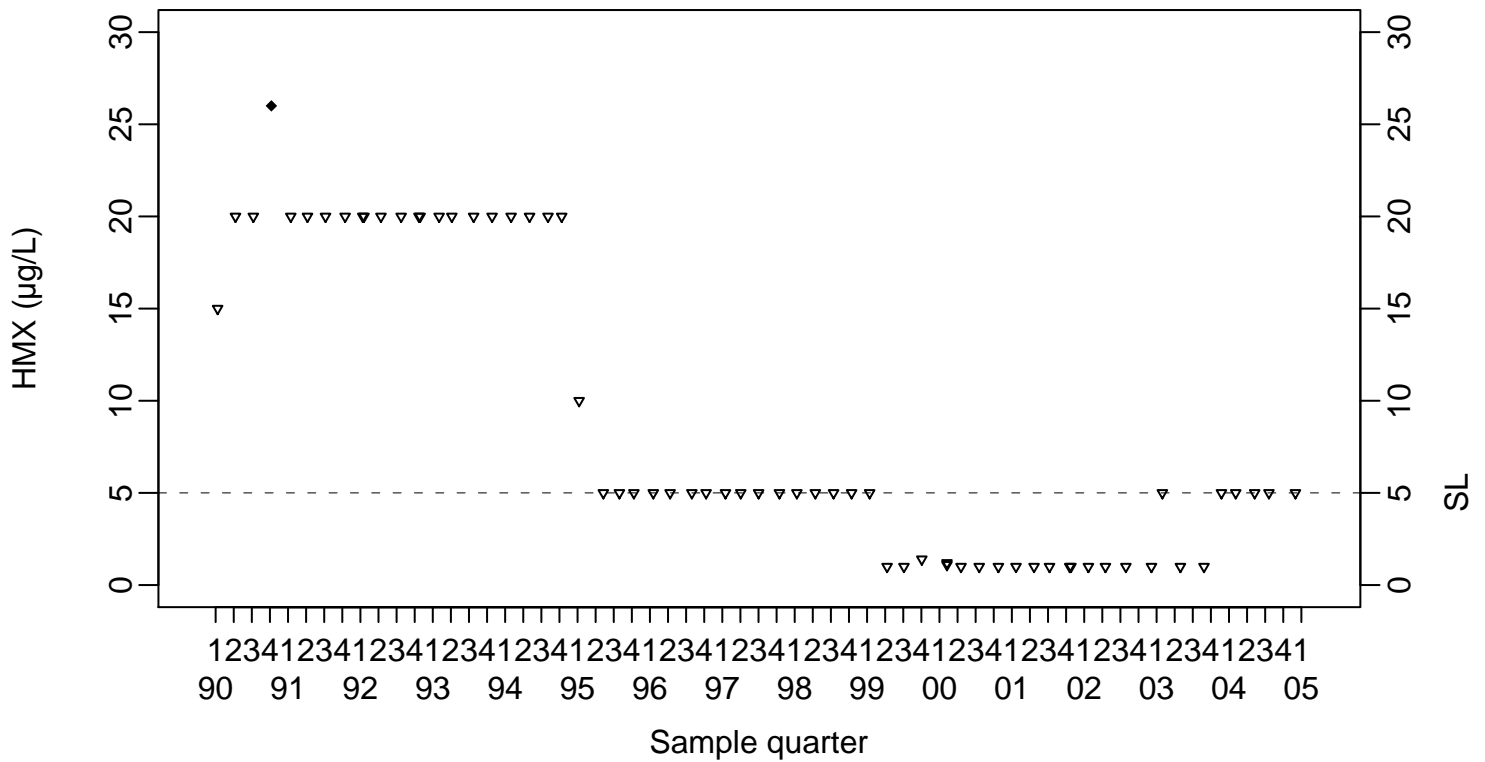
SL=5

◆ Above RL
▽ Below RL



Background Monitoring Point K1-07

SL=5

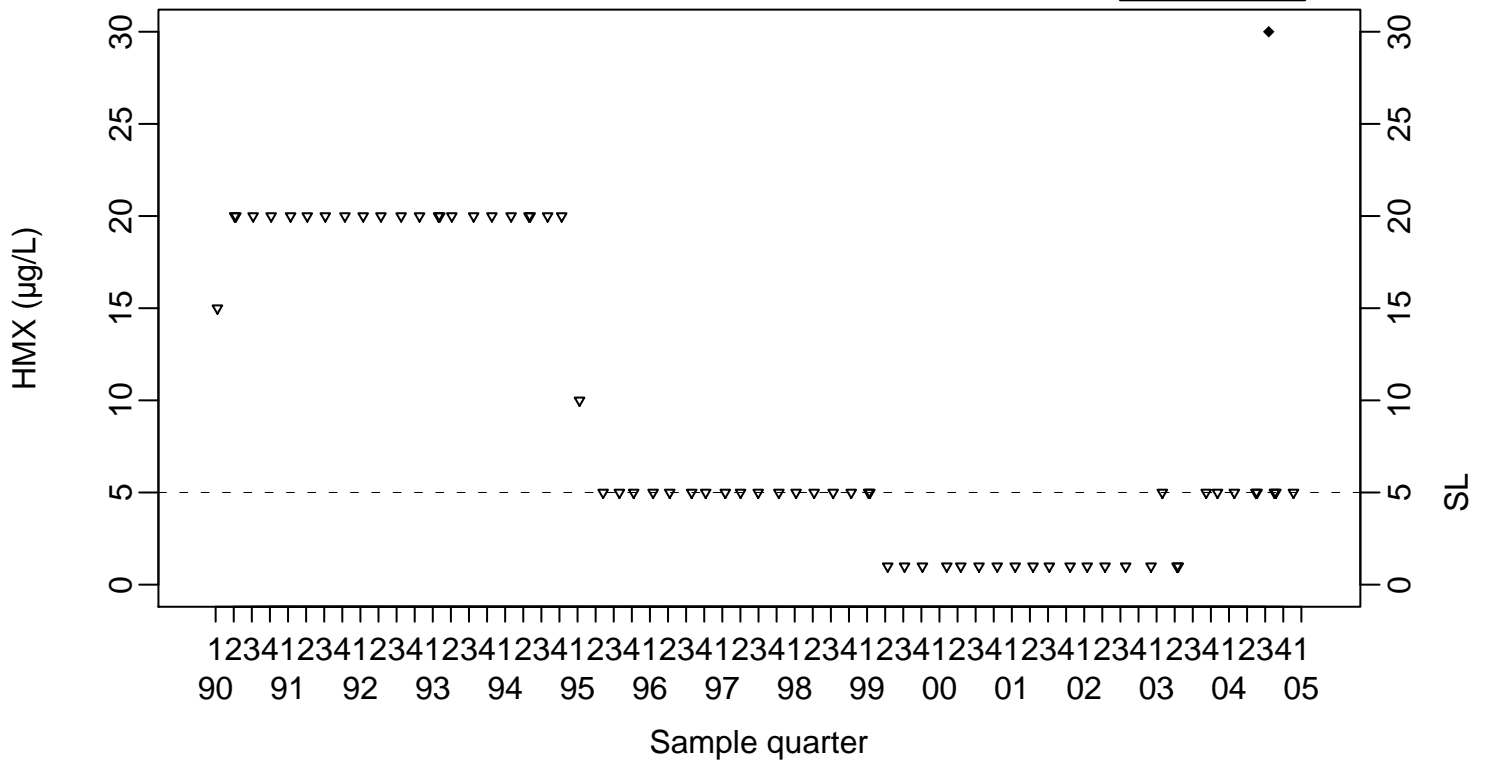


Pit 1 Area HMX ($\mu\text{g/L}$)

Compliance Monitoring Point K1-02B

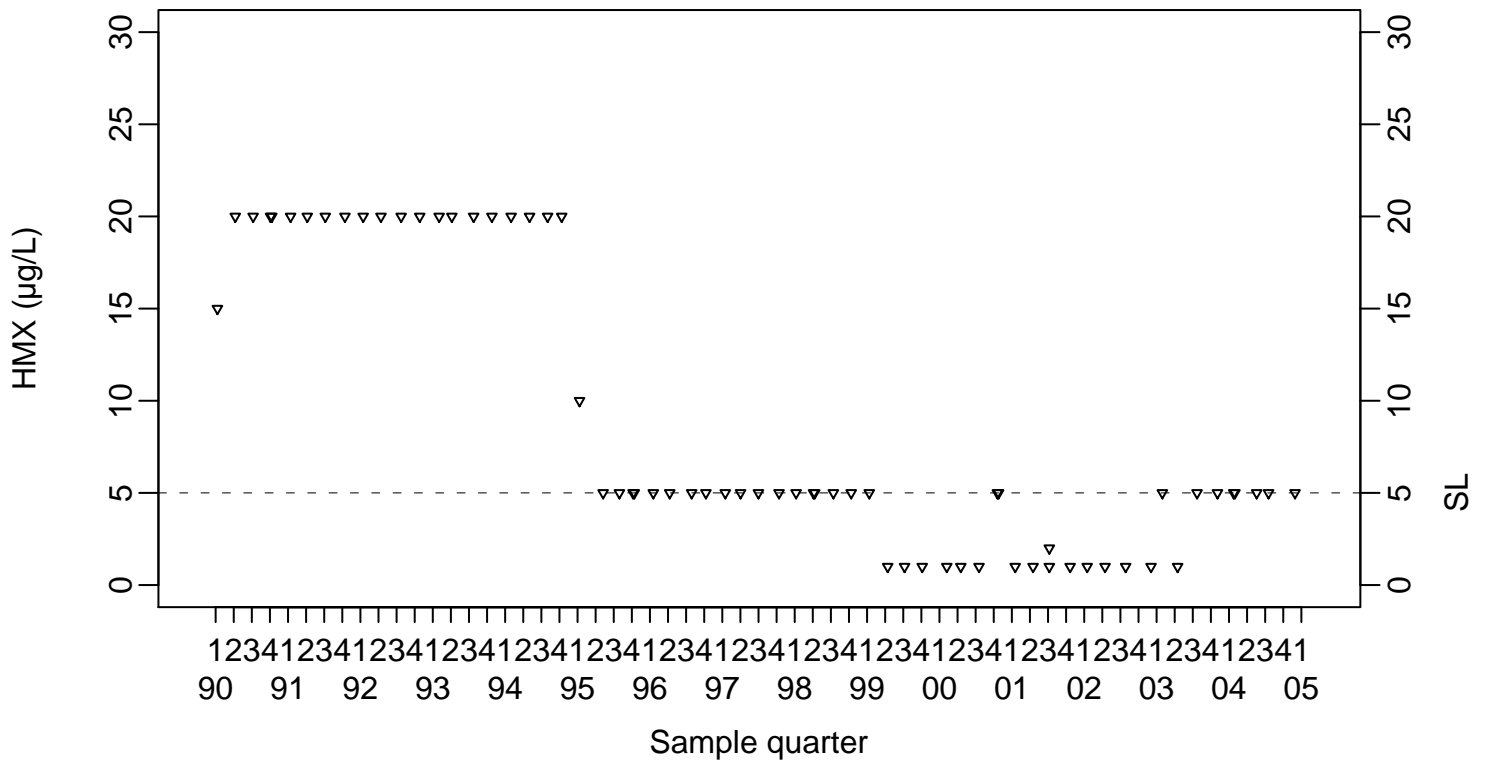
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K1-03

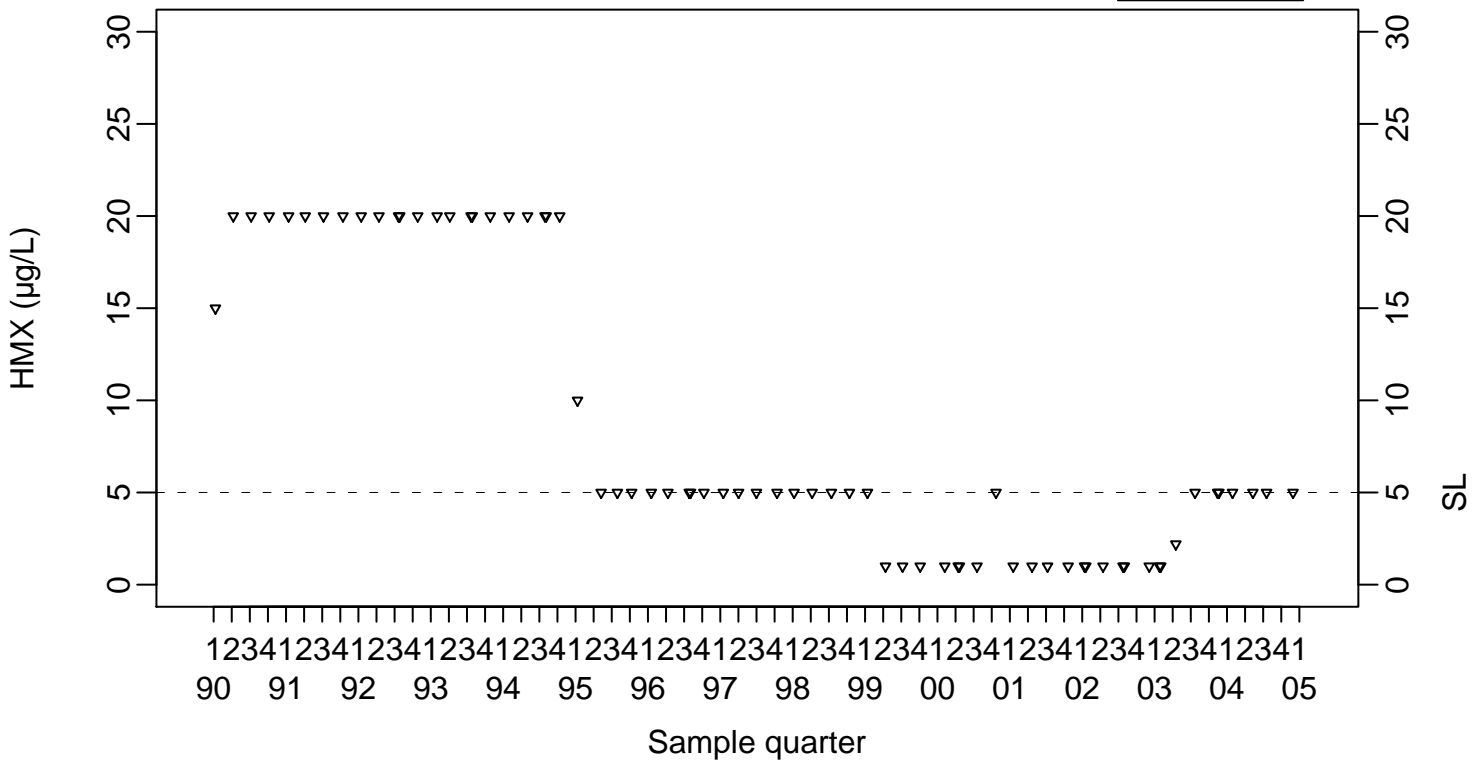


Pit 1 Area HMX ($\mu\text{g/L}$)

Compliance Monitoring Point K1-04

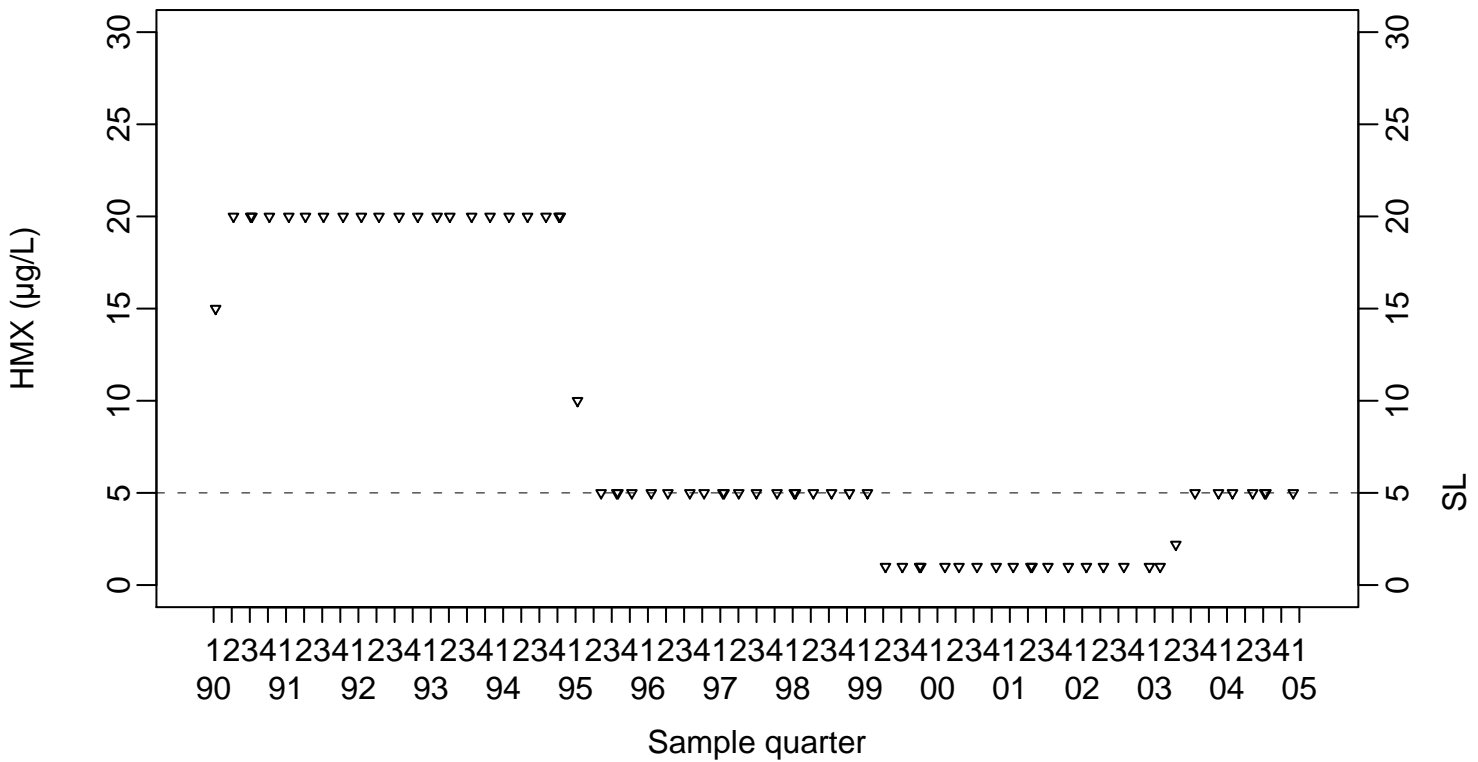
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K1-05

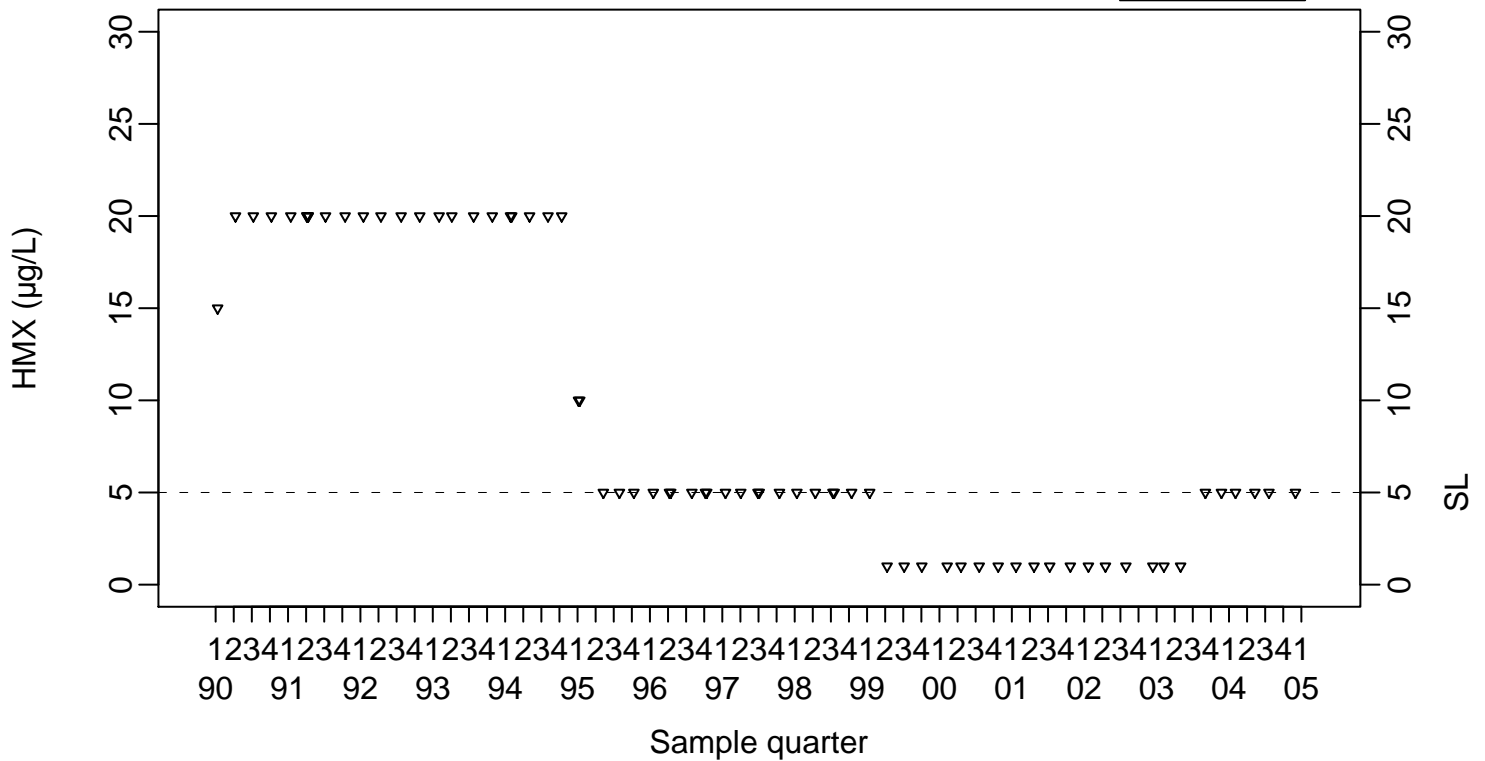


Pit 1 Area HMX ($\mu\text{g/L}$)

Compliance Monitoring Point K1-08

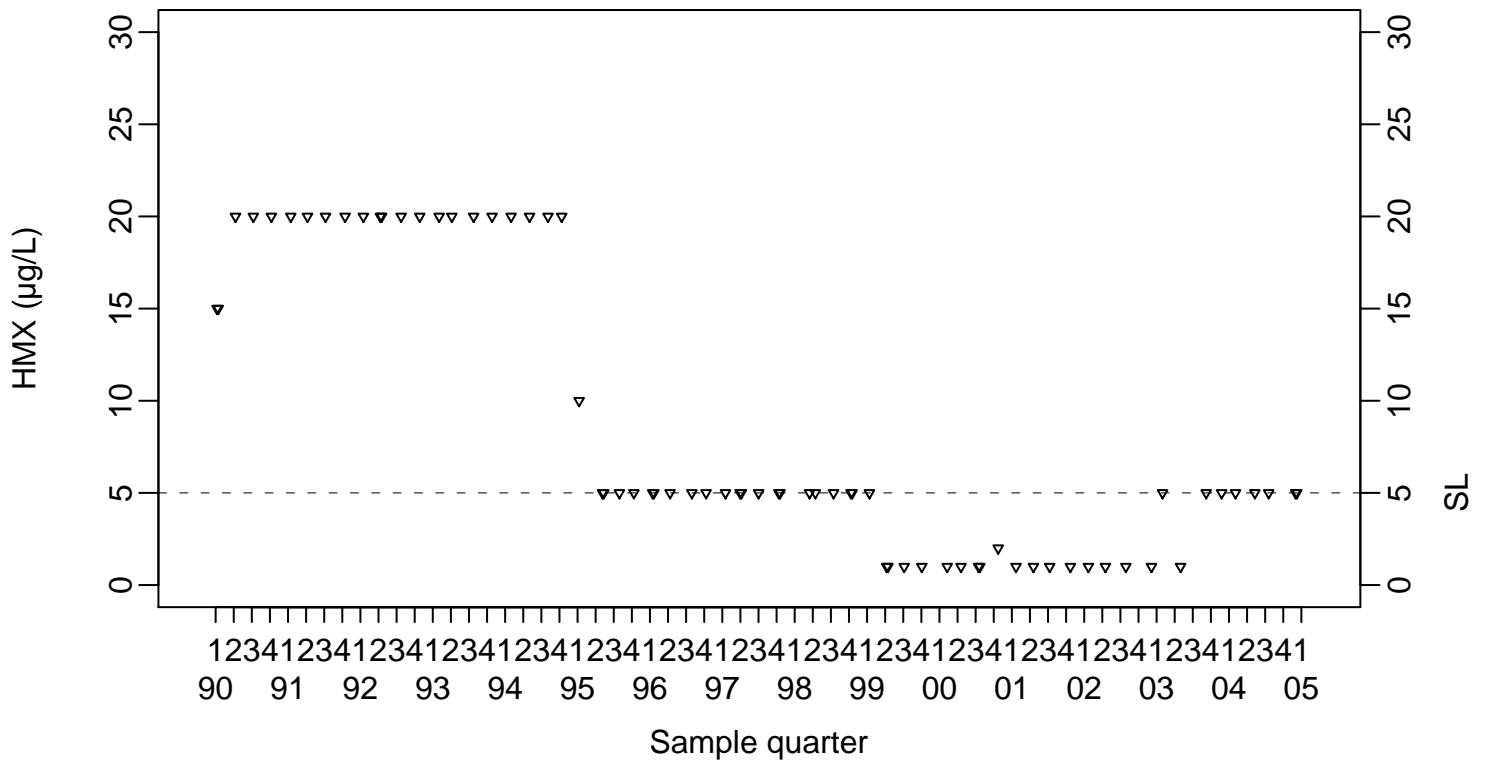
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K1-09

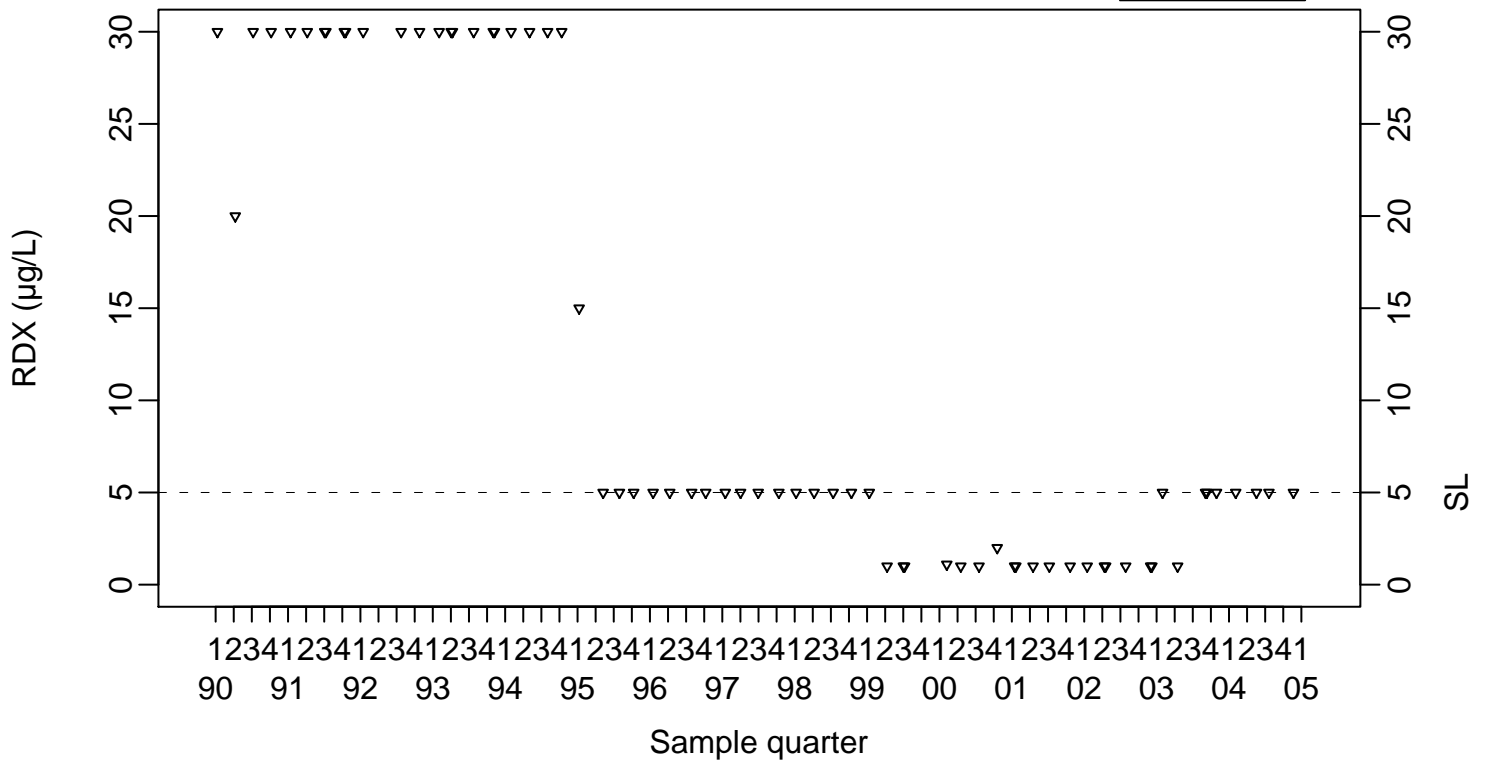


Pit 1 Area RDX ($\mu\text{g/L}$)

Background Monitoring Point K1-01C

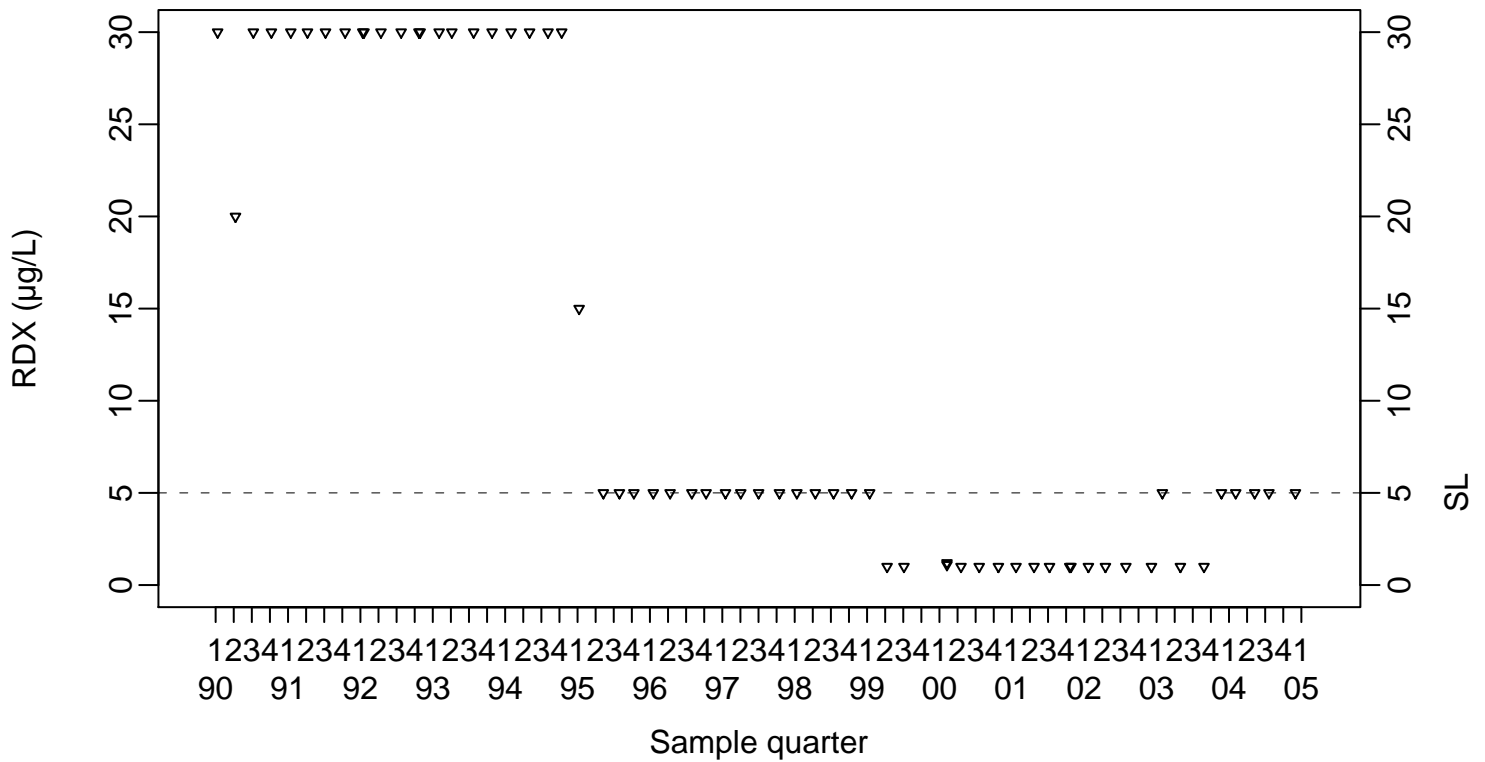
SL=5

◆ Above RL
▽ Below RL



SL=5

Background Monitoring Point K1-07

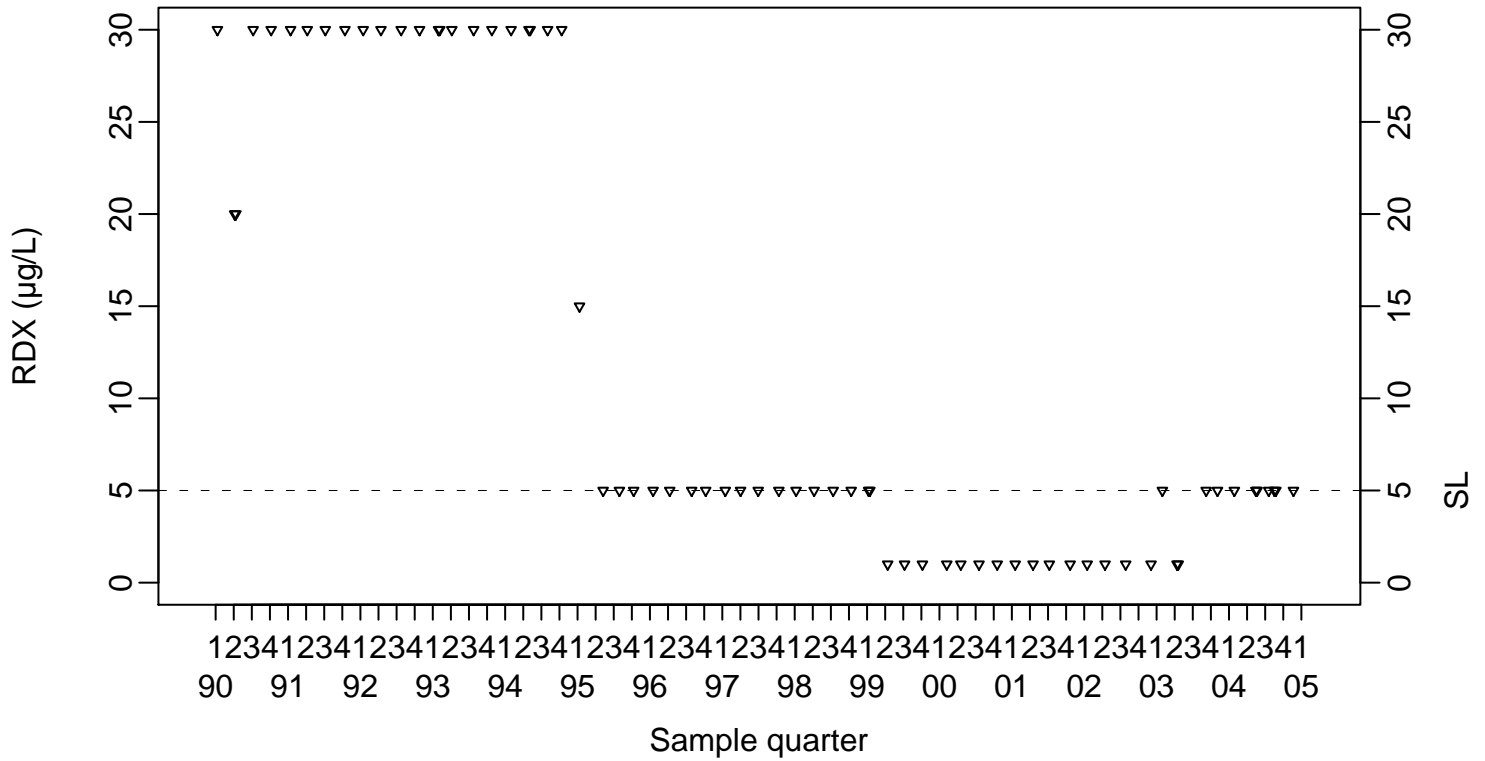


Pit 1 Area RDX ($\mu\text{g/L}$)

Compliance Monitoring Point K1-02B

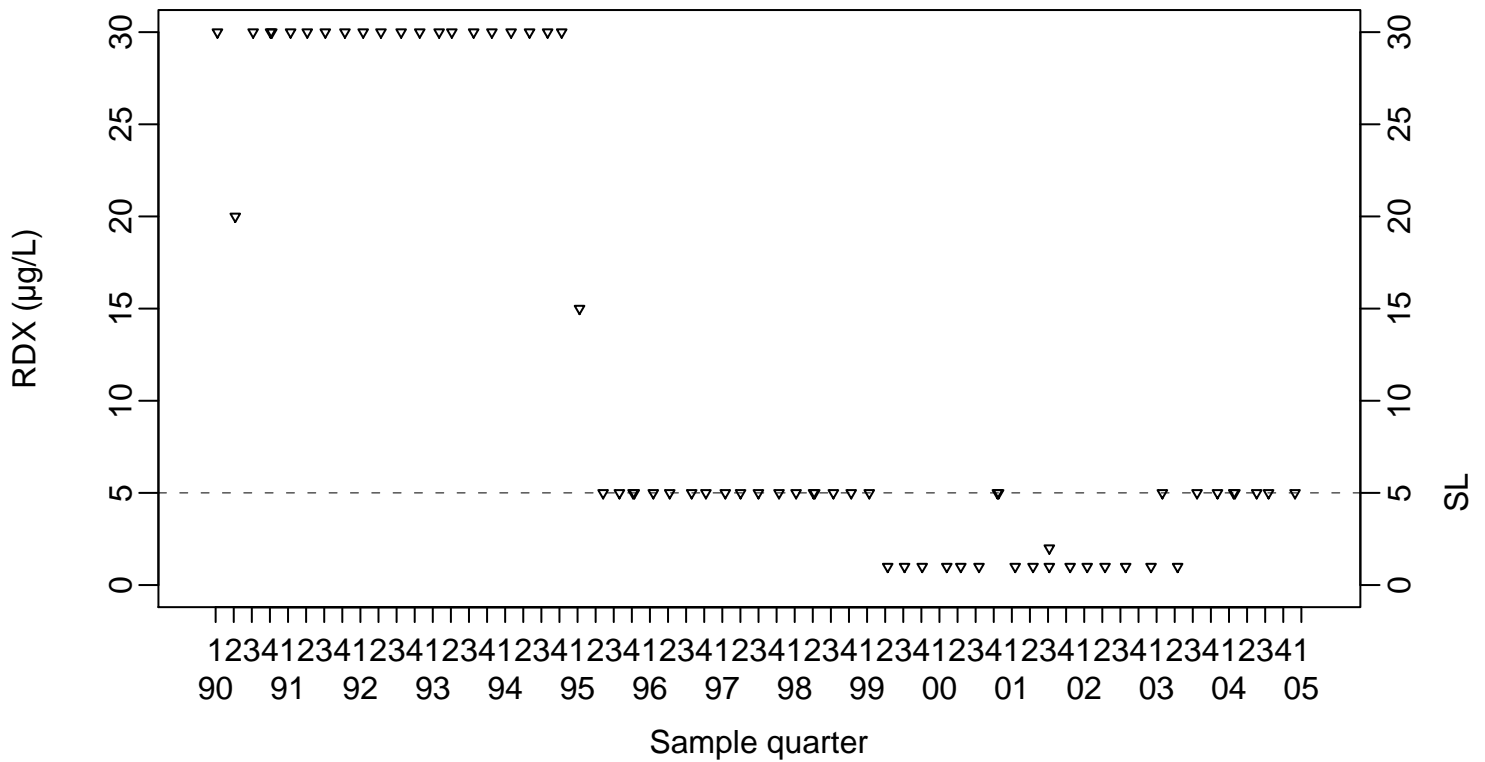
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K1-03

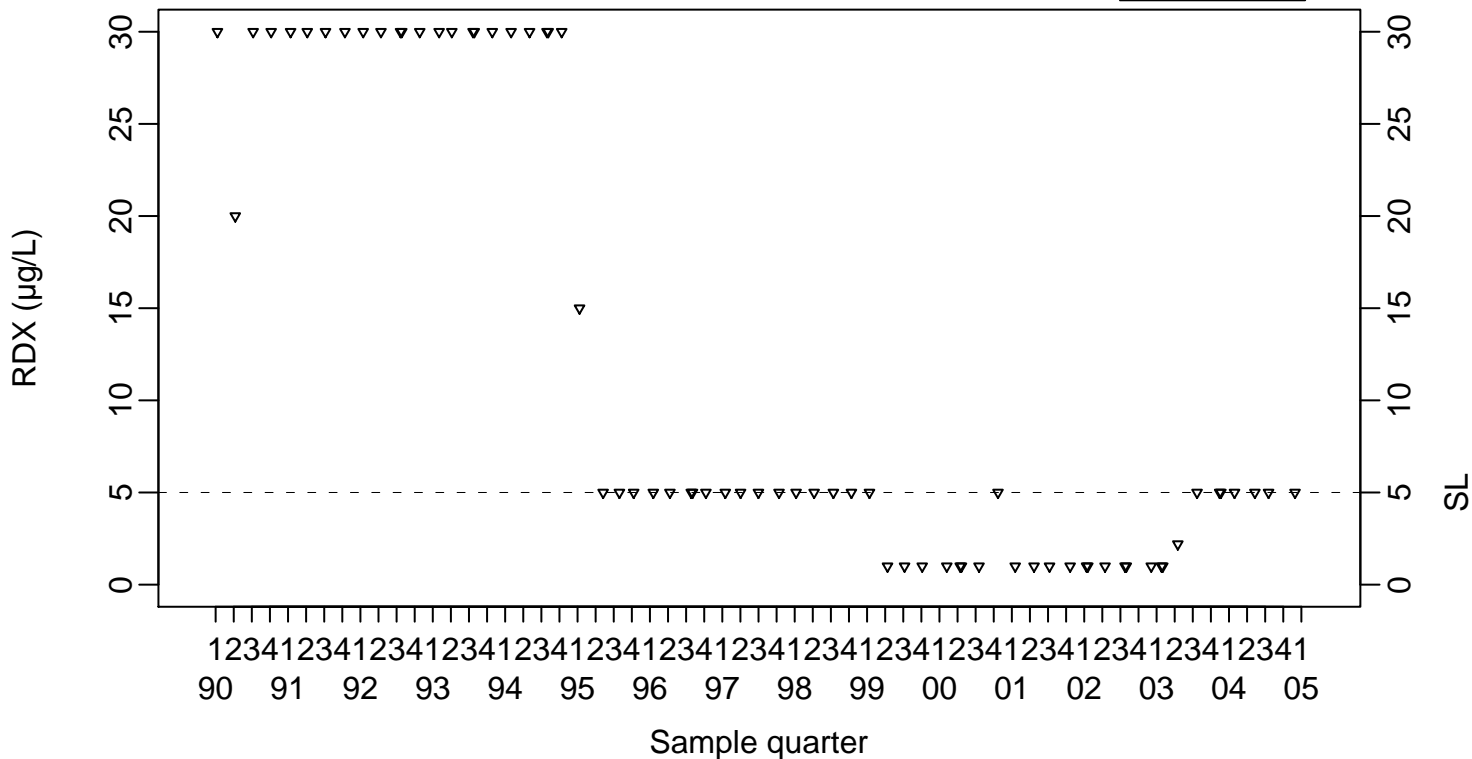


Pit 1 Area RDX ($\mu\text{g/L}$)

SL=5

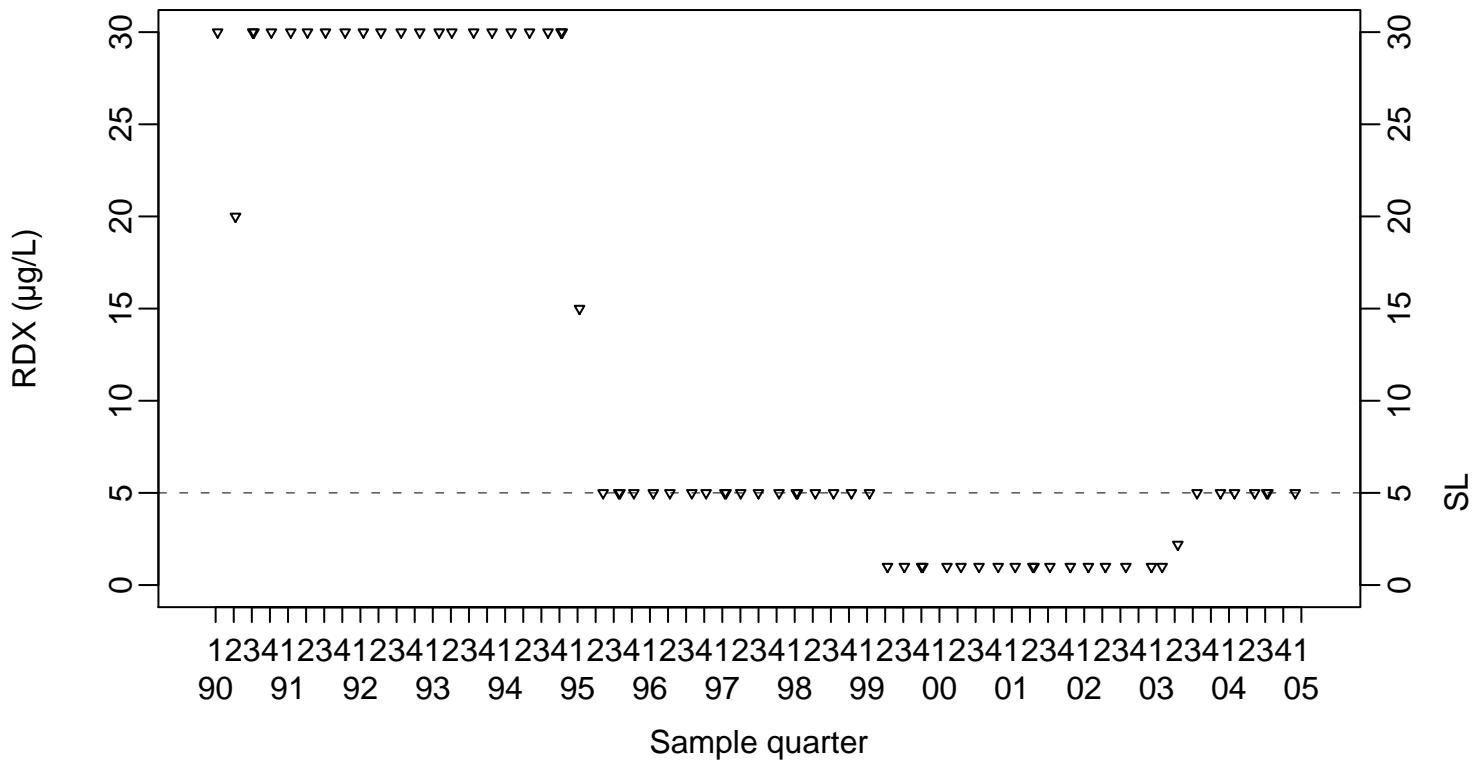
Compliance Monitoring Point K1-04

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K1-05

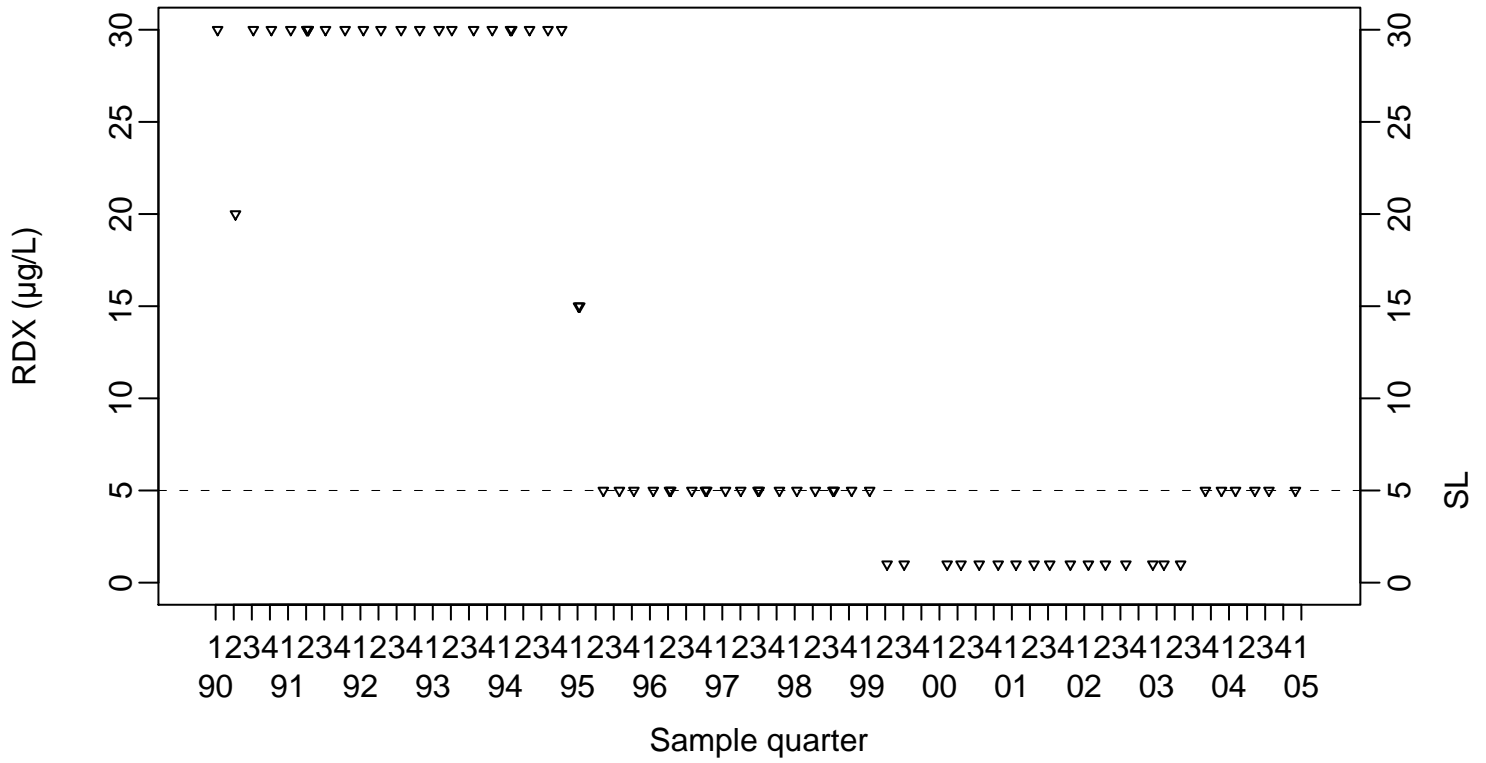


Pit 1 Area RDX ($\mu\text{g/L}$)

Compliance Monitoring Point K1-08

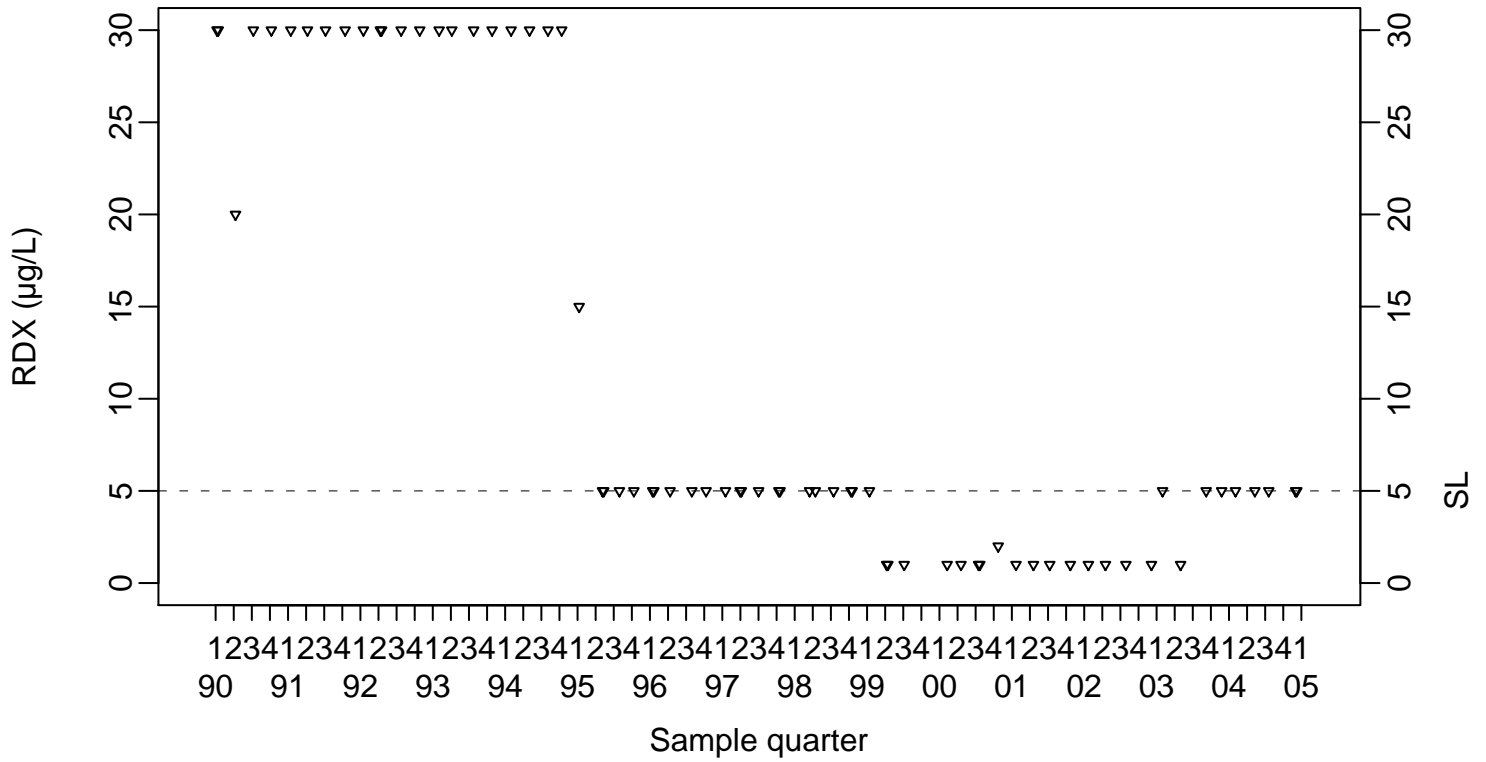
SL=5

◆ Above RL
▽ Below RL



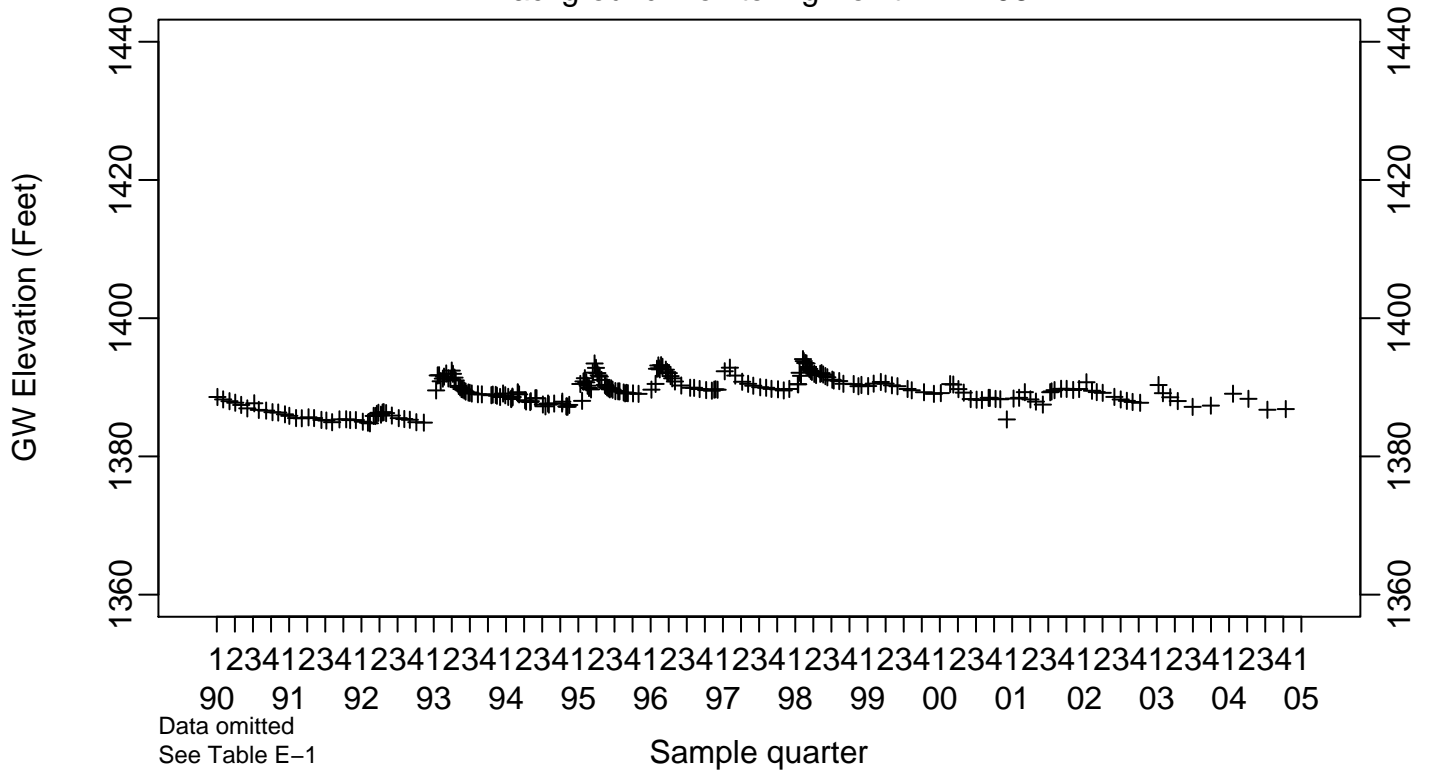
SL=5

Compliance Monitoring Point K1-09

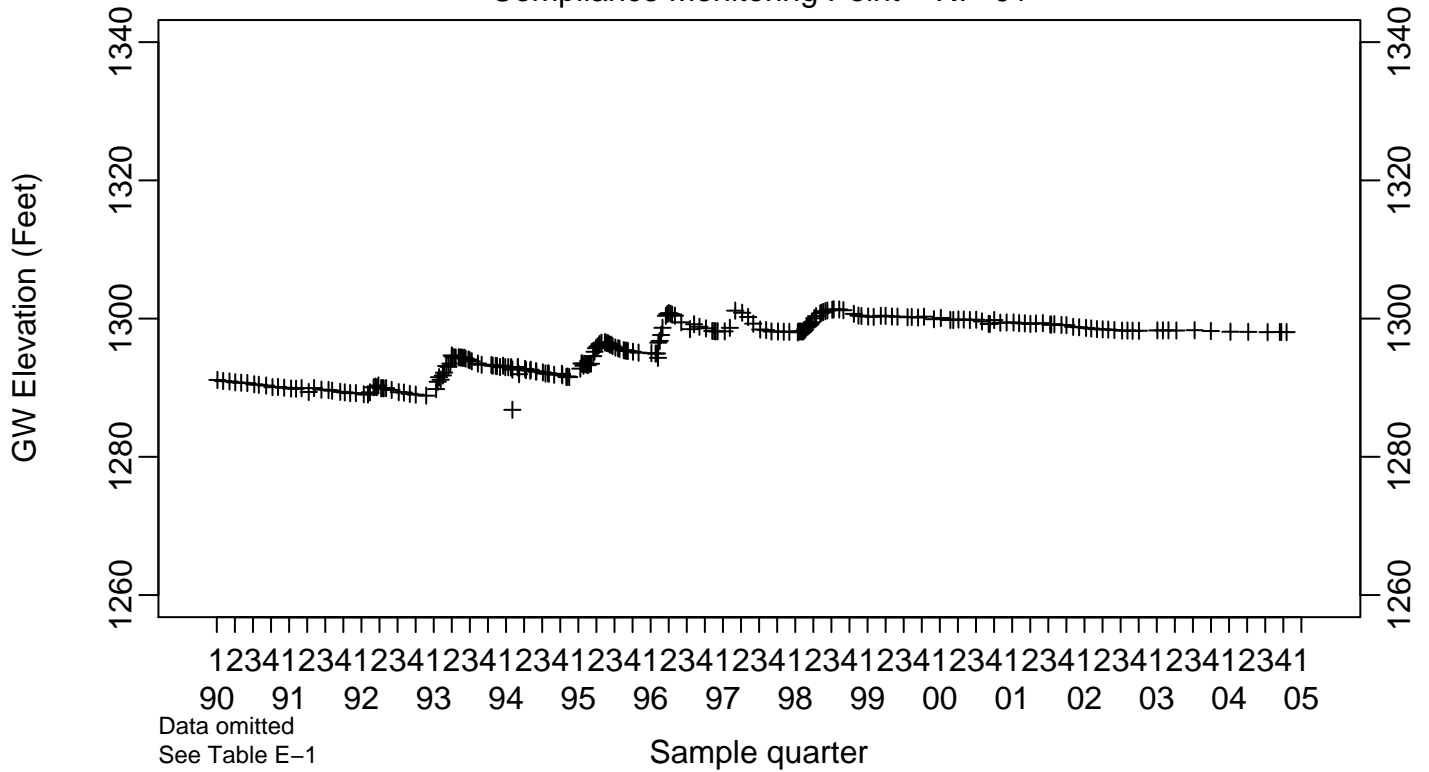


Pit 7 Complex GW Elevation (Feet)

Background Monitoring Point K7-06

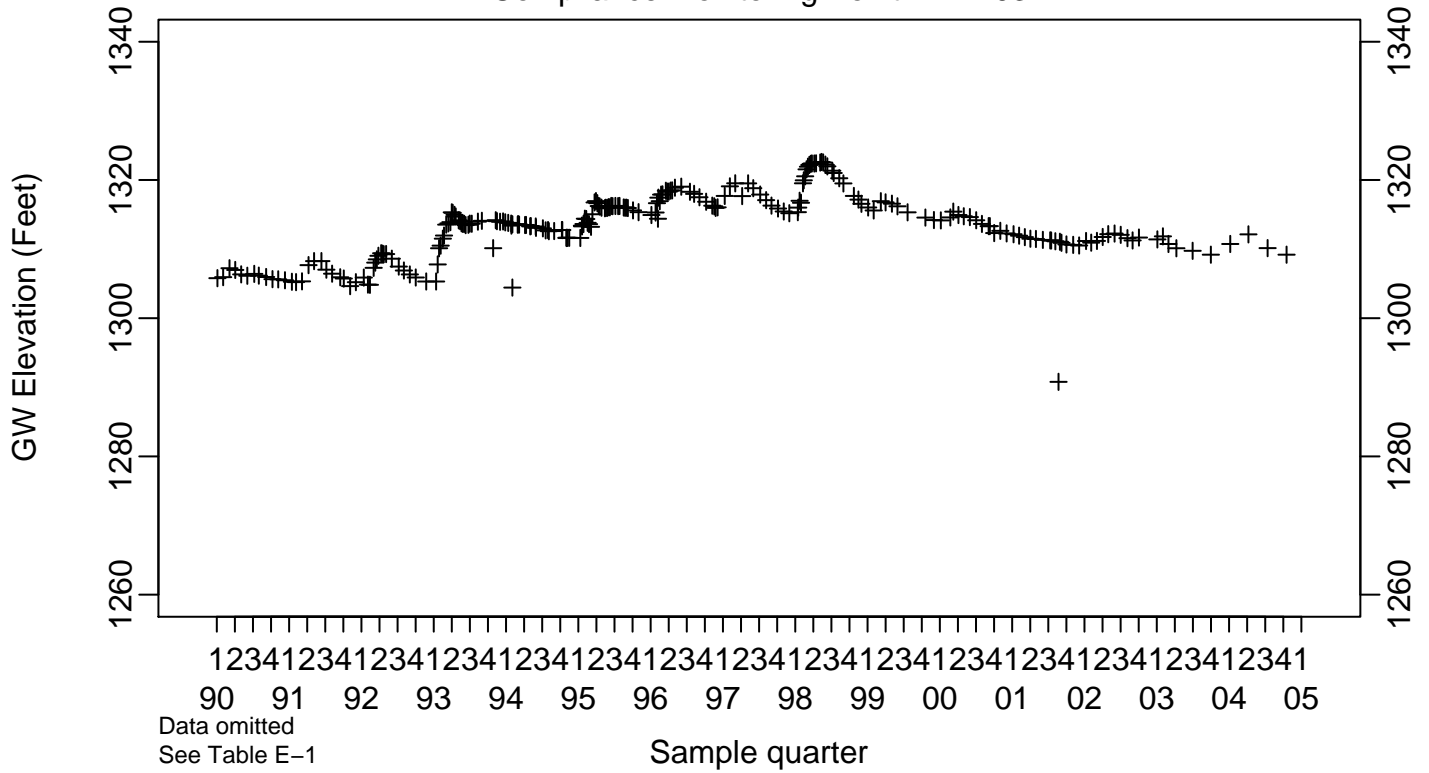


Compliance Monitoring Point K7-01

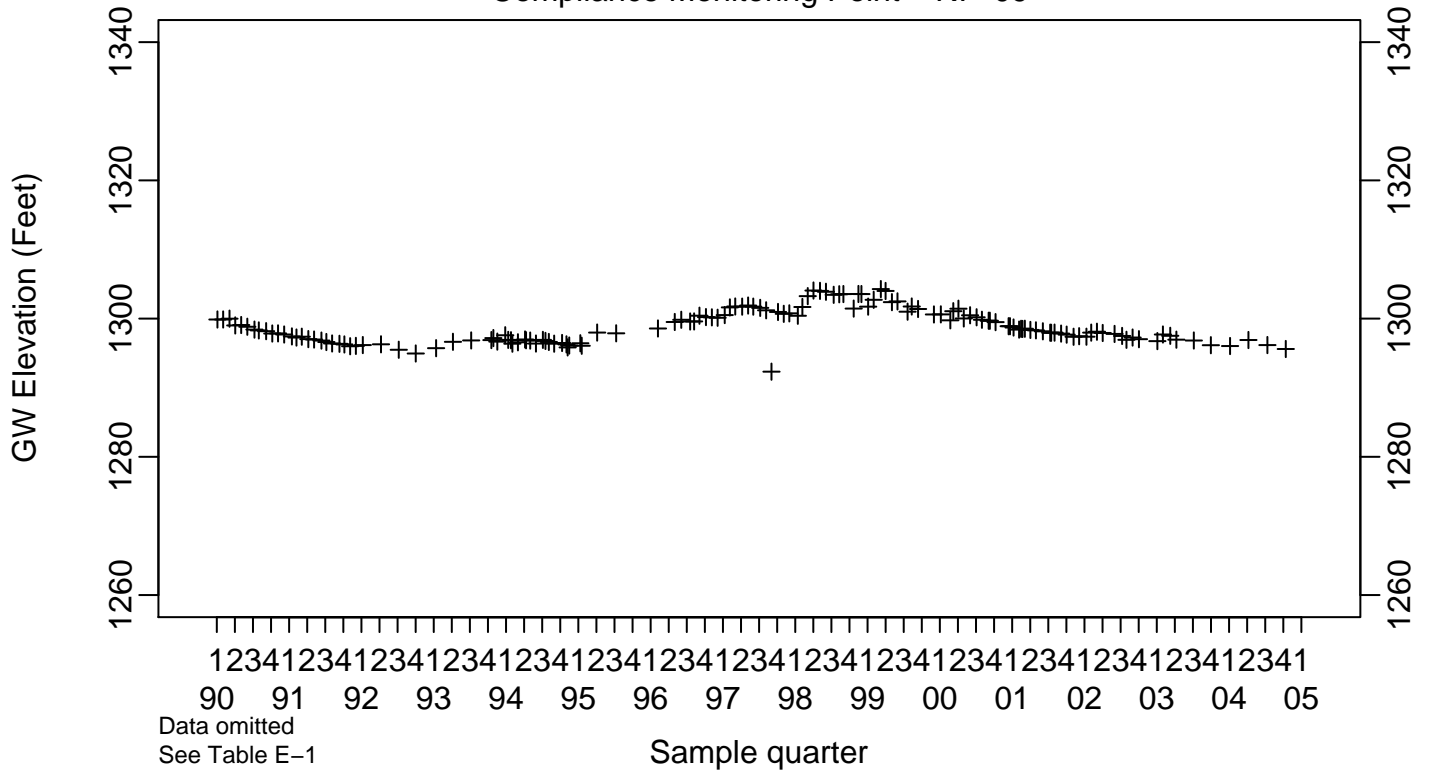


Pit 7 Complex GW Elevation (Feet)

Compliance Monitoring Point K7-03

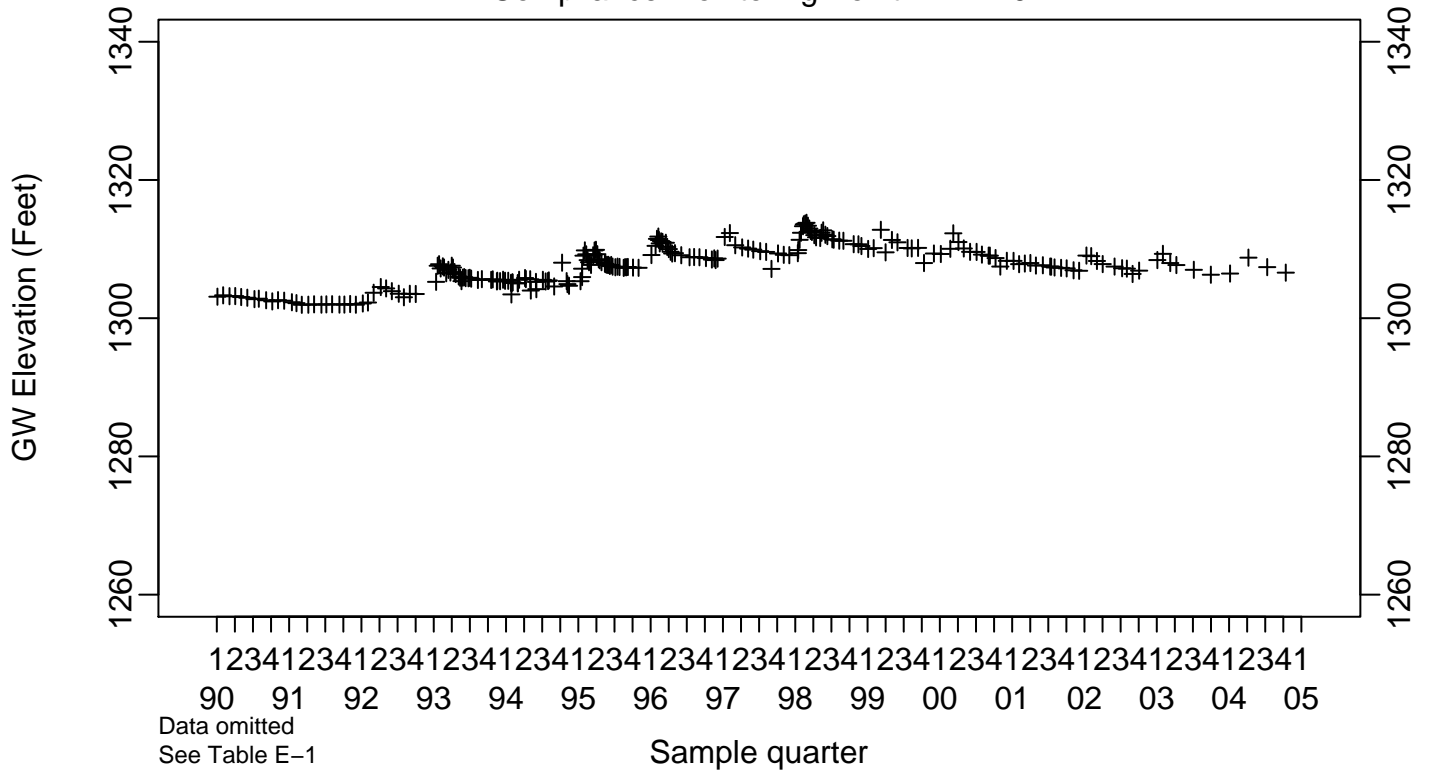


Compliance Monitoring Point K7-09

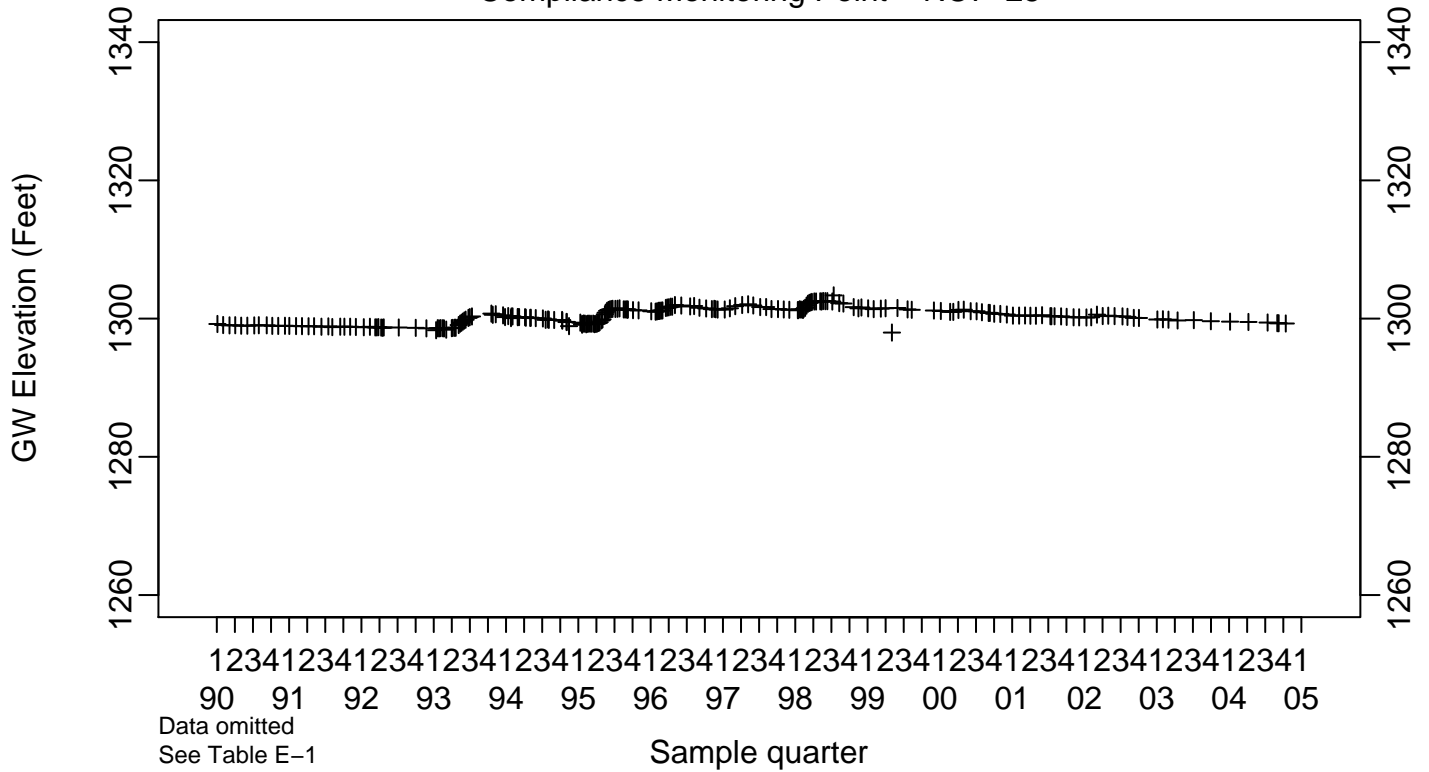


Pit 7 Complex GW Elevation (Feet)

Compliance Monitoring Point K7-10

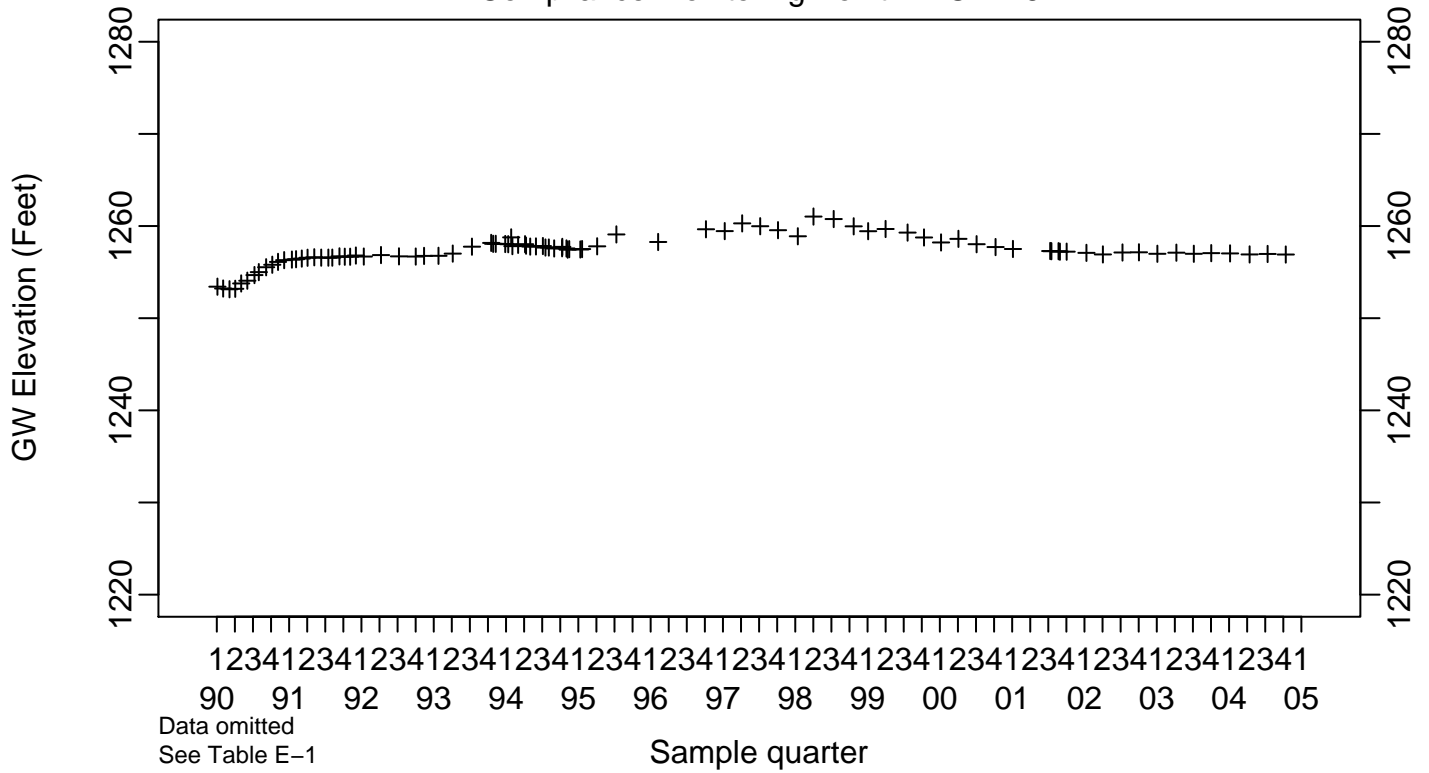


Compliance Monitoring Point NC7-25

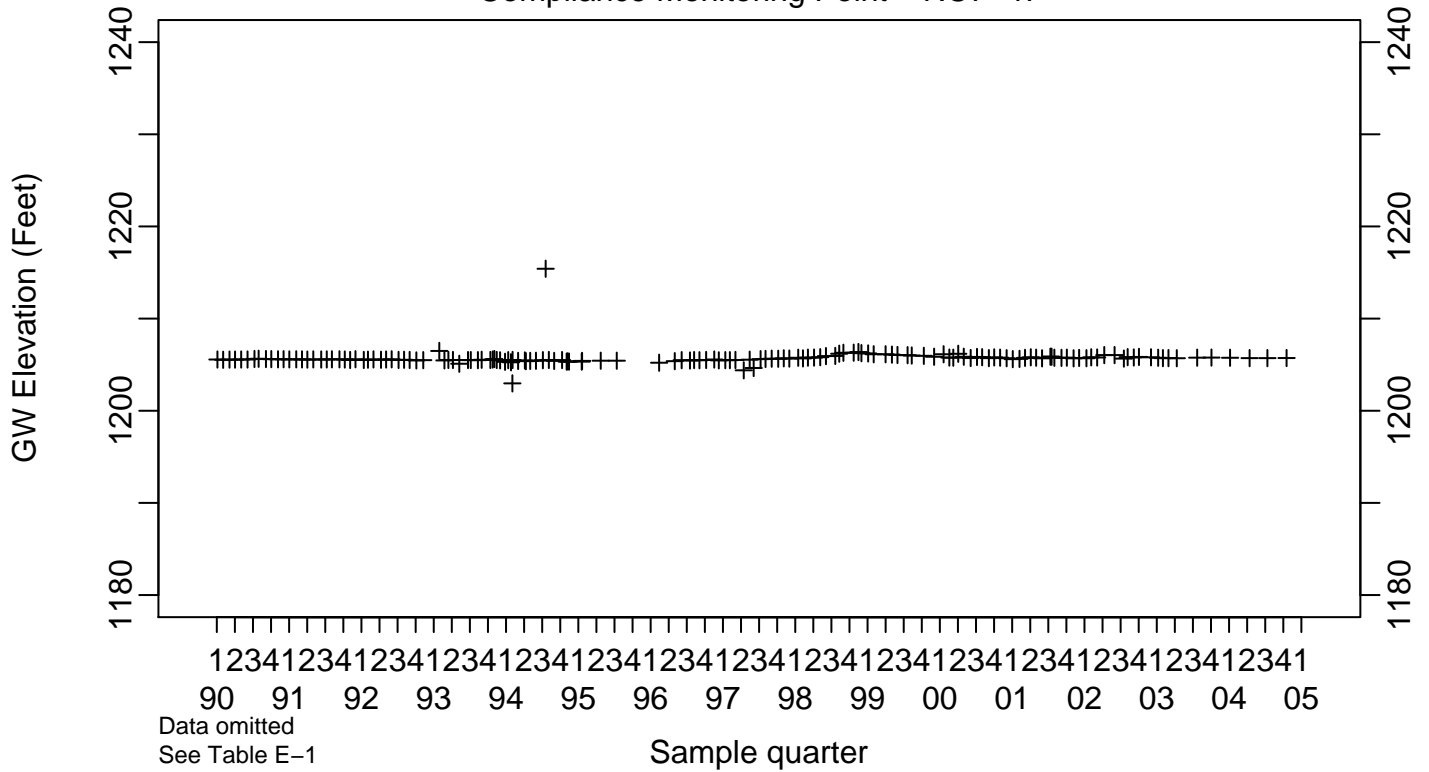


Pit 7 Complex GW Elevation (Feet)

Compliance Monitoring Point NC7-26

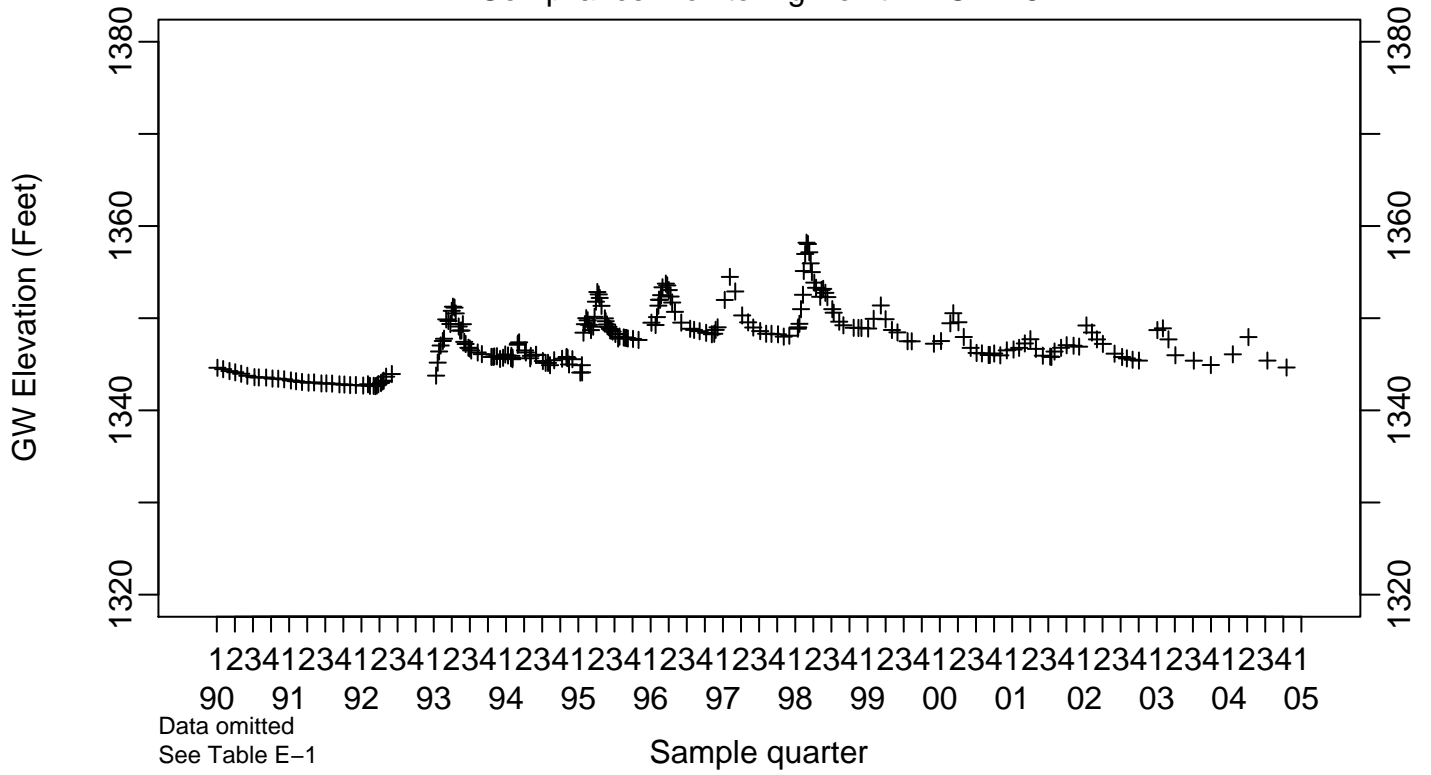


Compliance Monitoring Point NC7-47



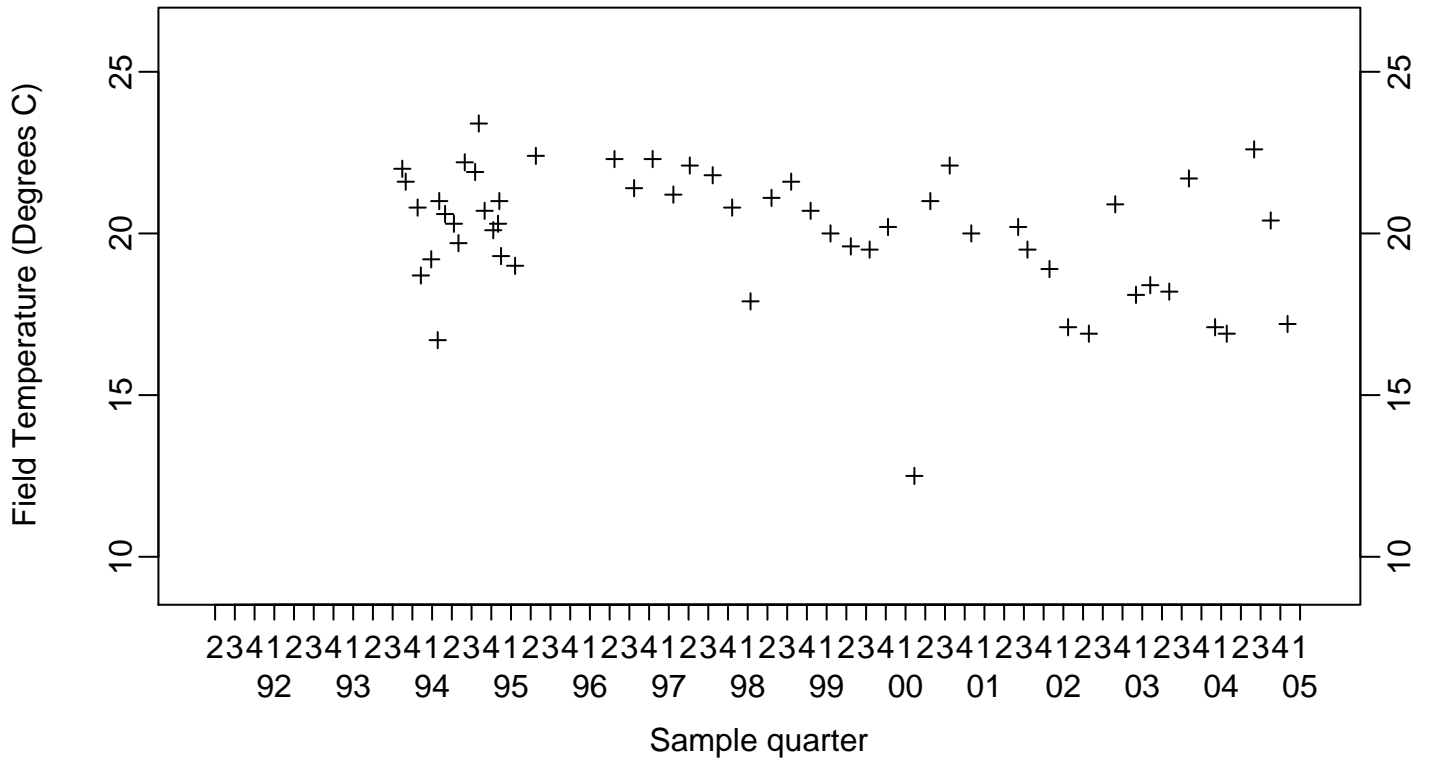
Pit 7 Complex GW Elevation (Feet)

Compliance Monitoring Point NC7-48

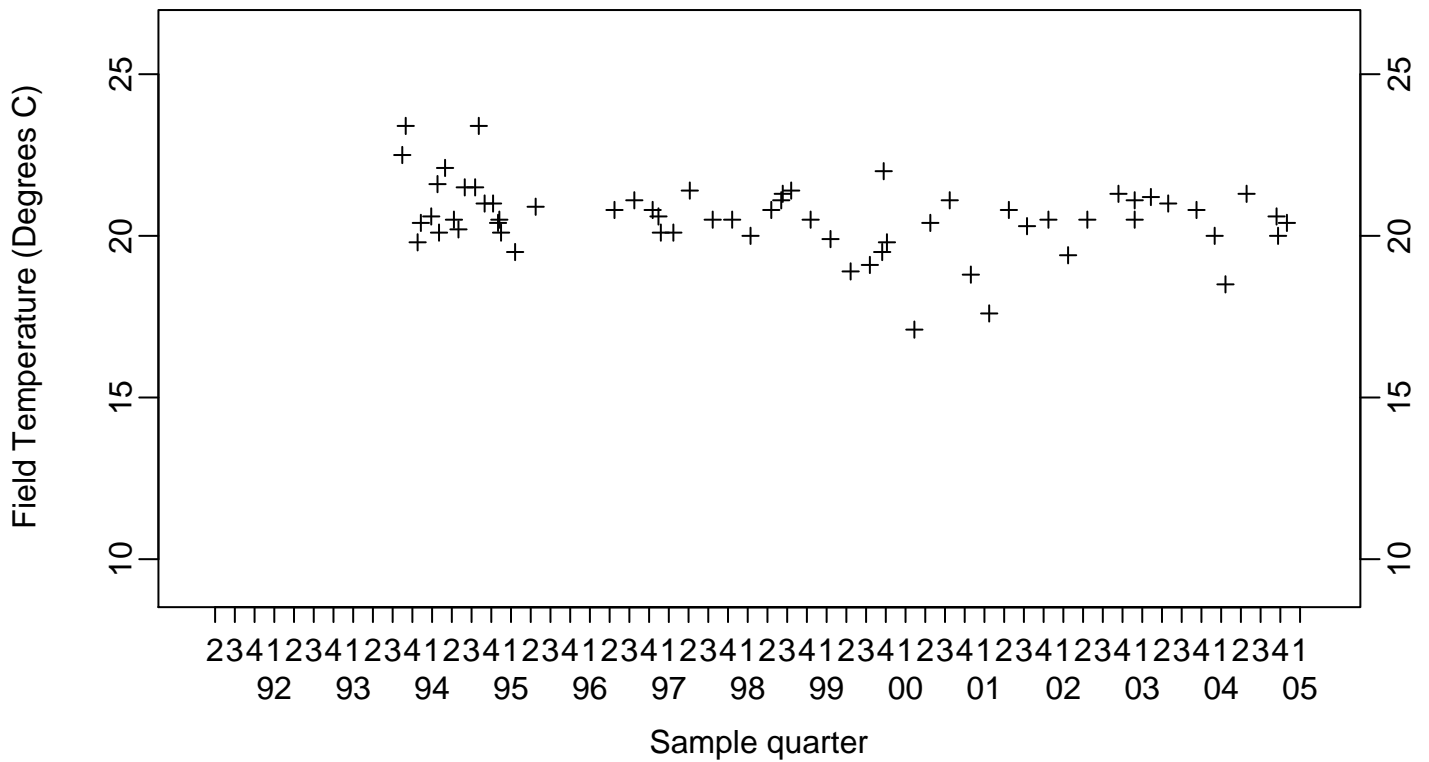


Pit 7 Complex Field Temperature (Degrees C)

Background Monitoring Point K7-06

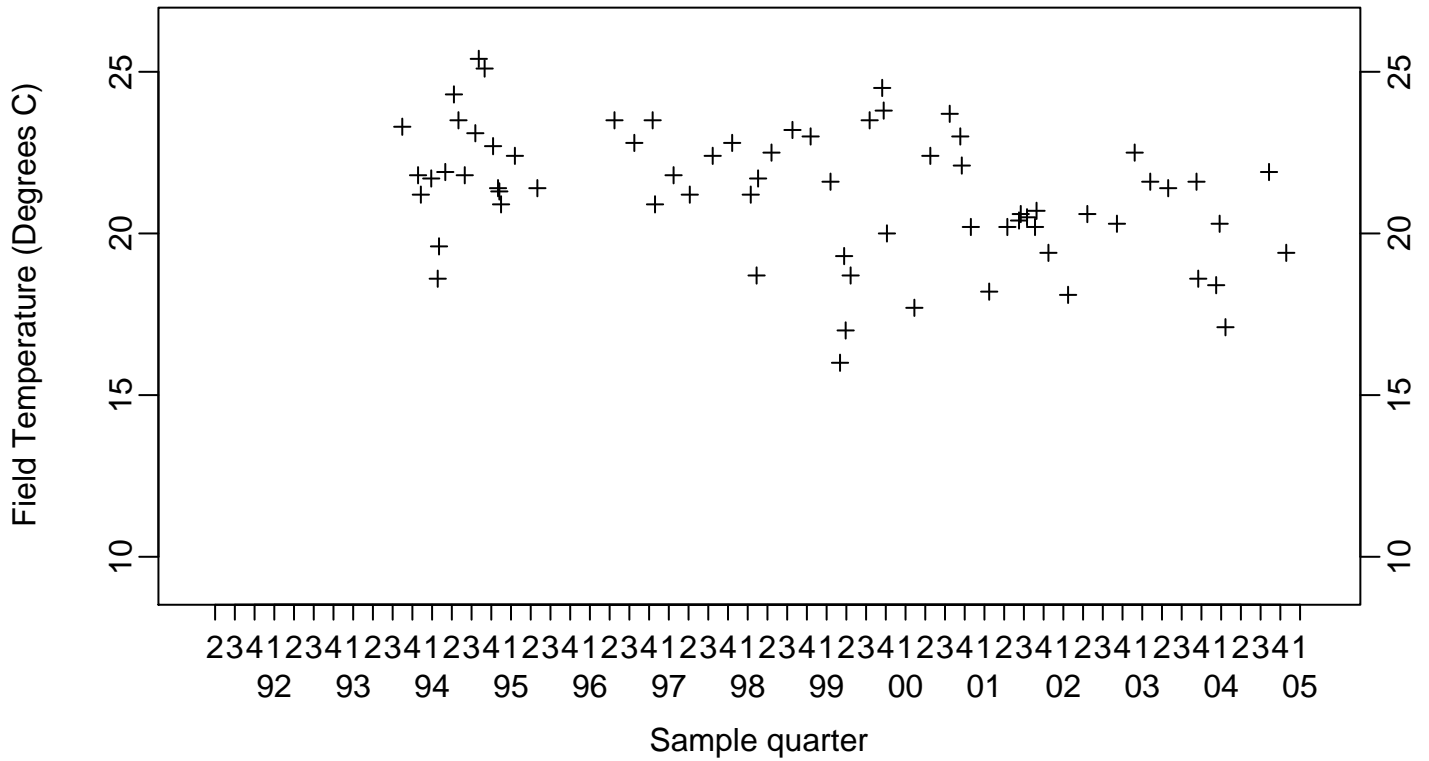


Compliance Monitoring Point K7-01

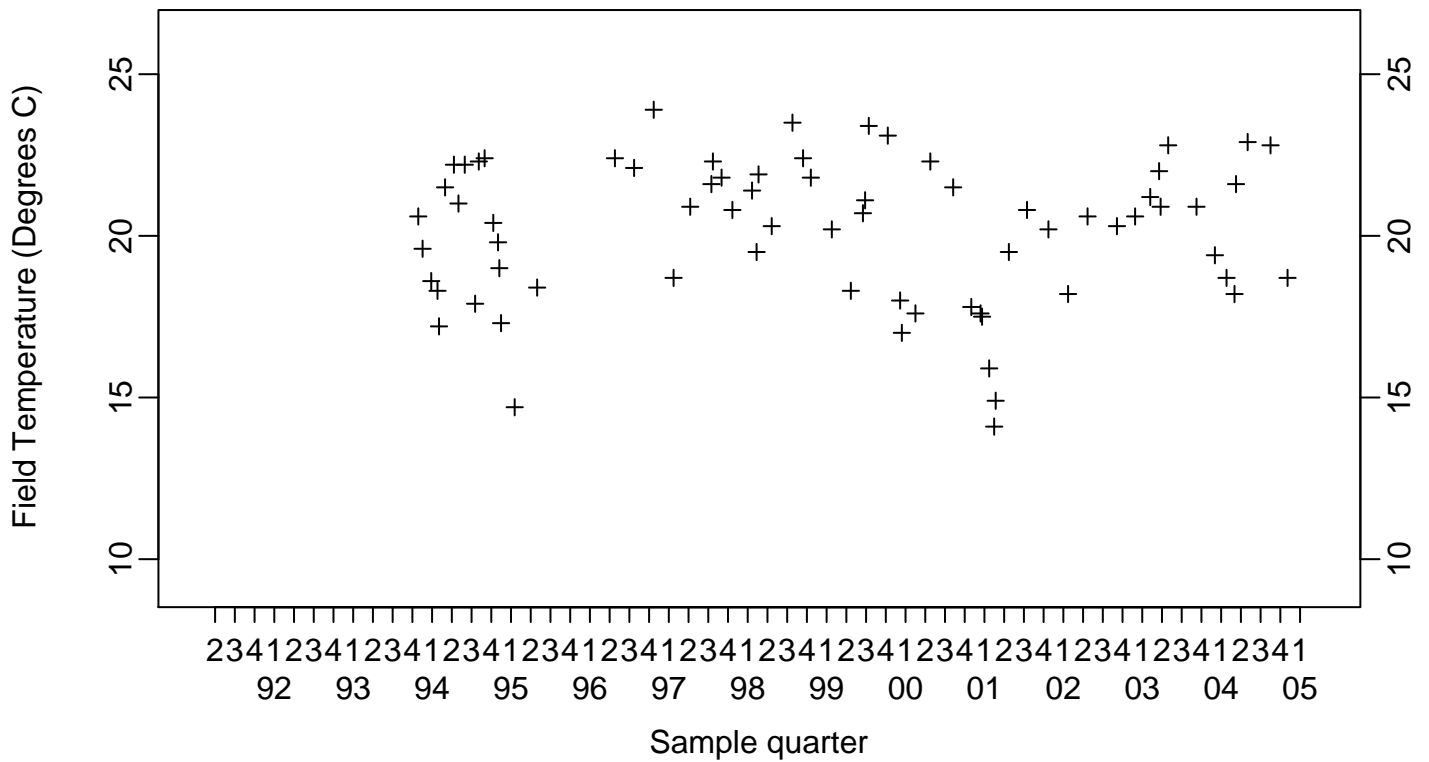


Pit 7 Complex Field Temperature (Degrees C)

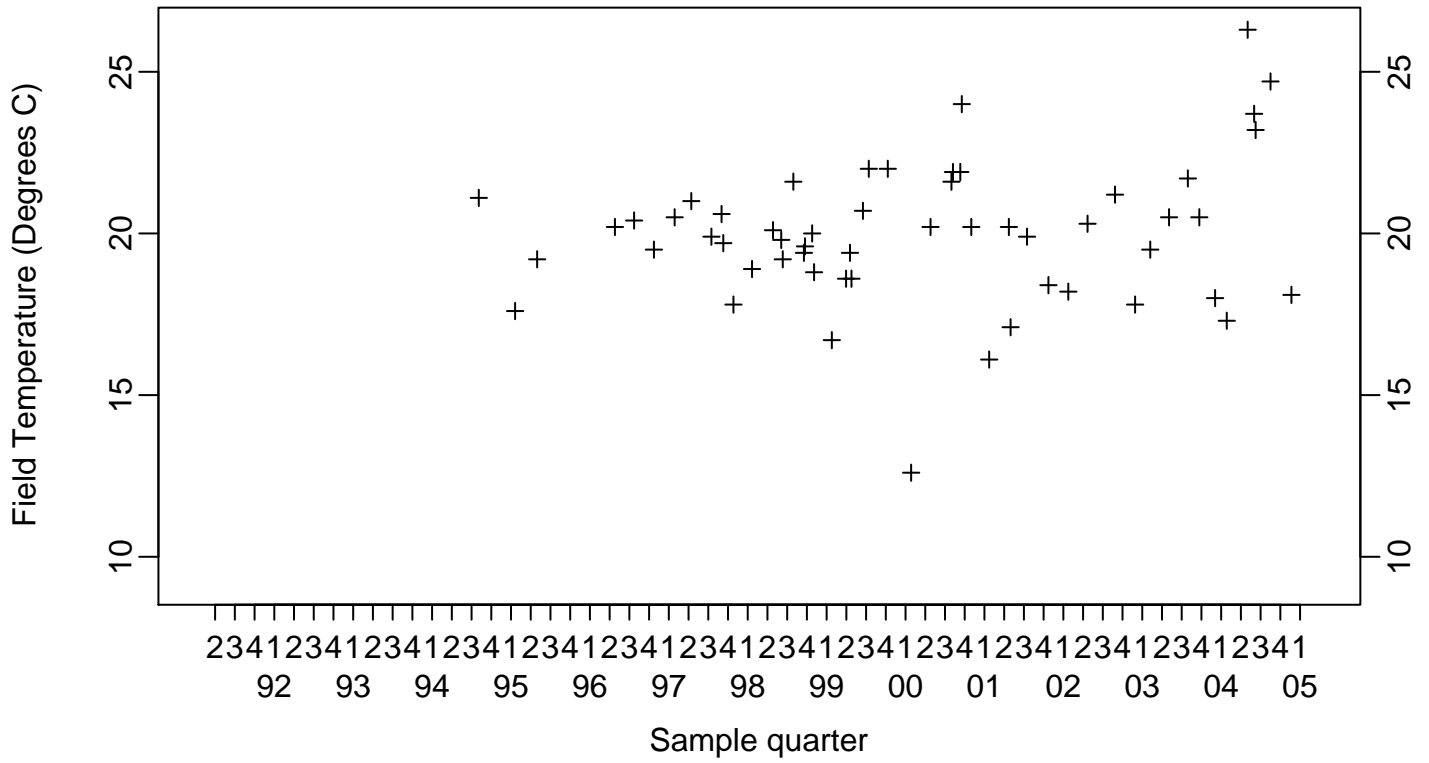
Compliance Monitoring Point K7-03



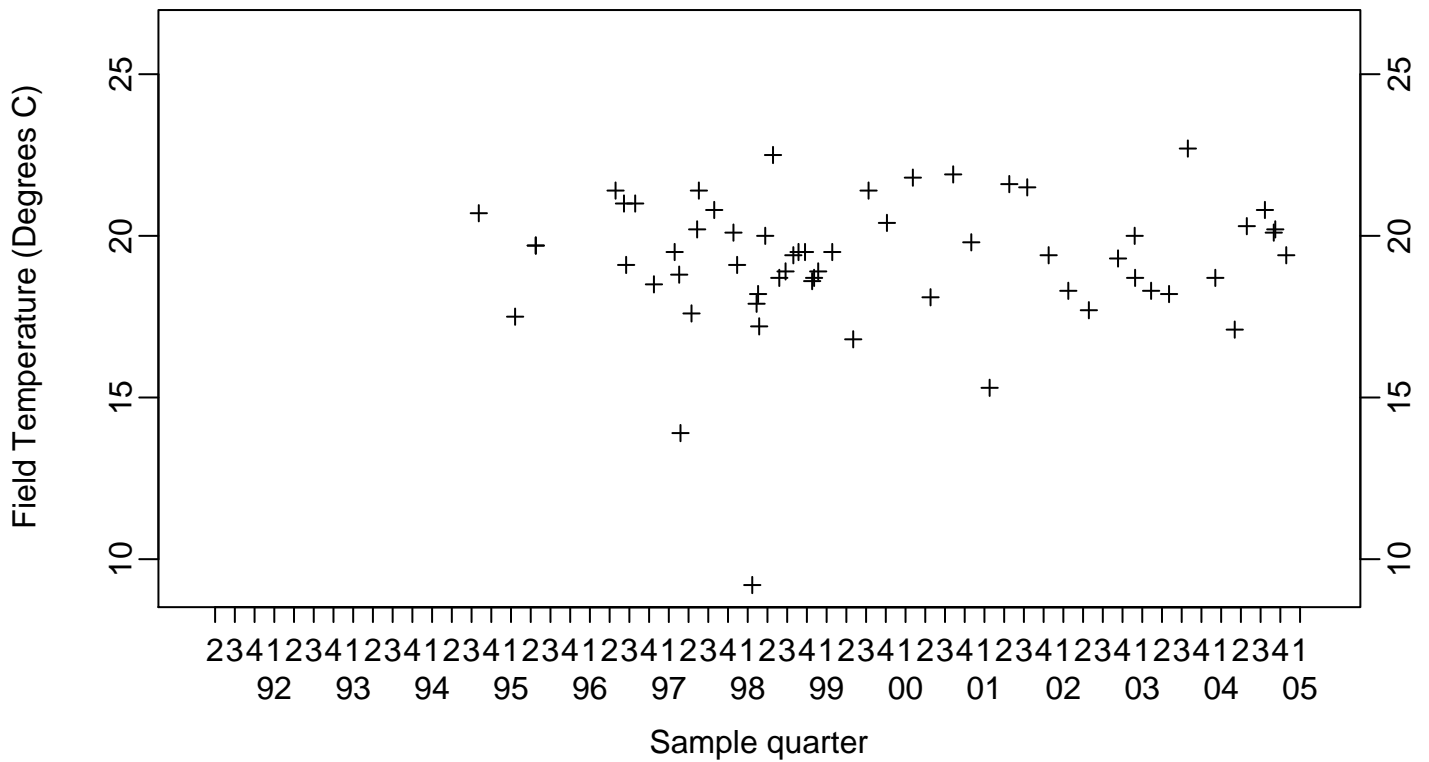
Compliance Monitoring Point K7-09



Pit 7 Complex Field Temperature (Degrees C) Compliance Monitoring Point K7-10

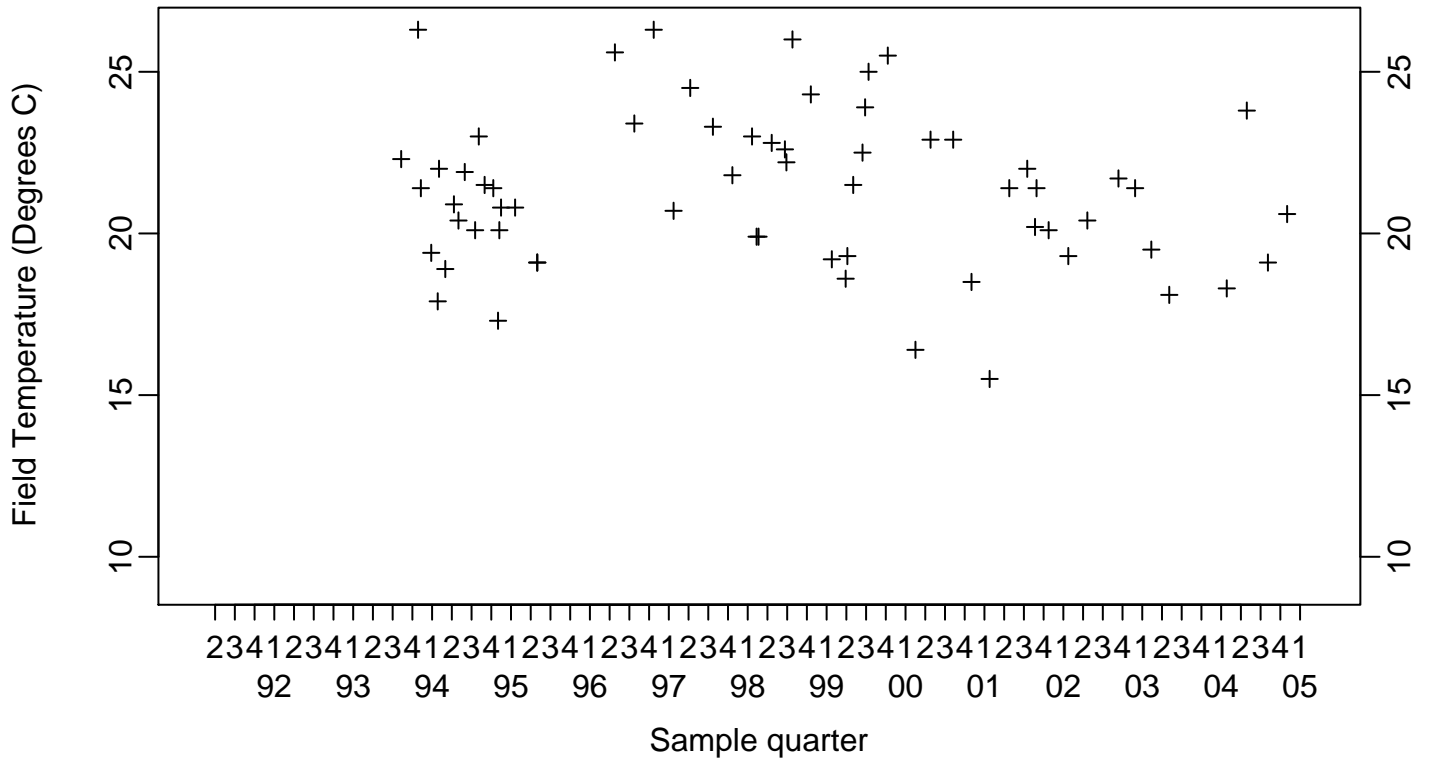


Compliance Monitoring Point NC7-25

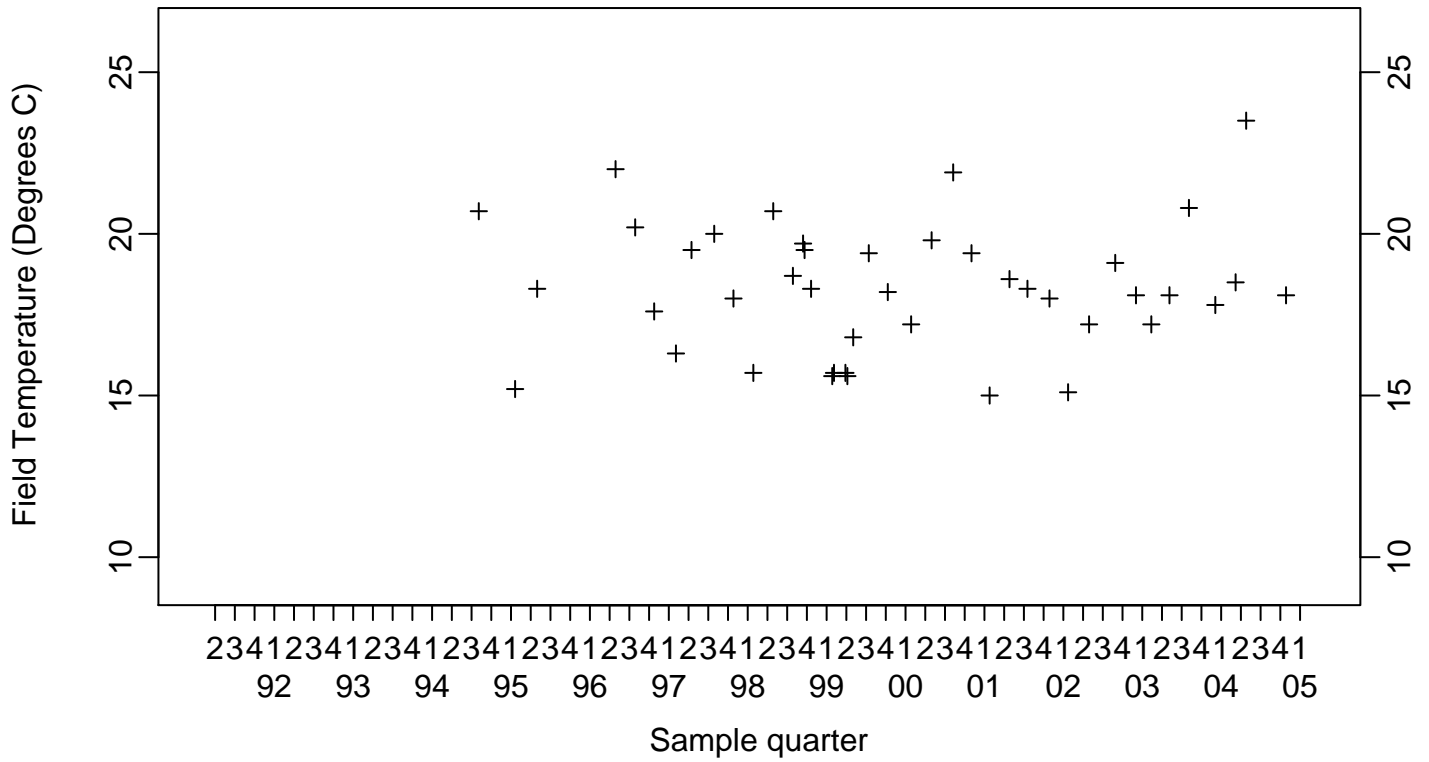


Pit 7 Complex Field Temperature (Degrees C)

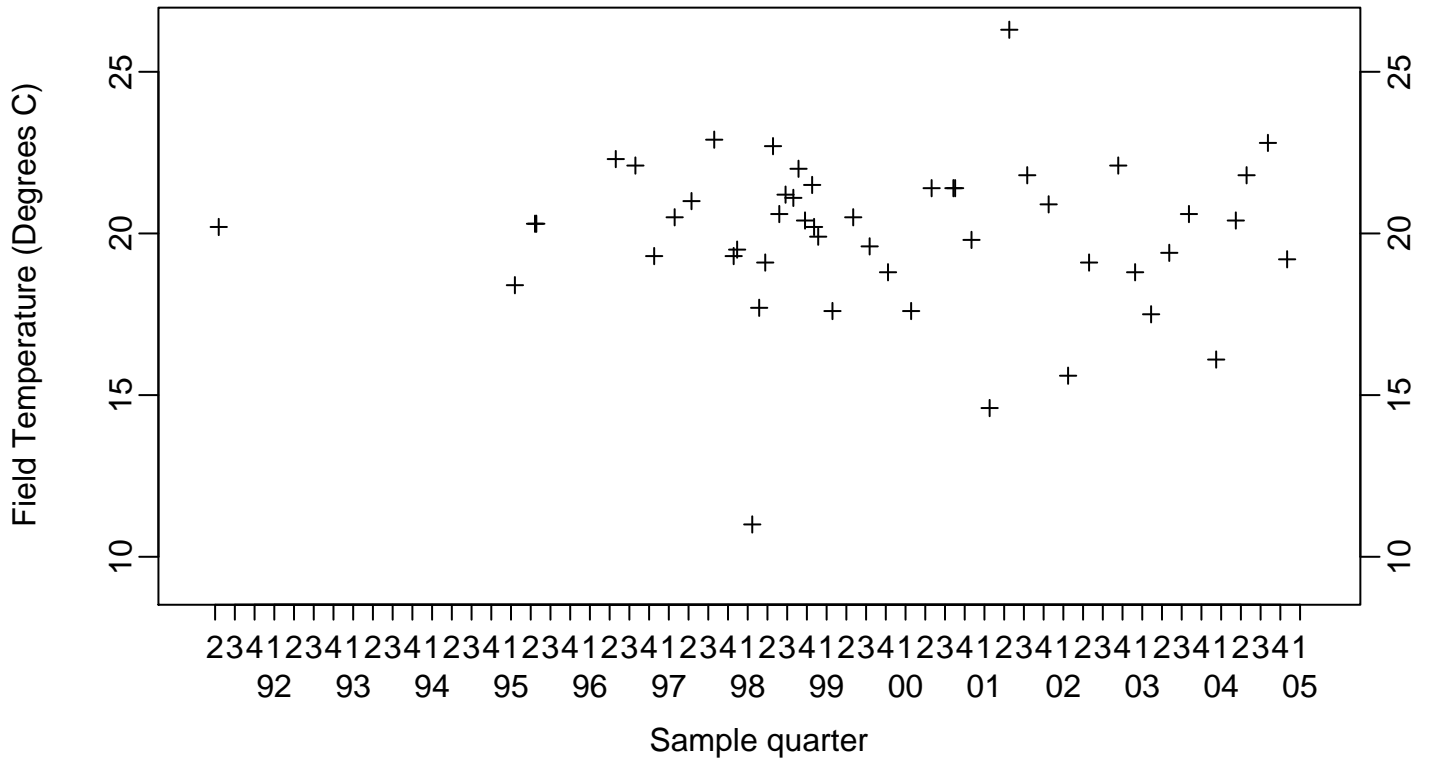
Compliance Monitoring Point NC7-26



Compliance Monitoring Point NC7-47



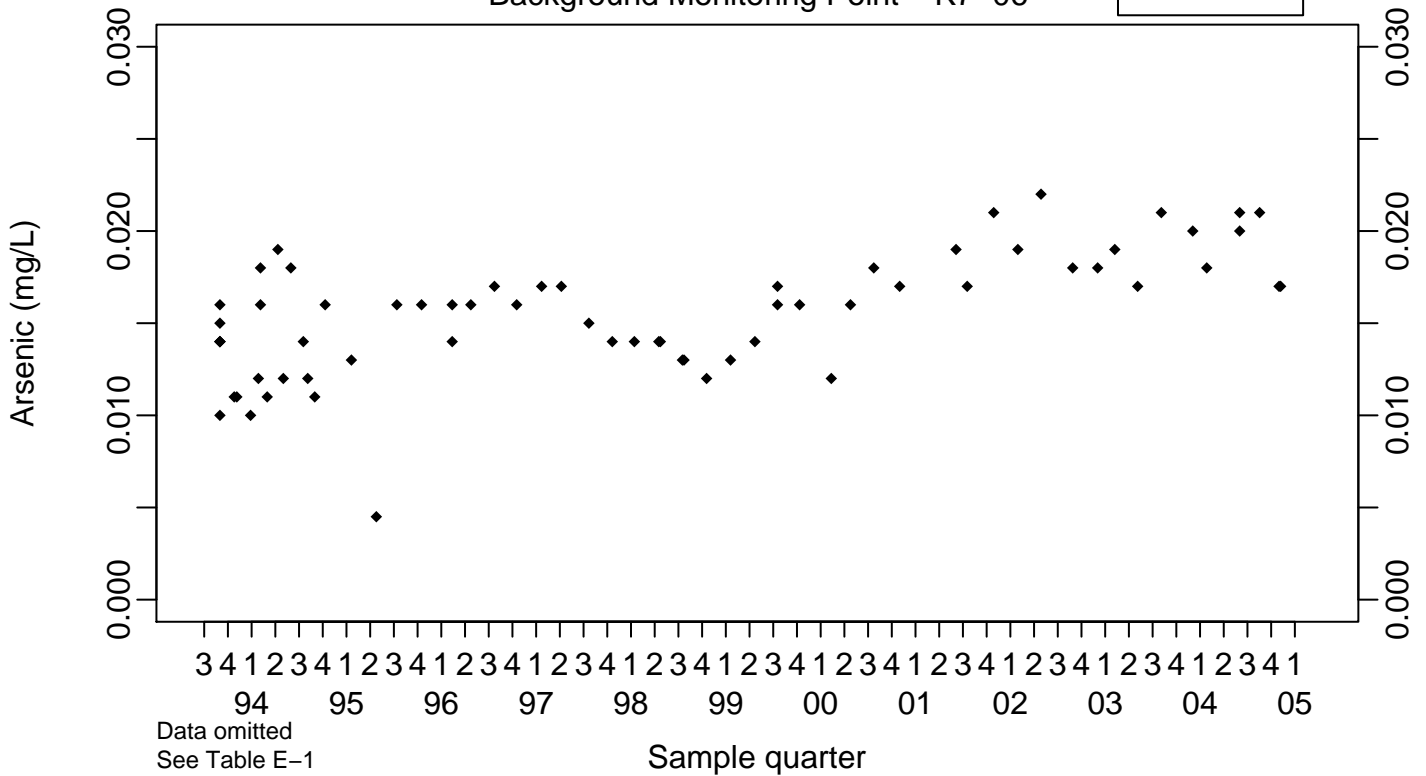
Pit 7 Complex
Field Temperature (Degrees C)
Compliance Monitoring Point NC7-48



Pit 7 Complex Arsenic (mg/L)

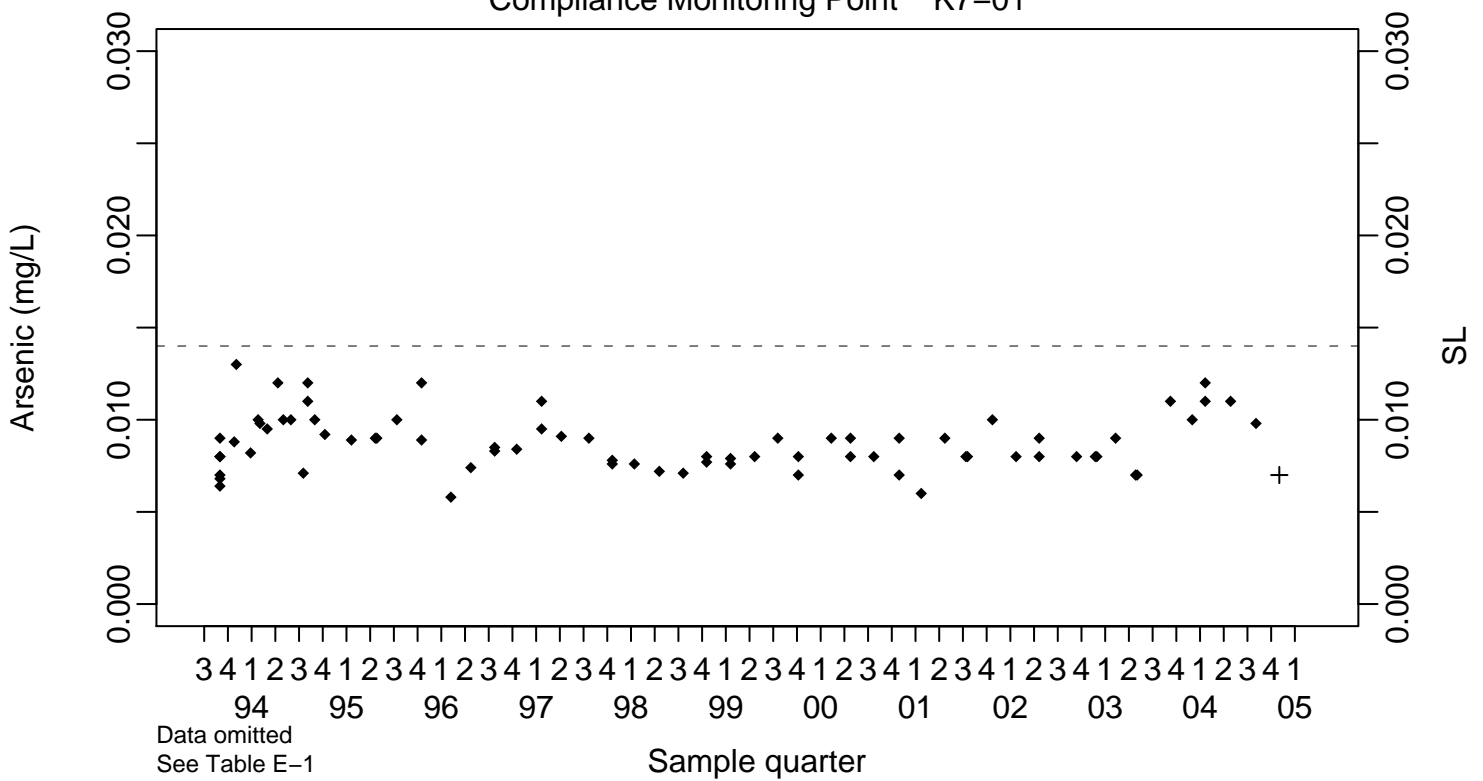
Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



SL=0.014

Compliance Monitoring Point K7-01

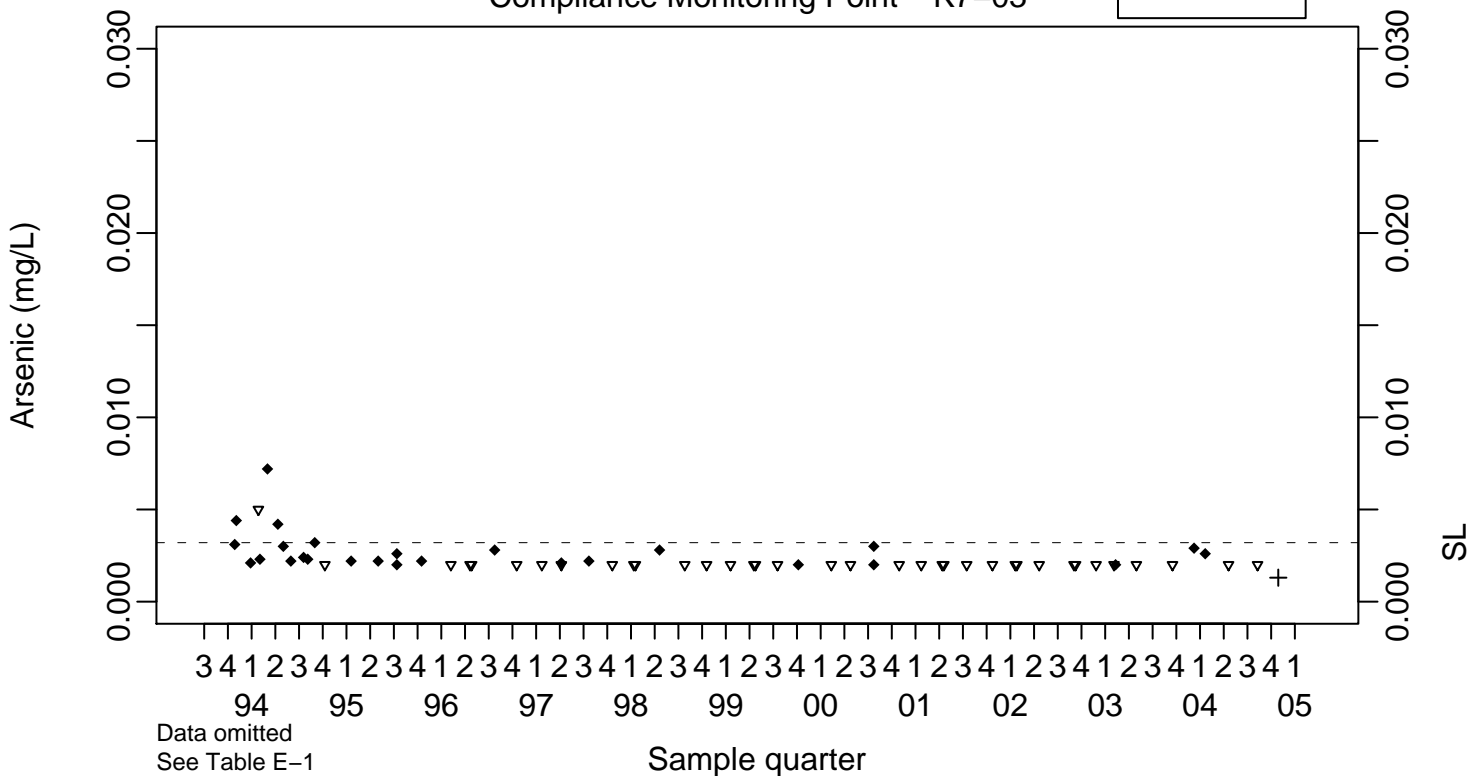


Pit 7 Complex Arsenic (mg/L)

Compliance Monitoring Point K7-03

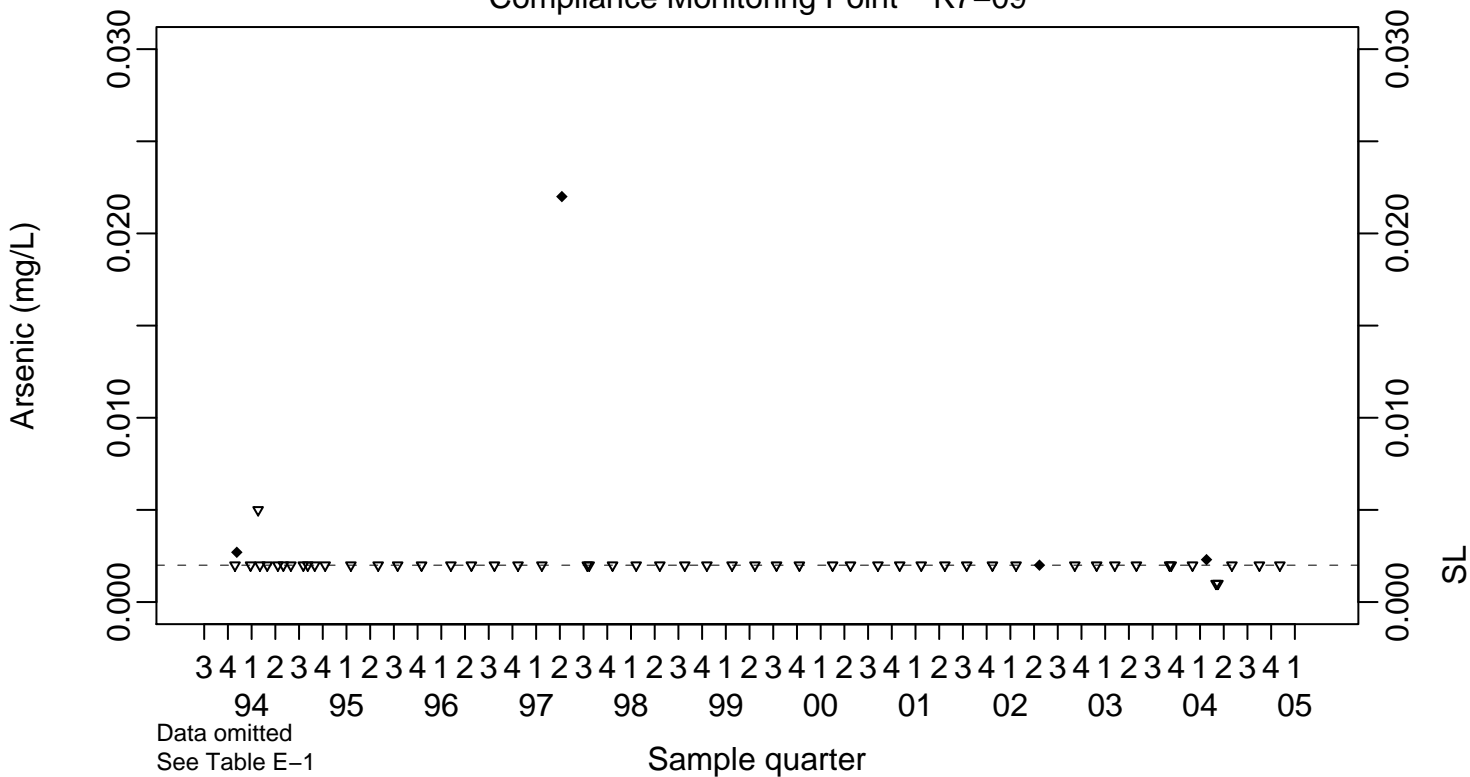
SL=0.0032

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point K7-09

SL=0.002

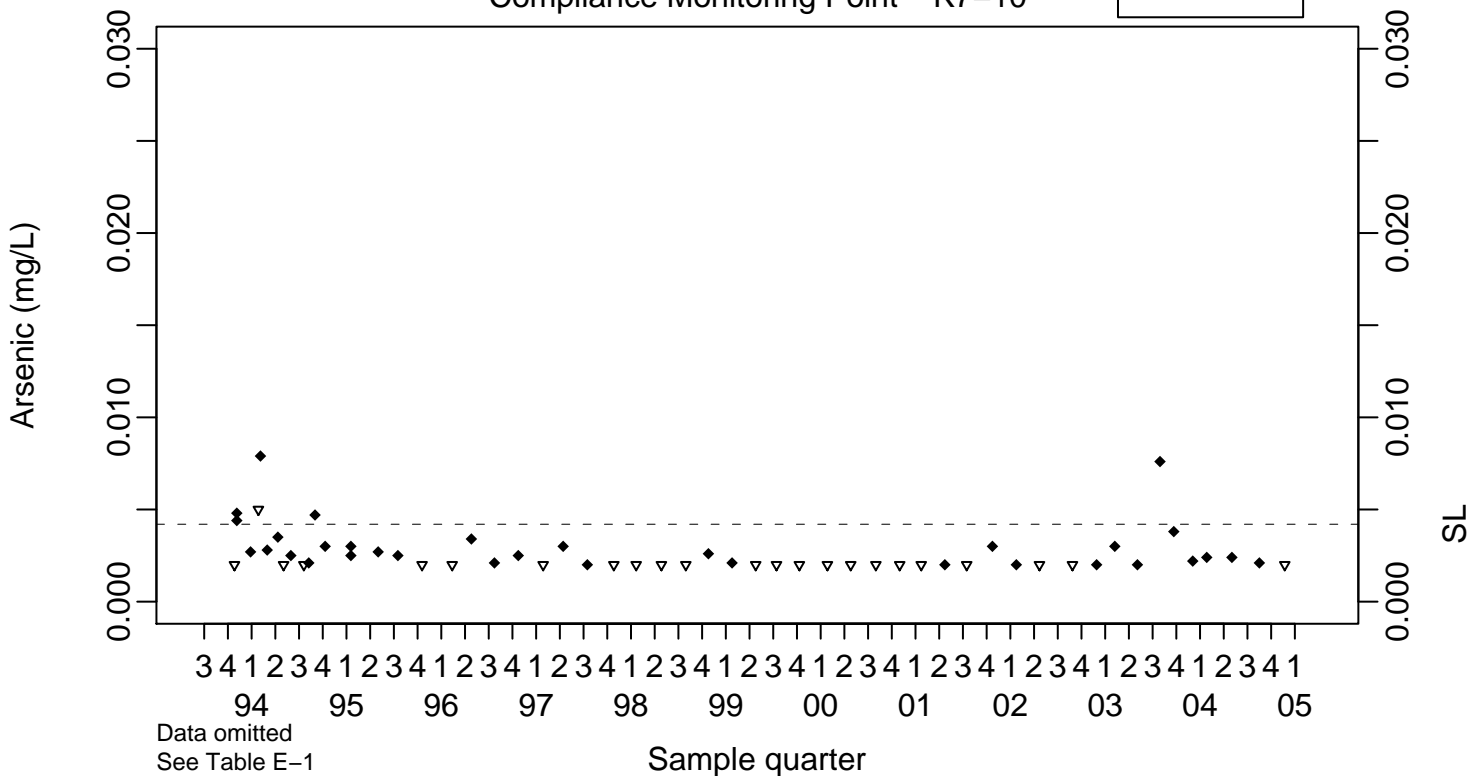


Pit 7 Complex Arsenic (mg/L)

SL=0.0042

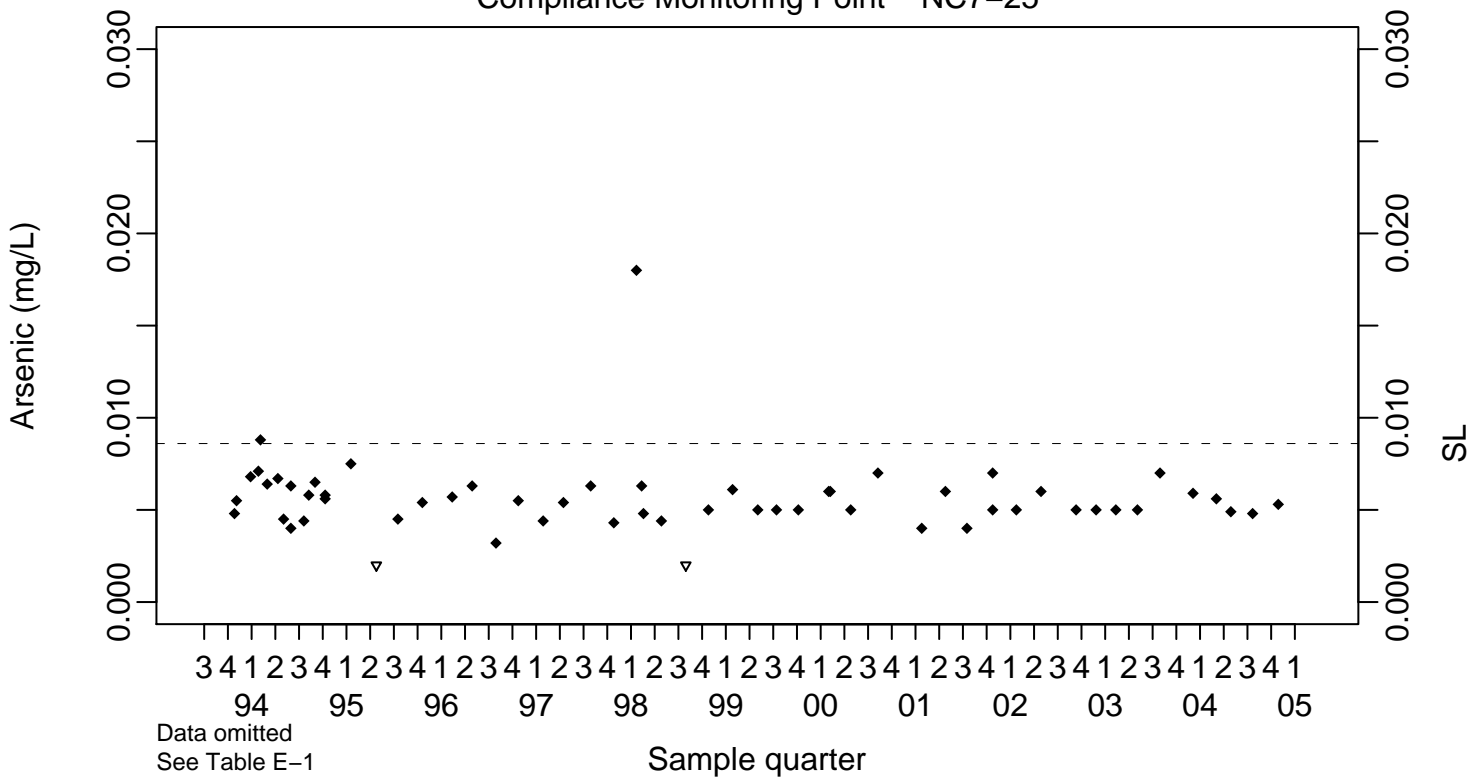
◆ Above RL
▽ Below RL

Compliance Monitoring Point K7-10



SL=0.0086

Compliance Monitoring Point NC7-25

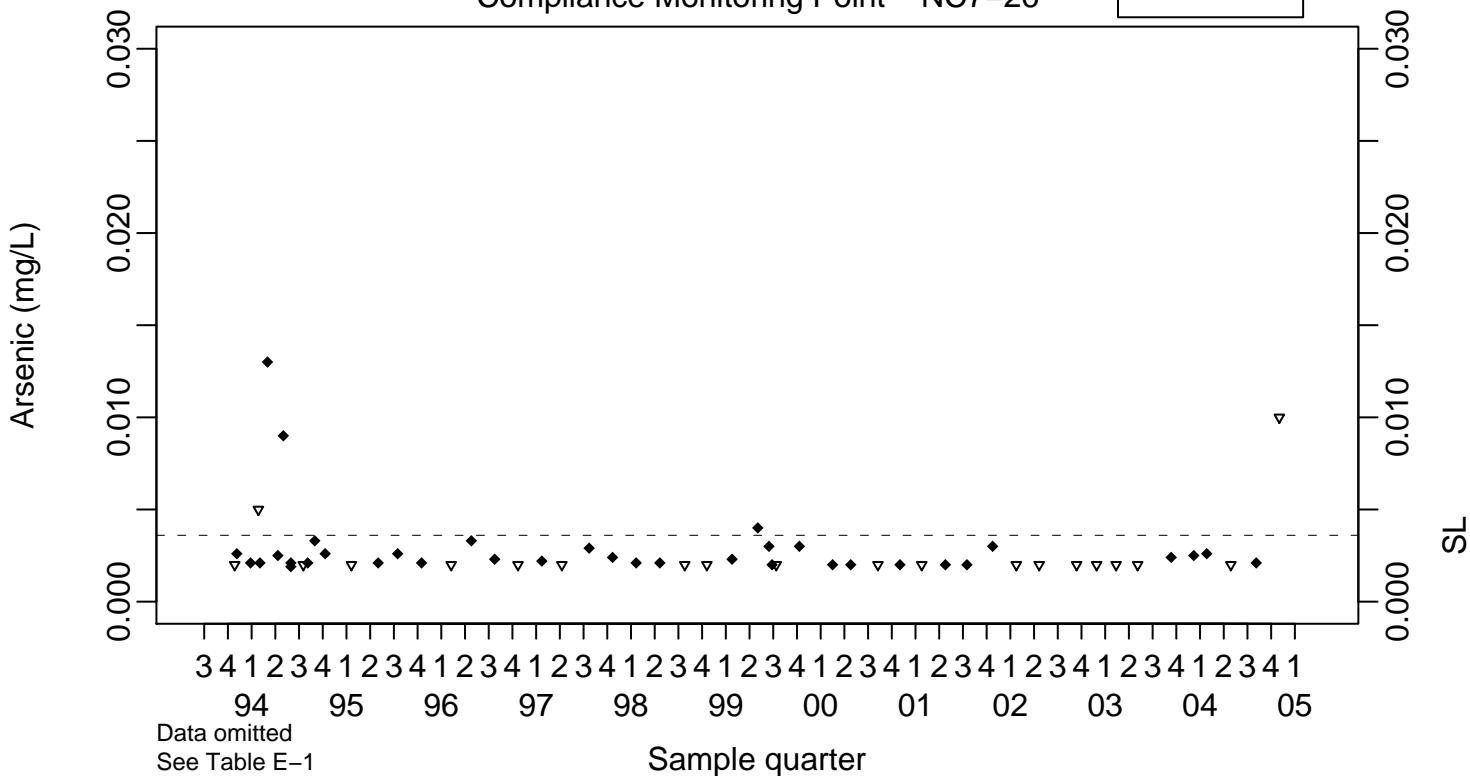


Pit 7 Complex Arsenic (mg/L)

SL=0.0036

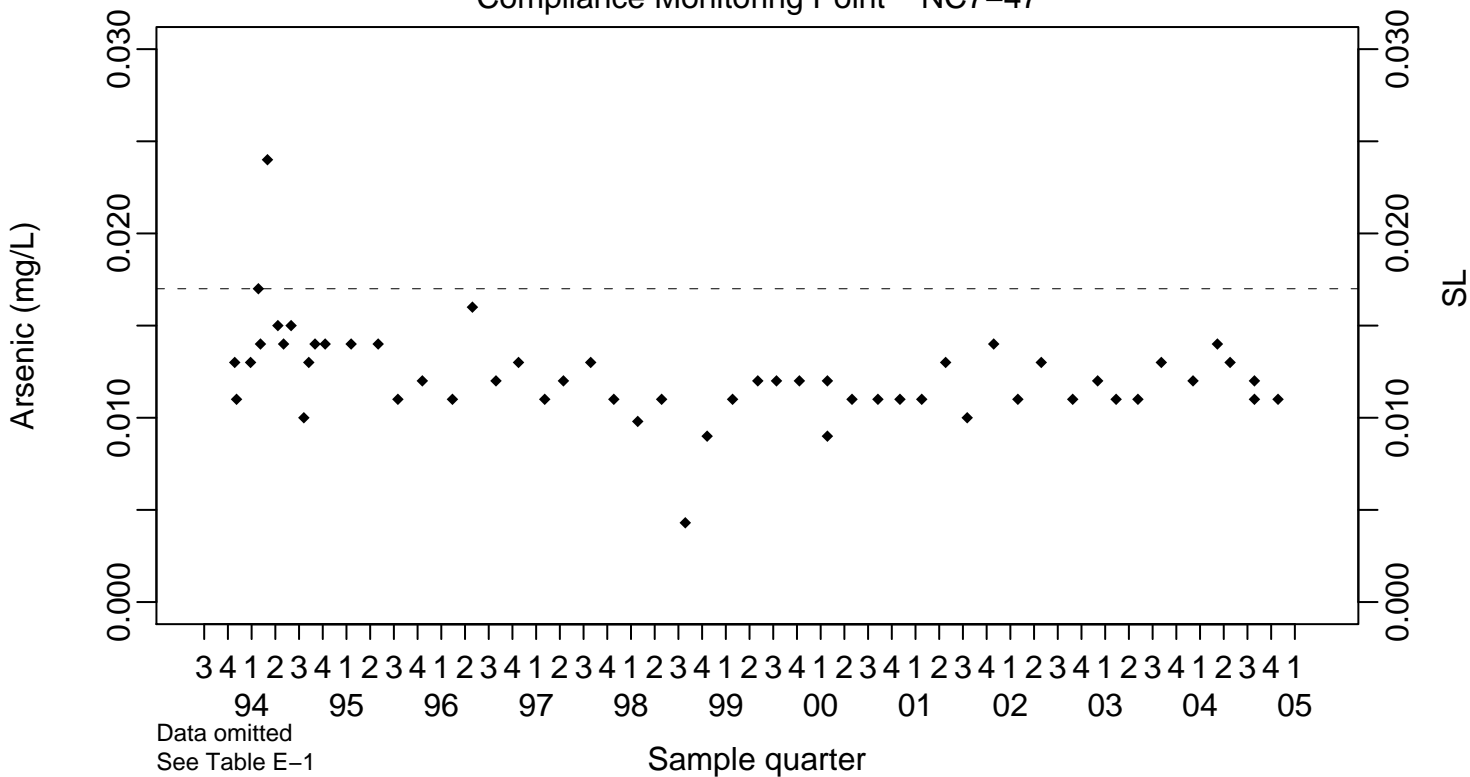
Compliance Monitoring Point NC7-26

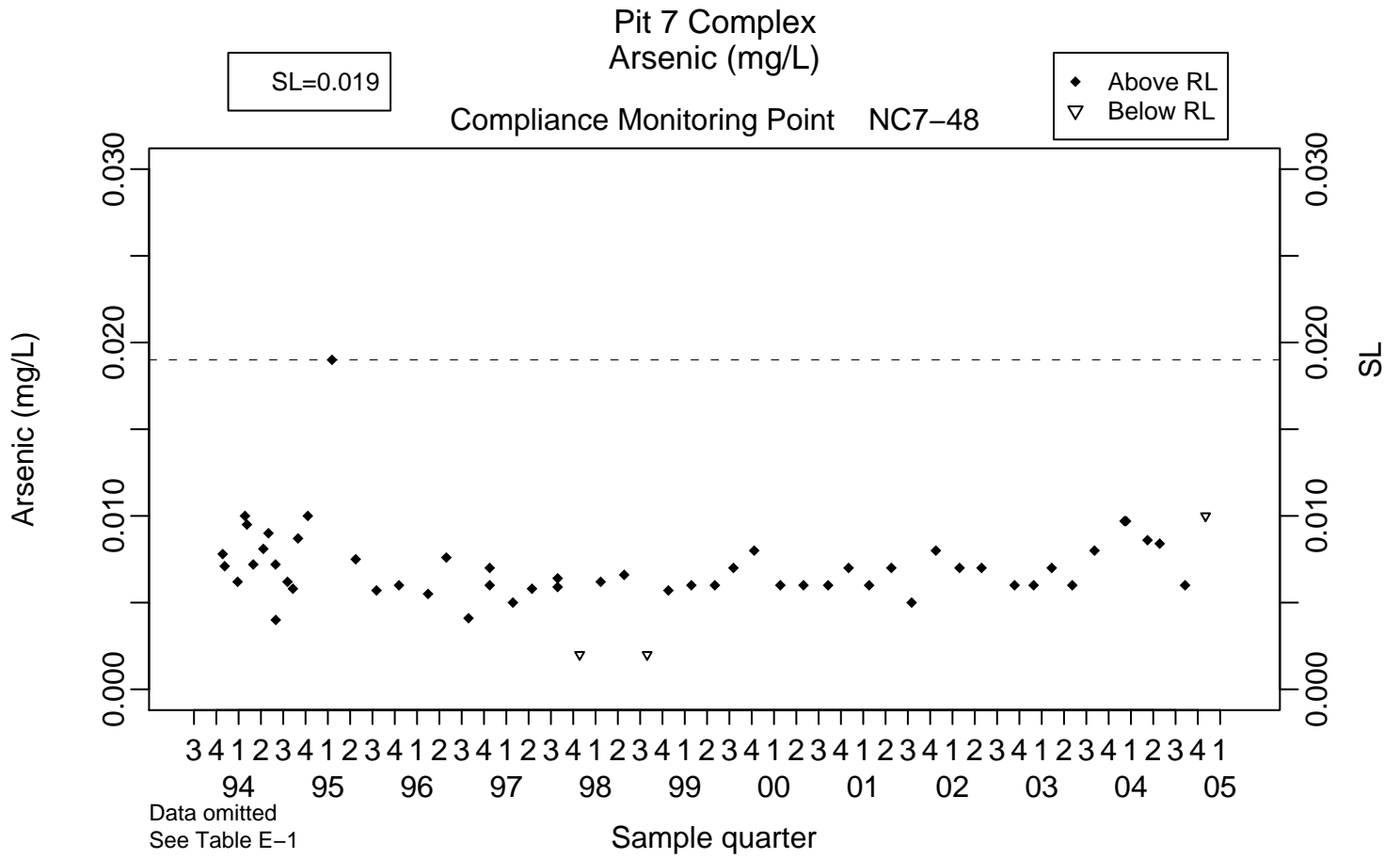
◆ Above RL
▽ Below RL



SL=0.017

Compliance Monitoring Point NC7-47

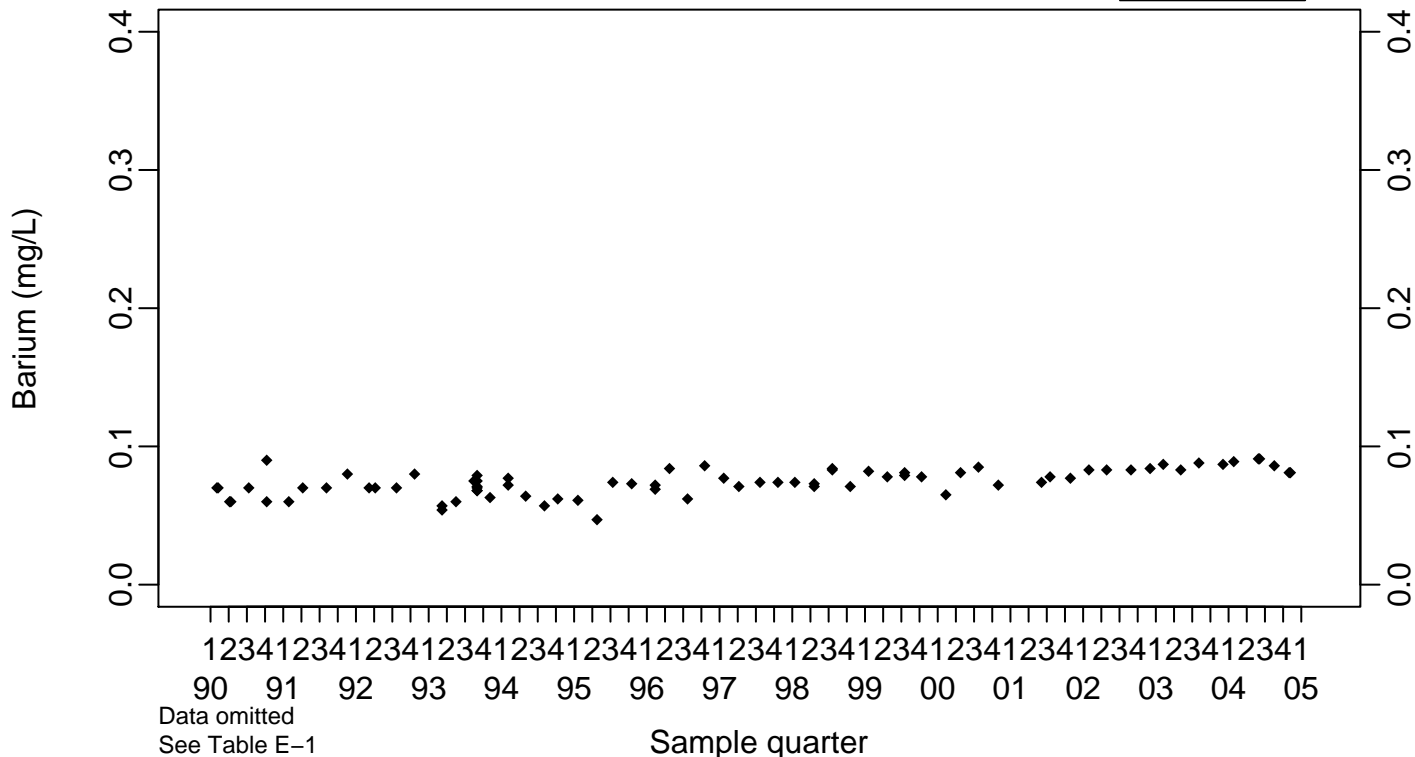




Pit 7 Complex Barium (mg/L)

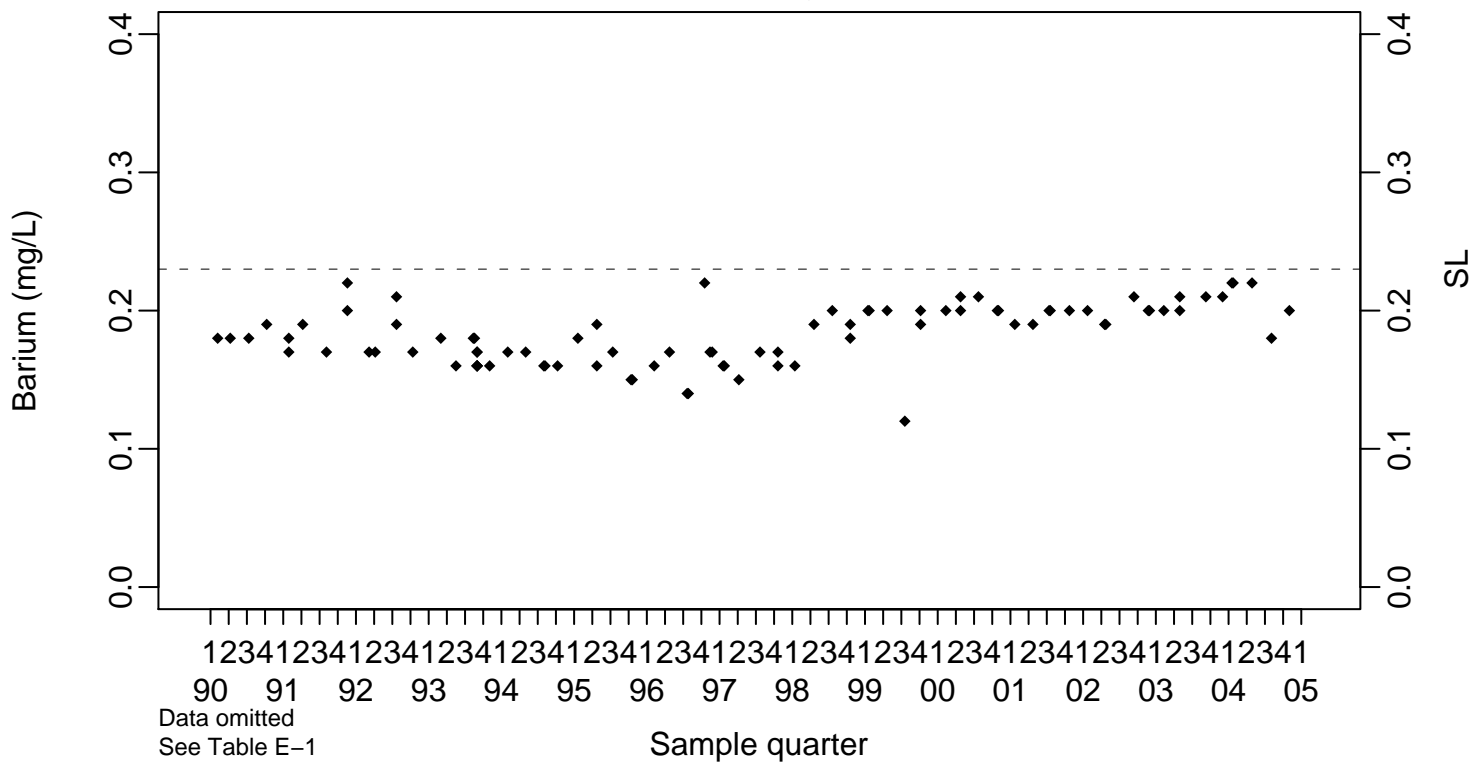
Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



SL=0.23

Compliance Monitoring Point K7-01

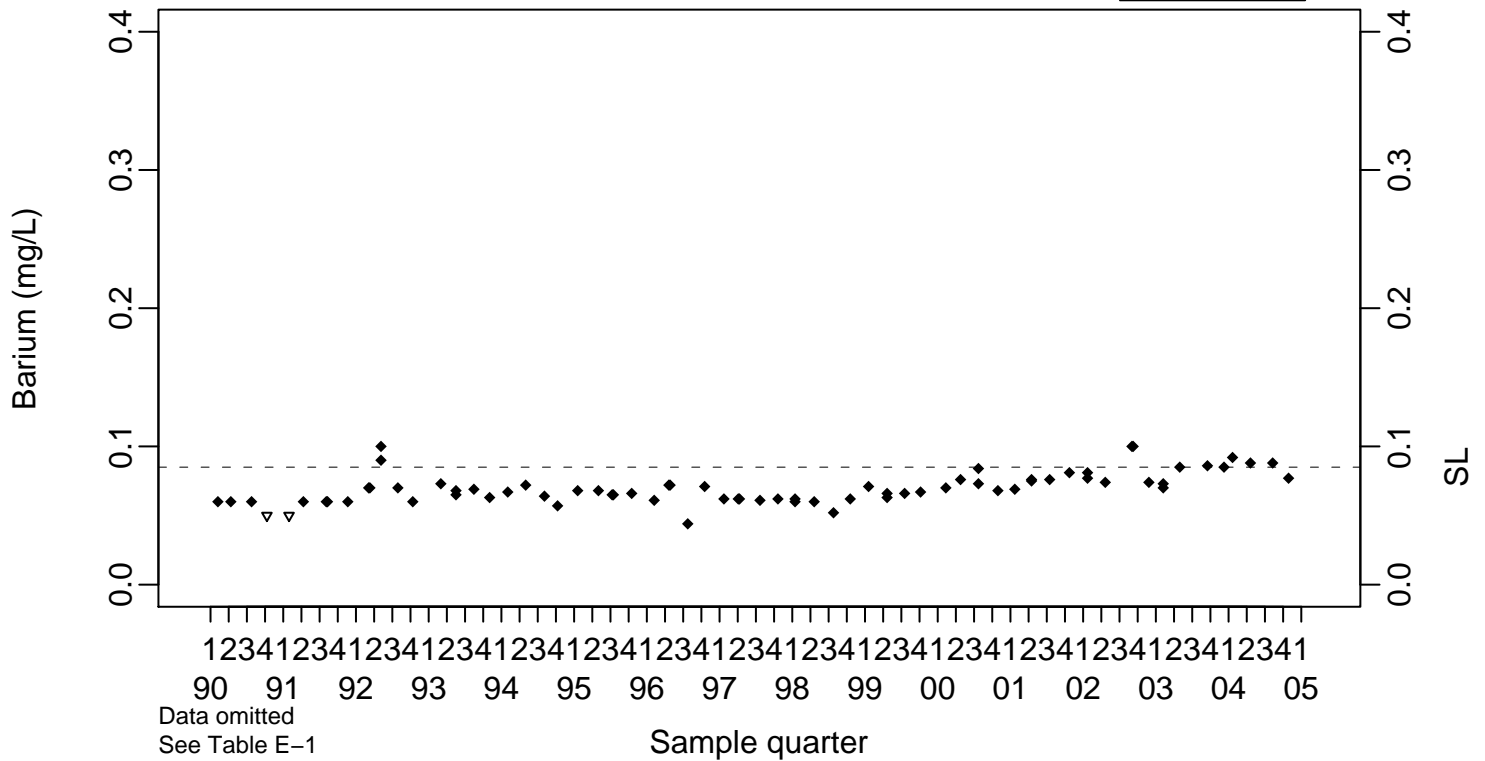


Pit 7 Complex Barium (mg/L)

SL=0.085

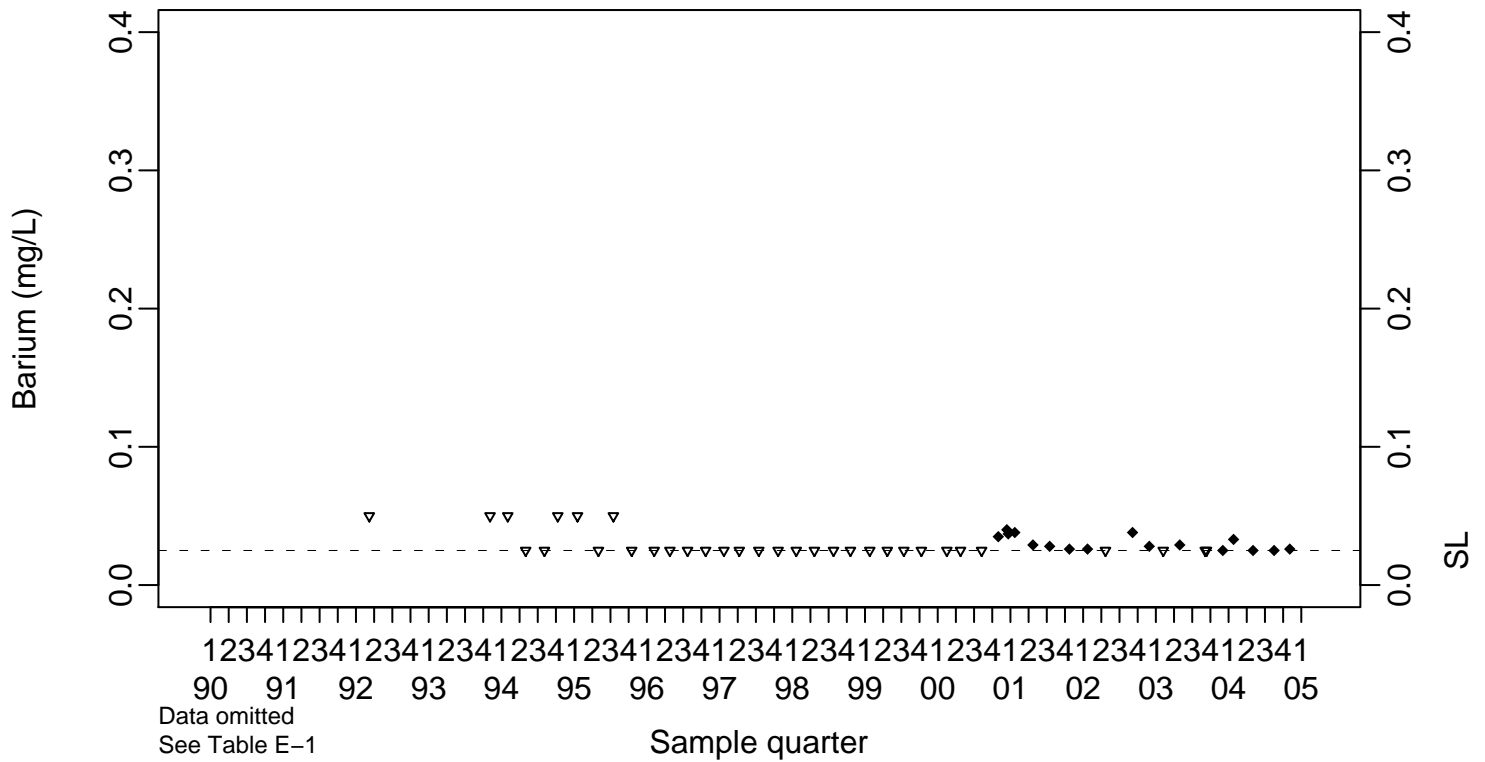
Compliance Monitoring Point K7-03

◆ Above RL
▽ Below RL



SL=0.025

Compliance Monitoring Point K7-09

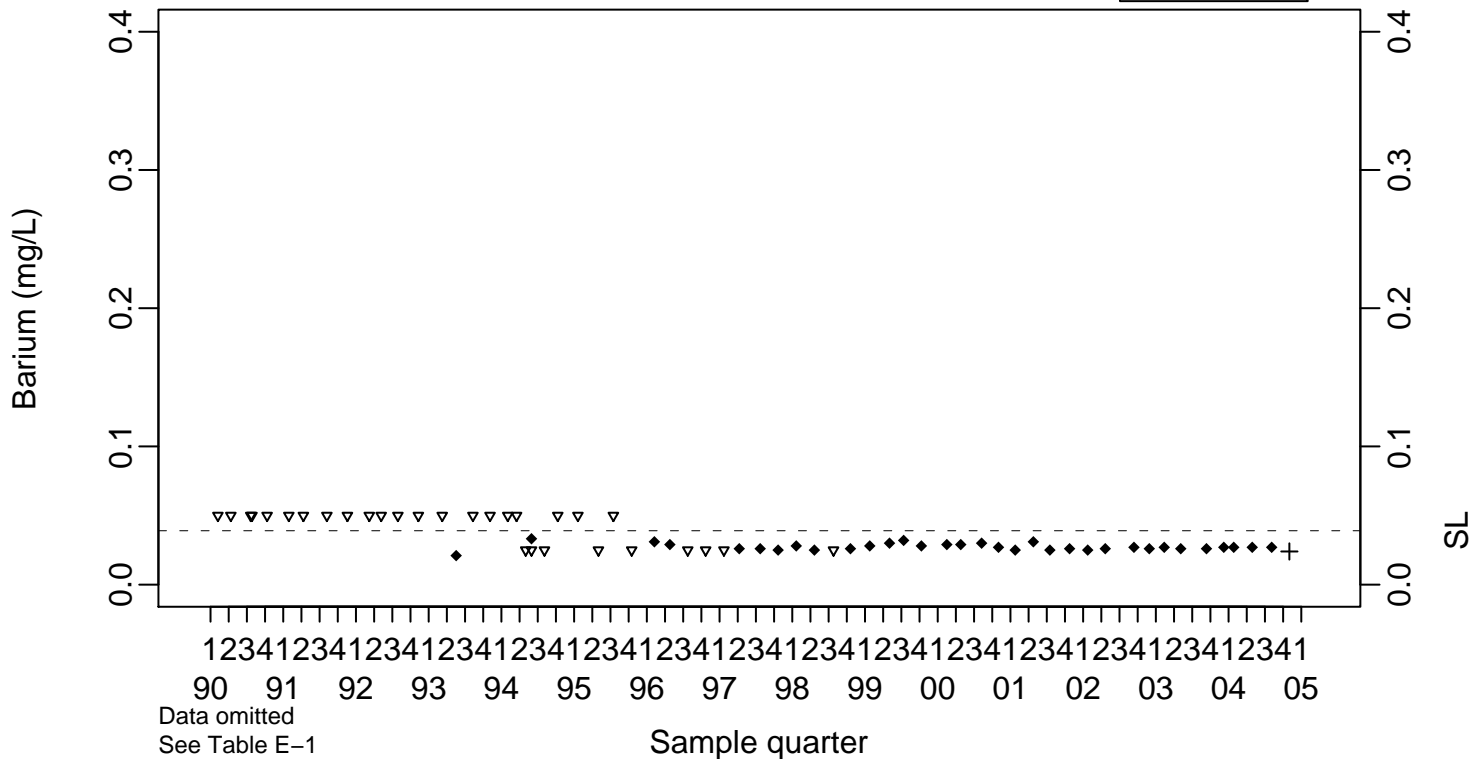


Pit 7 Complex Barium (mg/L)

SL=0.039

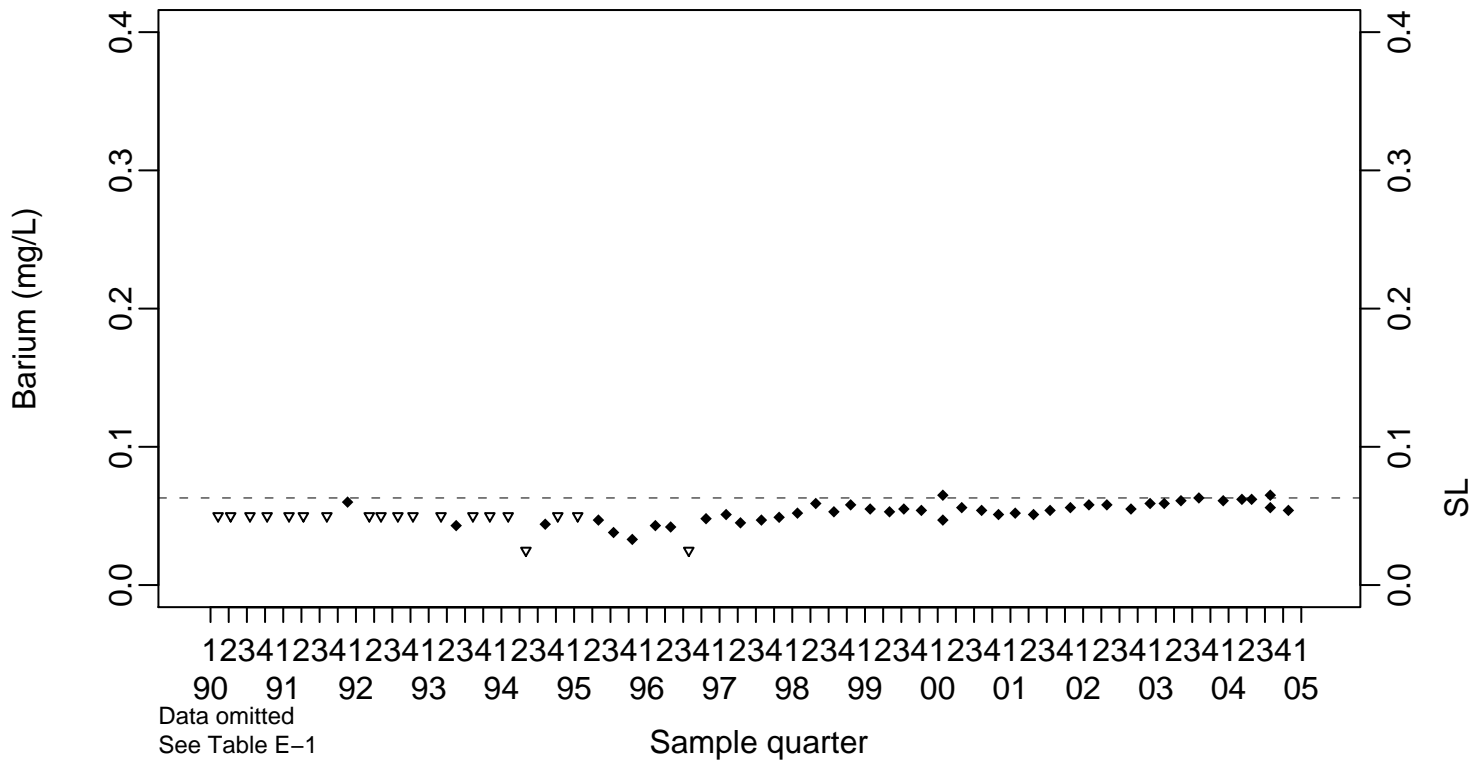
Compliance Monitoring Point NC7-26

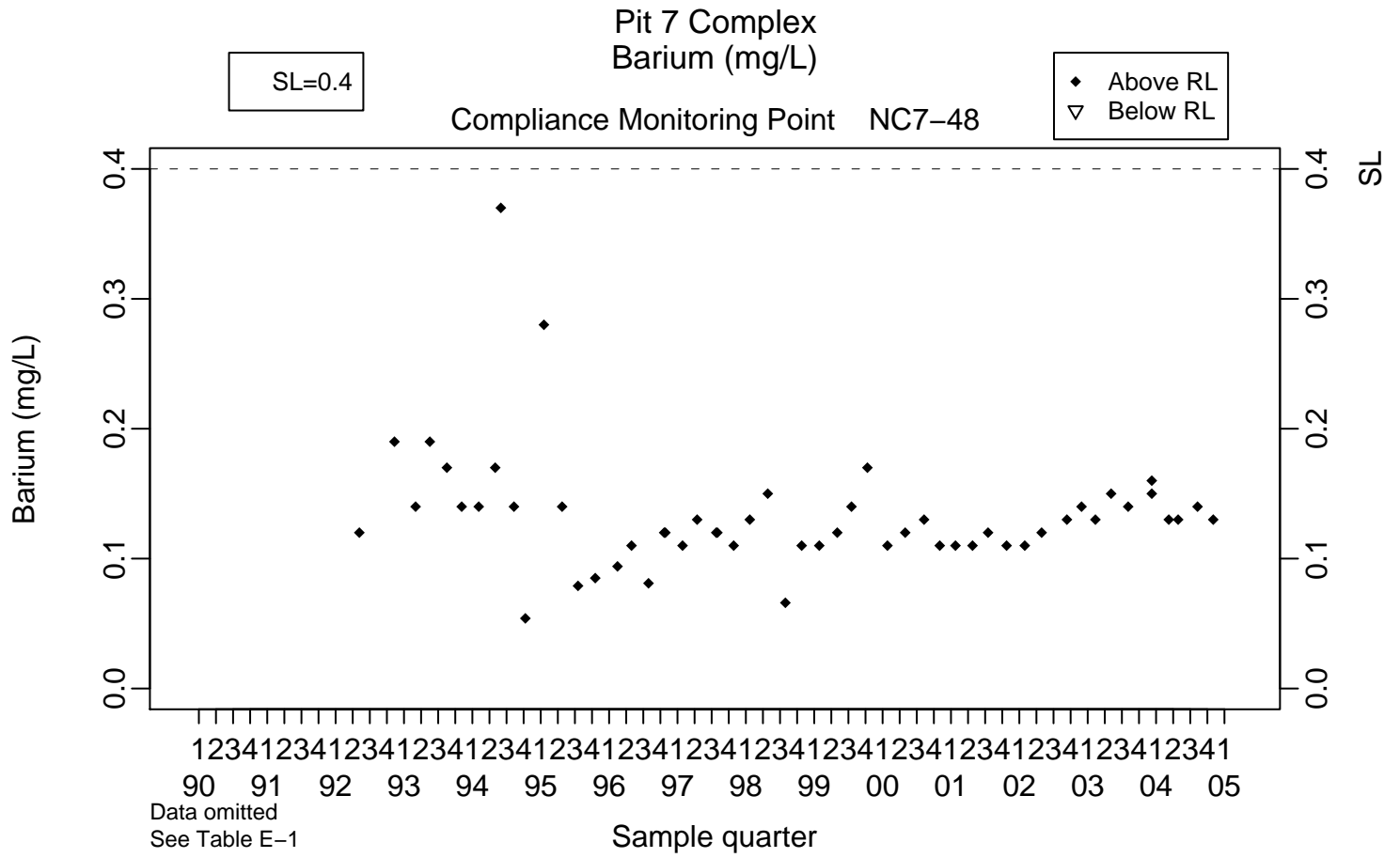
- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.063

Compliance Monitoring Point NC7-47



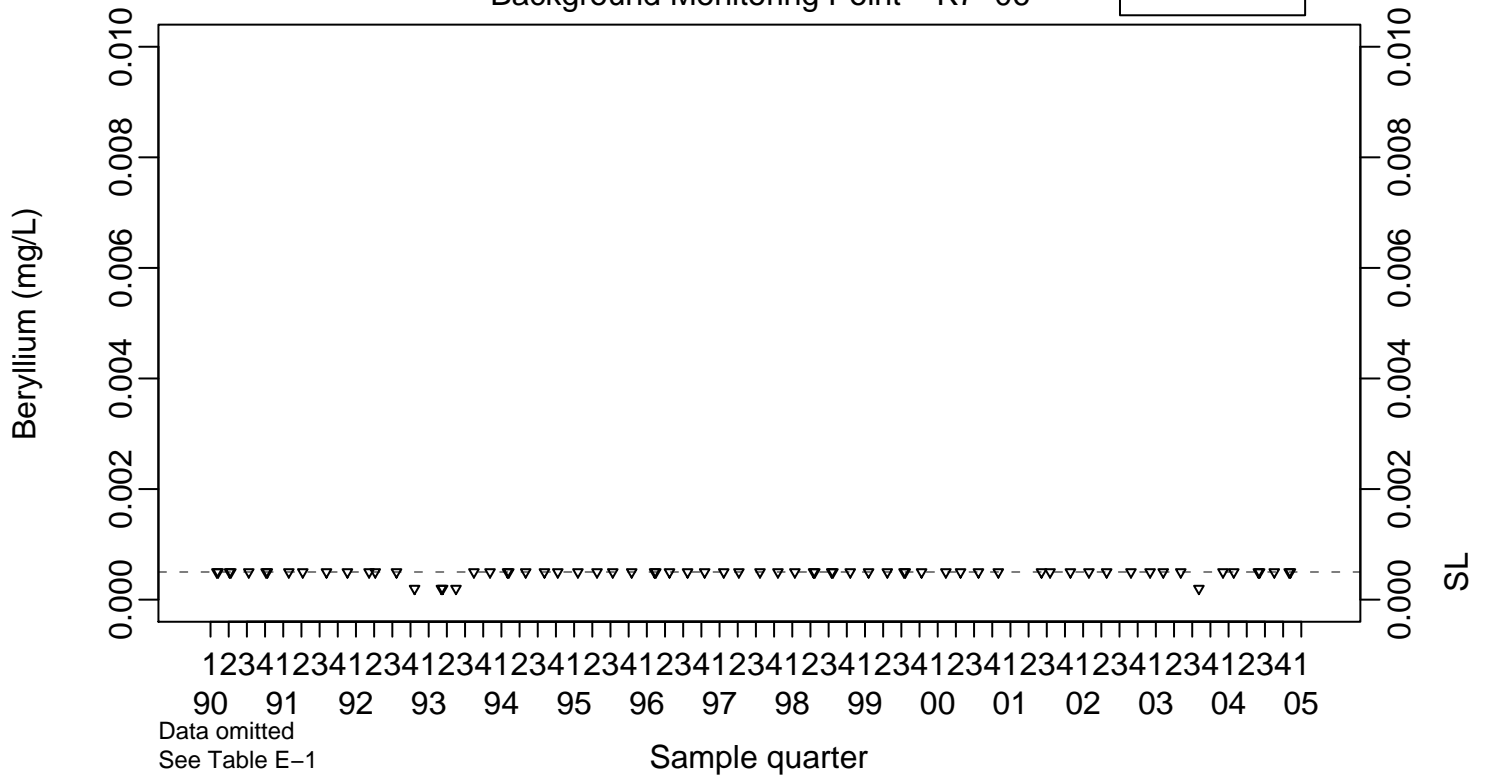


Pit 7 Complex Beryllium (mg/L)

Background Monitoring Point K7-06

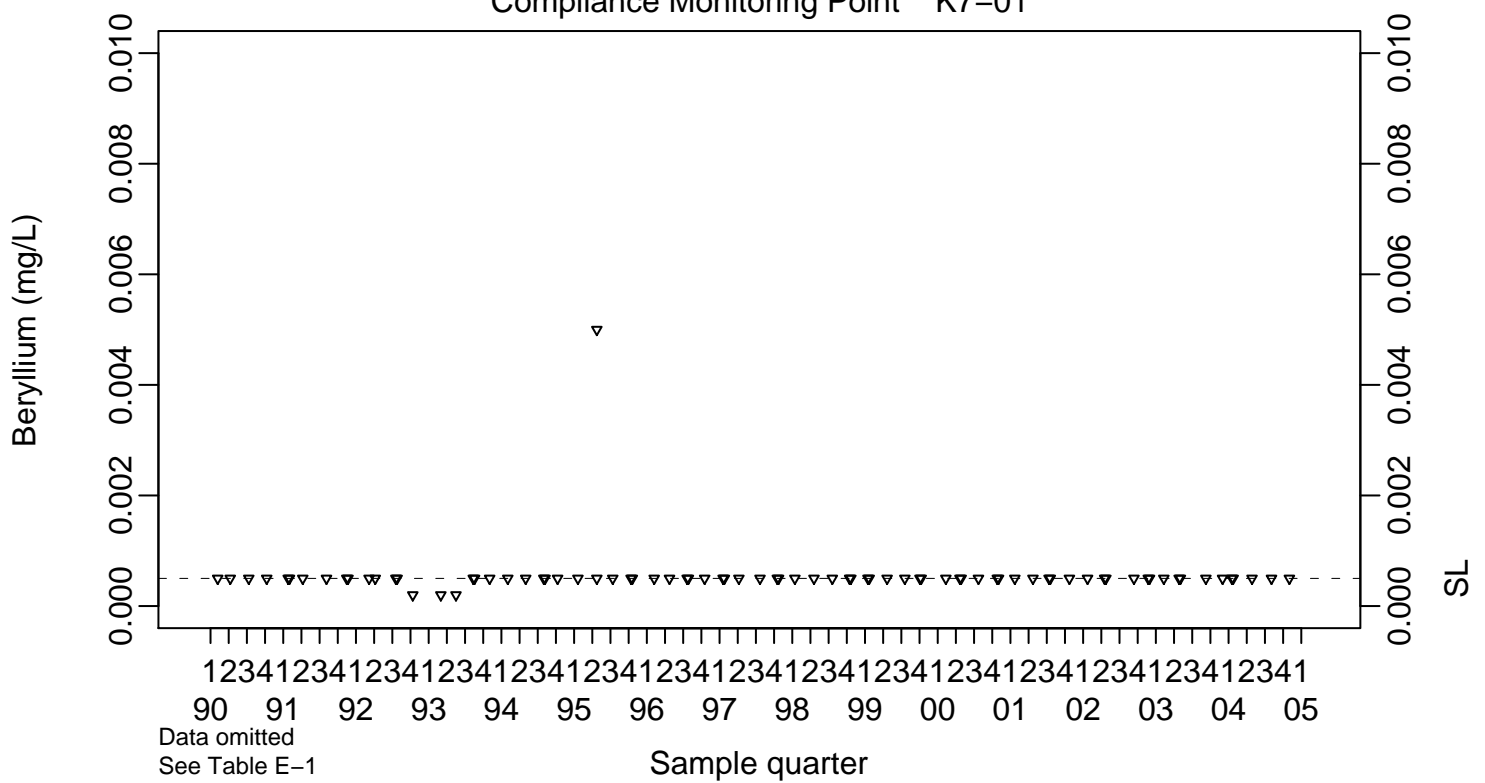
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point K7-01

SL=5e-04

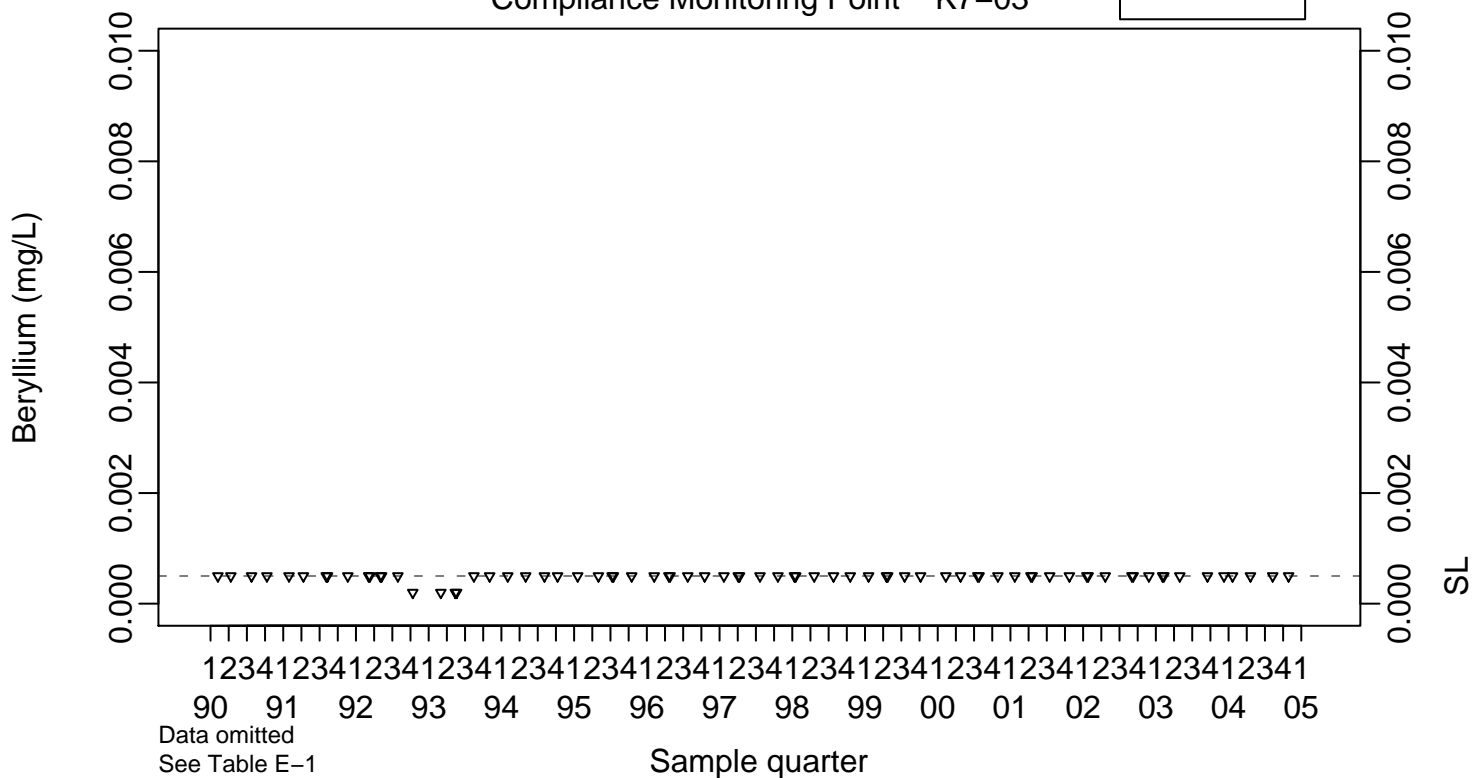


Pit 7 Complex Beryllium (mg/L)

Compliance Monitoring Point K7-03

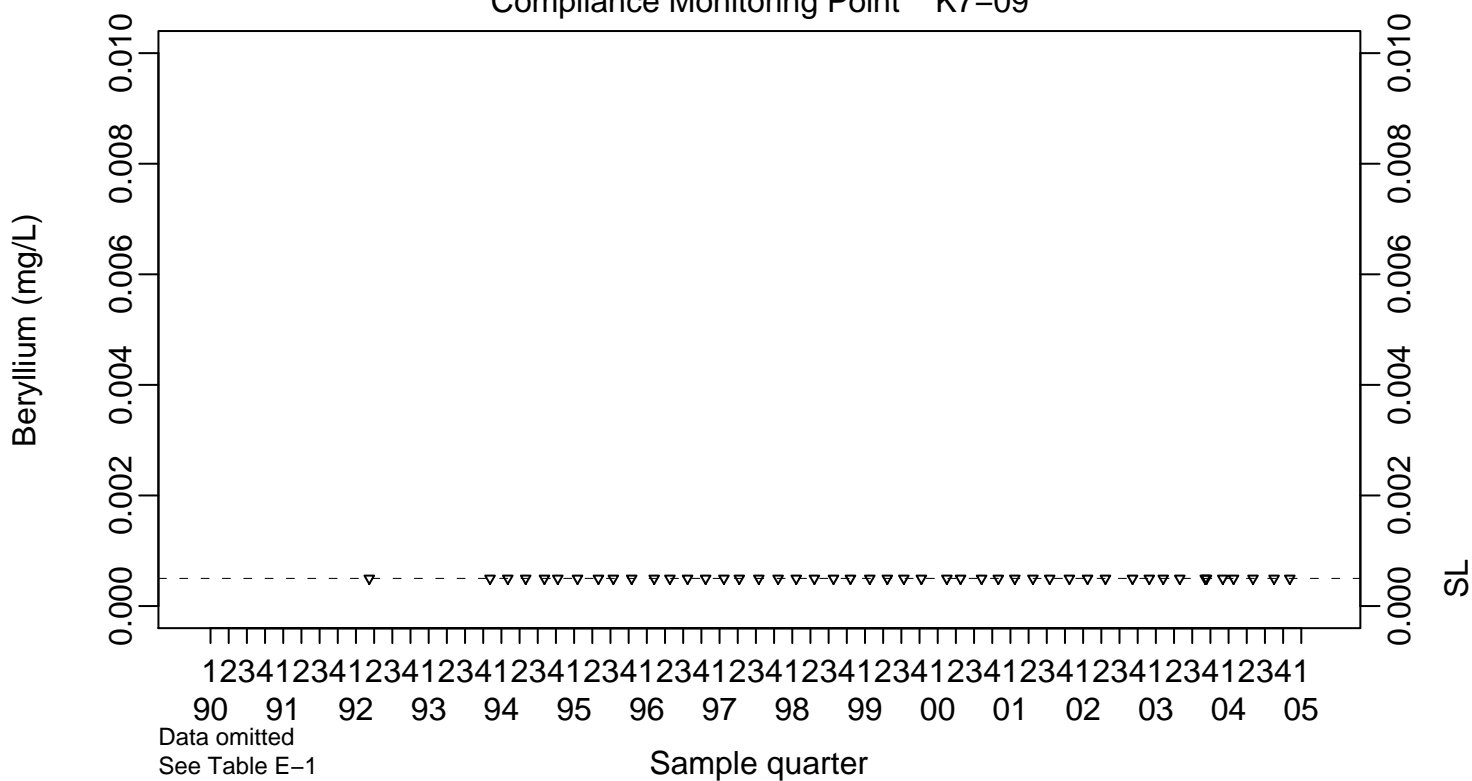
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point K7-09

SL=5e-04

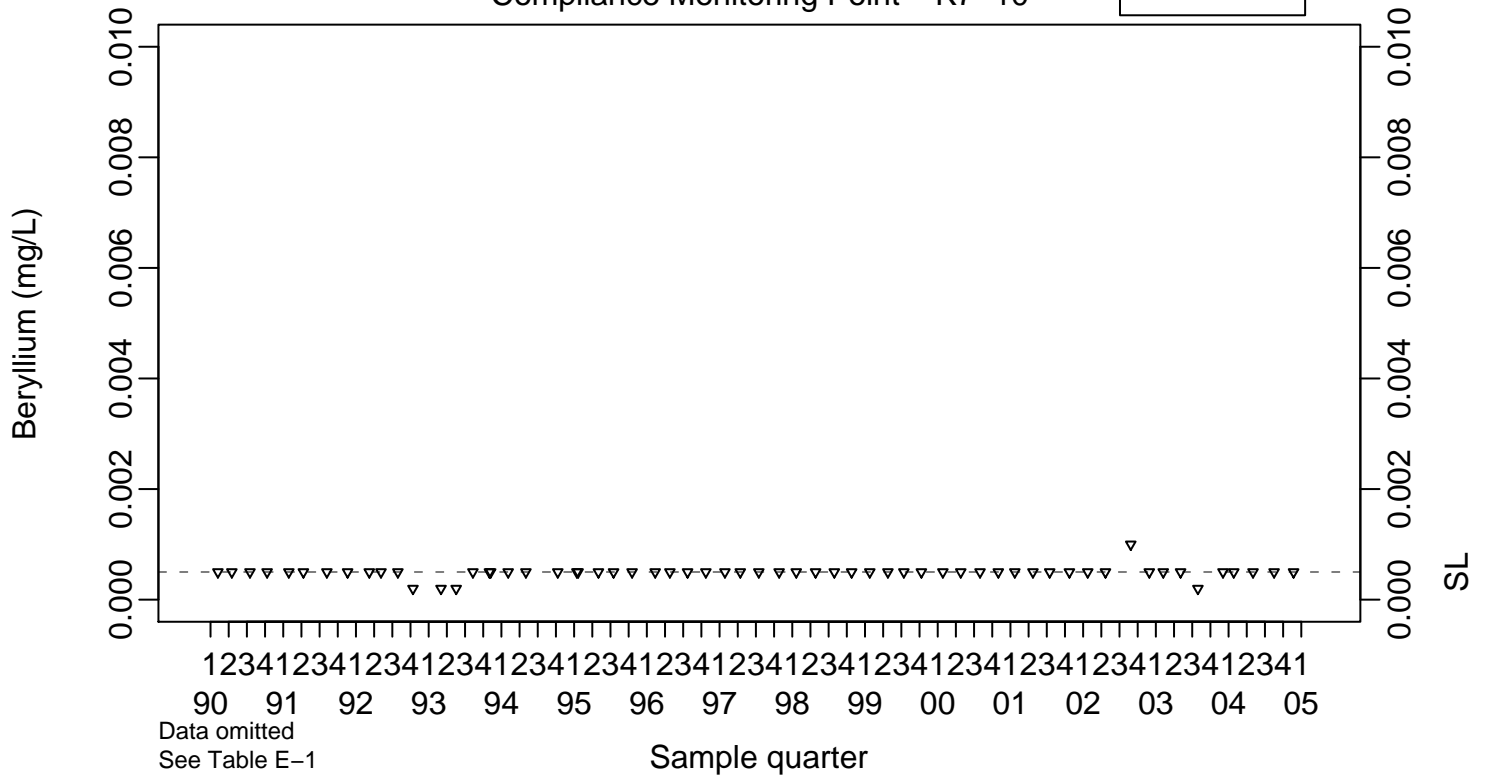


Pit 7 Complex Beryllium (mg/L)

Compliance Monitoring Point K7-10

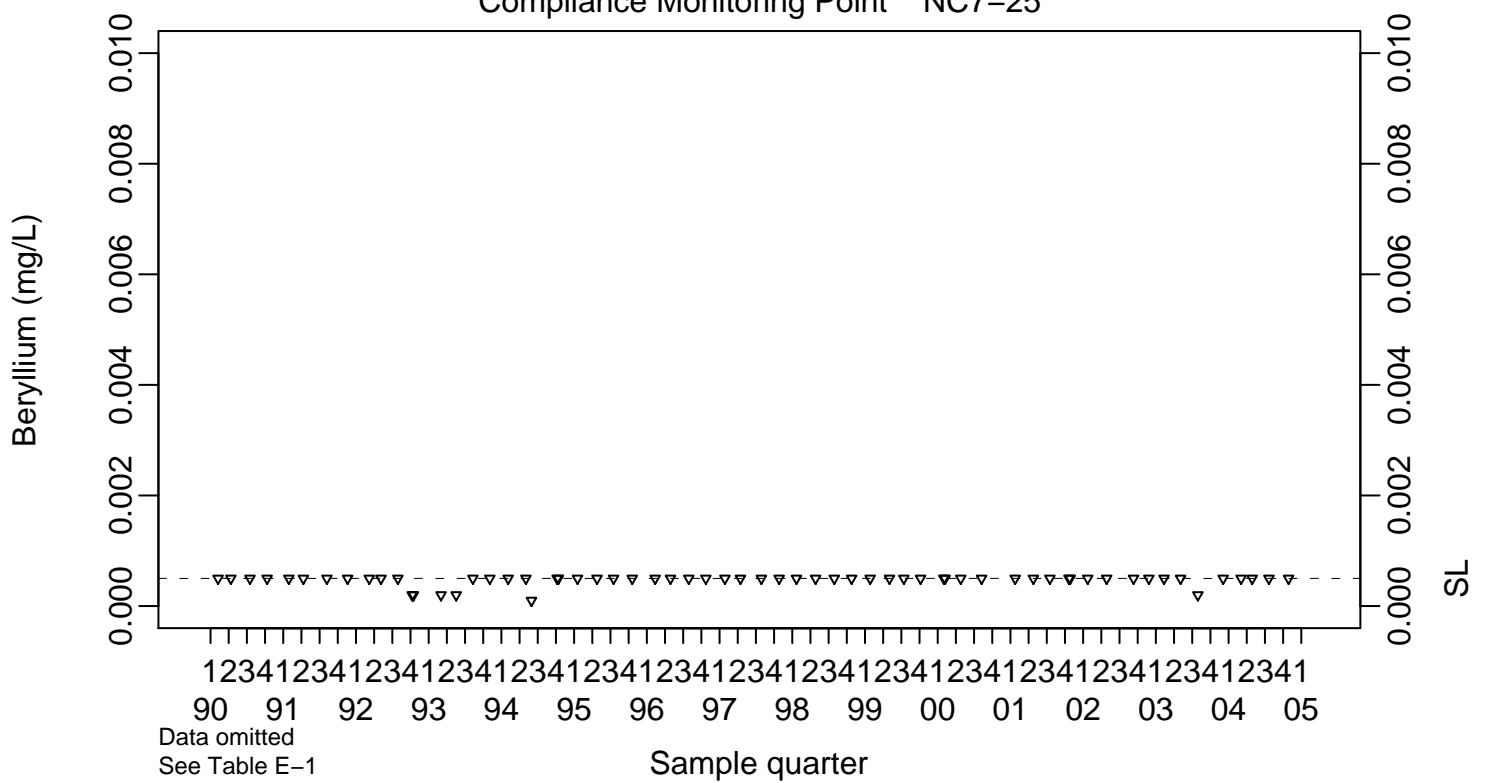
SL=5e-04

◆ Above RL
▽ Below RL



Compliance Monitoring Point NC7-25

SL=5e-04

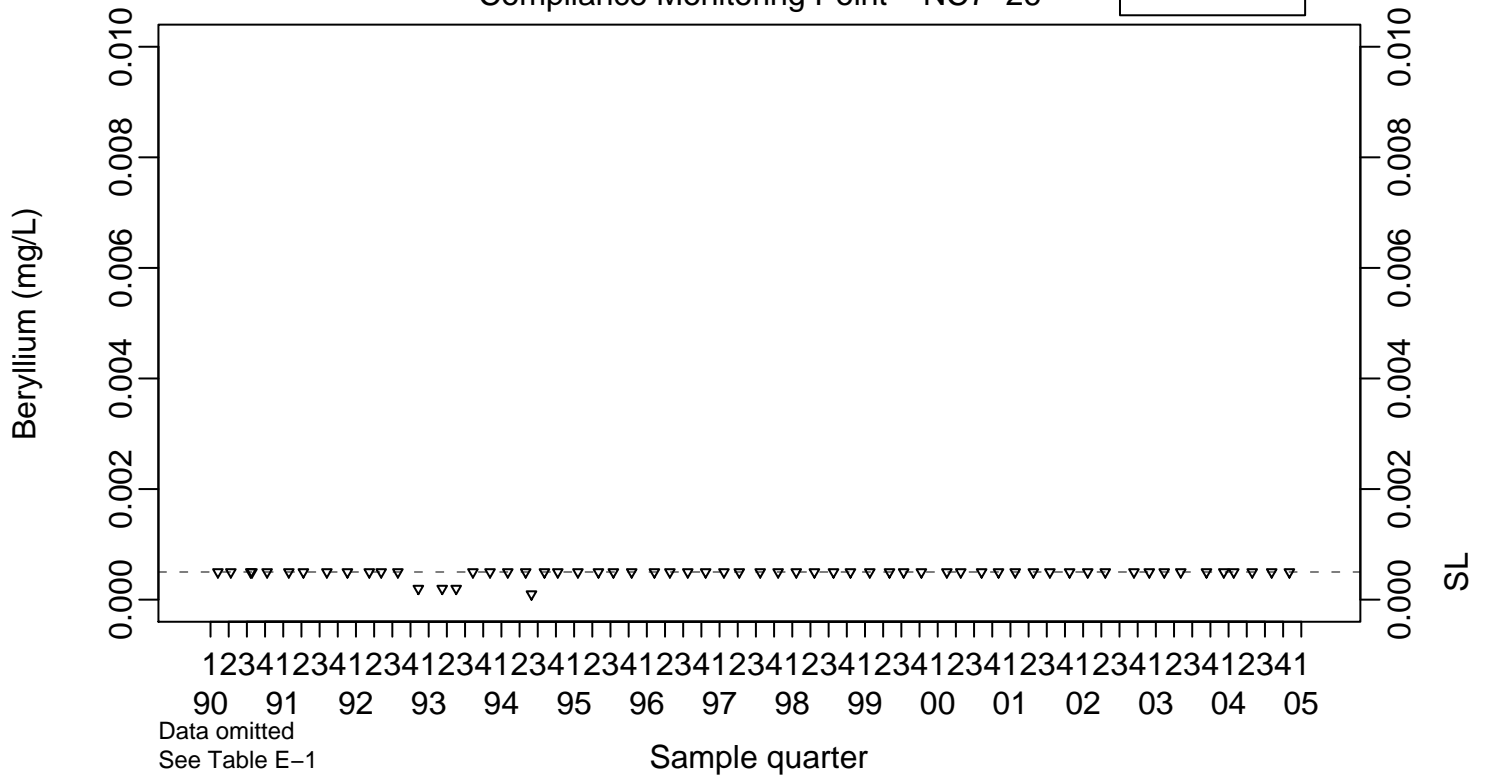


Pit 7 Complex Beryllium (mg/L)

Compliance Monitoring Point NC7-26

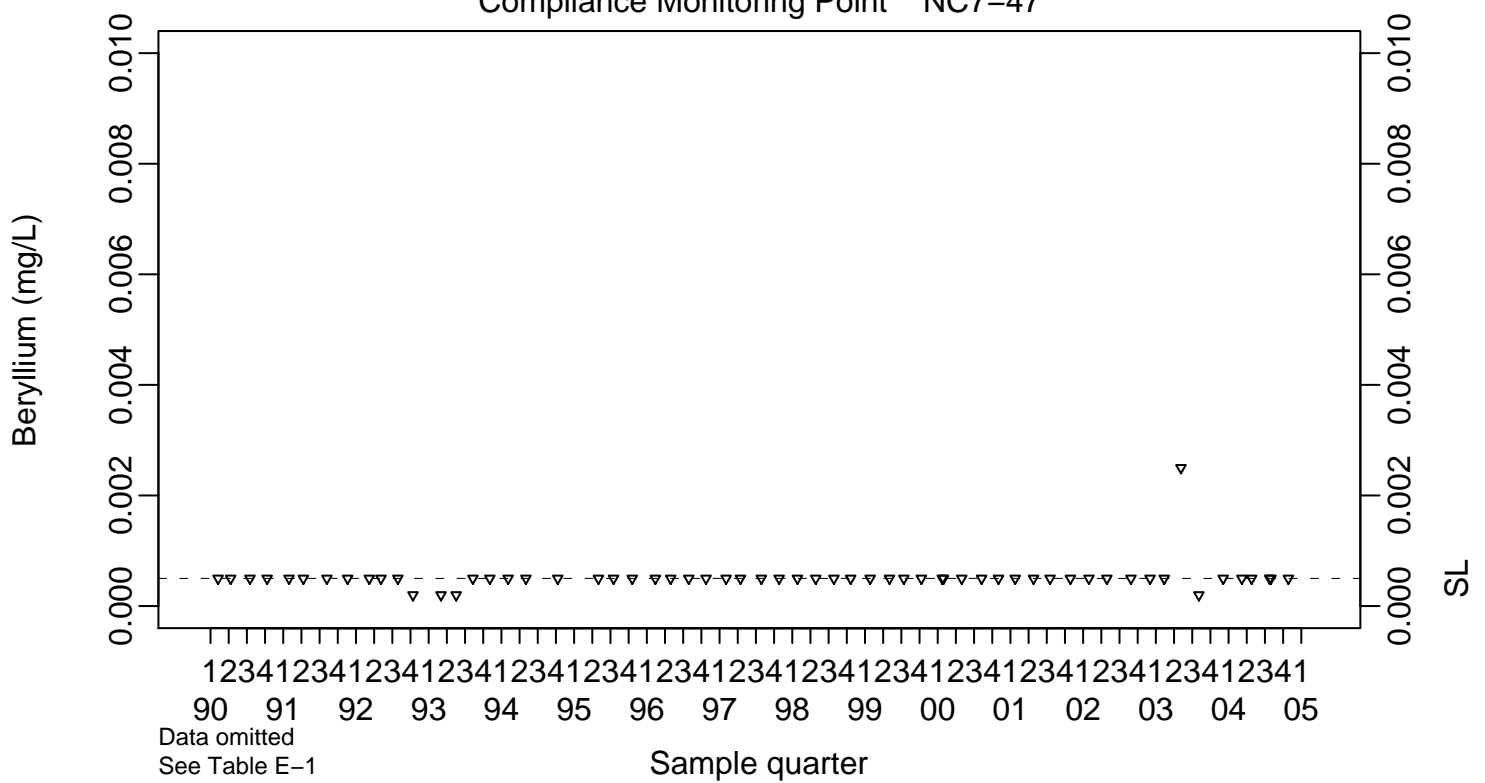
SL=5e-04

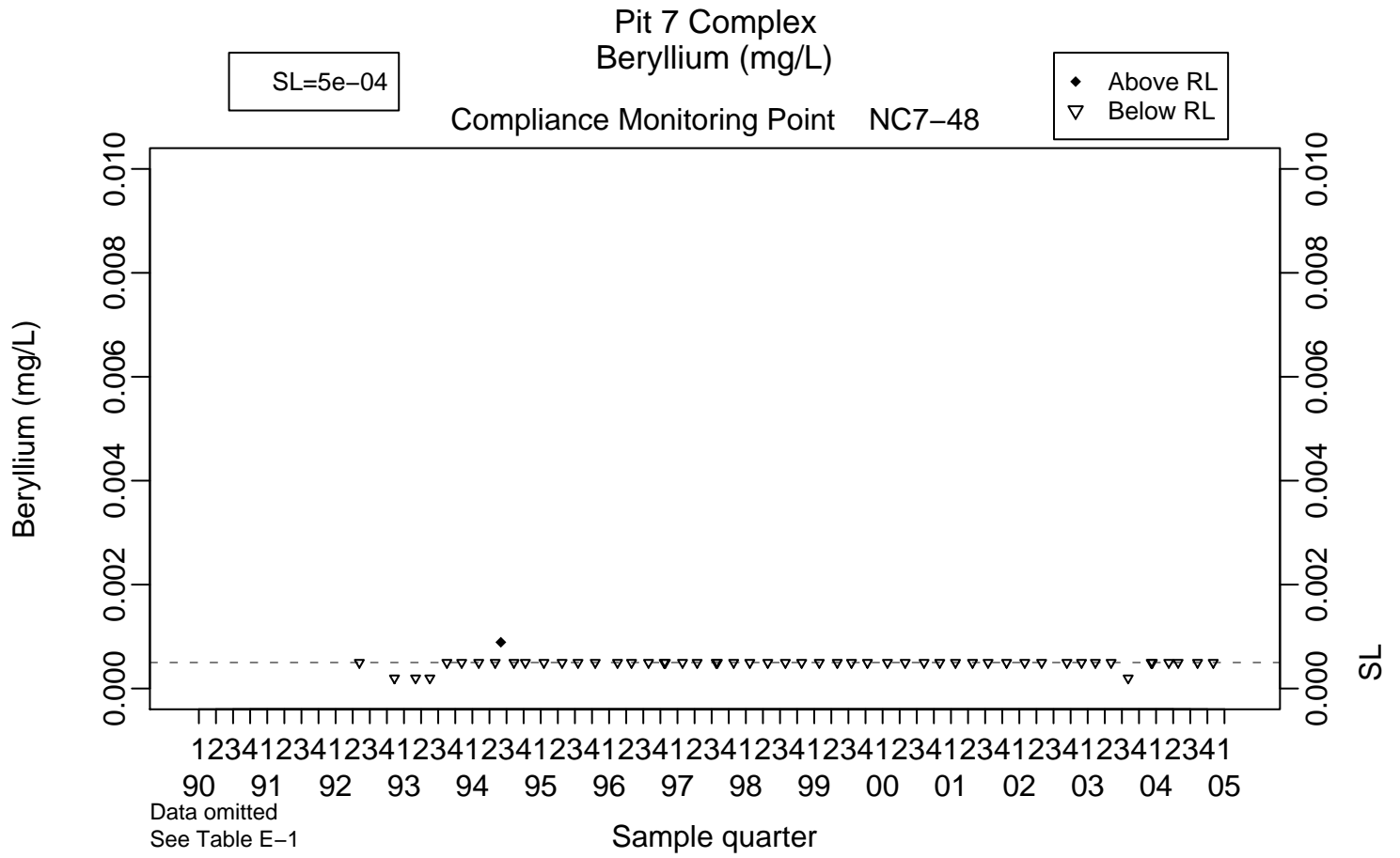
◆ Above RL
▽ Below RL



Compliance Monitoring Point NC7-47

SL=5e-04

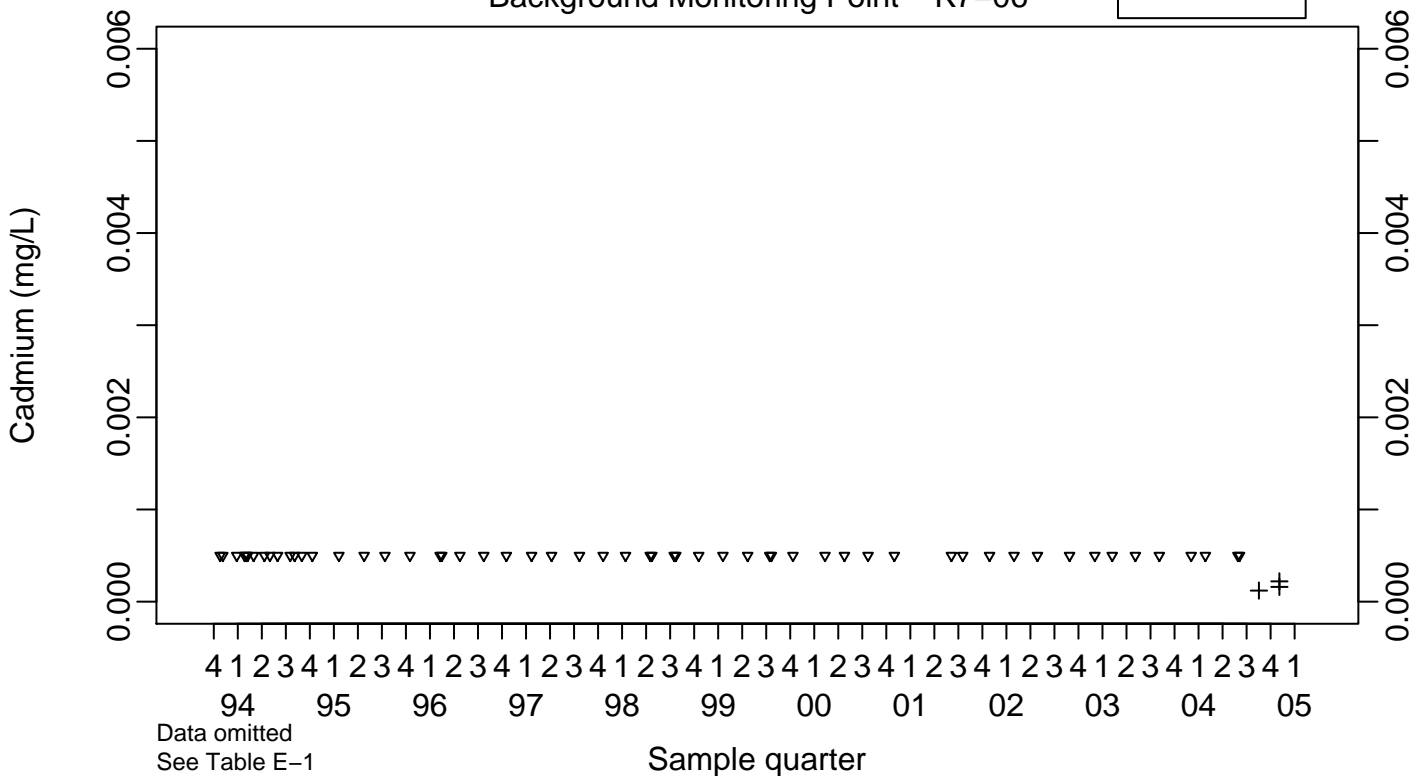




Pit 7 Complex
Cadmium (mg/L)

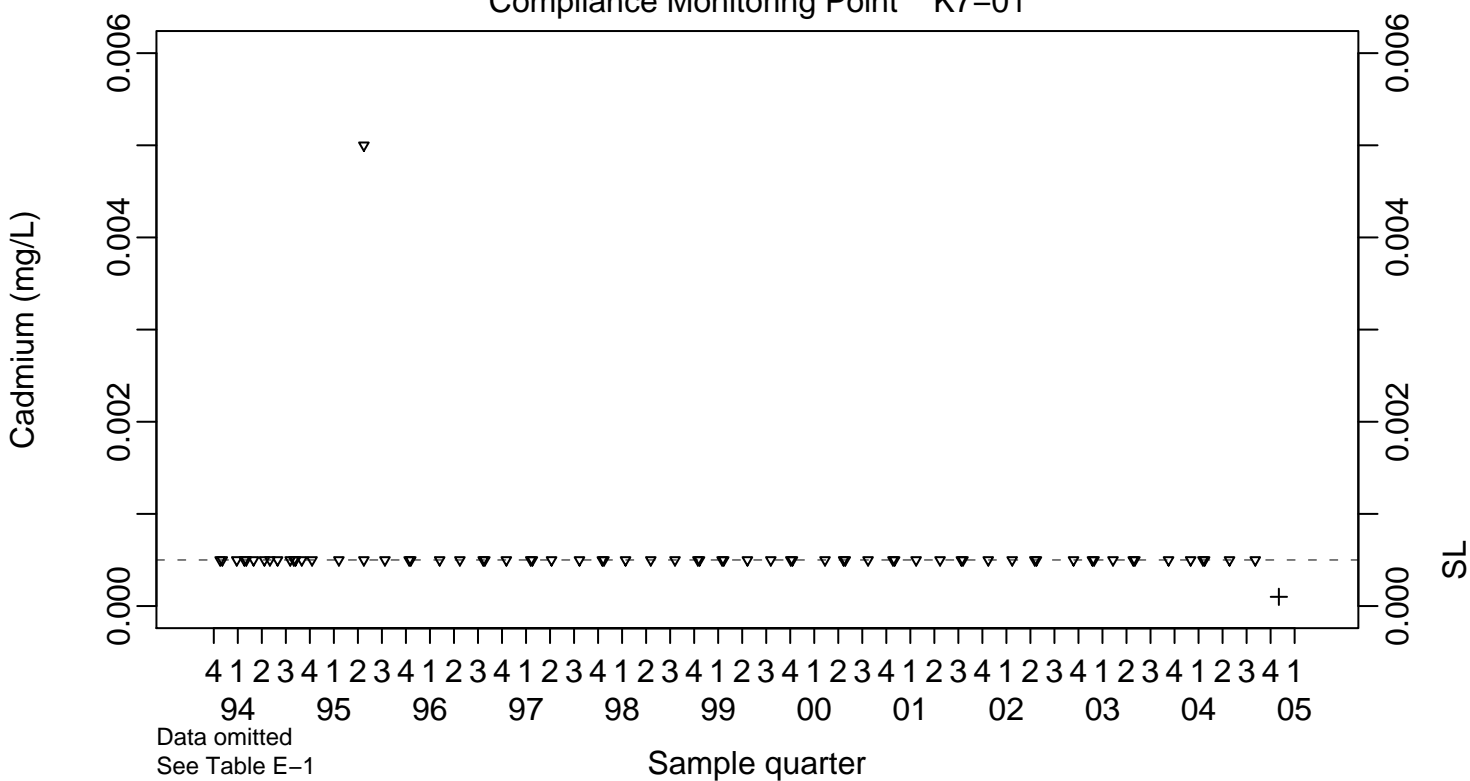
Background Monitoring Point K7-06

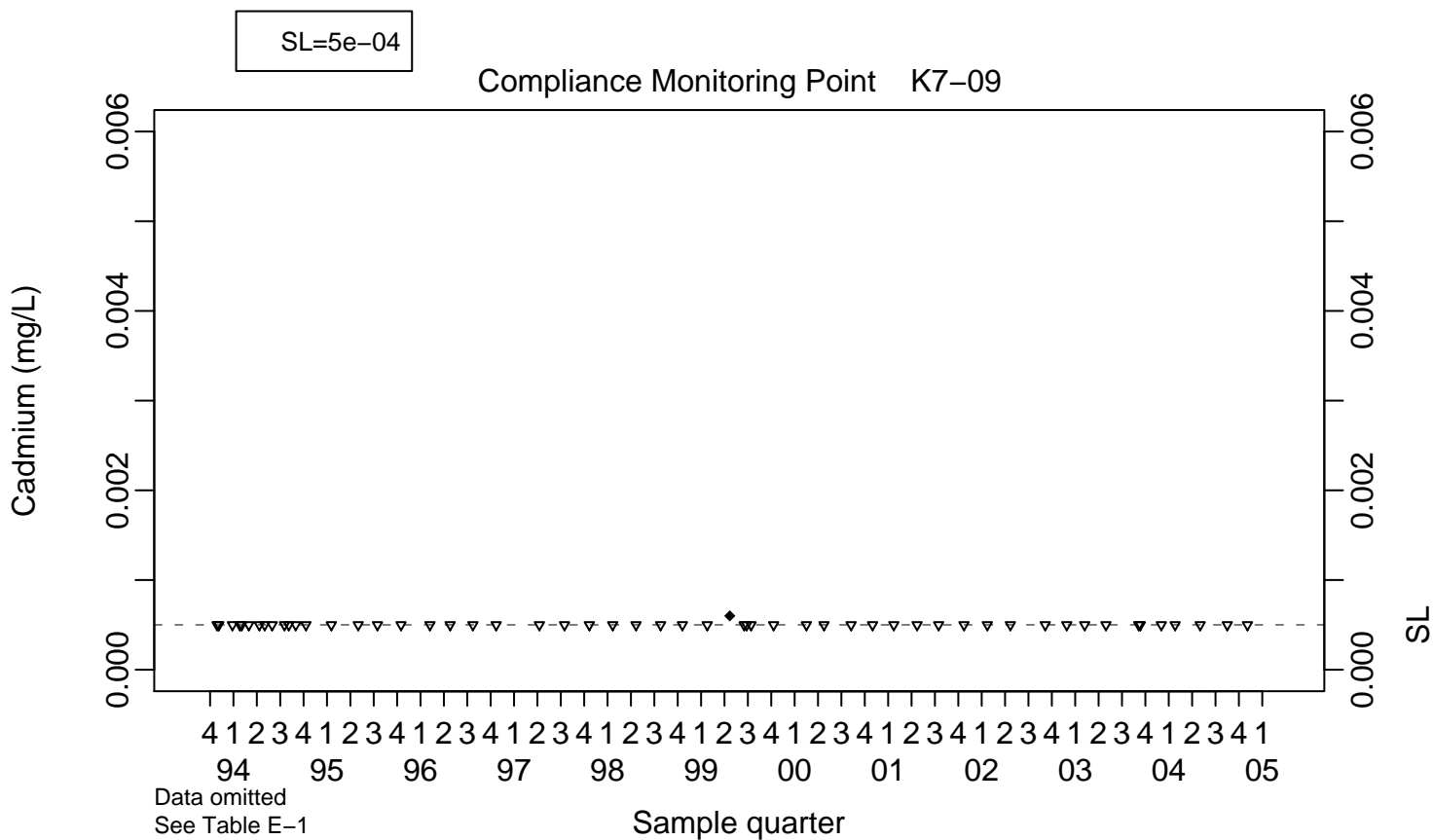
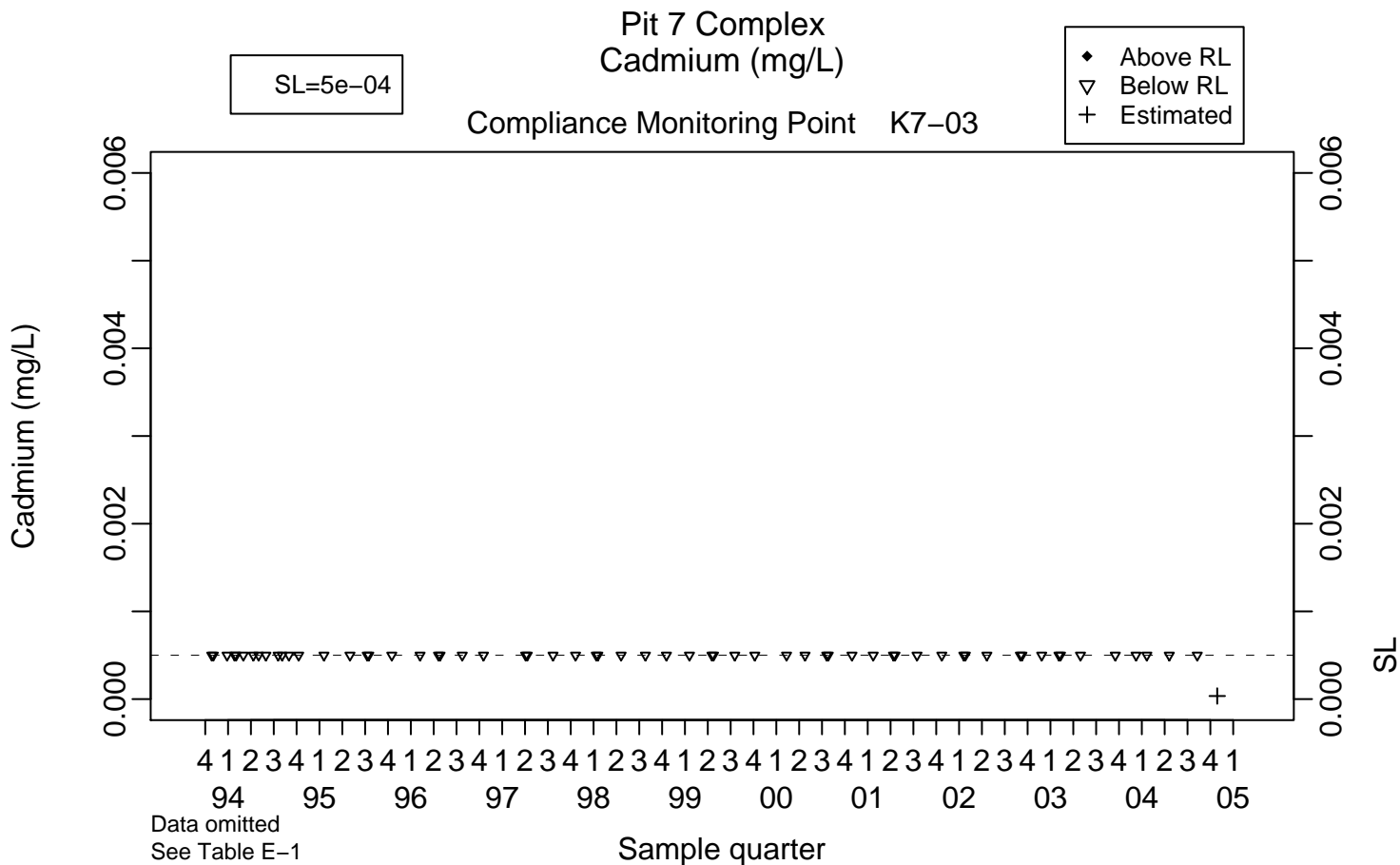
- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=5e-04

Compliance Monitoring Point K7-01



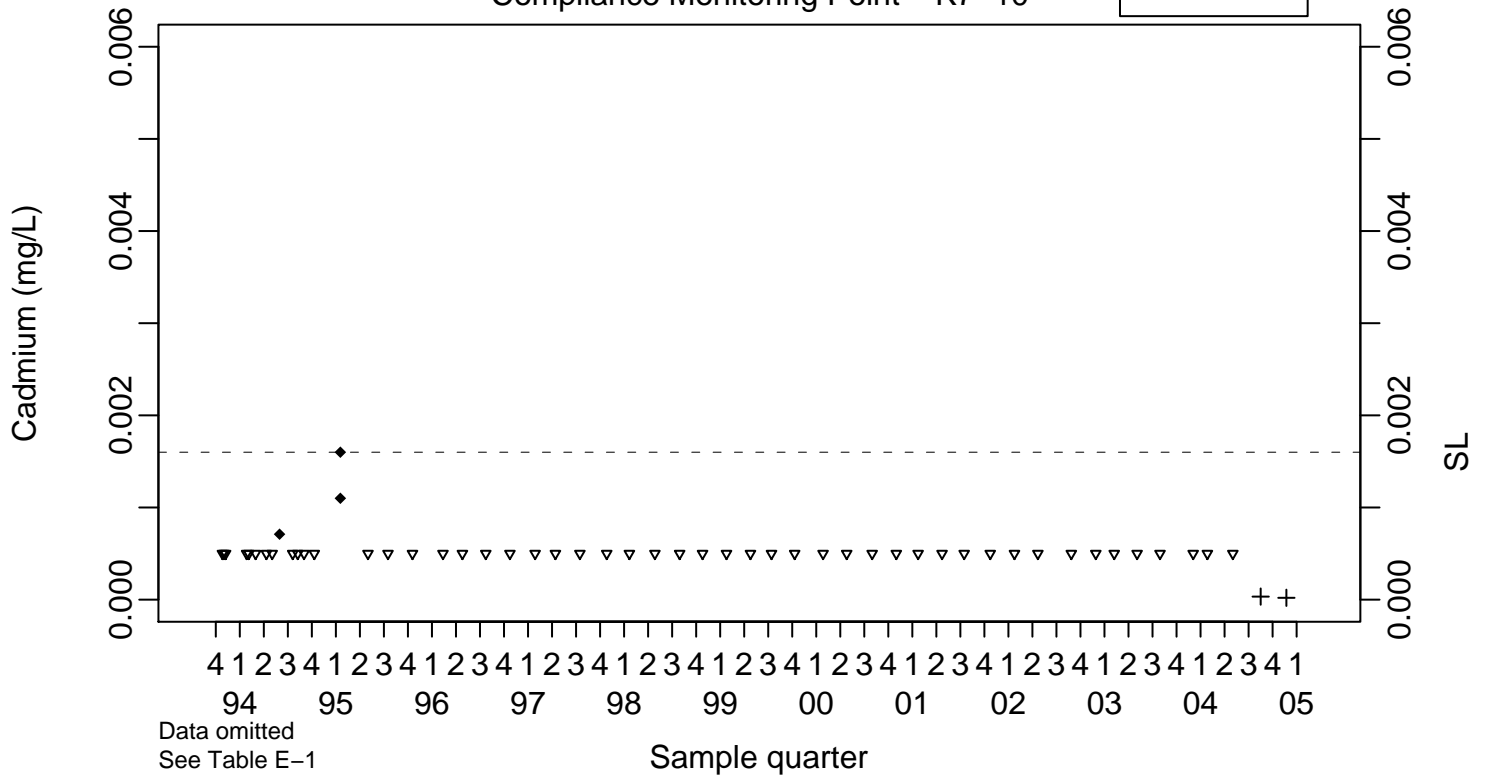


Pit 7 Complex Cadmium (mg/L)

Compliance Monitoring Point K7-10

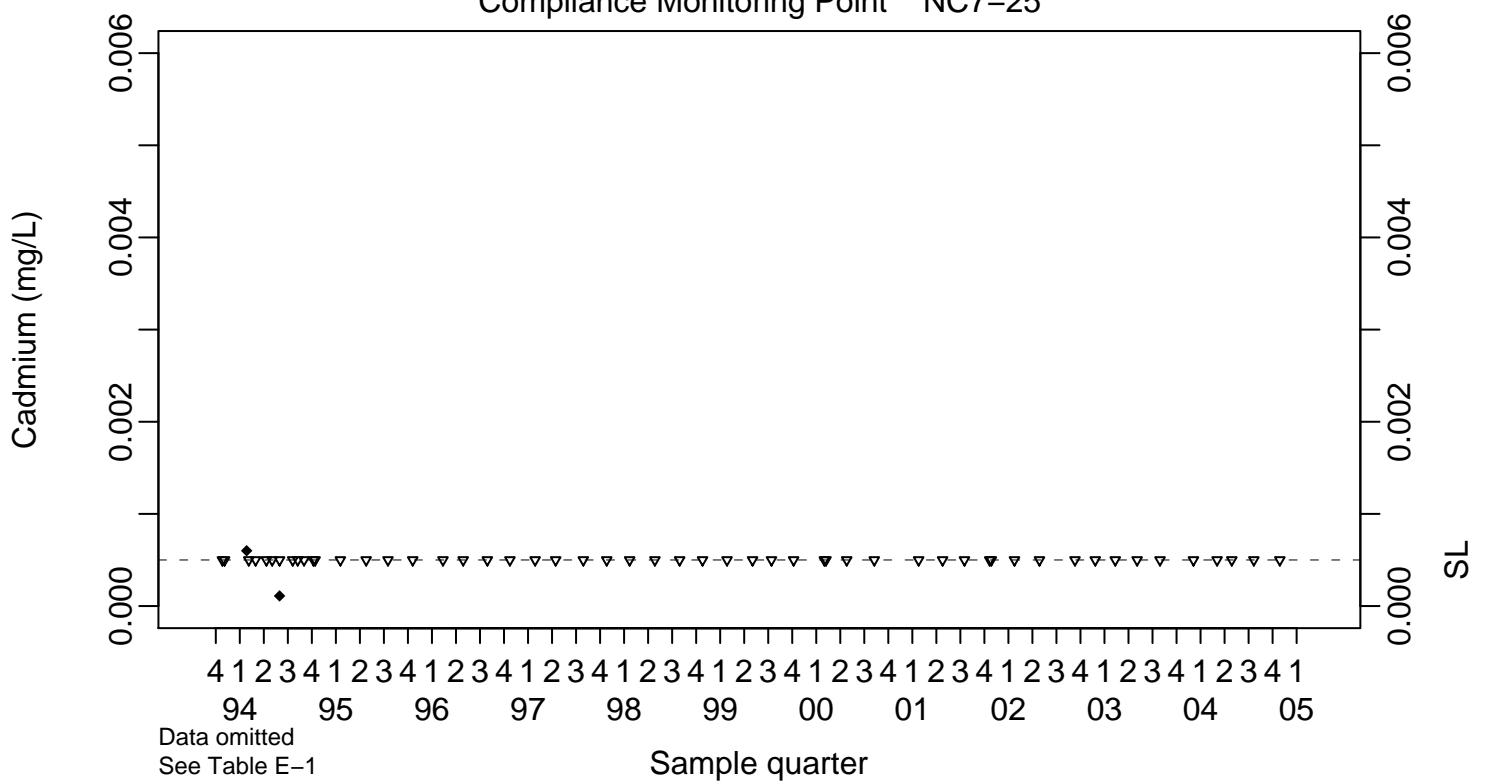
SL=0.0016

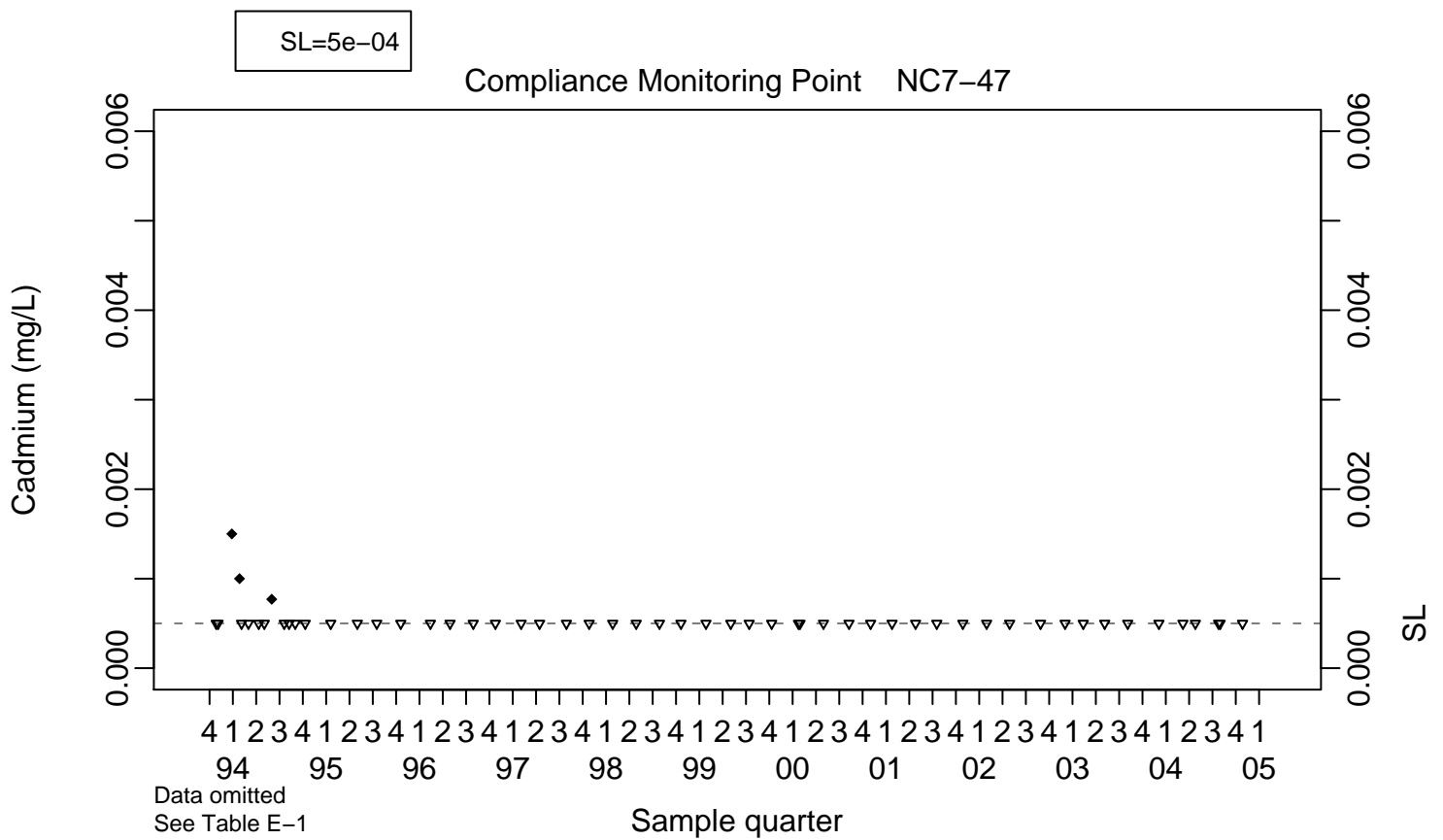
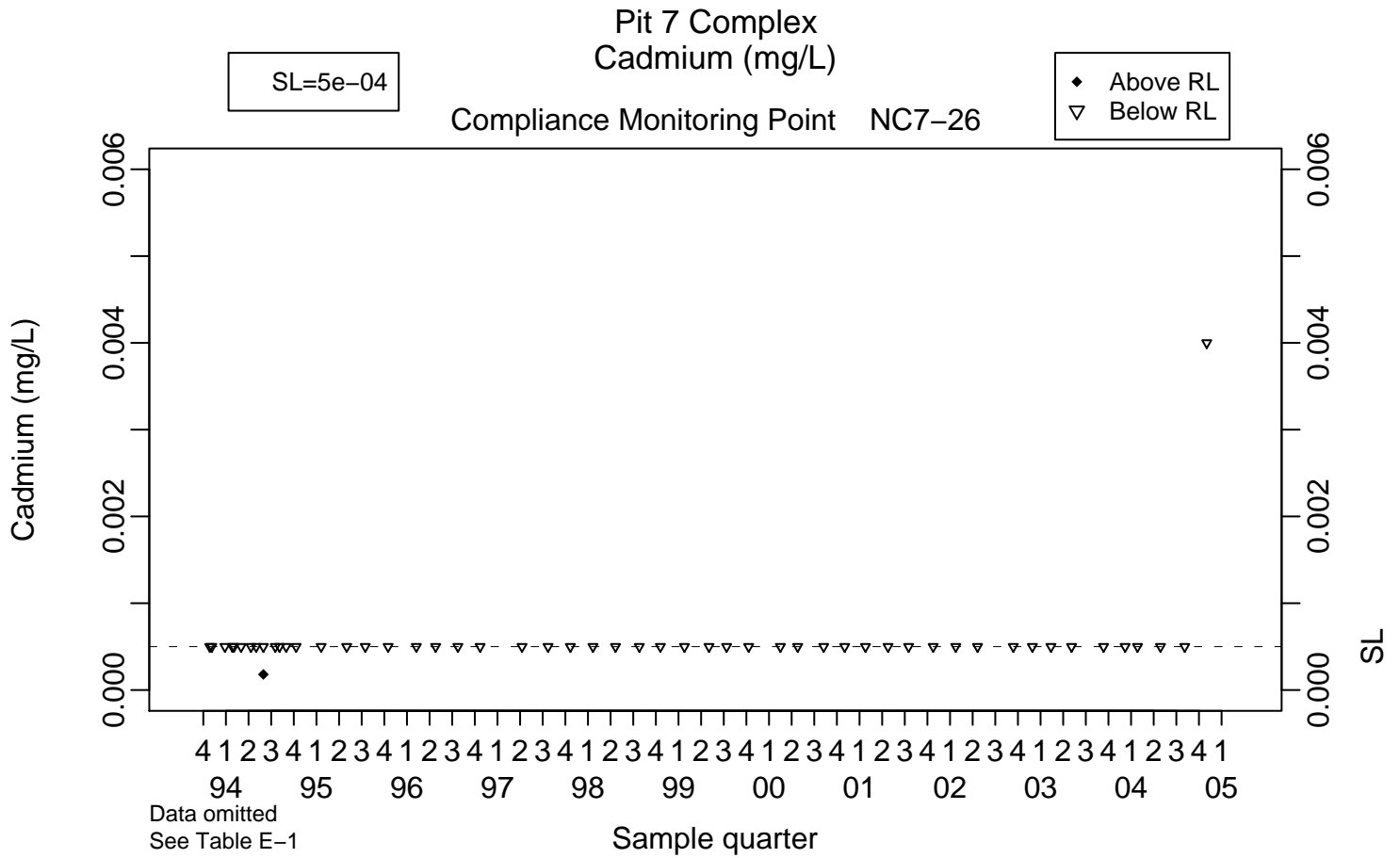
- ◆ Above RL
- ▽ Below RL
- + Estimated

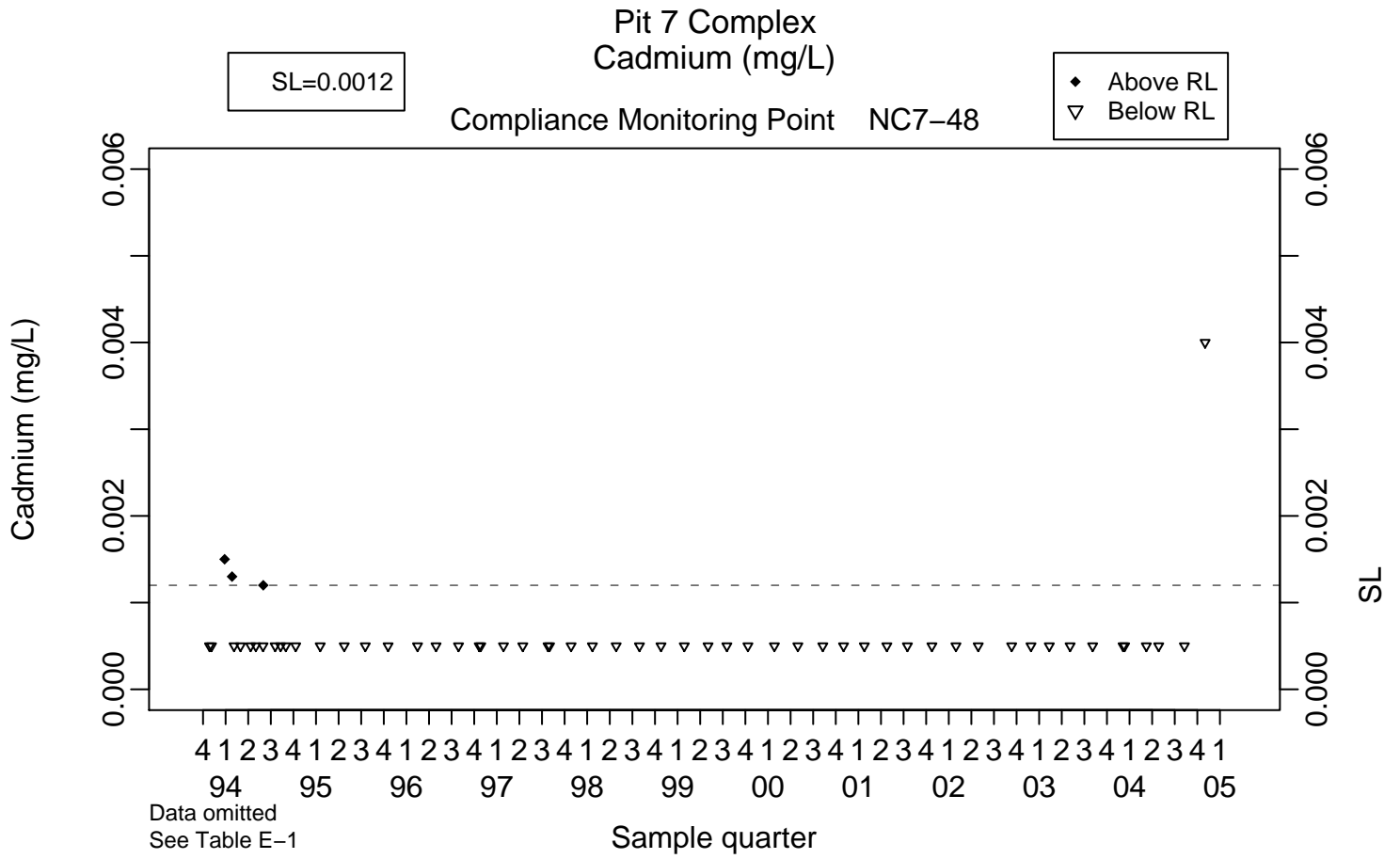


Compliance Monitoring Point NC7-25

SL=5e-04





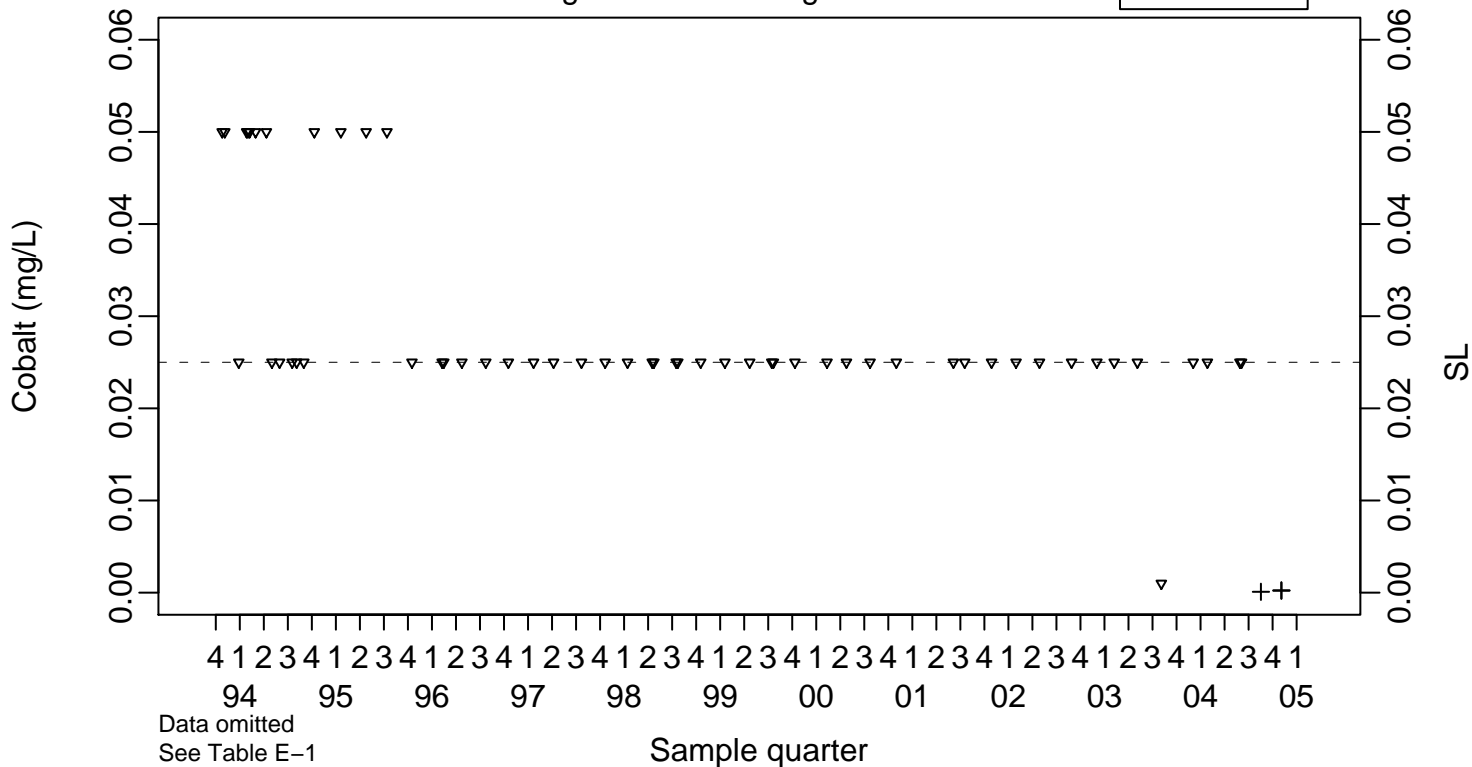


Pit 7 Complex Cobalt (mg/L)

SL=0.025

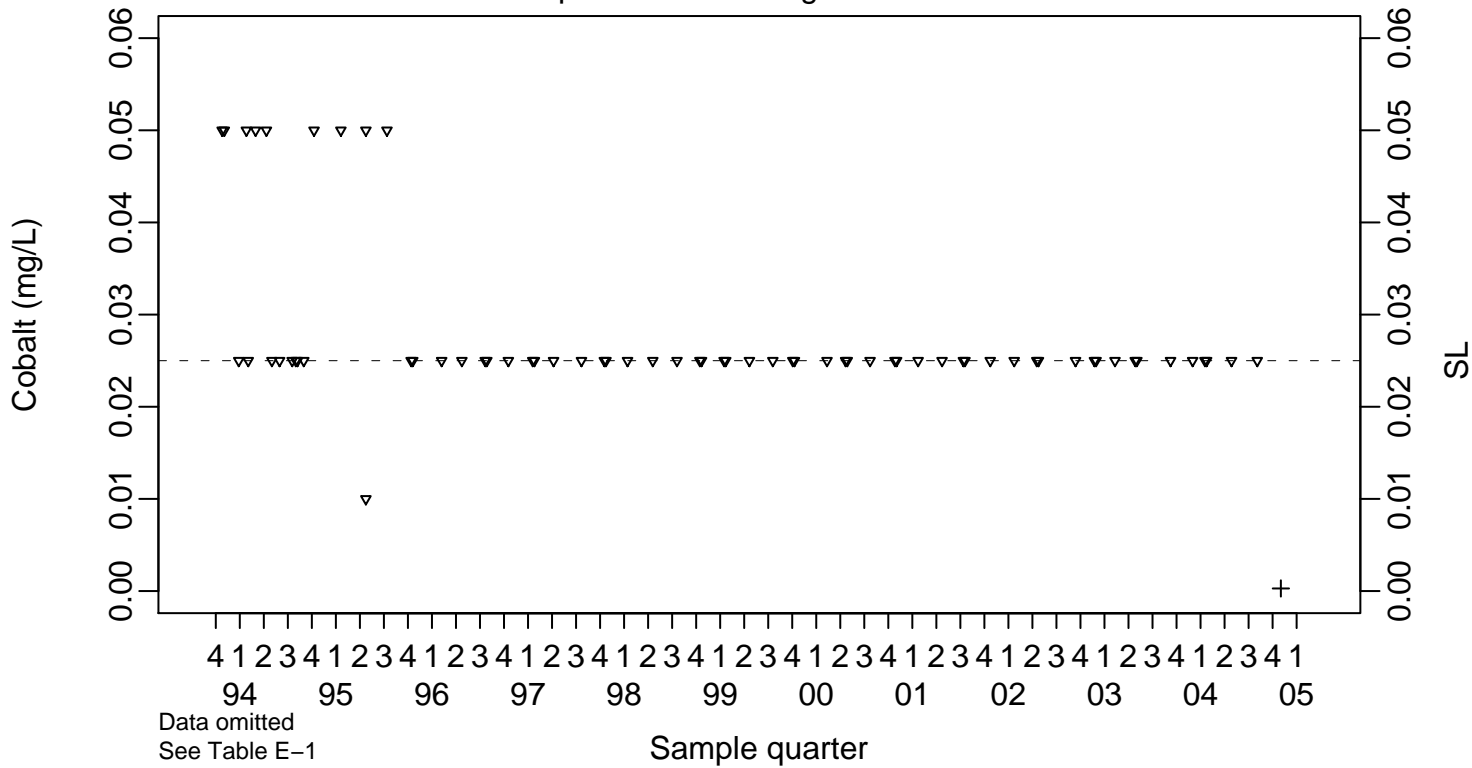
- ◆ Above RL
- ▽ Below RL
- + Estimated

Background Monitoring Point K7-06



SL=0.025

Compliance Monitoring Point K7-01

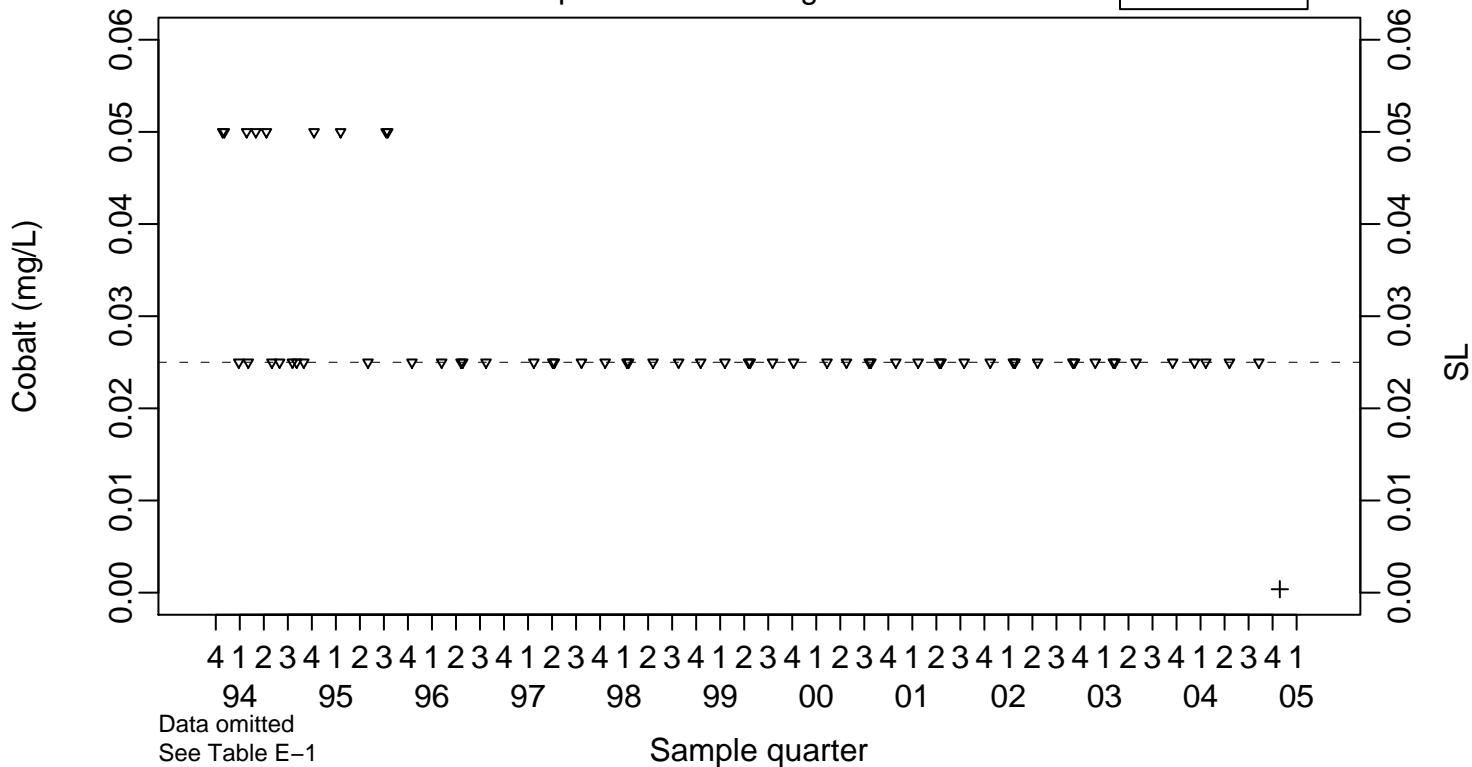


Pit 7 Complex Cobalt (mg/L)

Compliance Monitoring Point K7-03

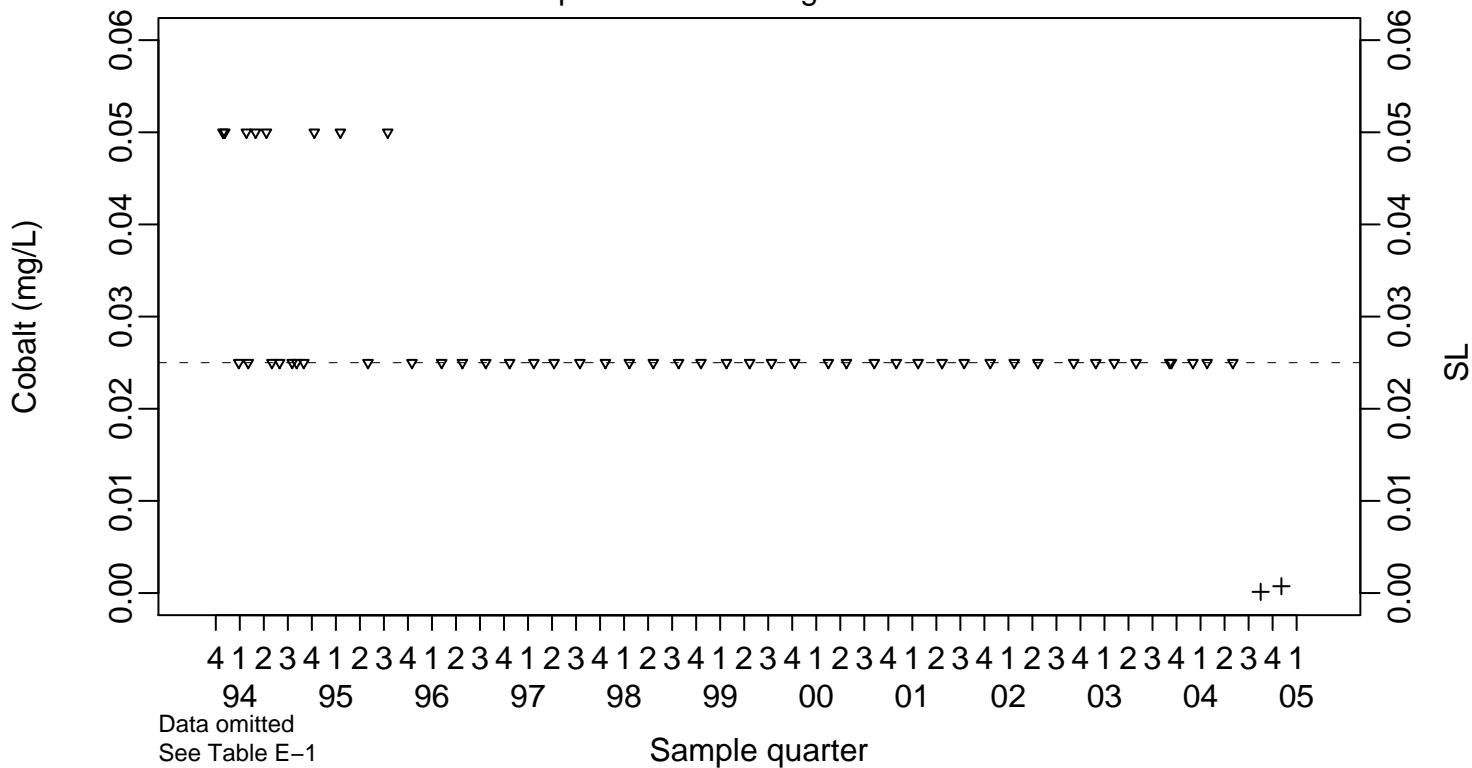
SL=0.025

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point K7-09

SL=0.025

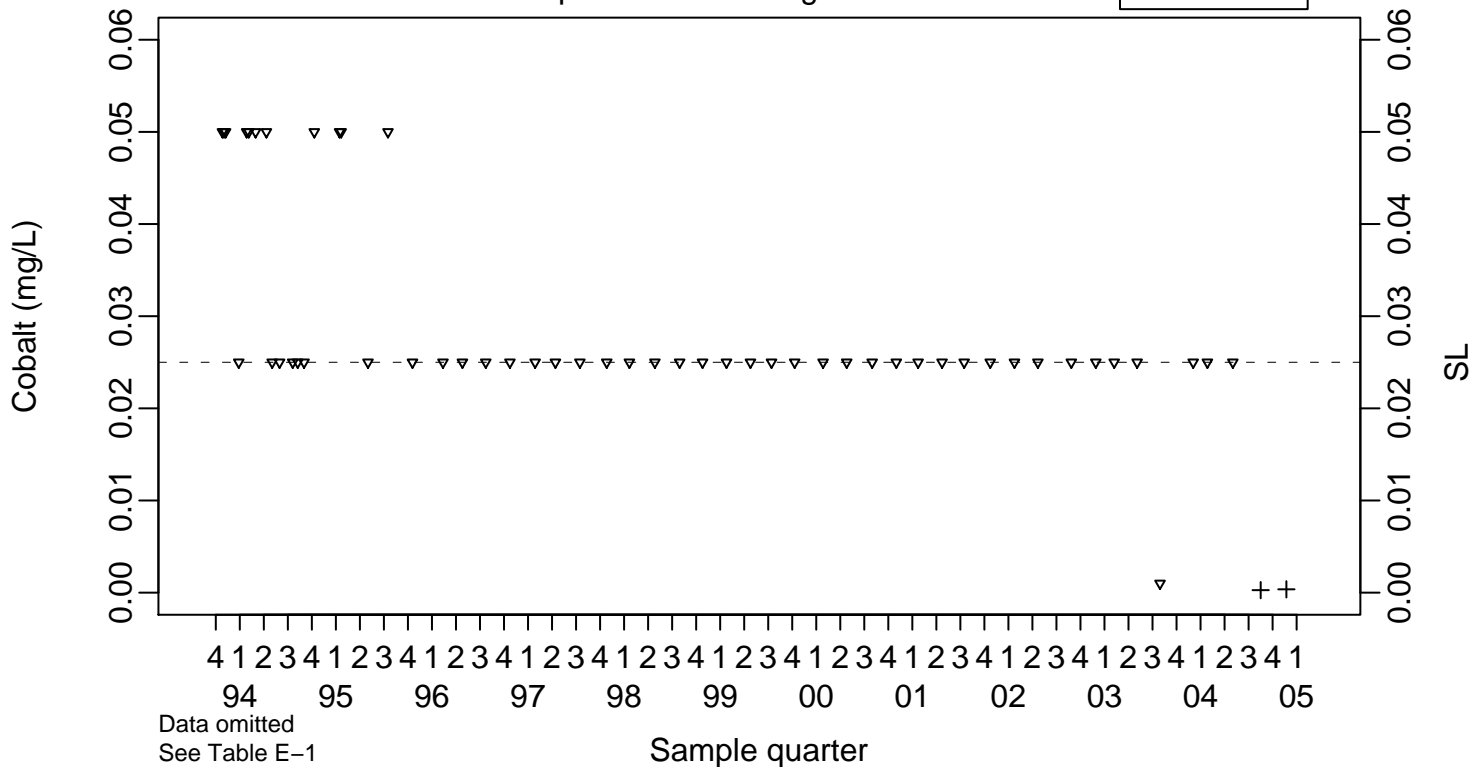


Pit 7 Complex
Cobalt (mg/L)

Compliance Monitoring Point K7-10

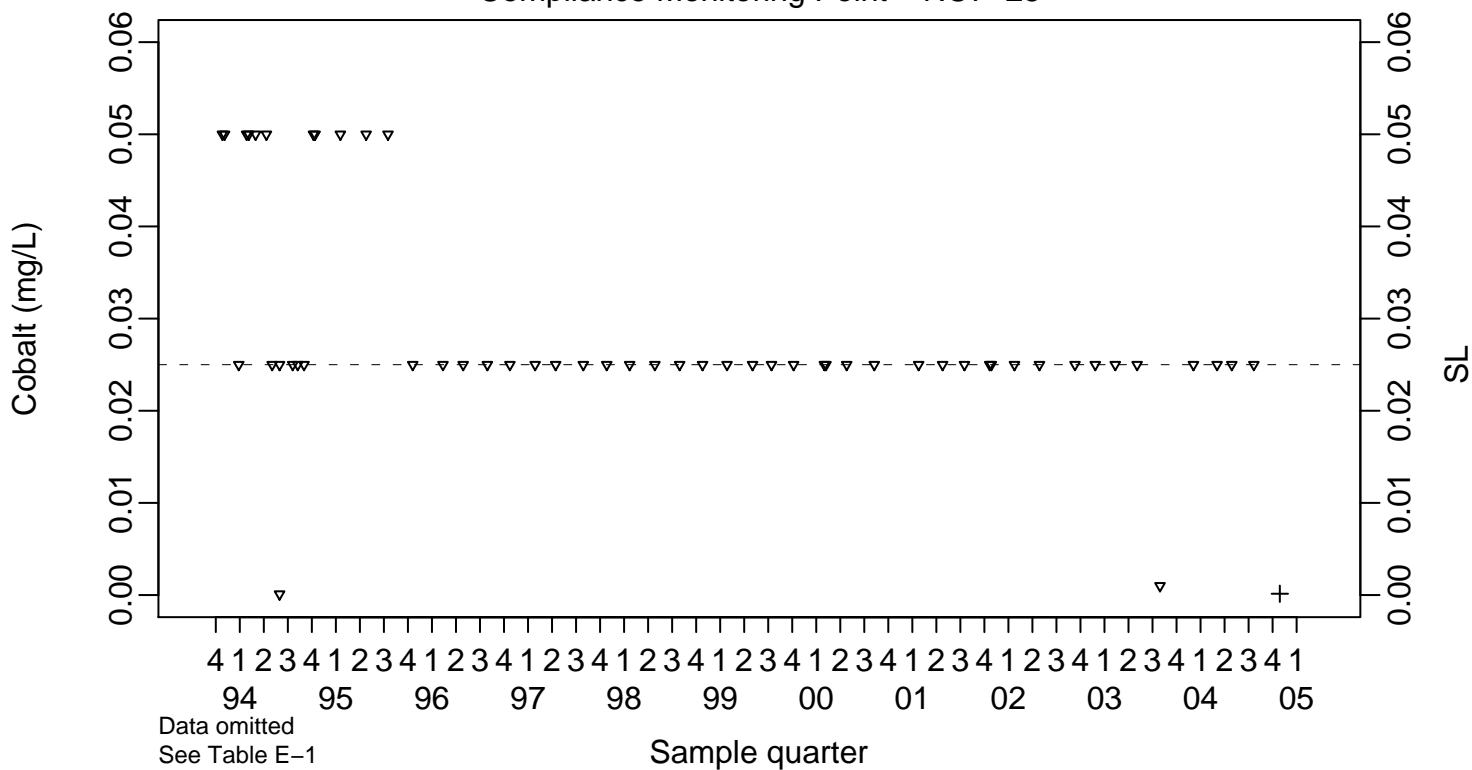
SL=0.025

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-25

SL=0.025

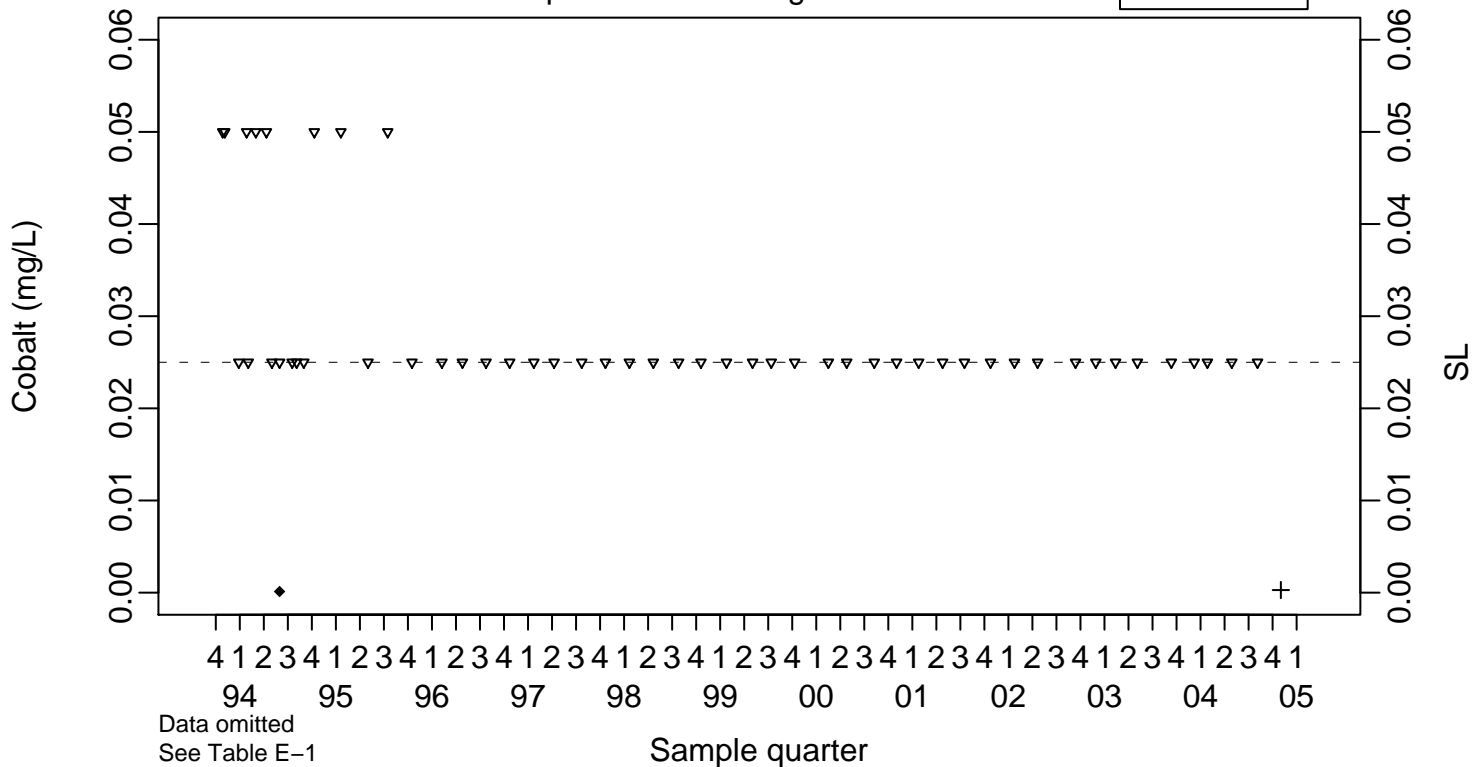


Pit 7 Complex Cobalt (mg/L)

Compliance Monitoring Point NC7-26

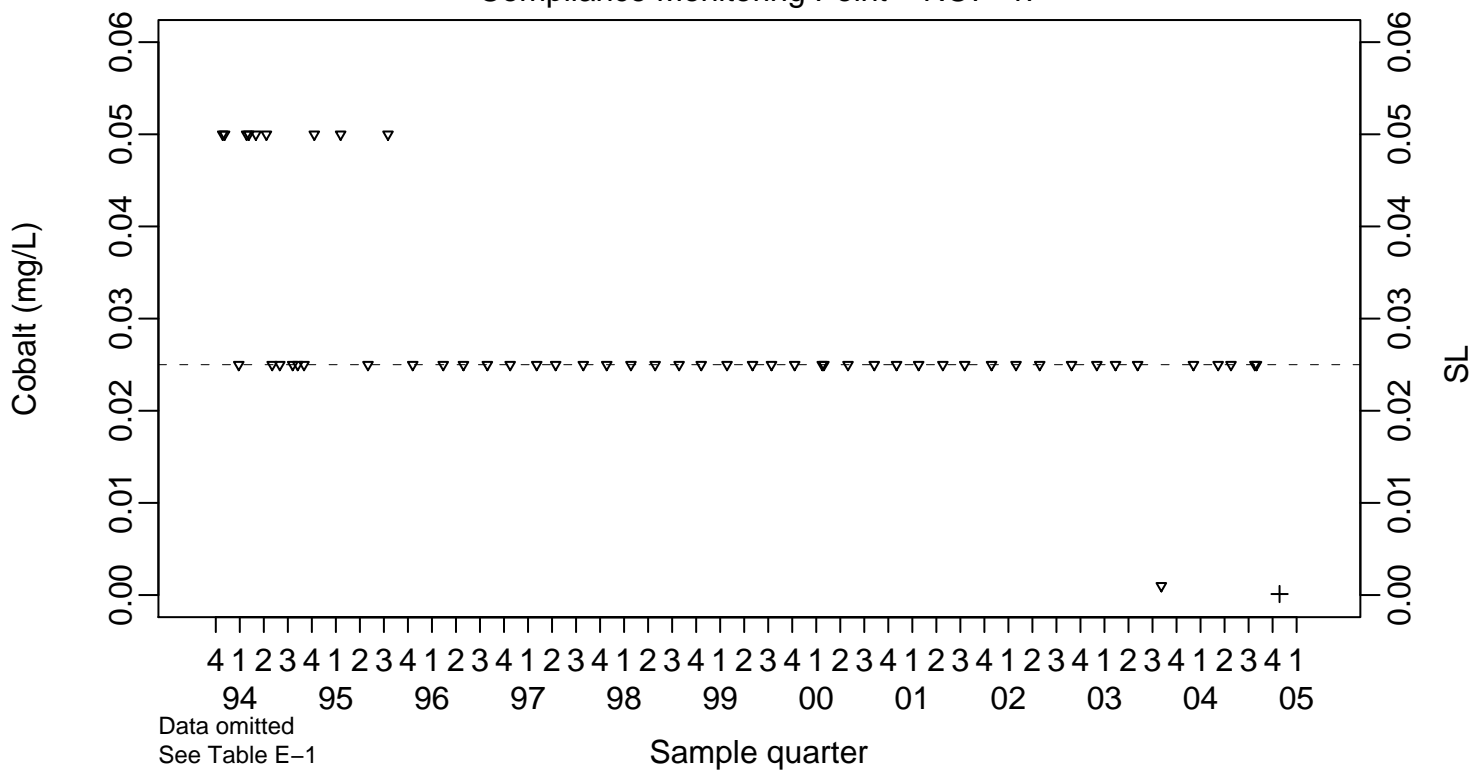
SL=0.025

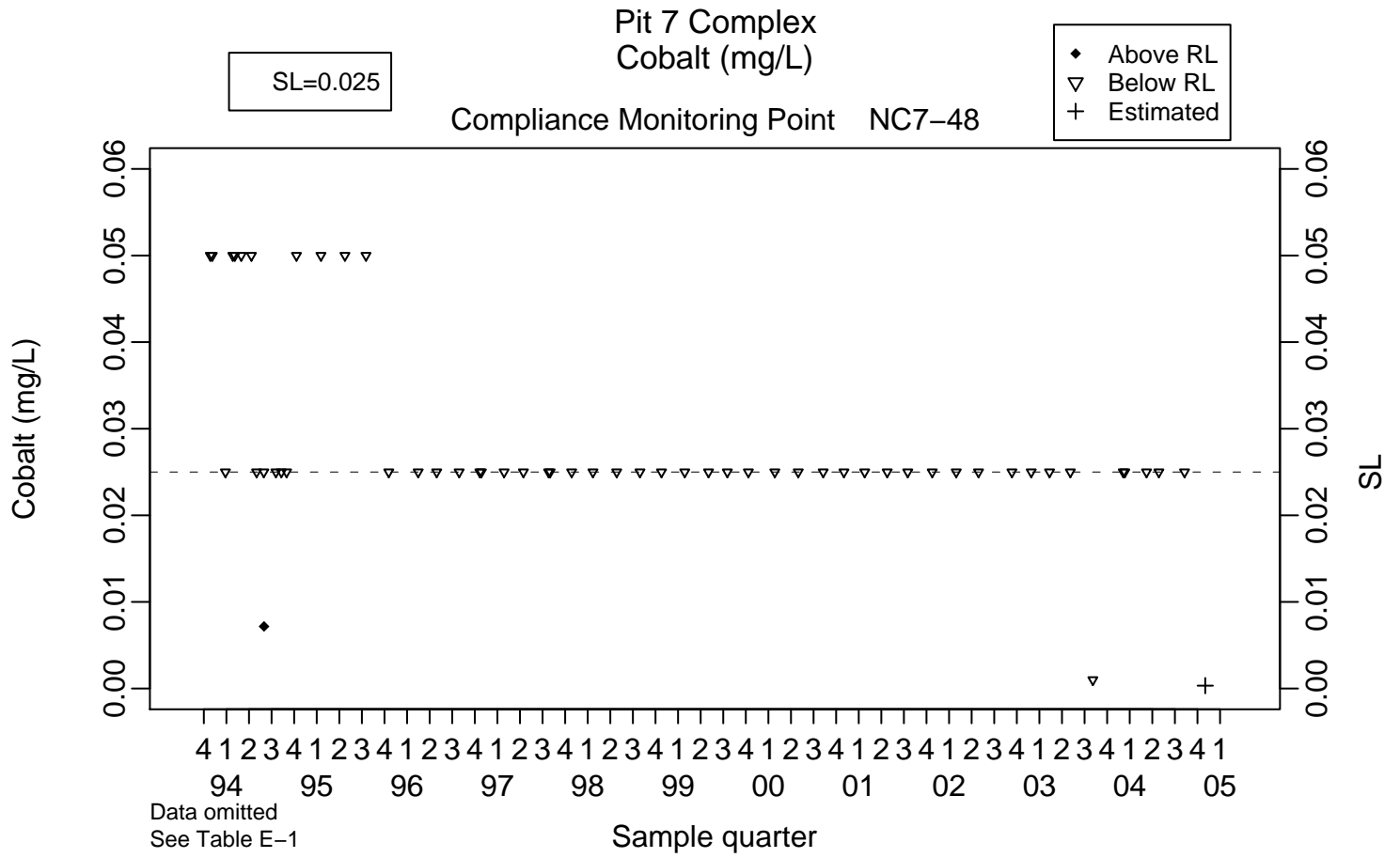
- ◆ Above RL
- ▽ Below RL
- + Estimated

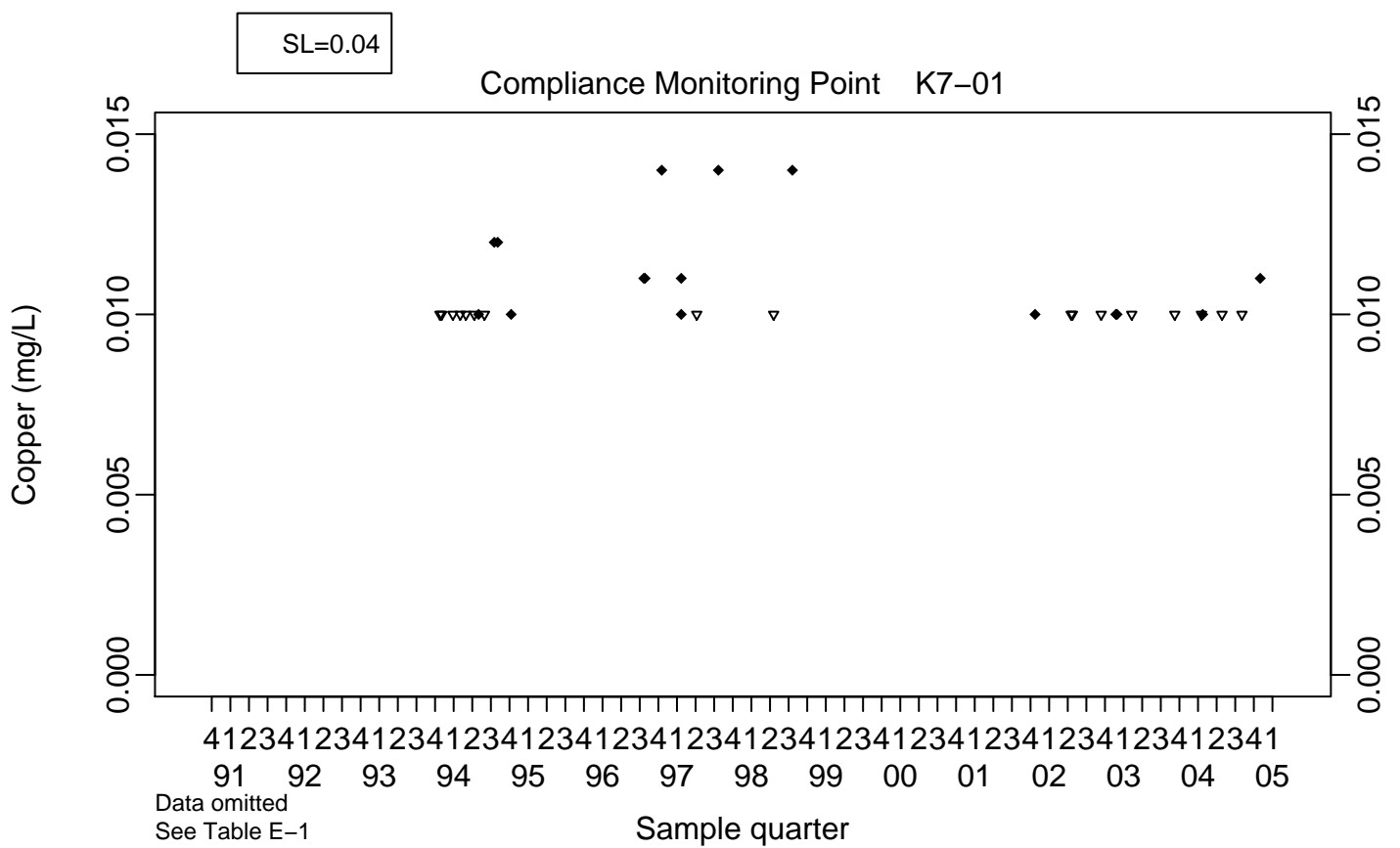
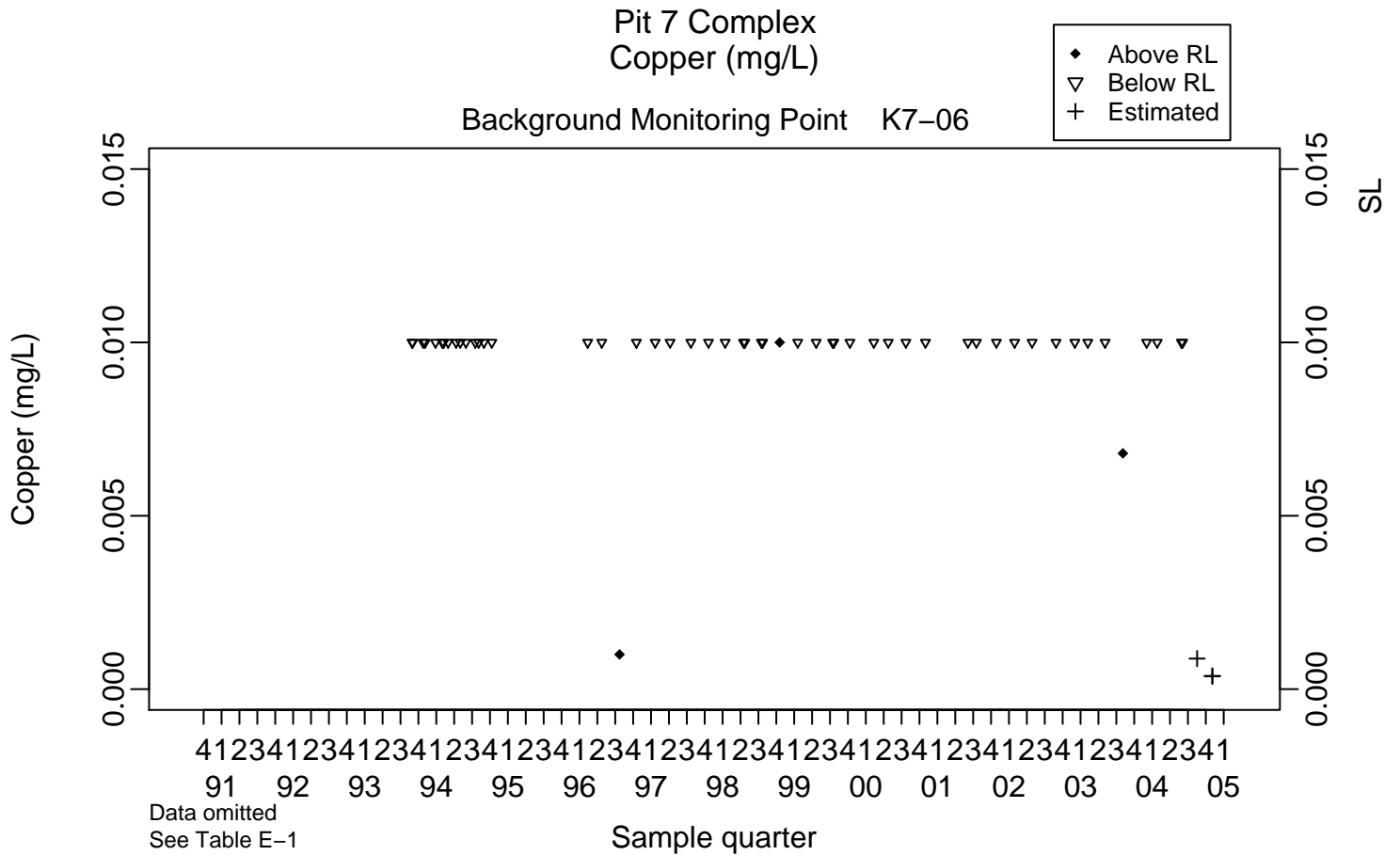


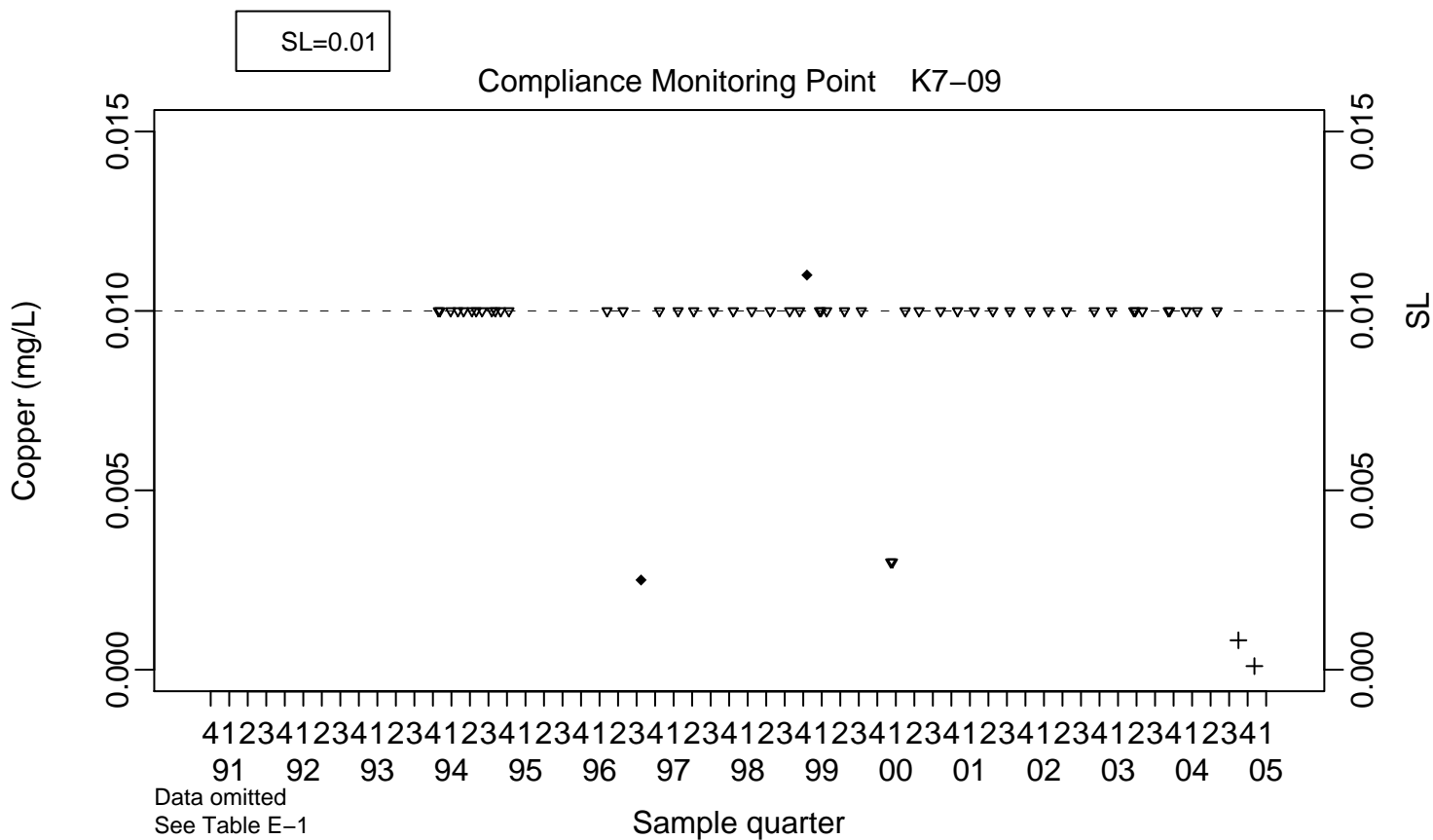
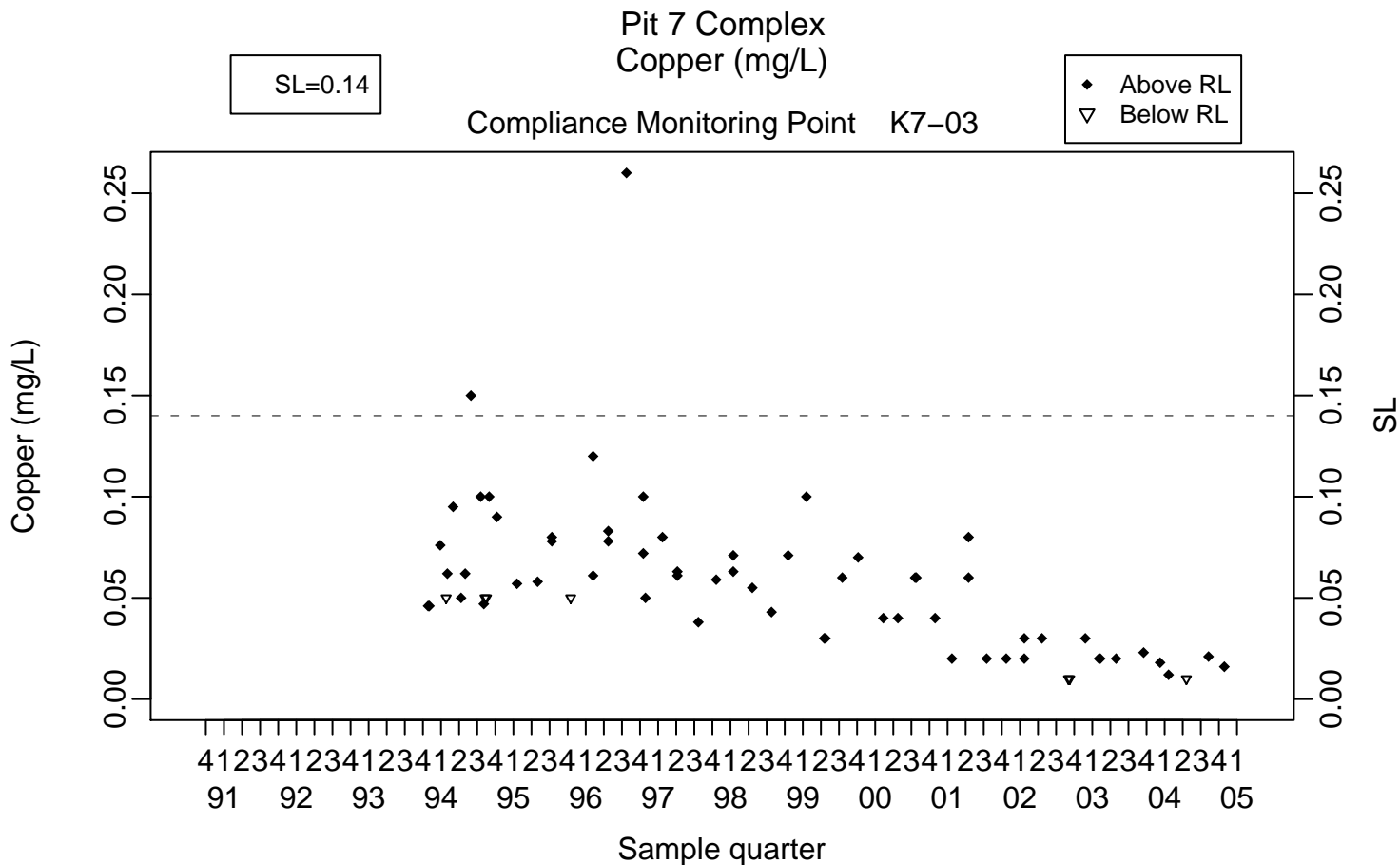
Compliance Monitoring Point NC7-47

SL=0.025







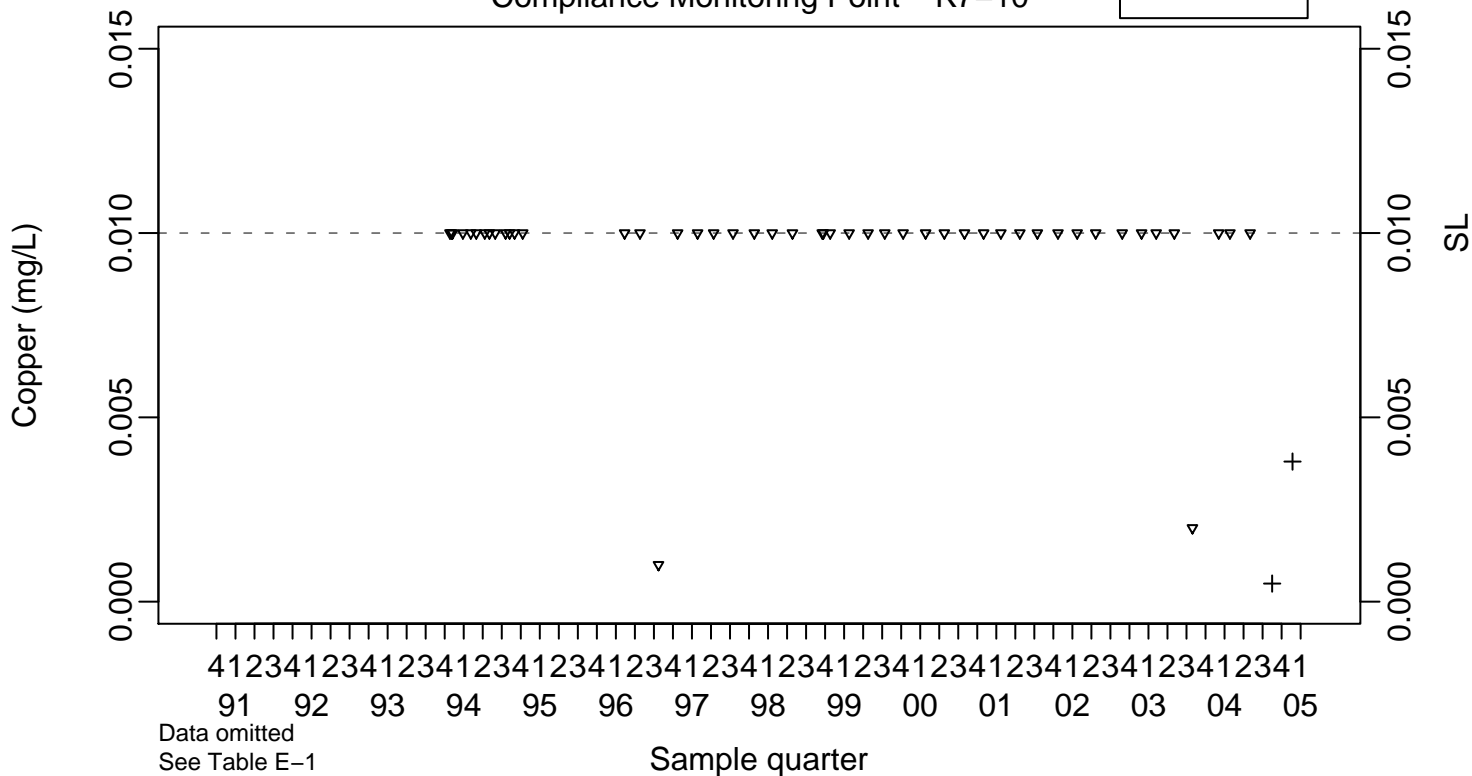


Pit 7 Complex Copper (mg/L)

Compliance Monitoring Point K7-10

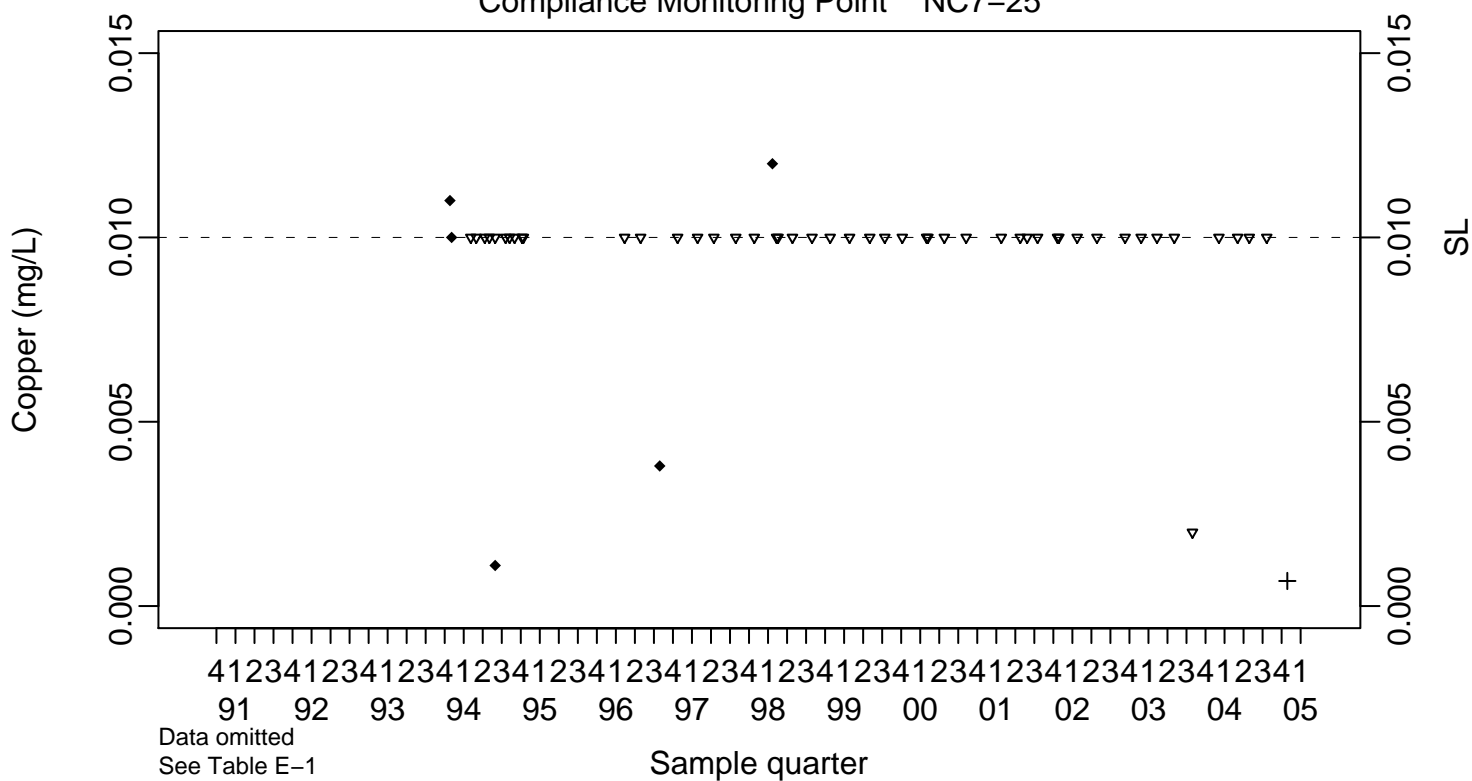
SL=0.01

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-25

SL=0.01

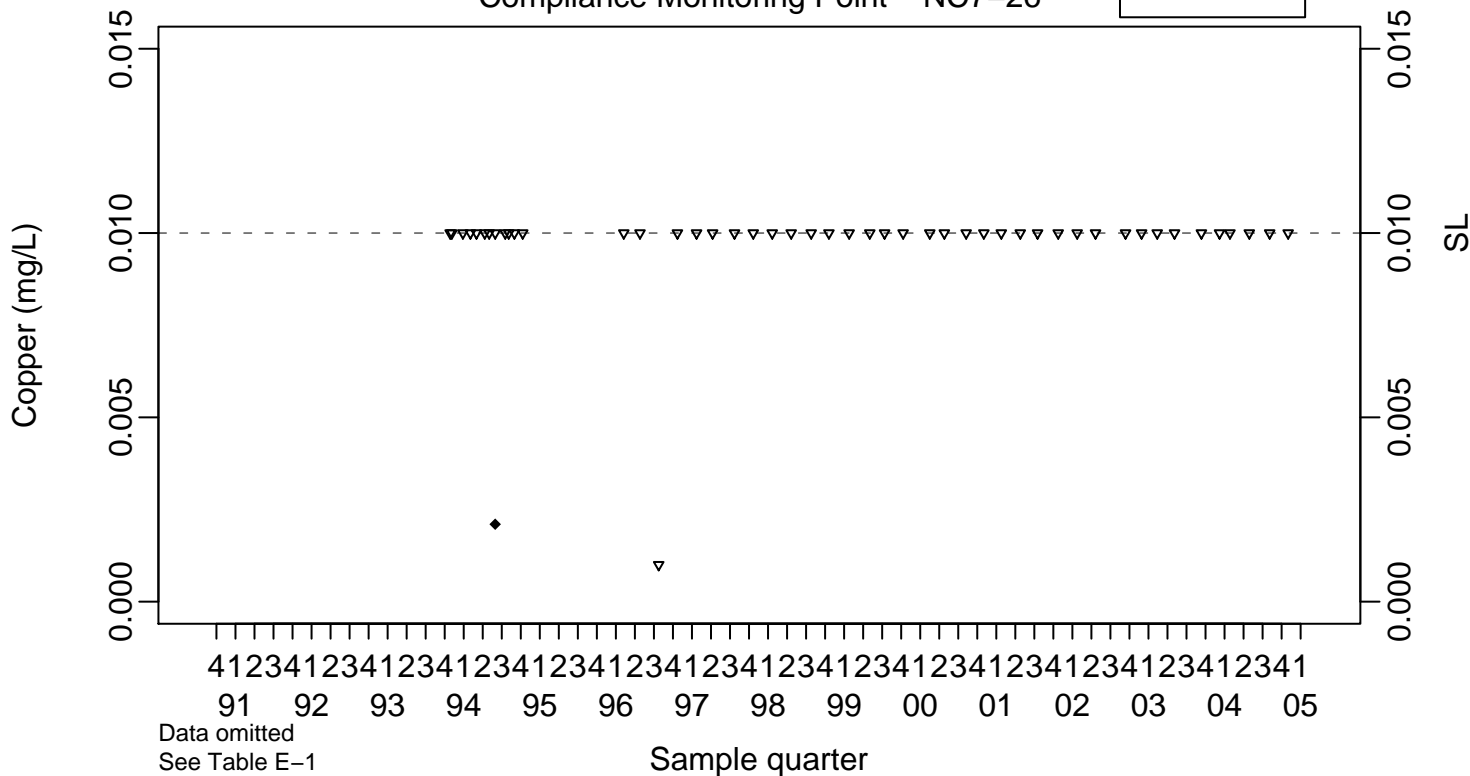


Pit 7 Complex Copper (mg/L)

Compliance Monitoring Point NC7-26

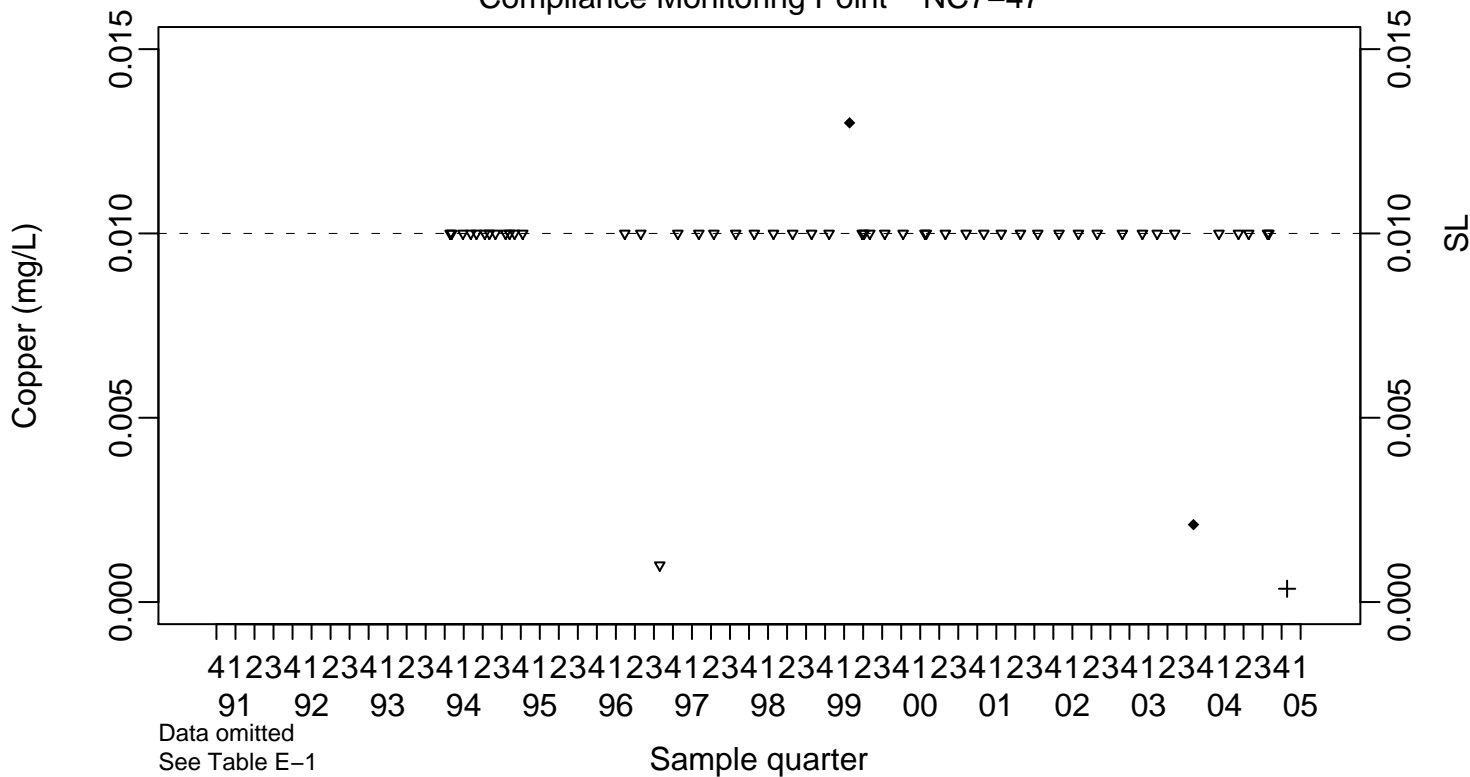
SL=0.01

◆ Above RL
▽ Below RL



Compliance Monitoring Point NC7-47

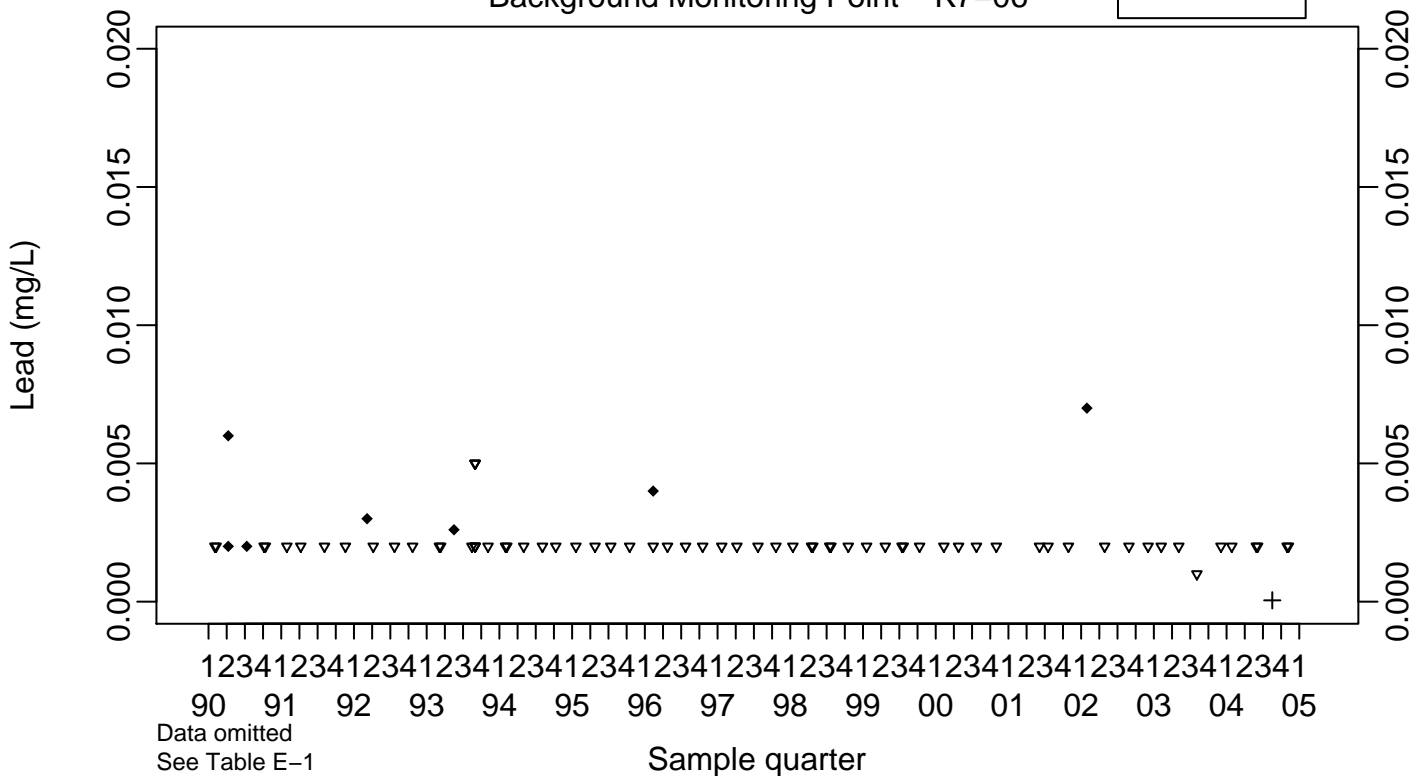
SL=0.01



Pit 7 Complex Lead (mg/L)

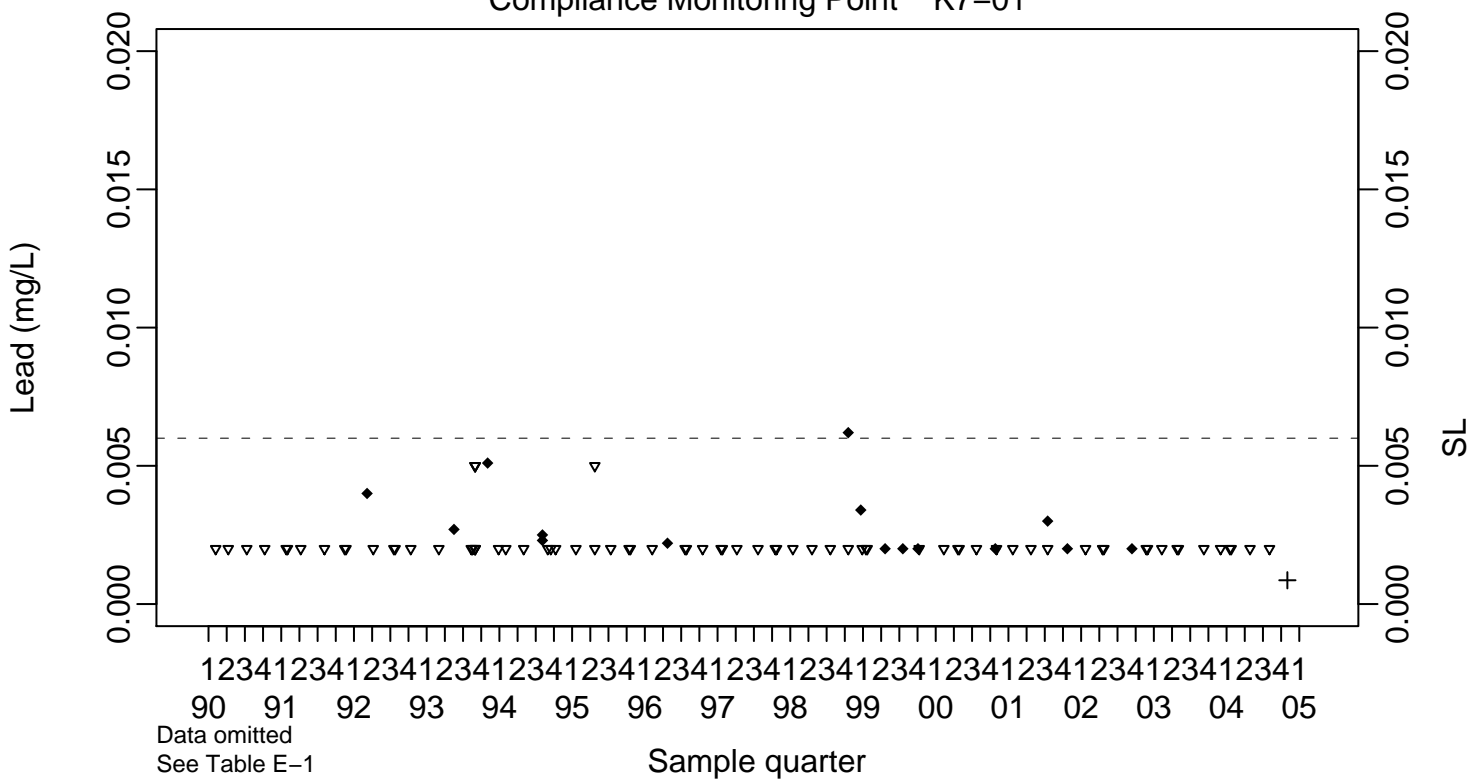
Background Monitoring Point K7-06

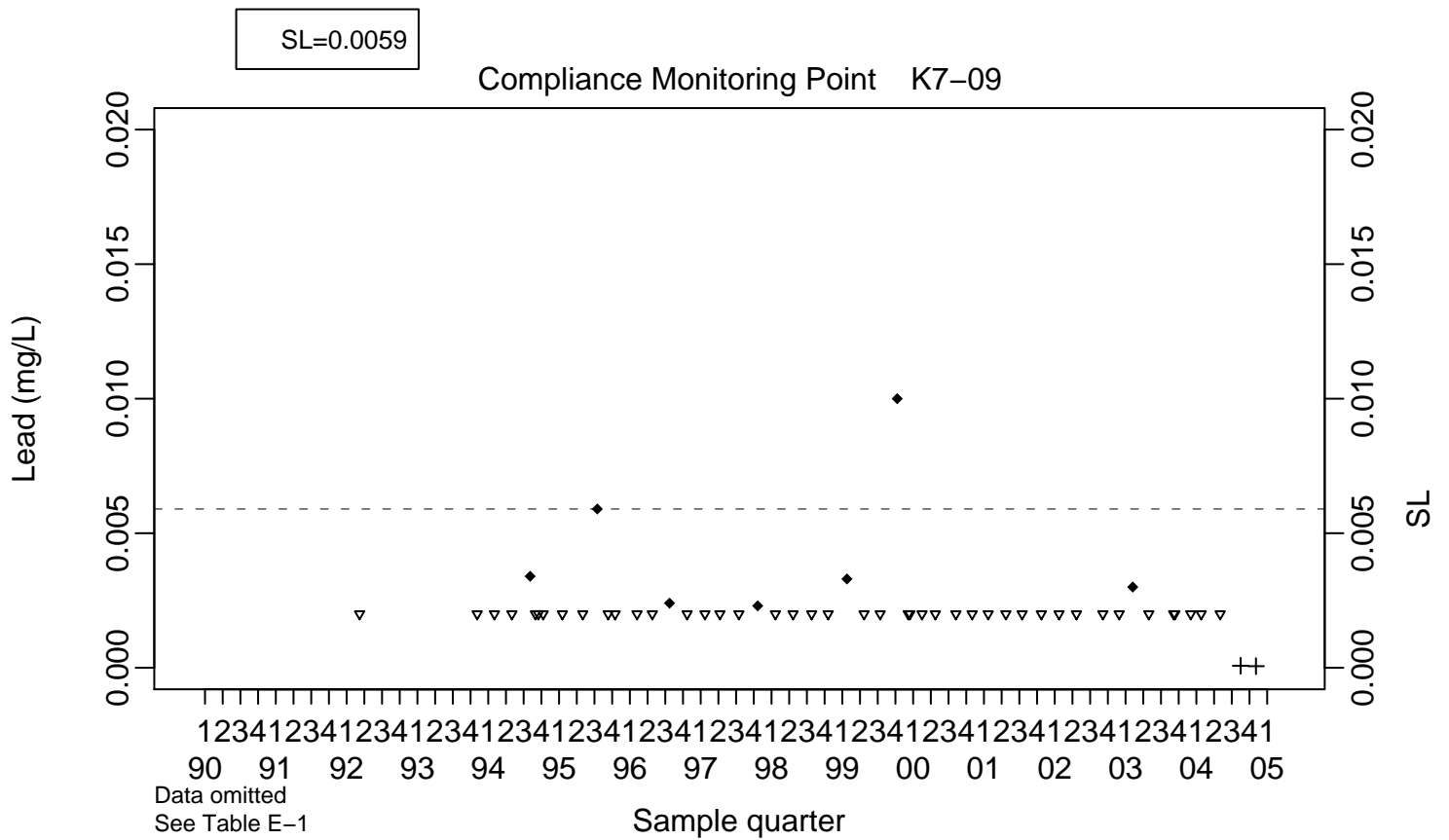
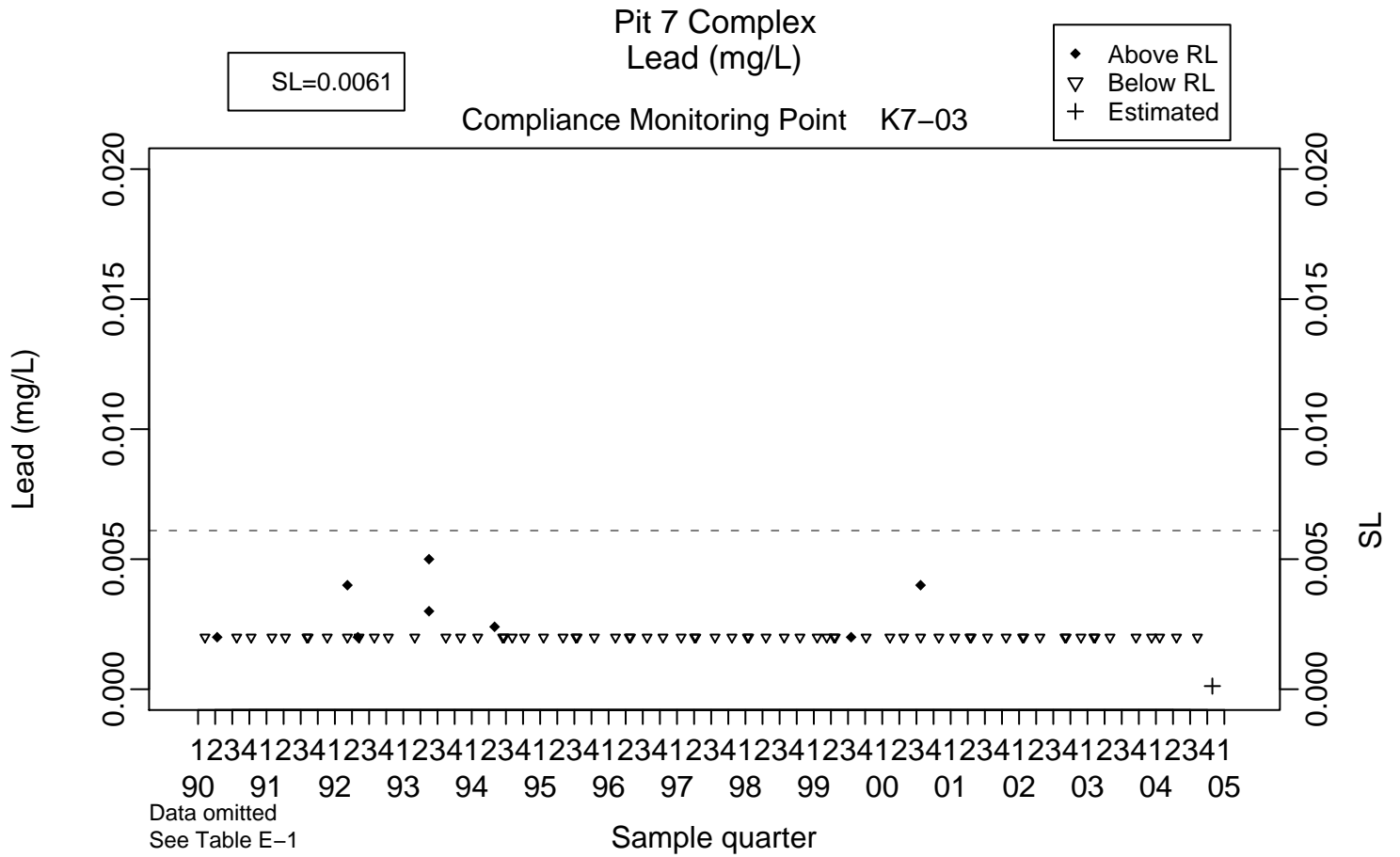
- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.006

Compliance Monitoring Point K7-01



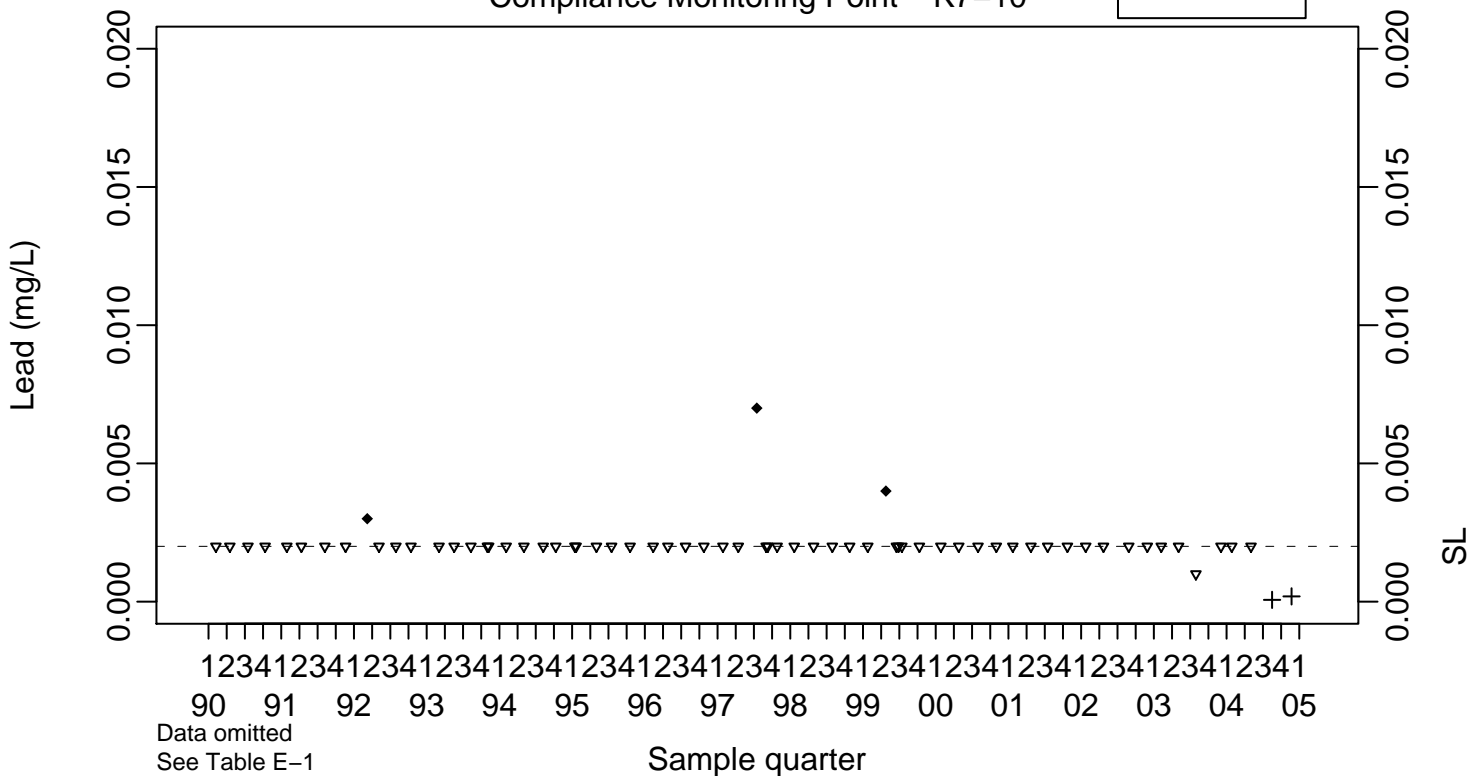


Pit 7 Complex Lead (mg/L)

Compliance Monitoring Point K7-10

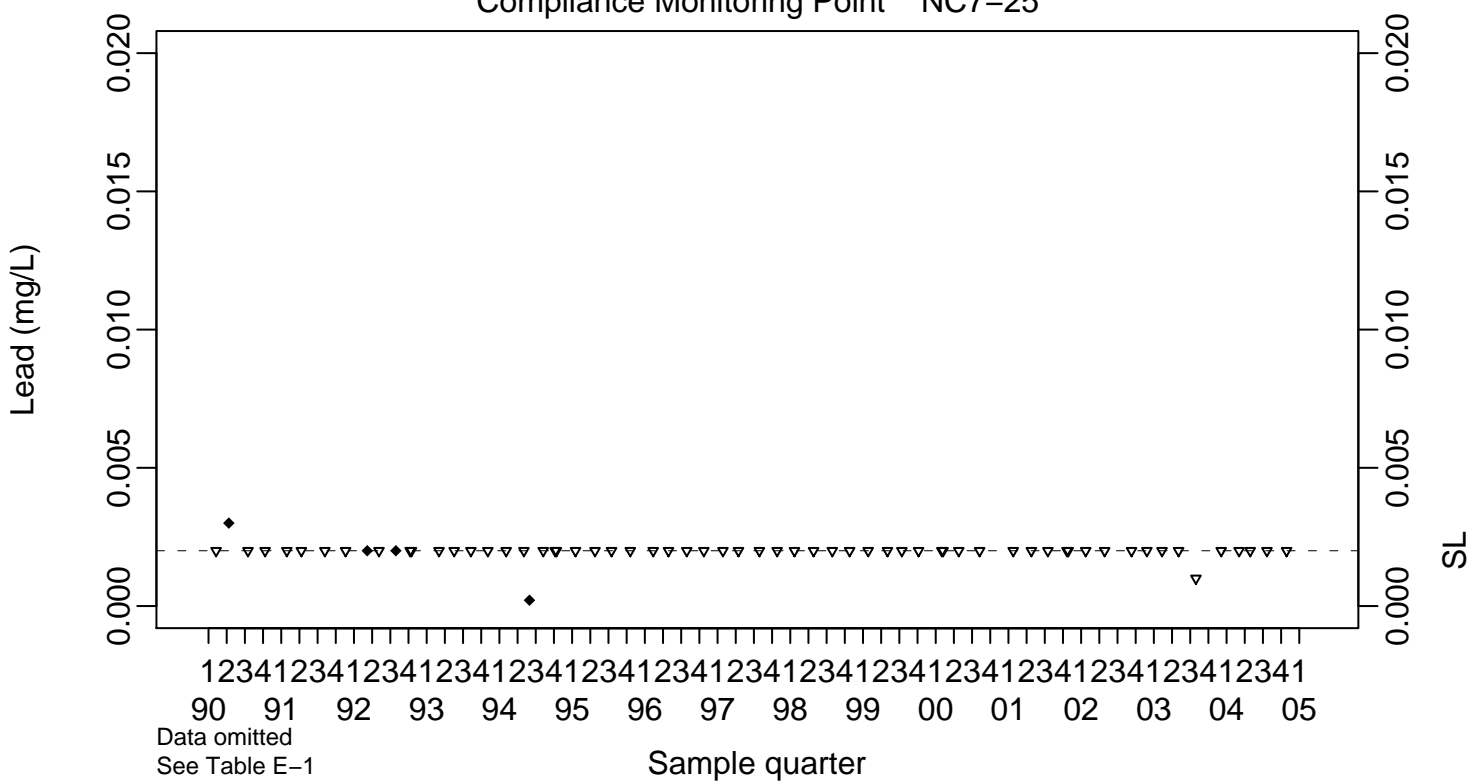
SL=0.002

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-25

SL=0.002

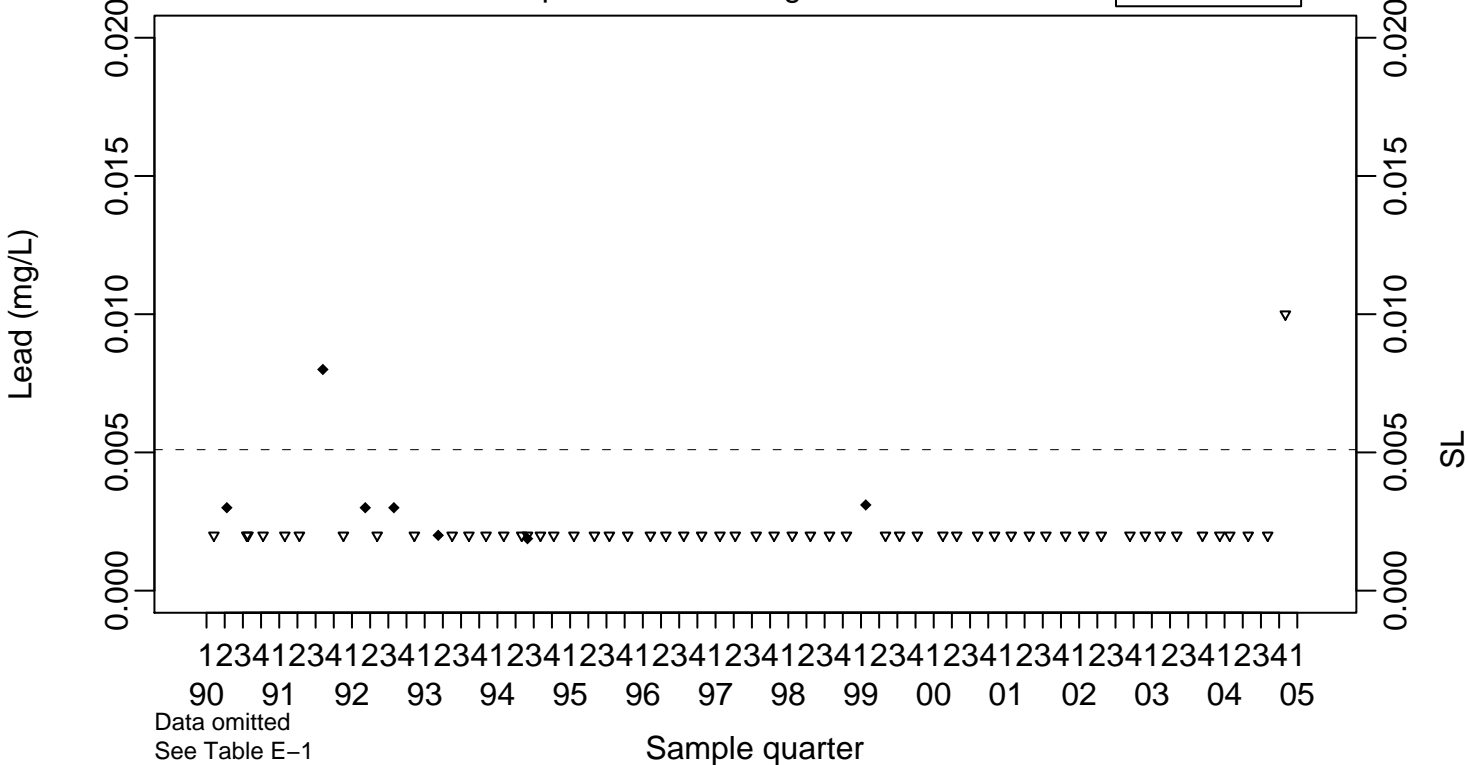


Pit 7 Complex Lead (mg/L)

SL=0.0051

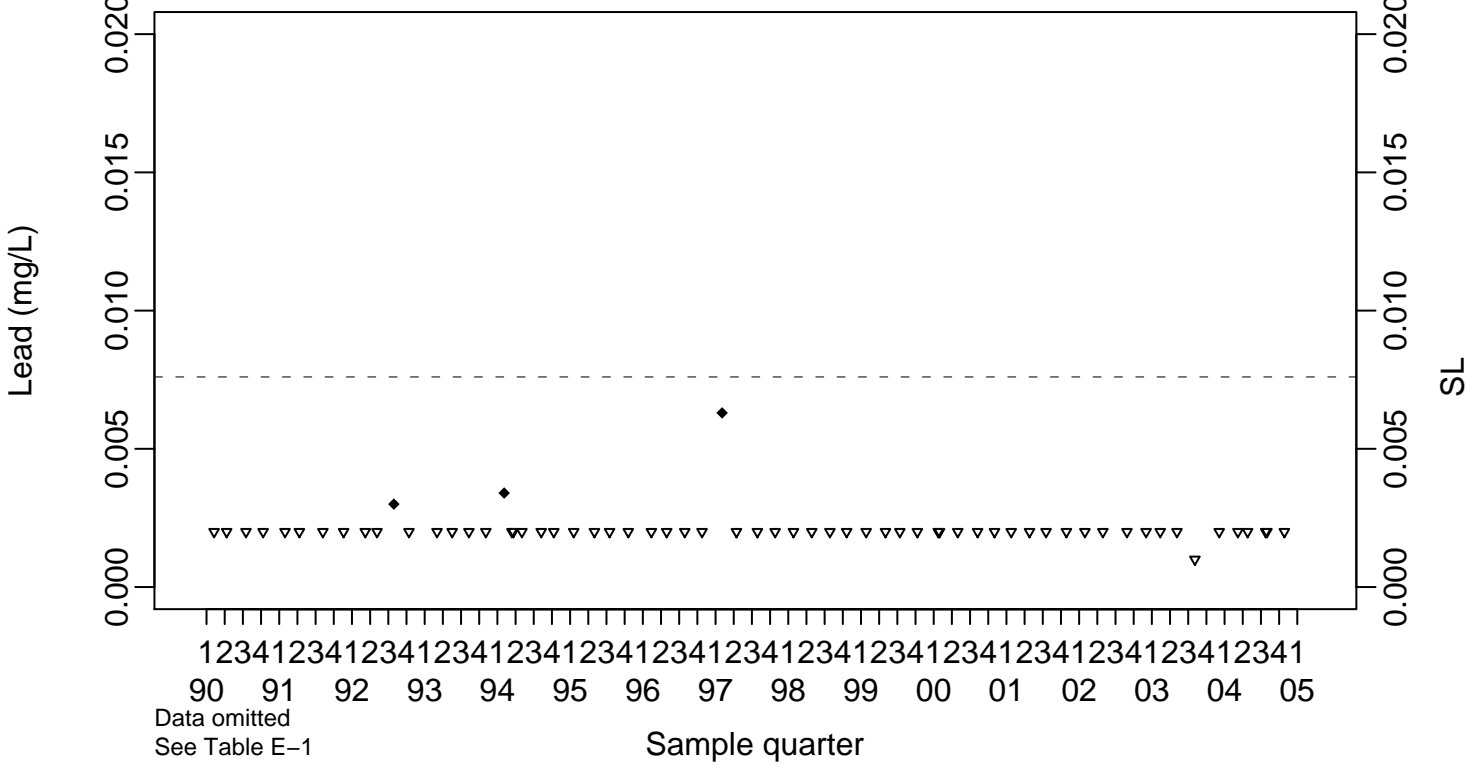
Compliance Monitoring Point NC7-26

◆ Above RL
▽ Below RL



SL=0.0076

Compliance Monitoring Point NC7-47

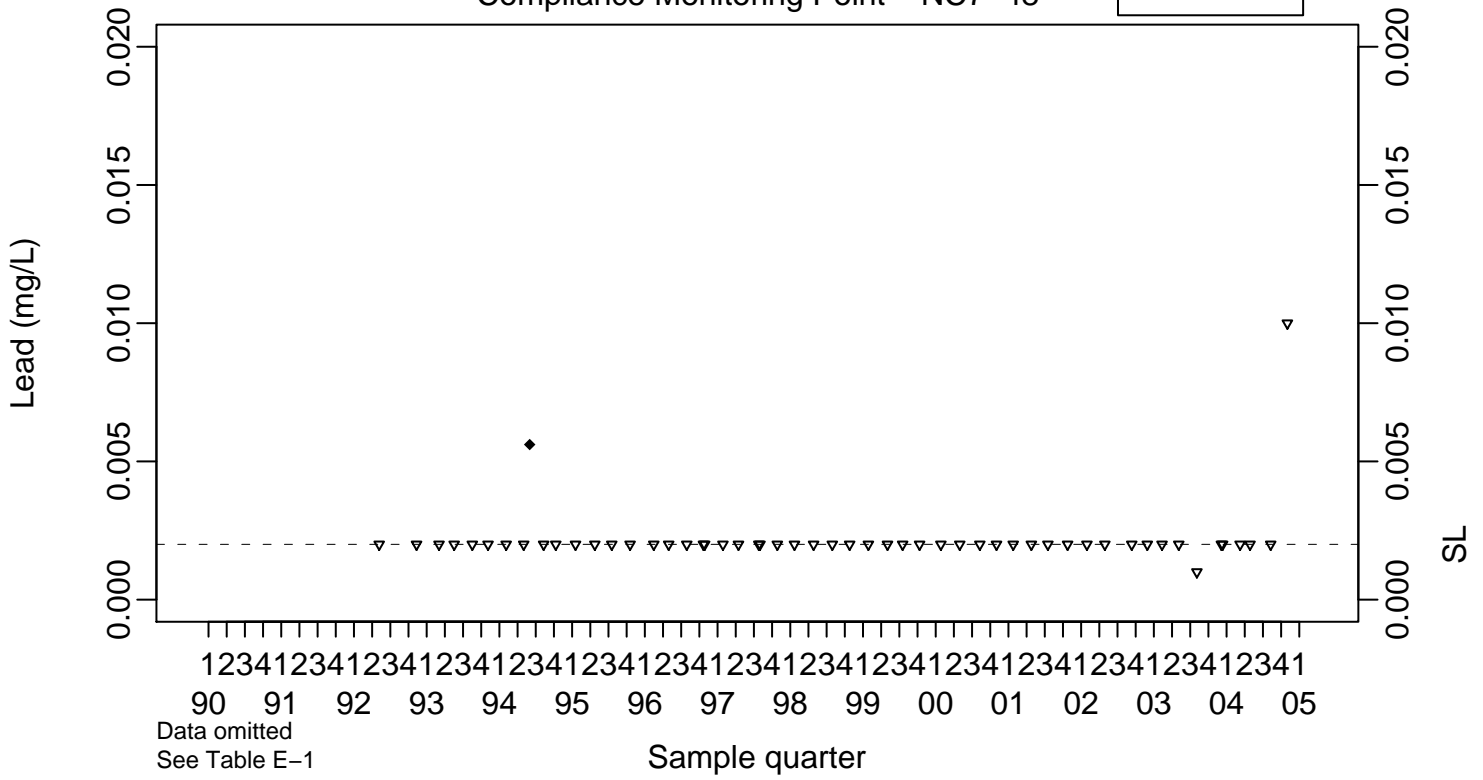


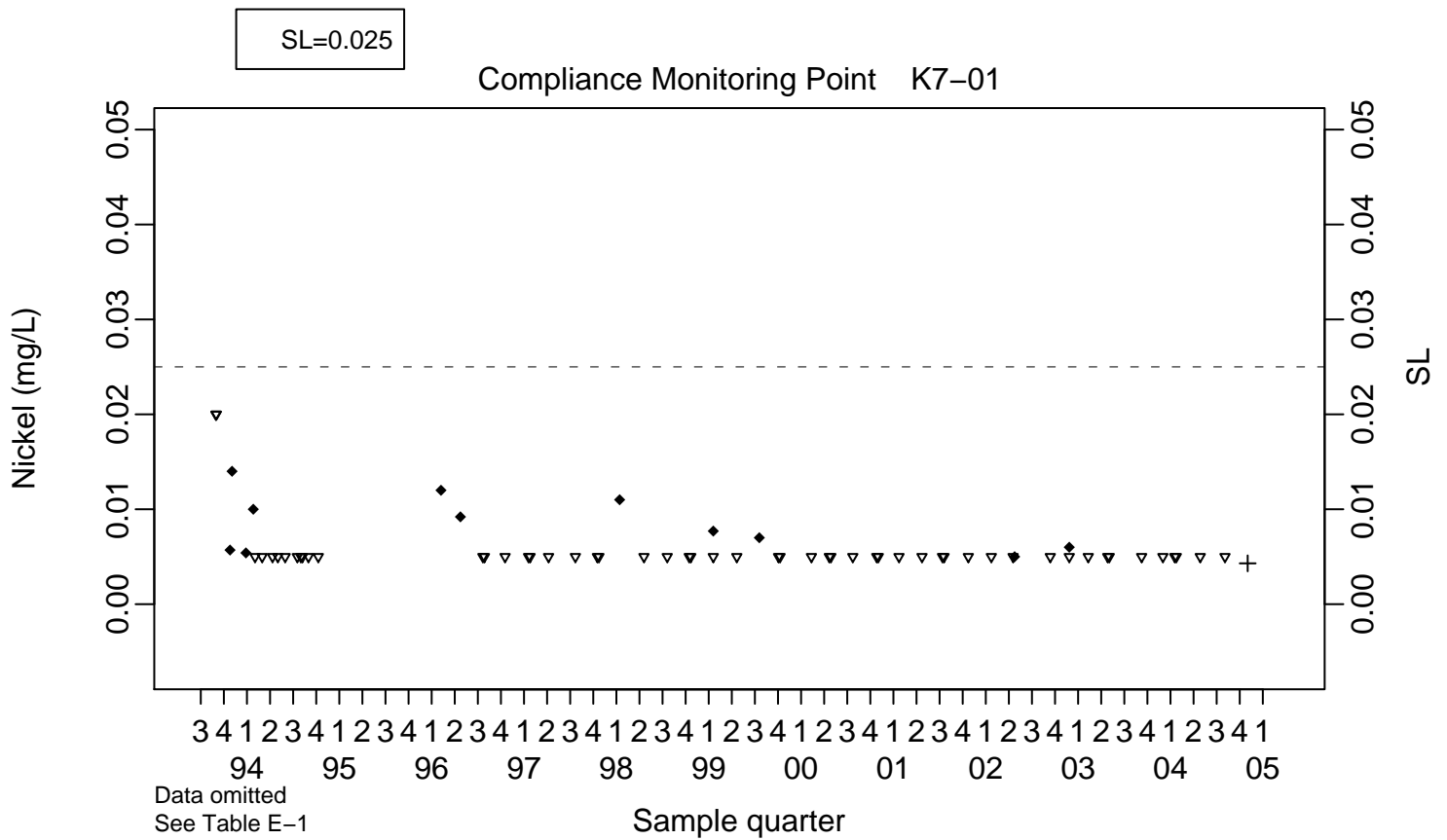
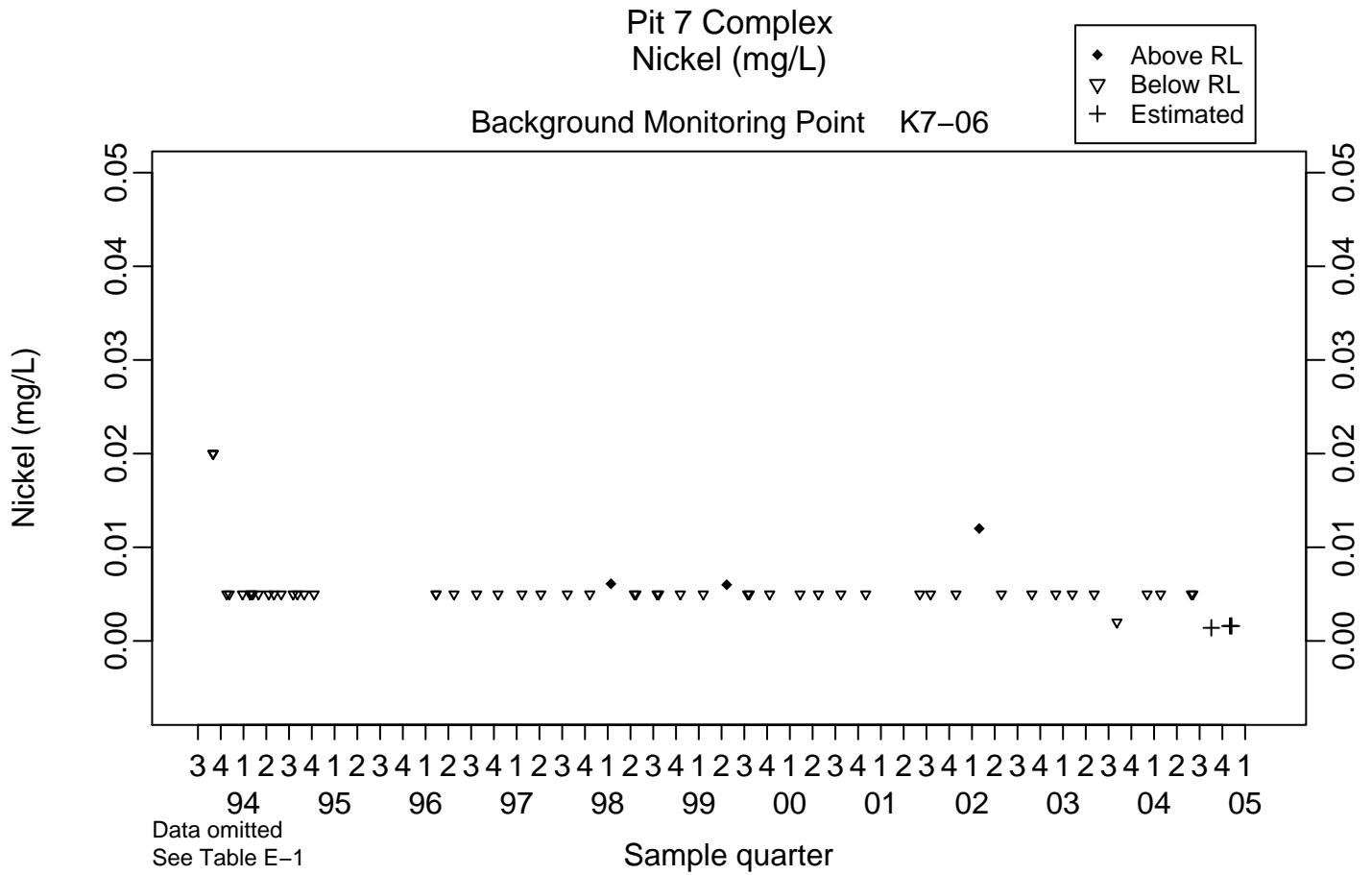
Pit 7 Complex Lead (mg/L)

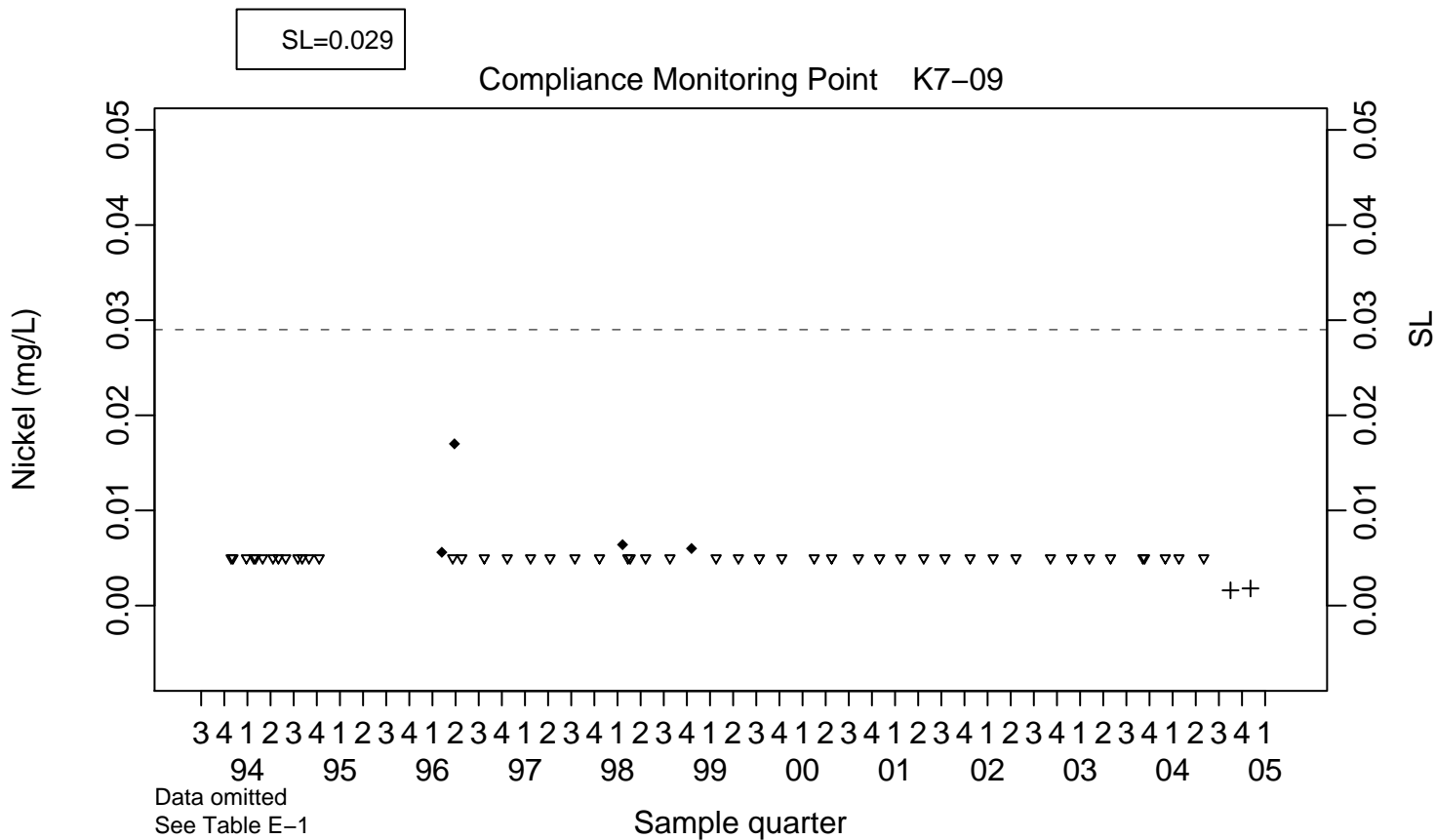
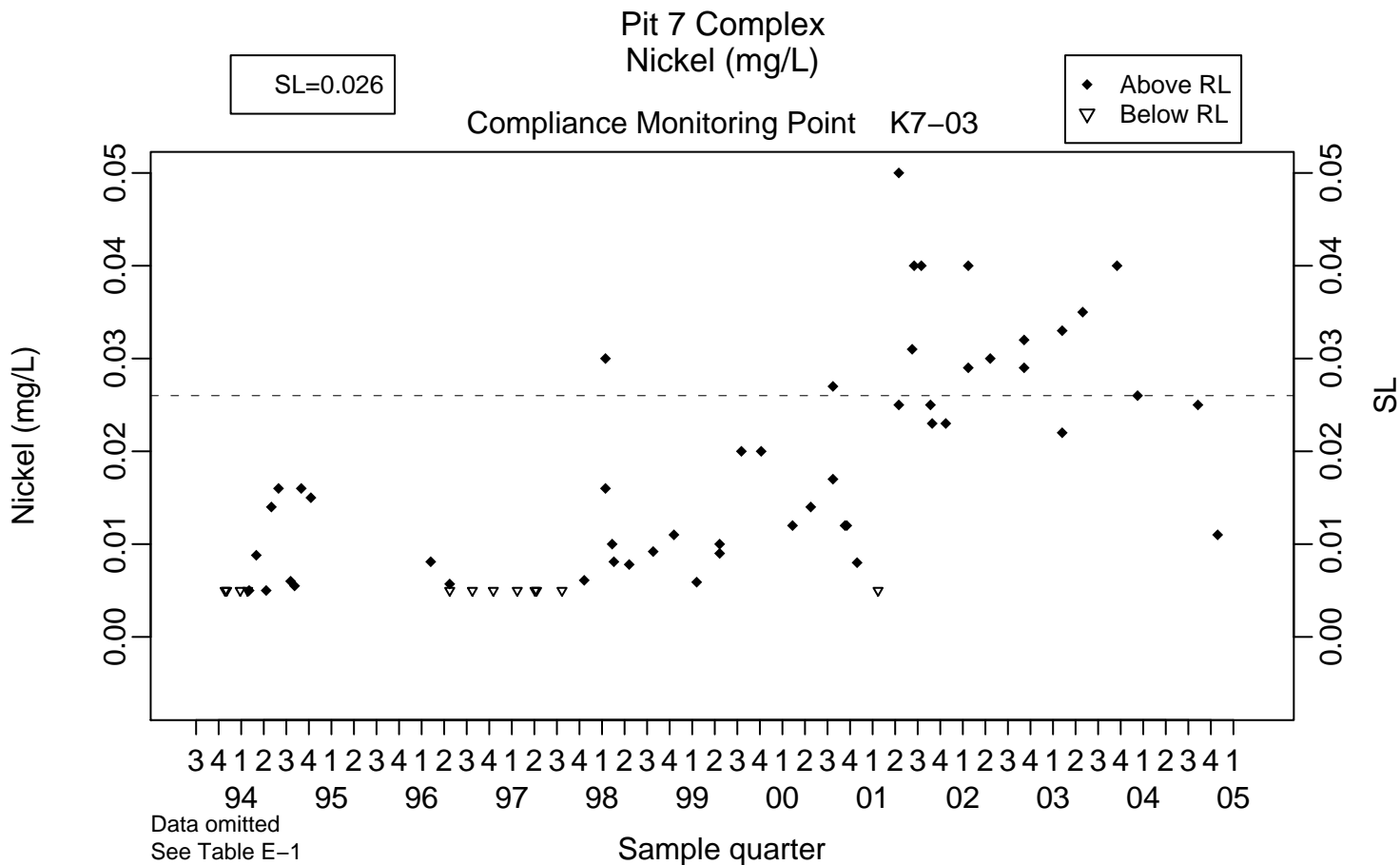
Compliance Monitoring Point NC7-48

SL=0.002

◆ Above RL
▽ Below RL





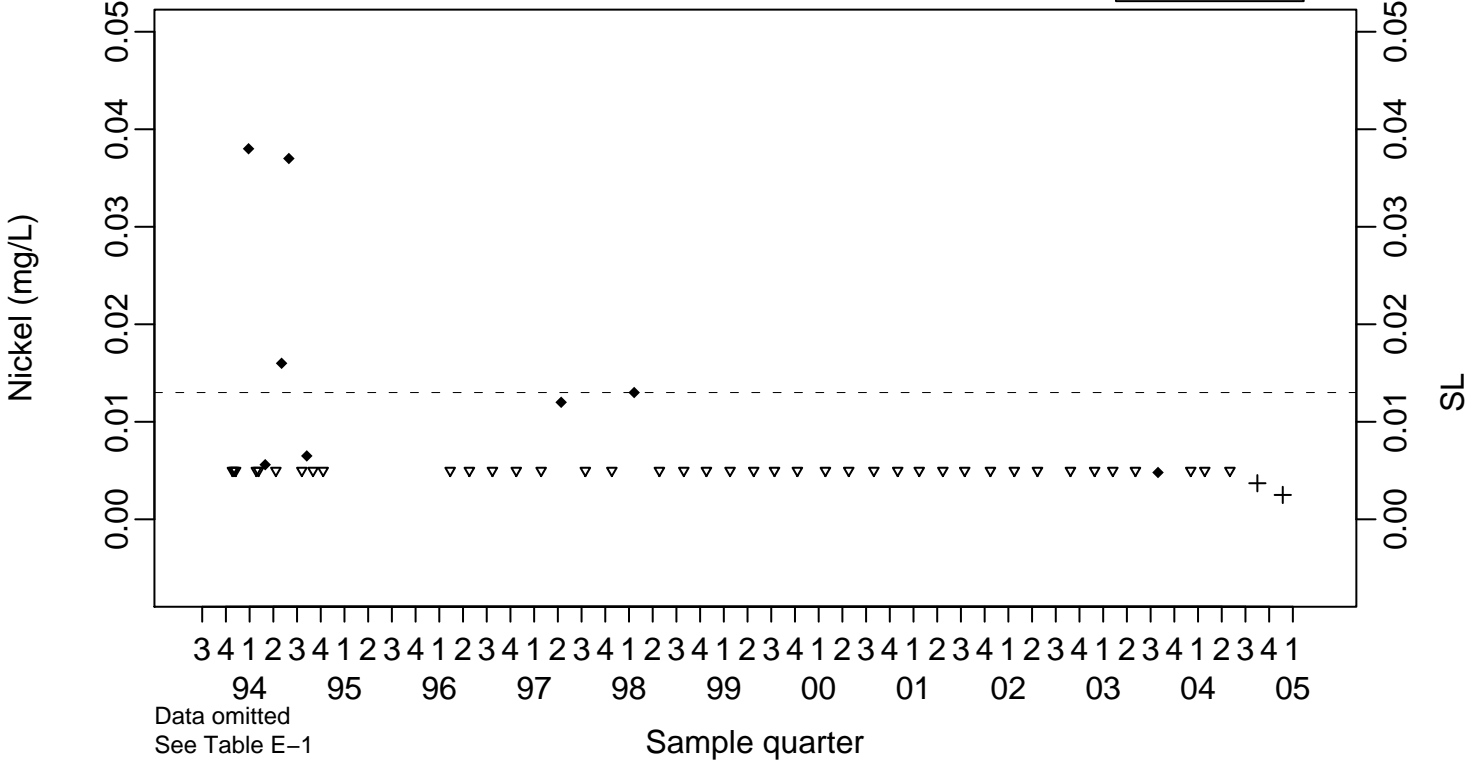


Pit 7 Complex
Nickel (mg/L)

SL=0.013

Compliance Monitoring Point K7-10

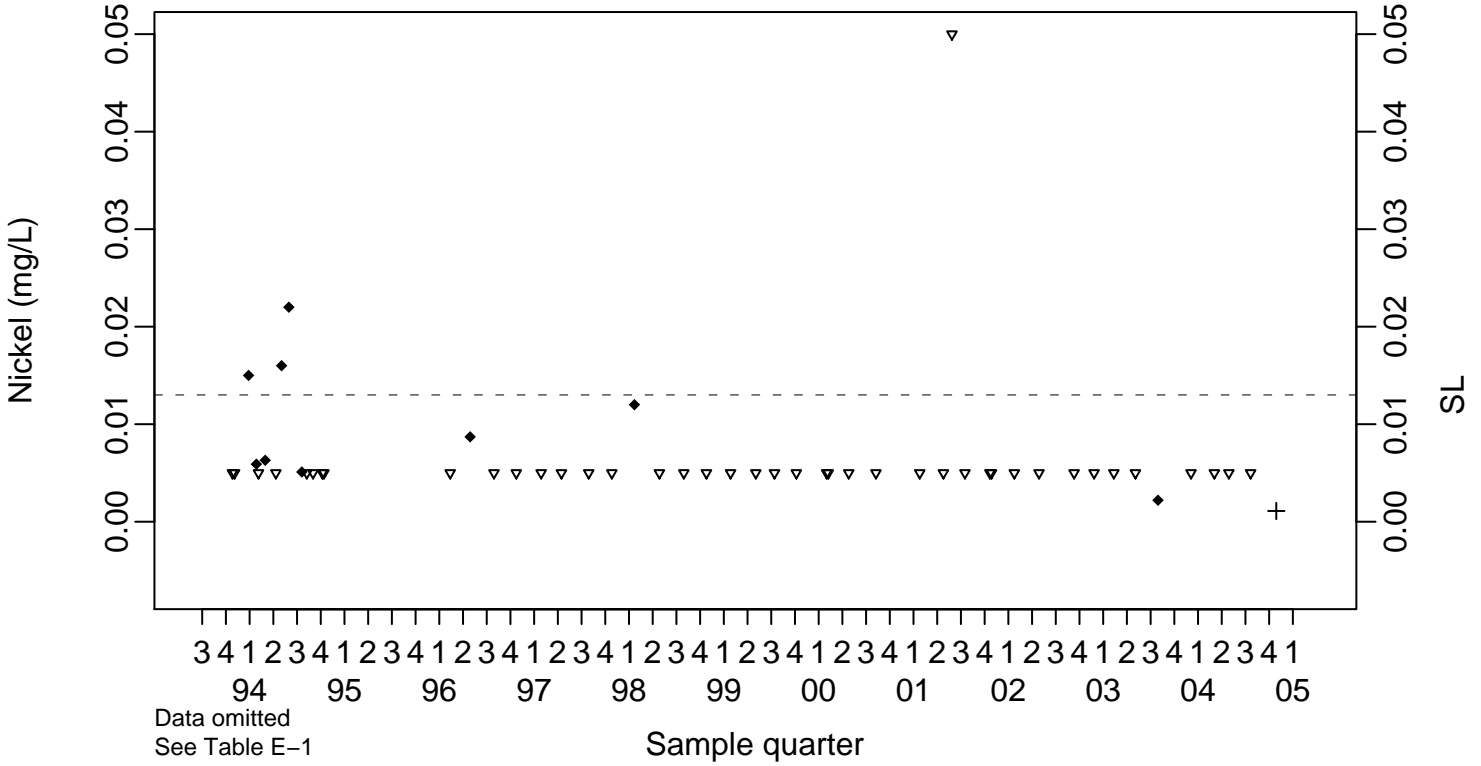
- ◆ Above RL
- ▽ Below RL
- + Estimated



Data omitted
See Table E-1

SL=0.013

Compliance Monitoring Point NC7-25



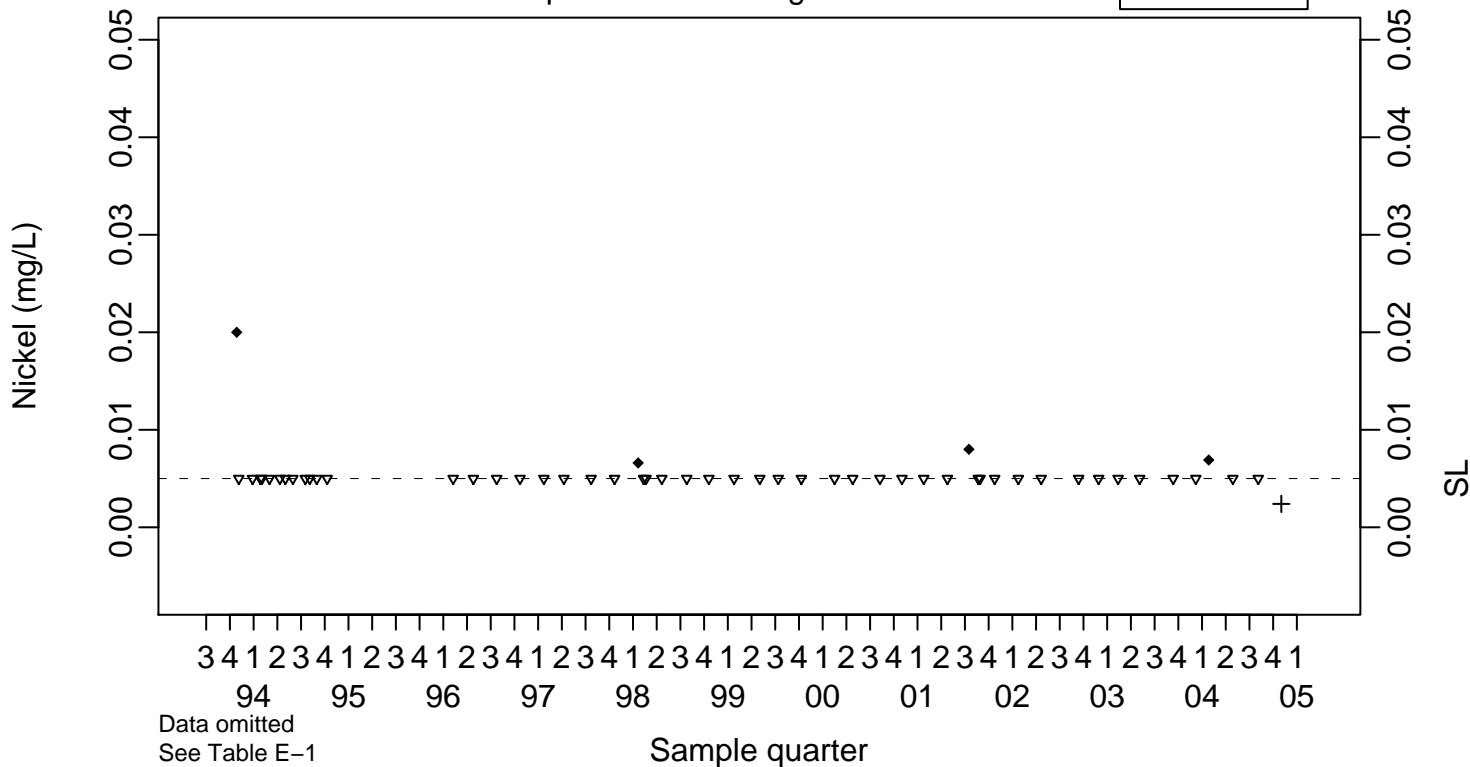
Data omitted
See Table E-1

Pit 7 Complex Nickel (mg/L)

Compliance Monitoring Point NC7-26

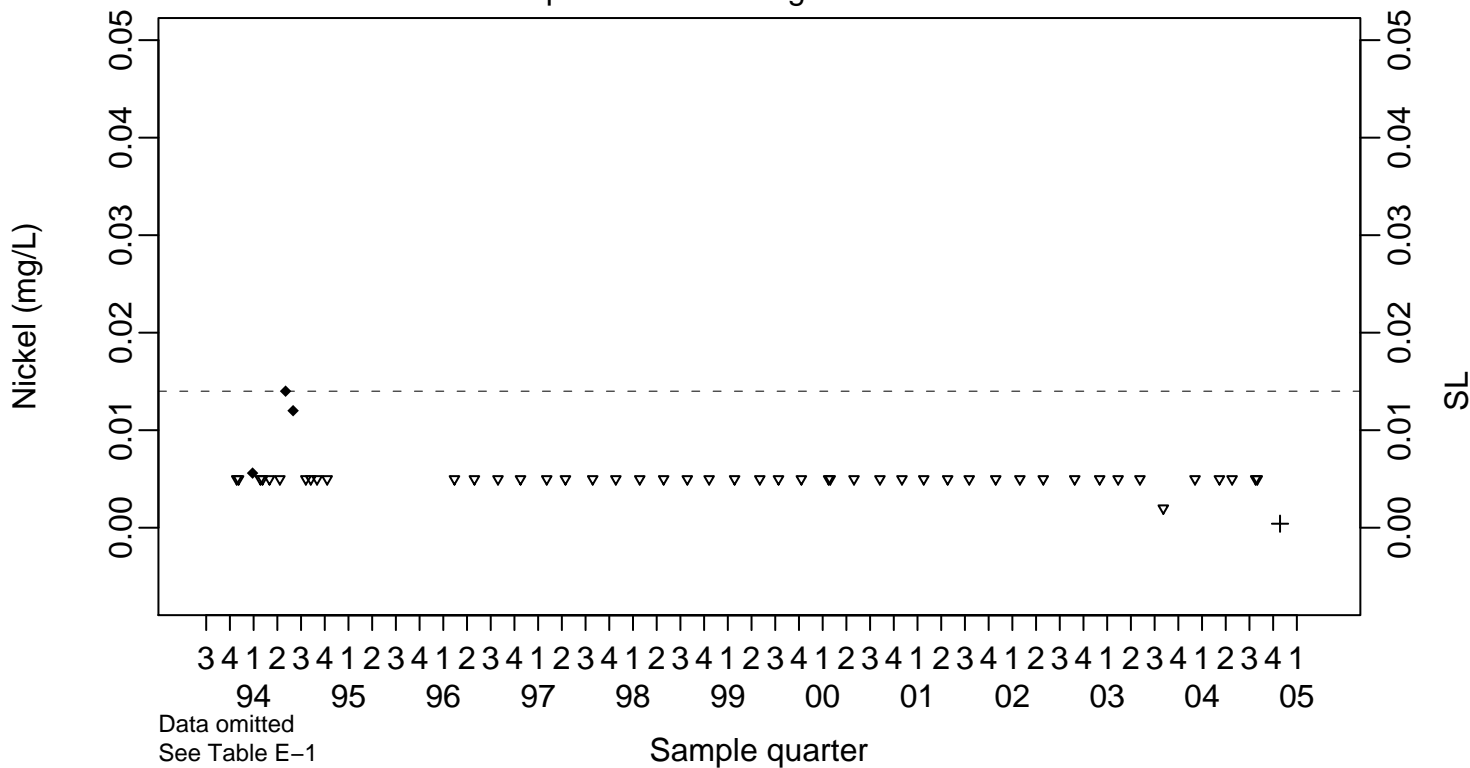
SL=0.005

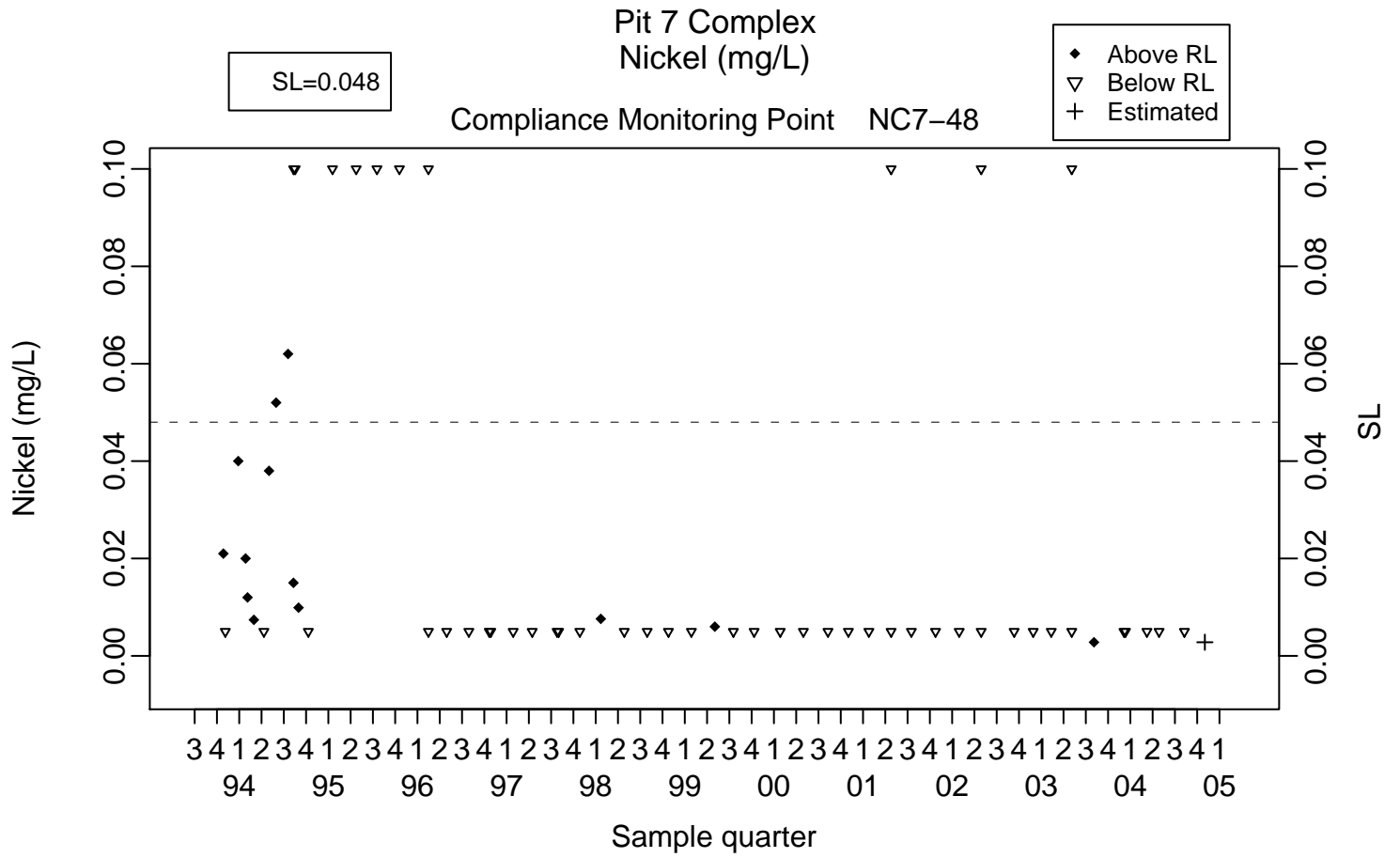
- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-47

SL=0.014

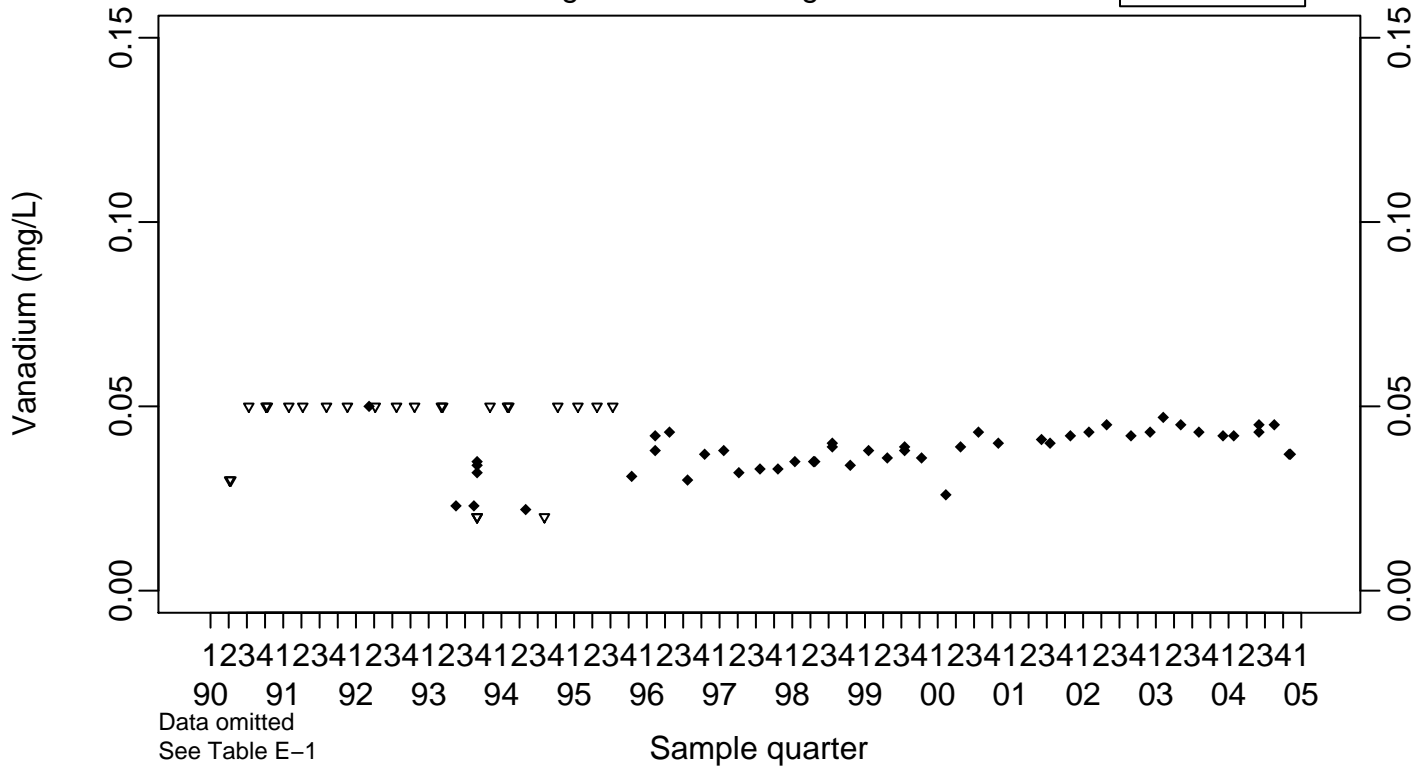




Pit 7 Complex Vanadium (mg/L)

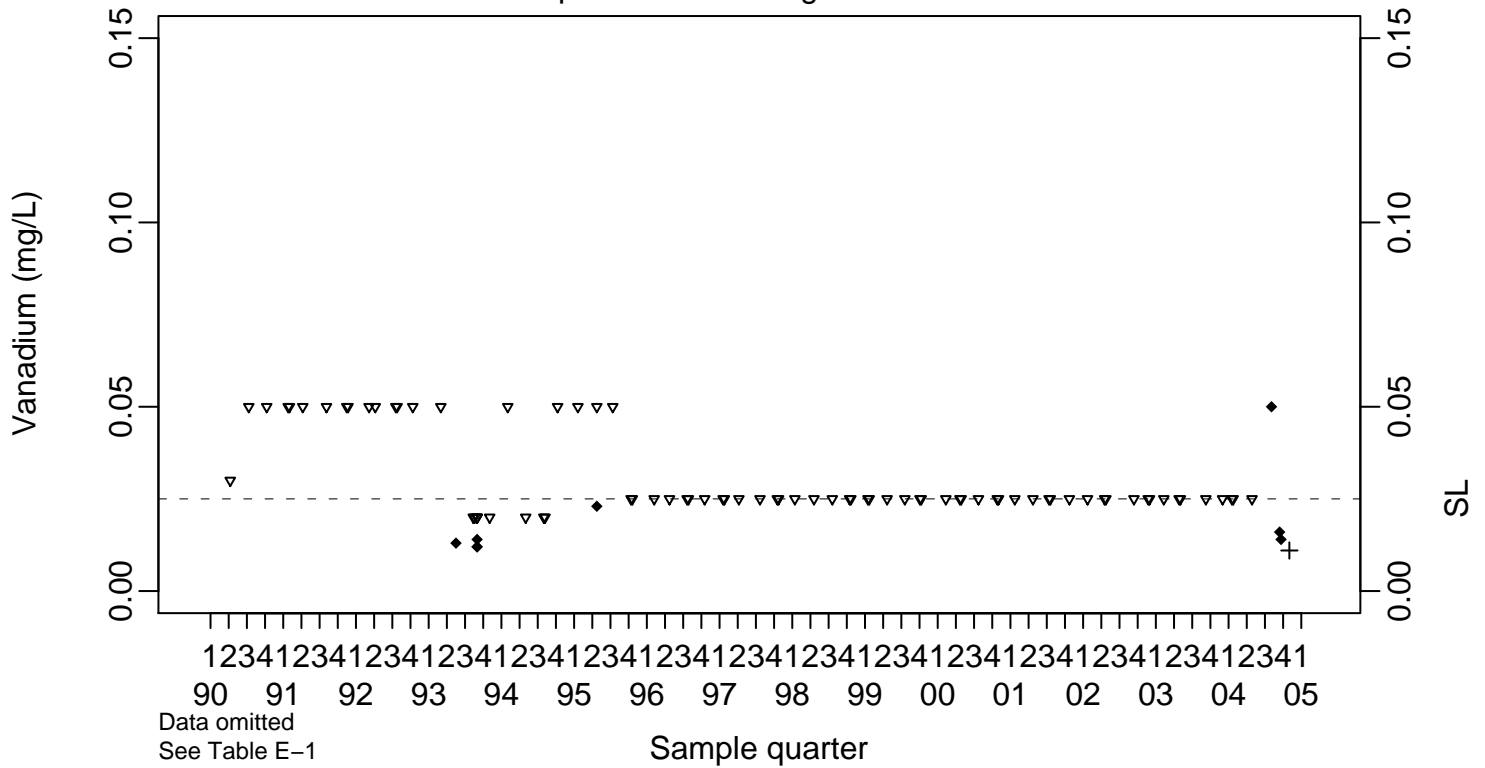
Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



SL=0.025

Compliance Monitoring Point K7-01

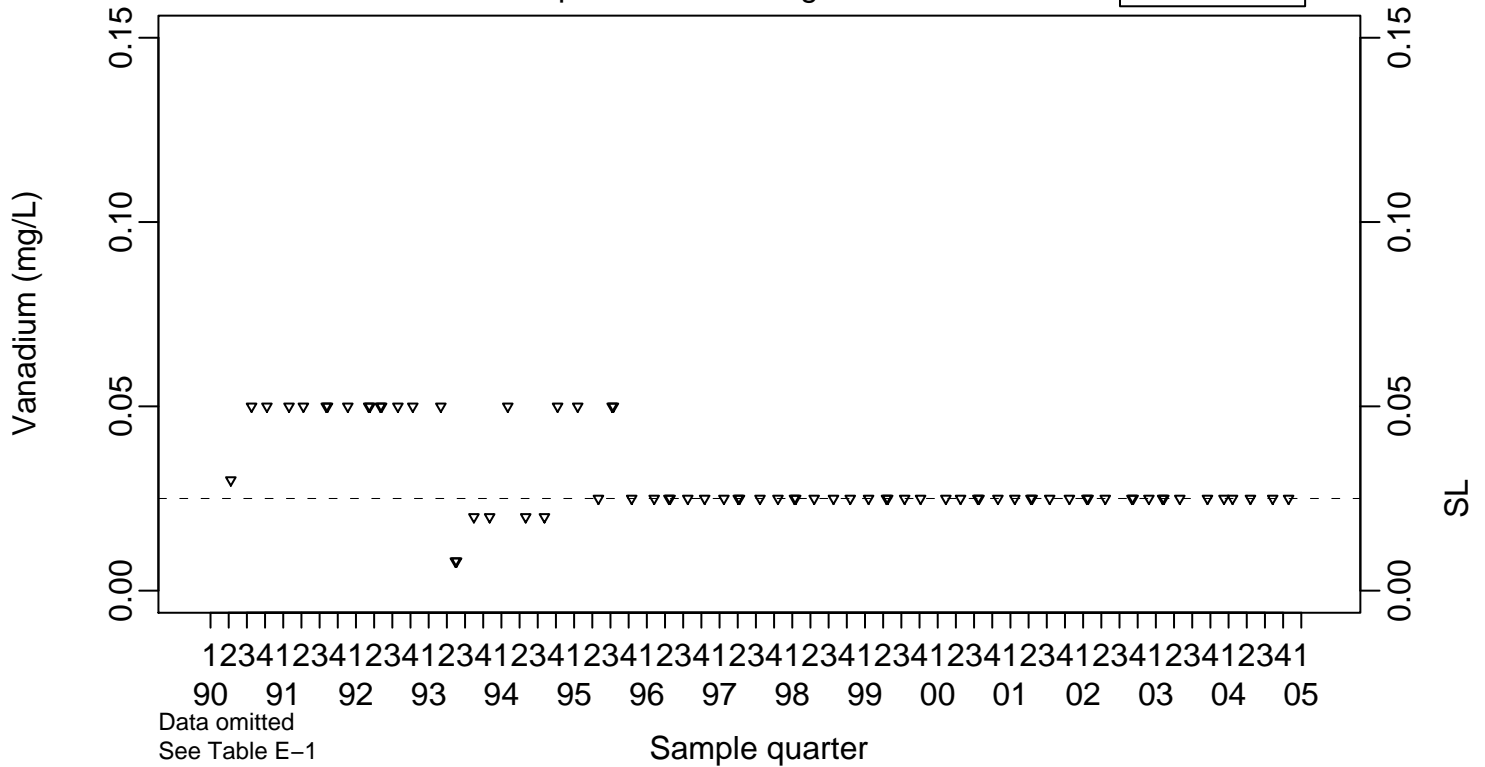


Pit 7 Complex Vanadium (mg/L)

Compliance Monitoring Point K7-03

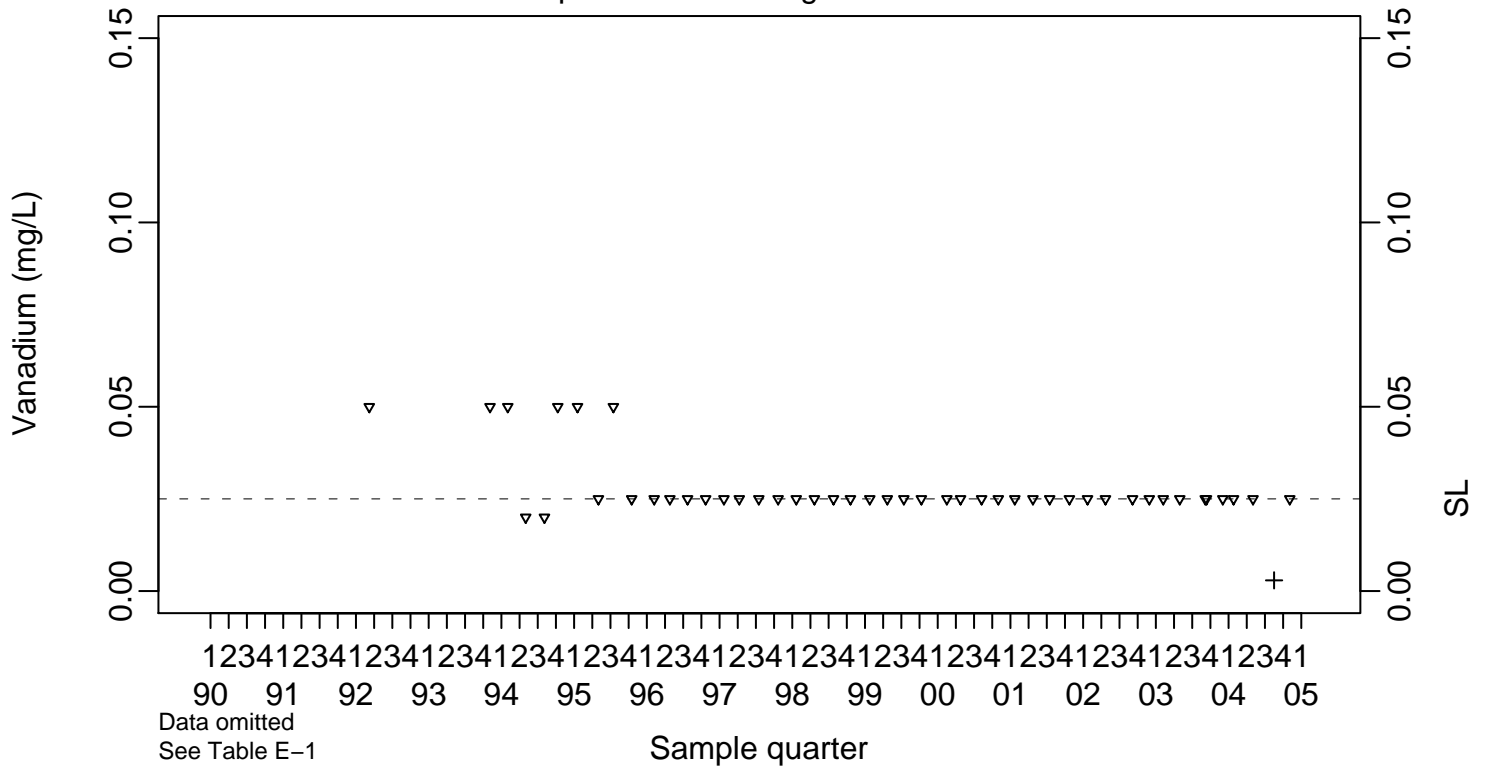
SL=0.025

◆ Above RL
▽ Below RL



SL=0.025

Compliance Monitoring Point K7-09

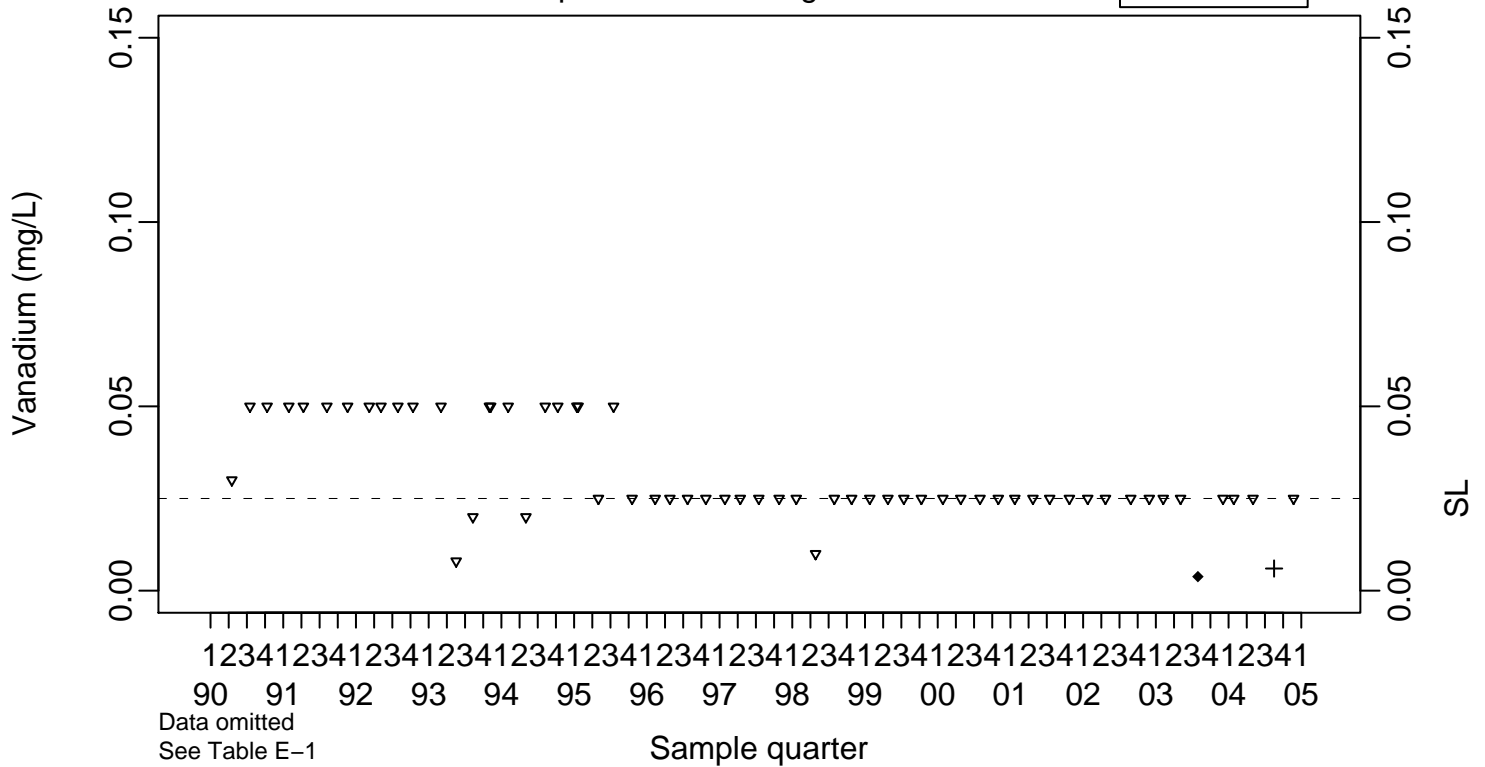


Pit 7 Complex Vanadium (mg/L)

SL=0.025

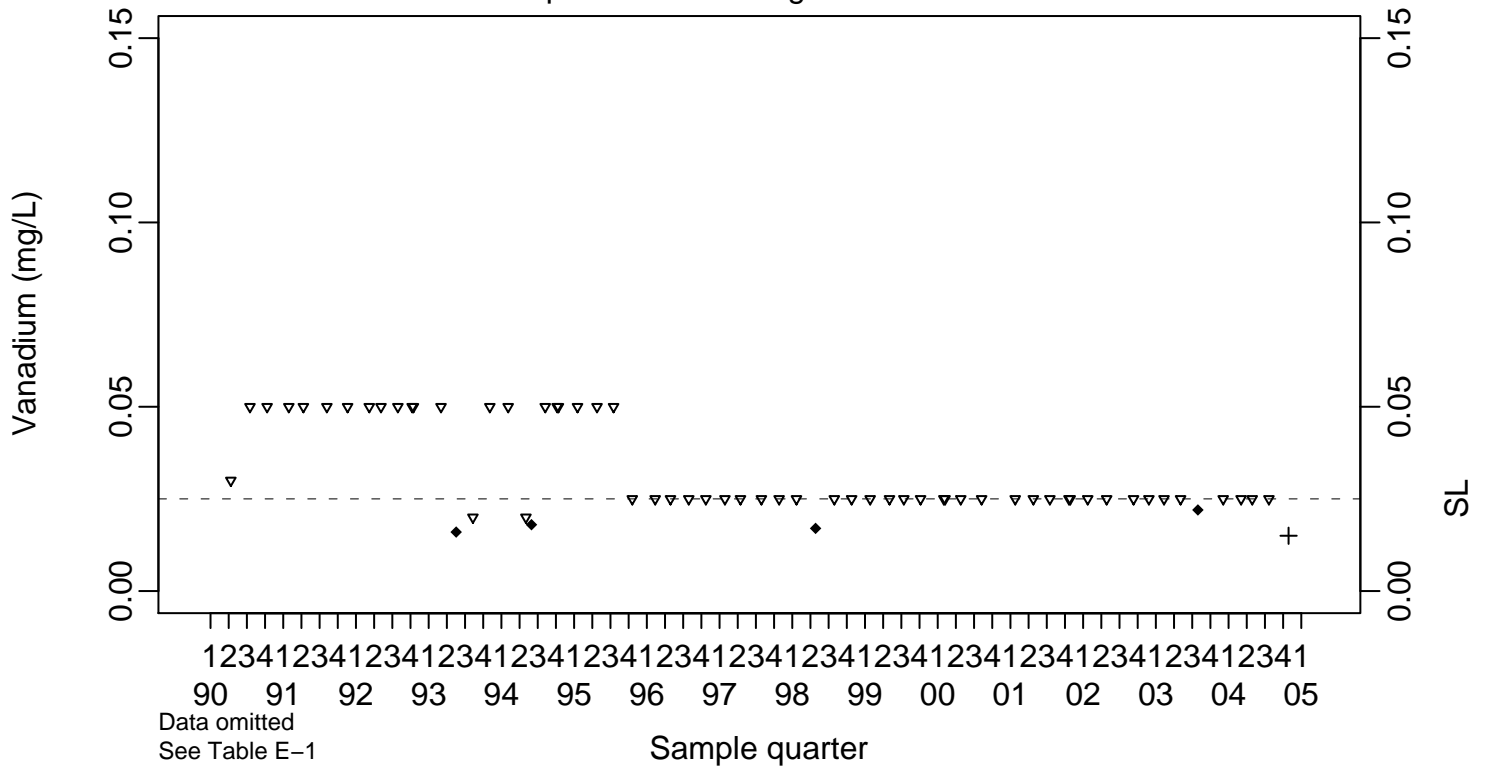
Compliance Monitoring Point K7-10

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.025

Compliance Monitoring Point NC7-25

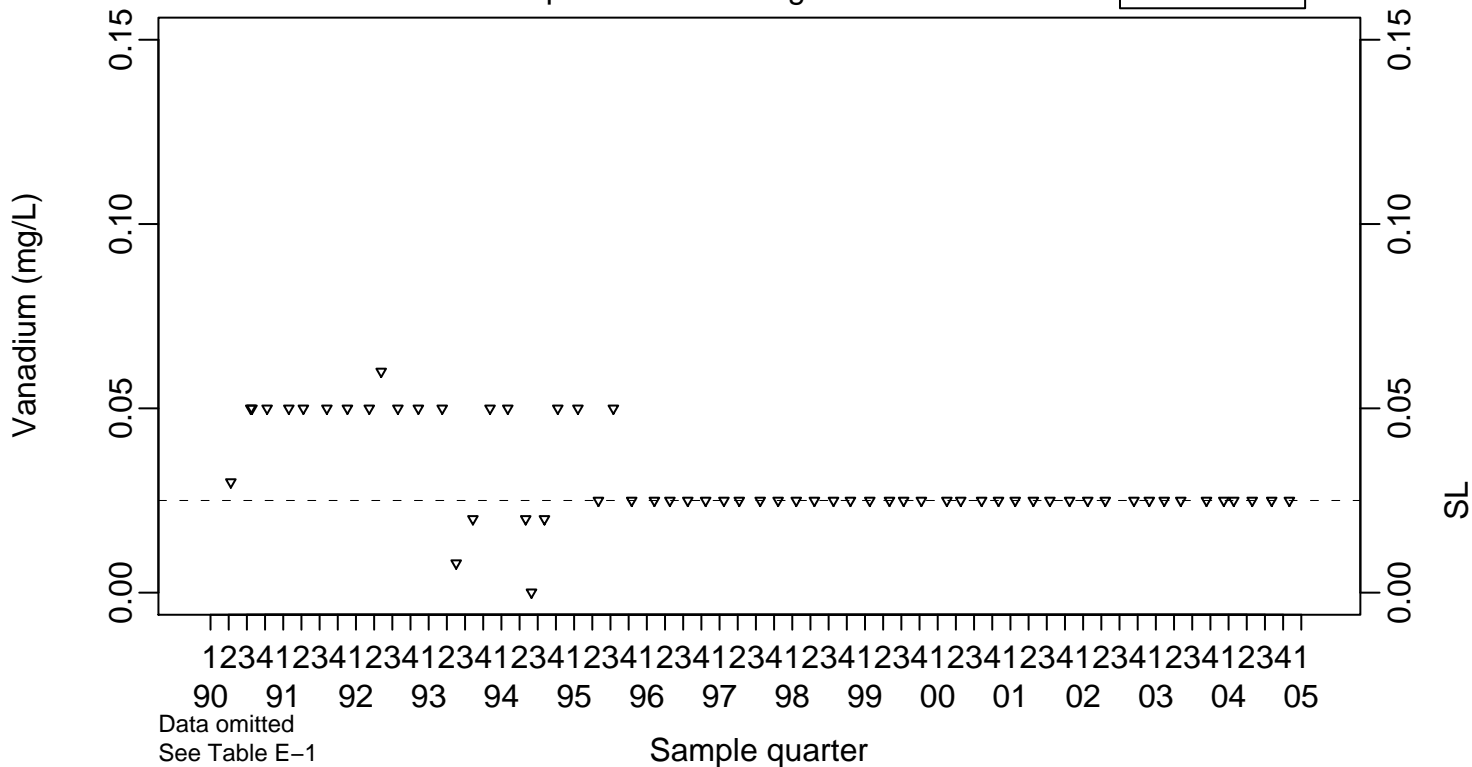


Pit 7 Complex Vanadium (mg/L)

Compliance Monitoring Point NC7-26

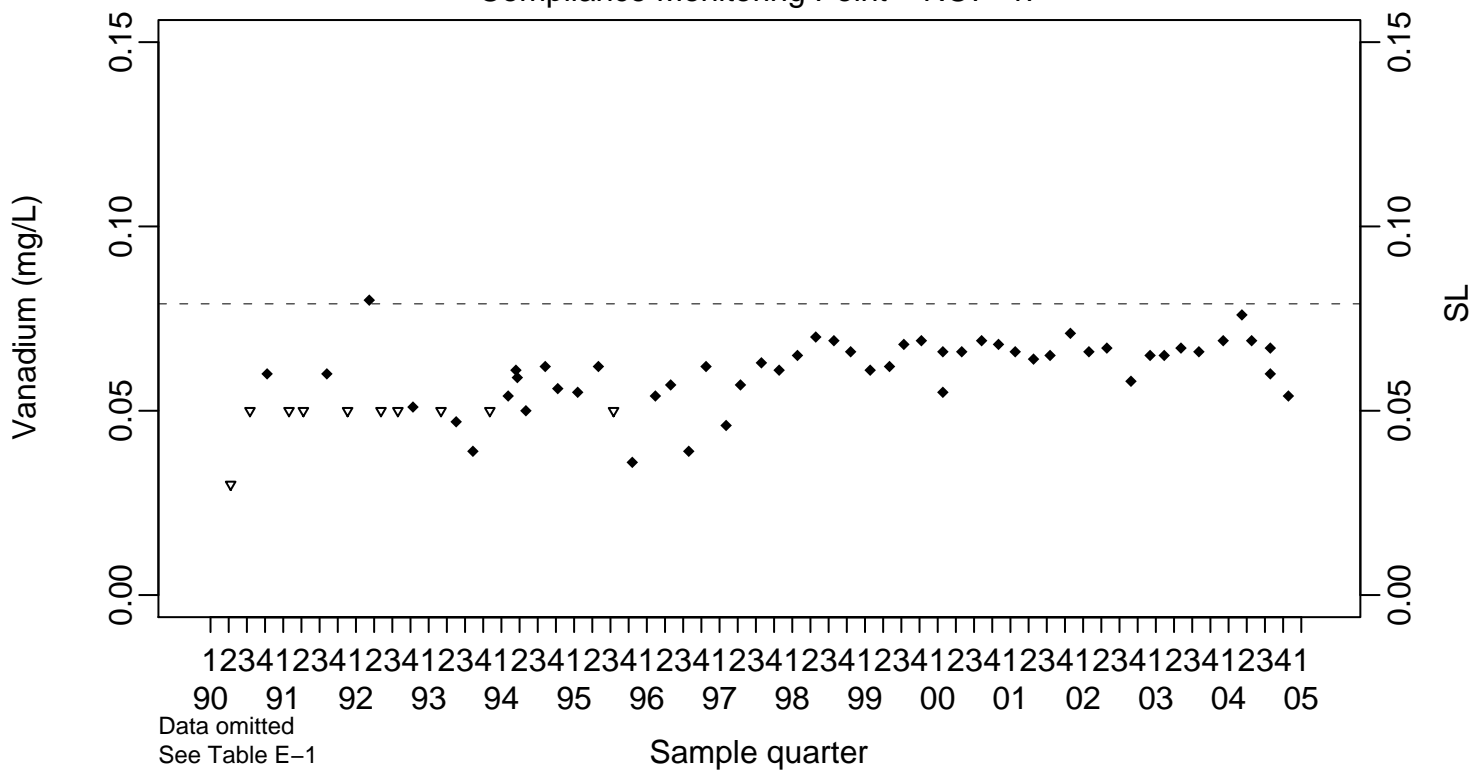
SL=0.025

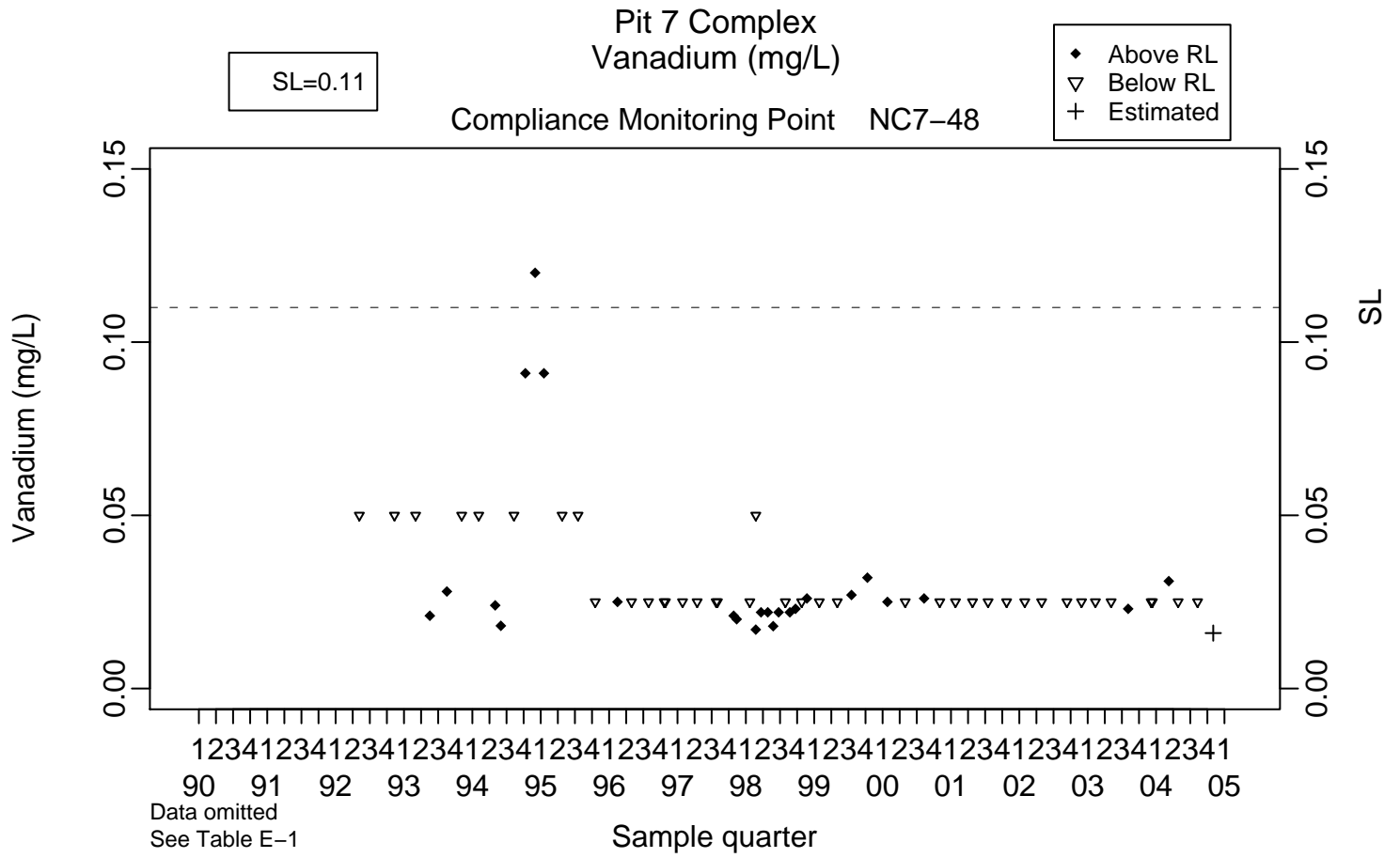
◆ Above RL
▽ Below RL

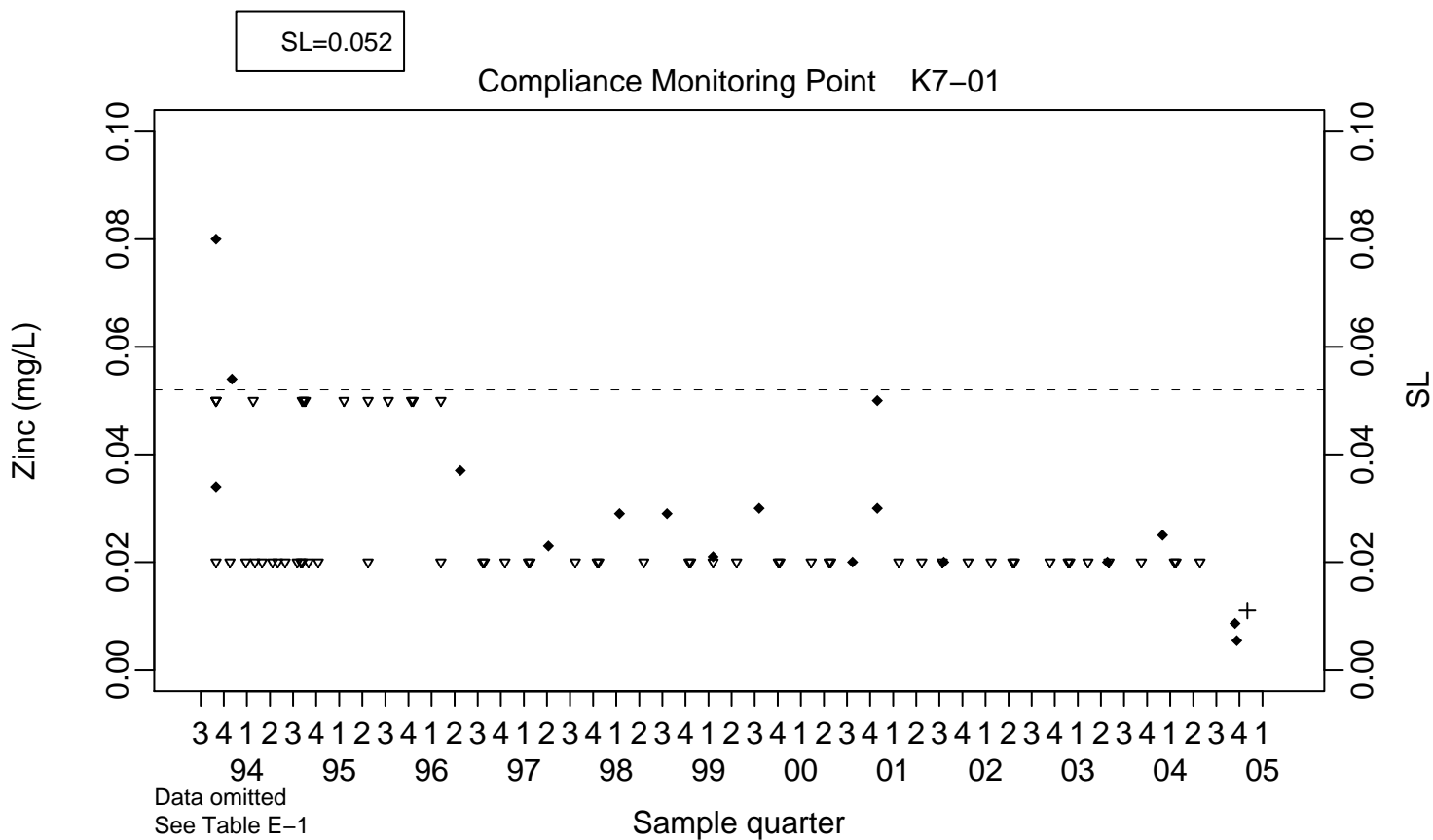
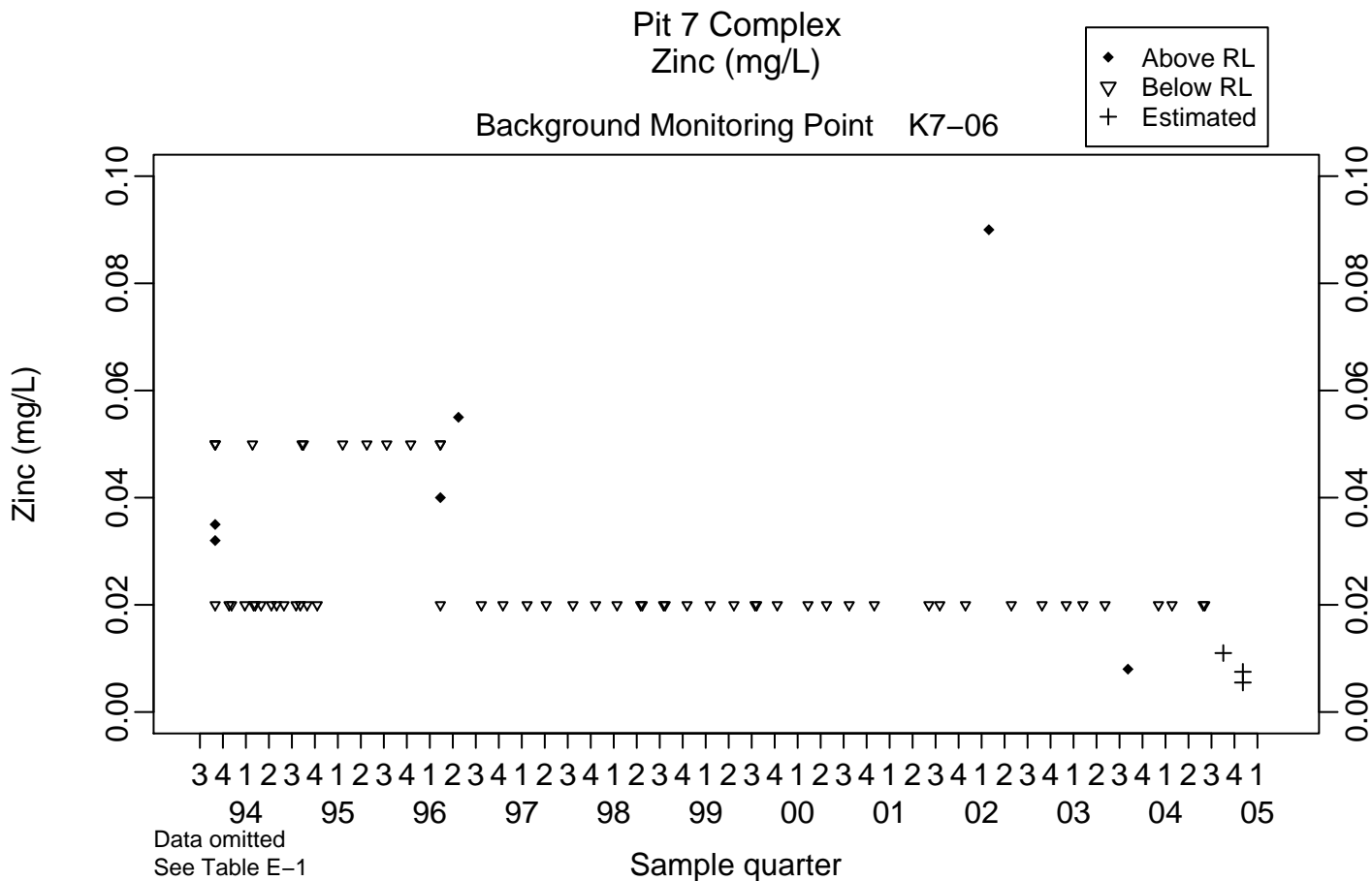


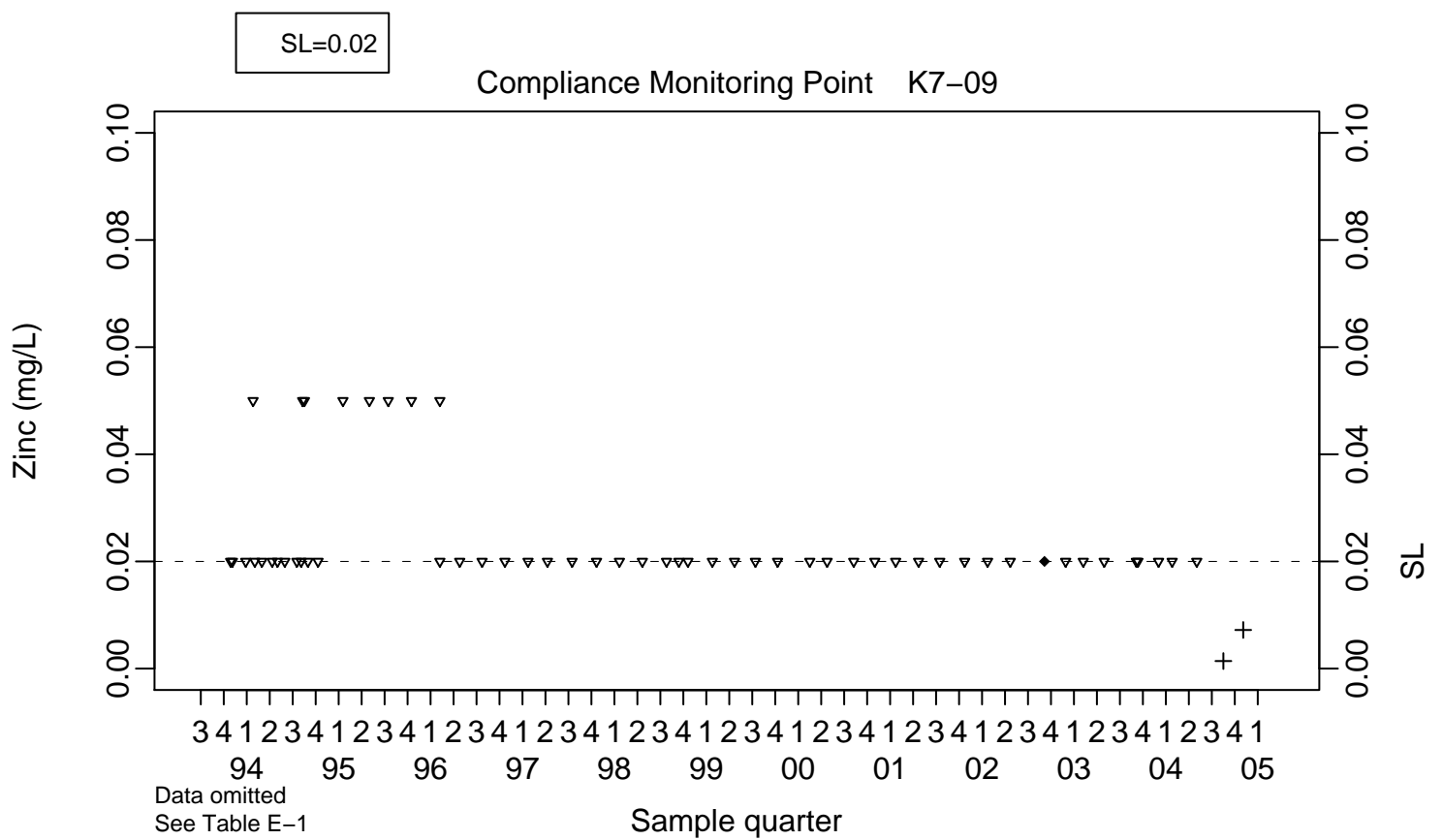
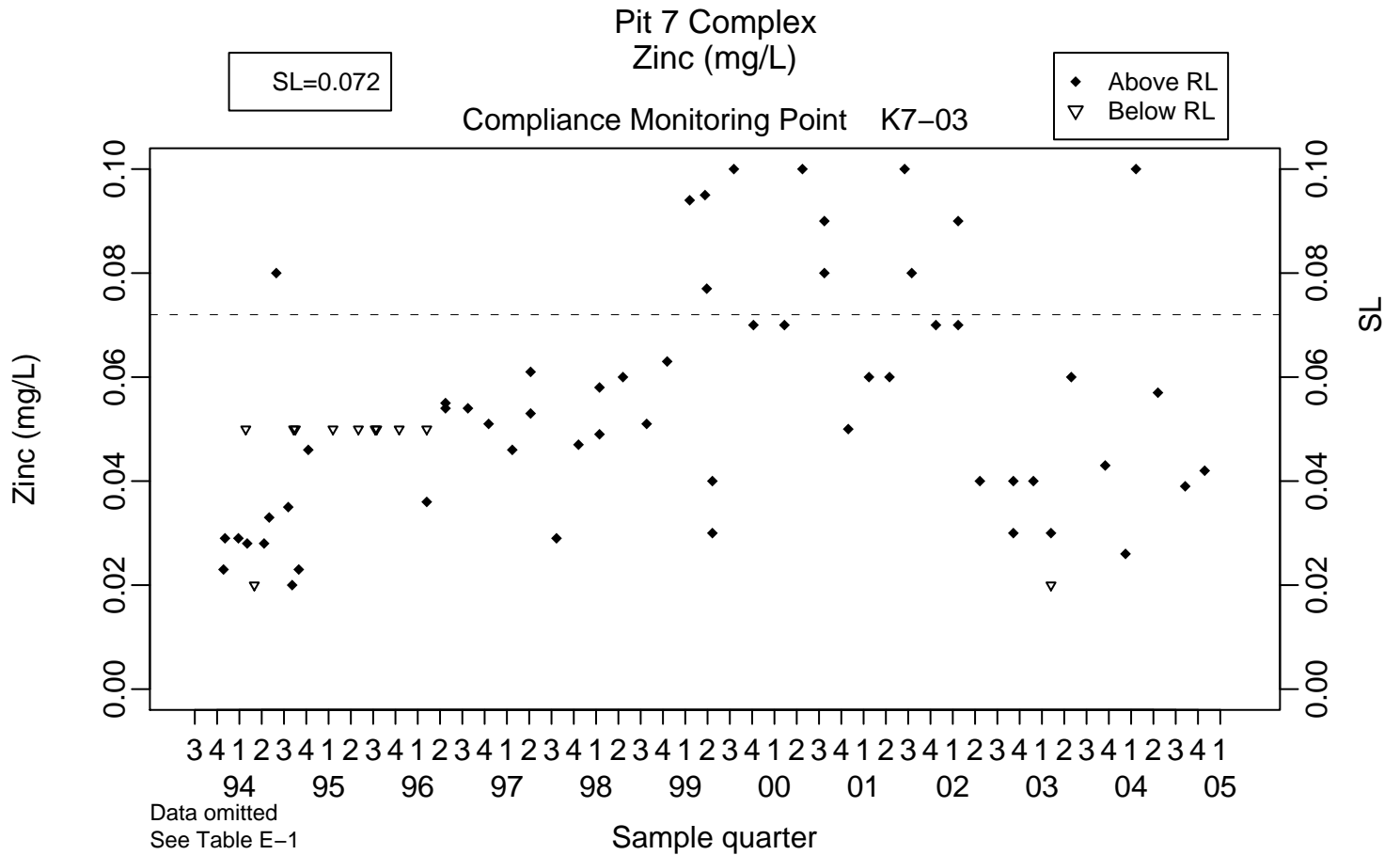
Compliance Monitoring Point NC7-47

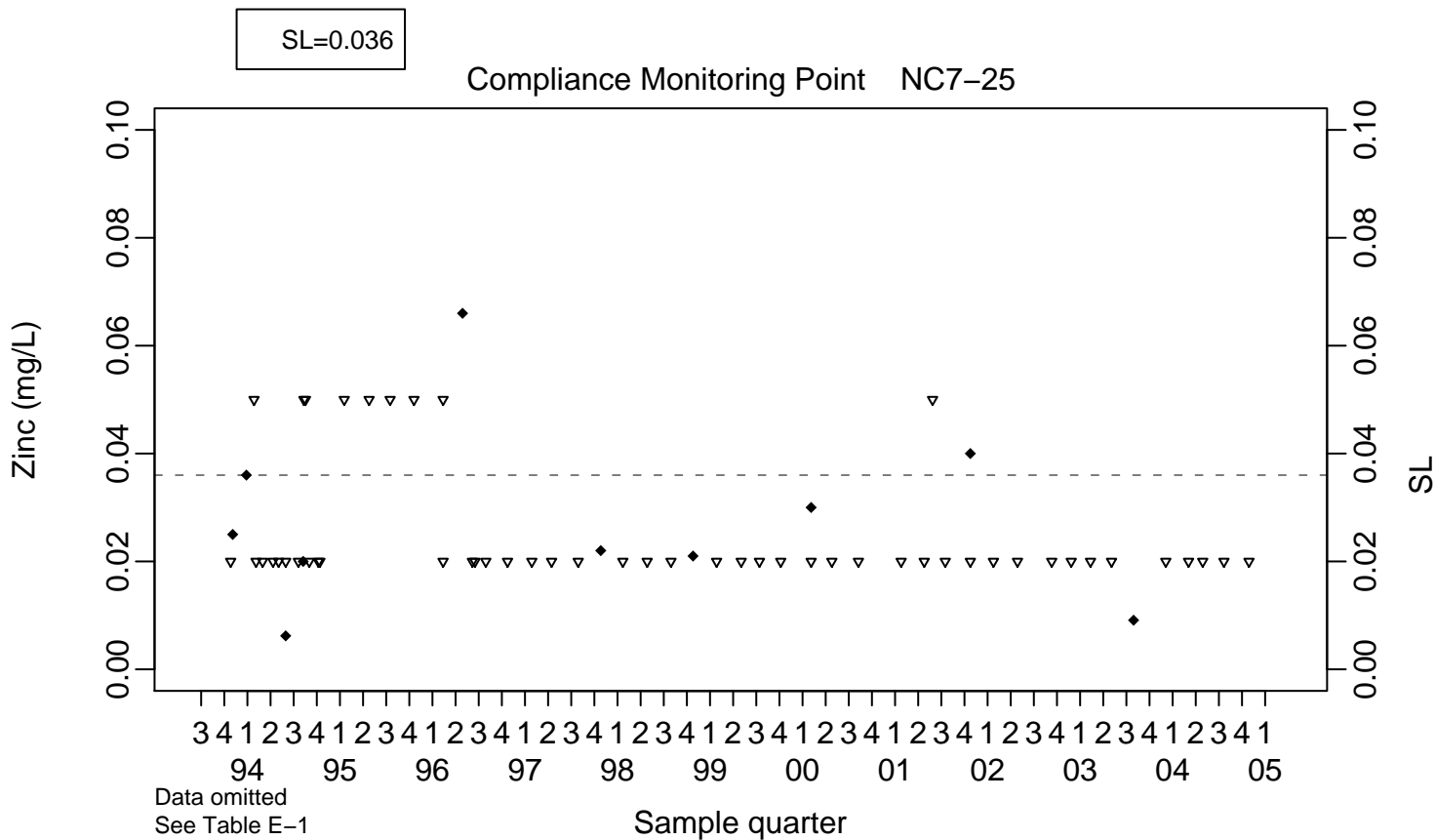
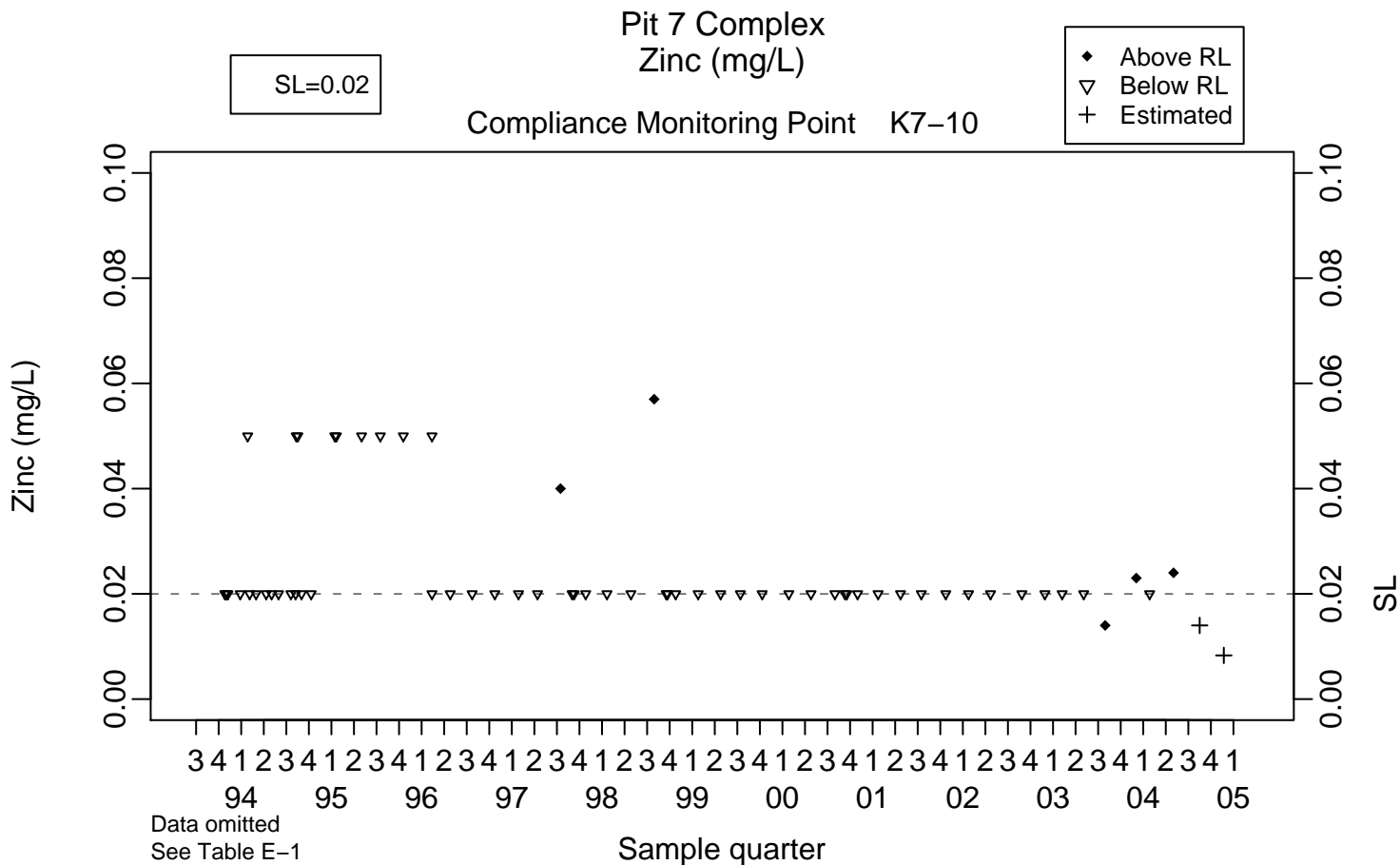
SL=0.079









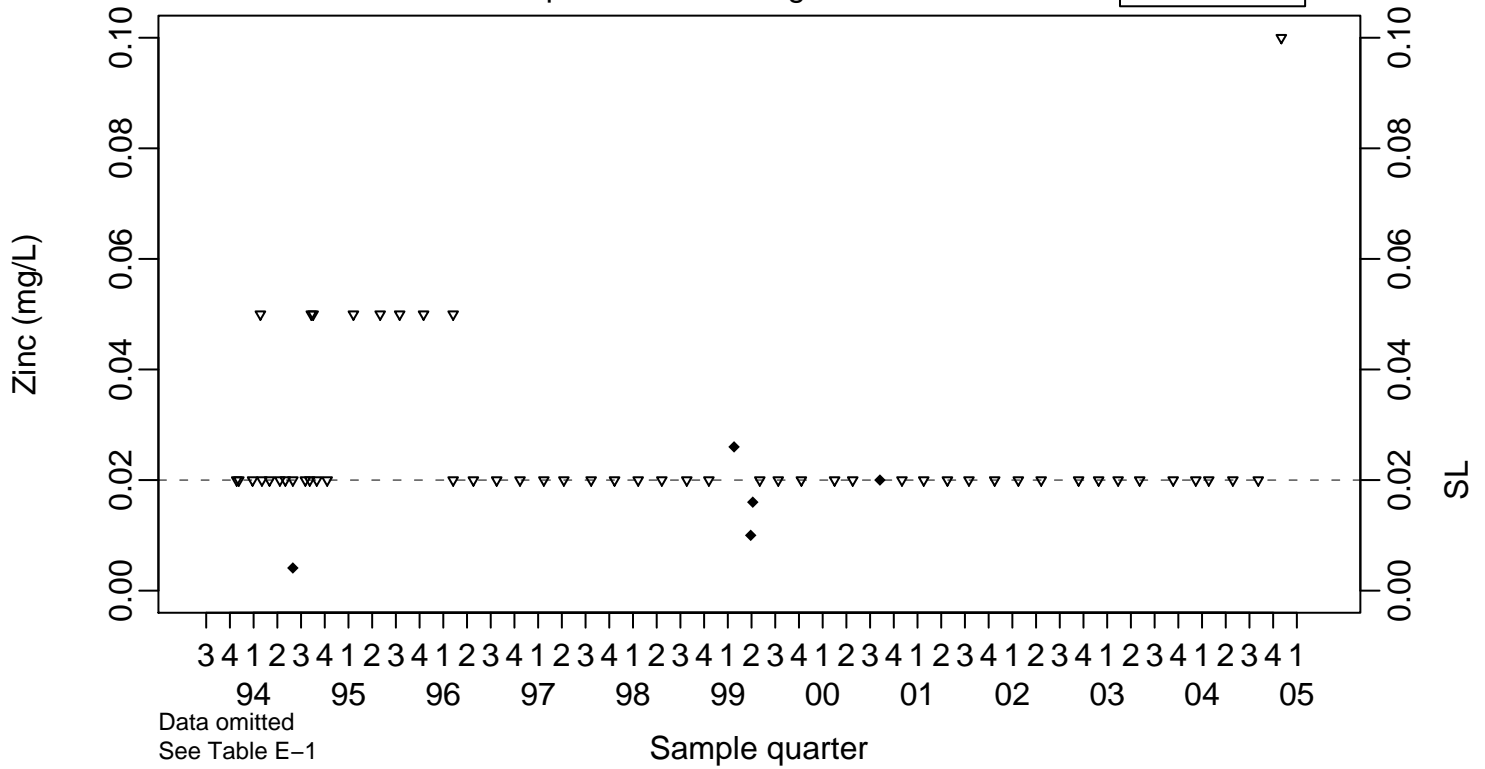


Pit 7 Complex Zinc (mg/L)

Compliance Monitoring Point NC7-26

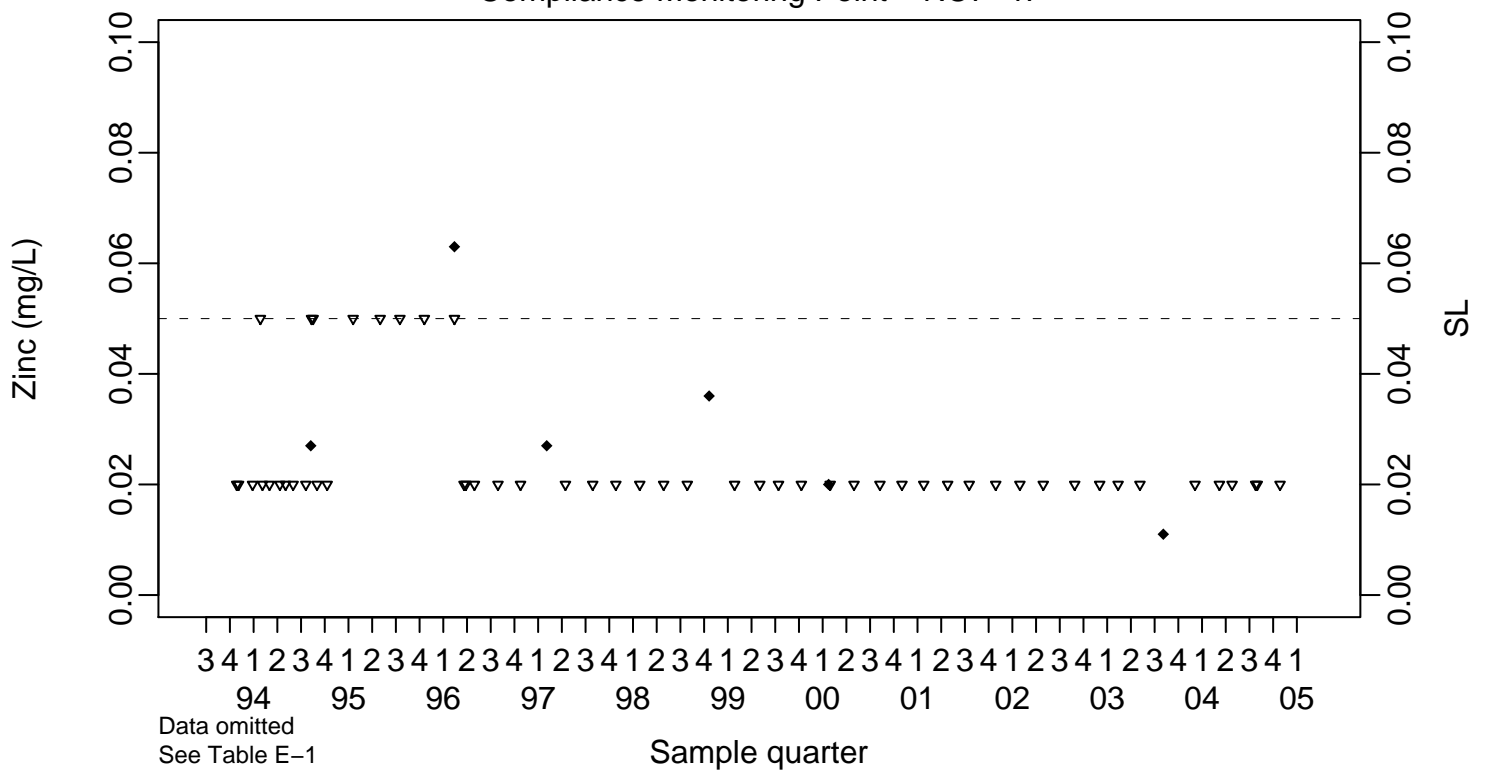
SL=0.02

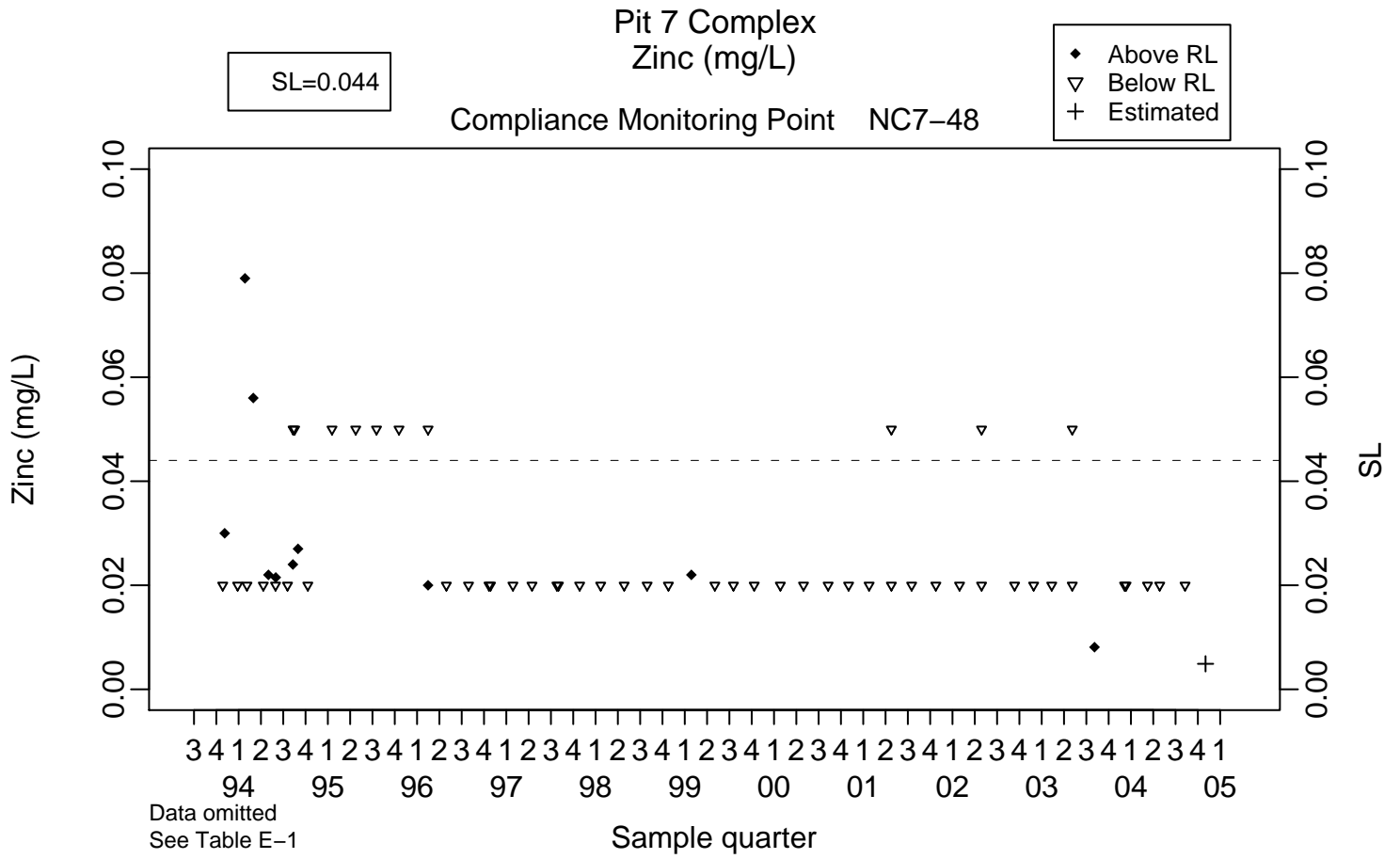
◆ Above RL
▽ Below RL



Compliance Monitoring Point NC7-47

SL=0.05

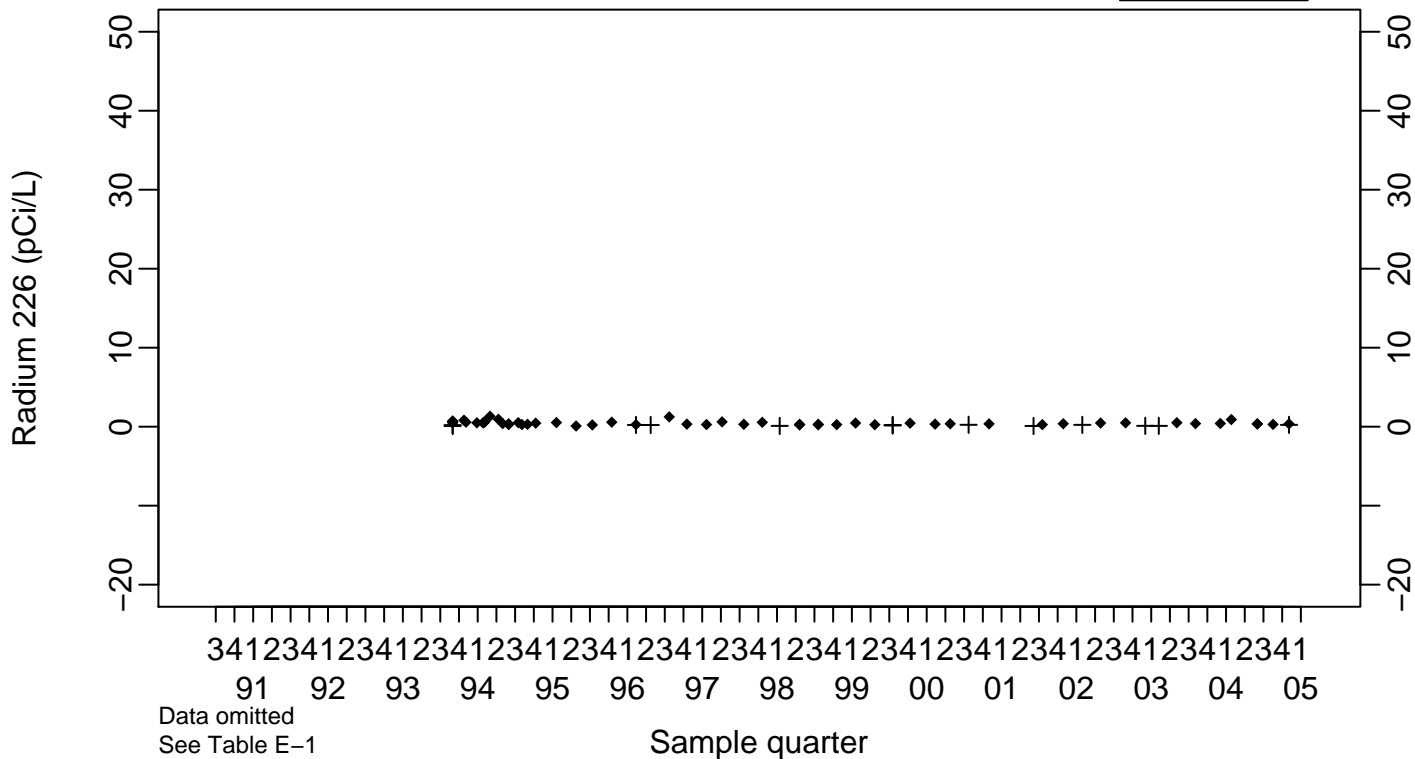




Pit 7 Complex Radium 226 (pCi/L)

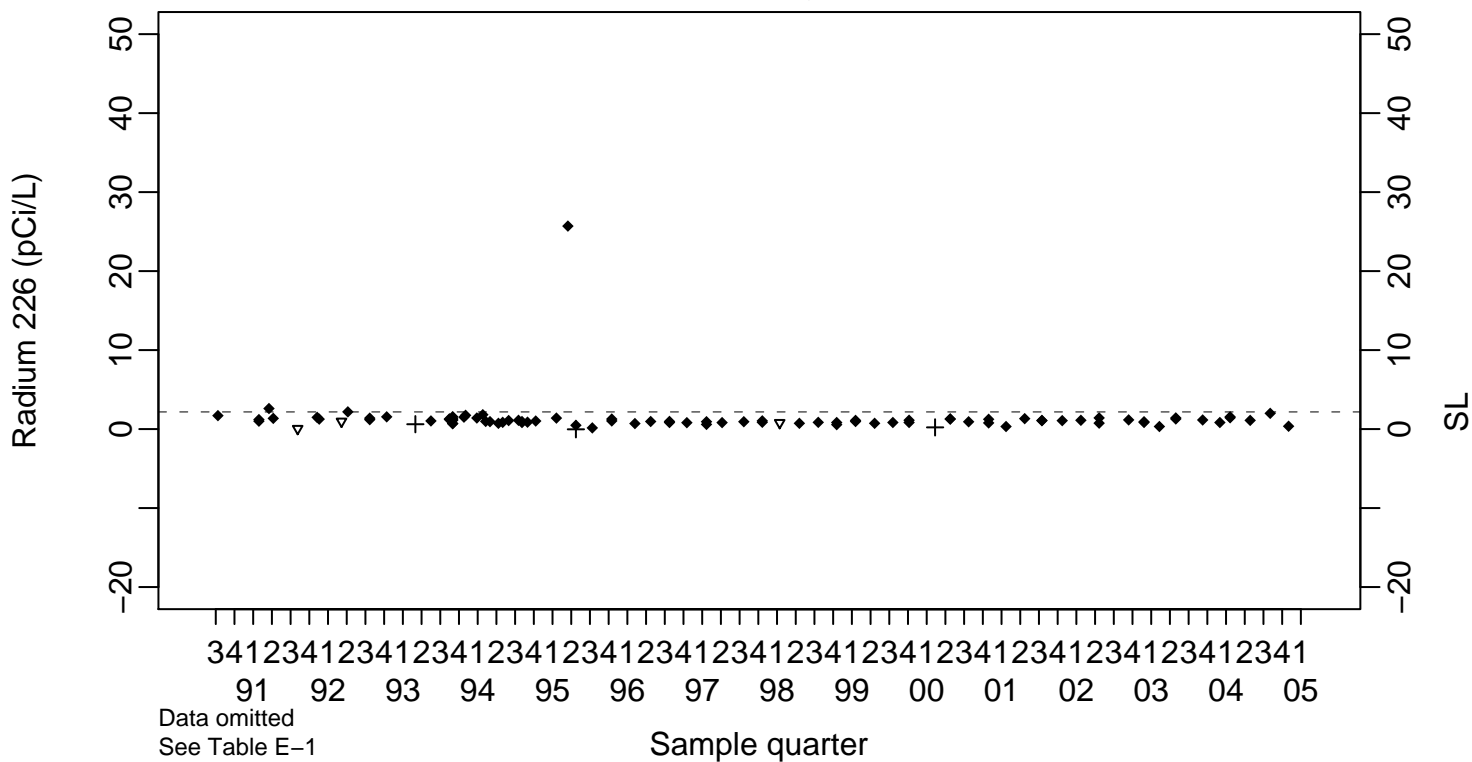
Background Monitoring Point K7-06

◆ Above RL
+ Estimated



SL=2.17

Compliance Monitoring Point K7-01

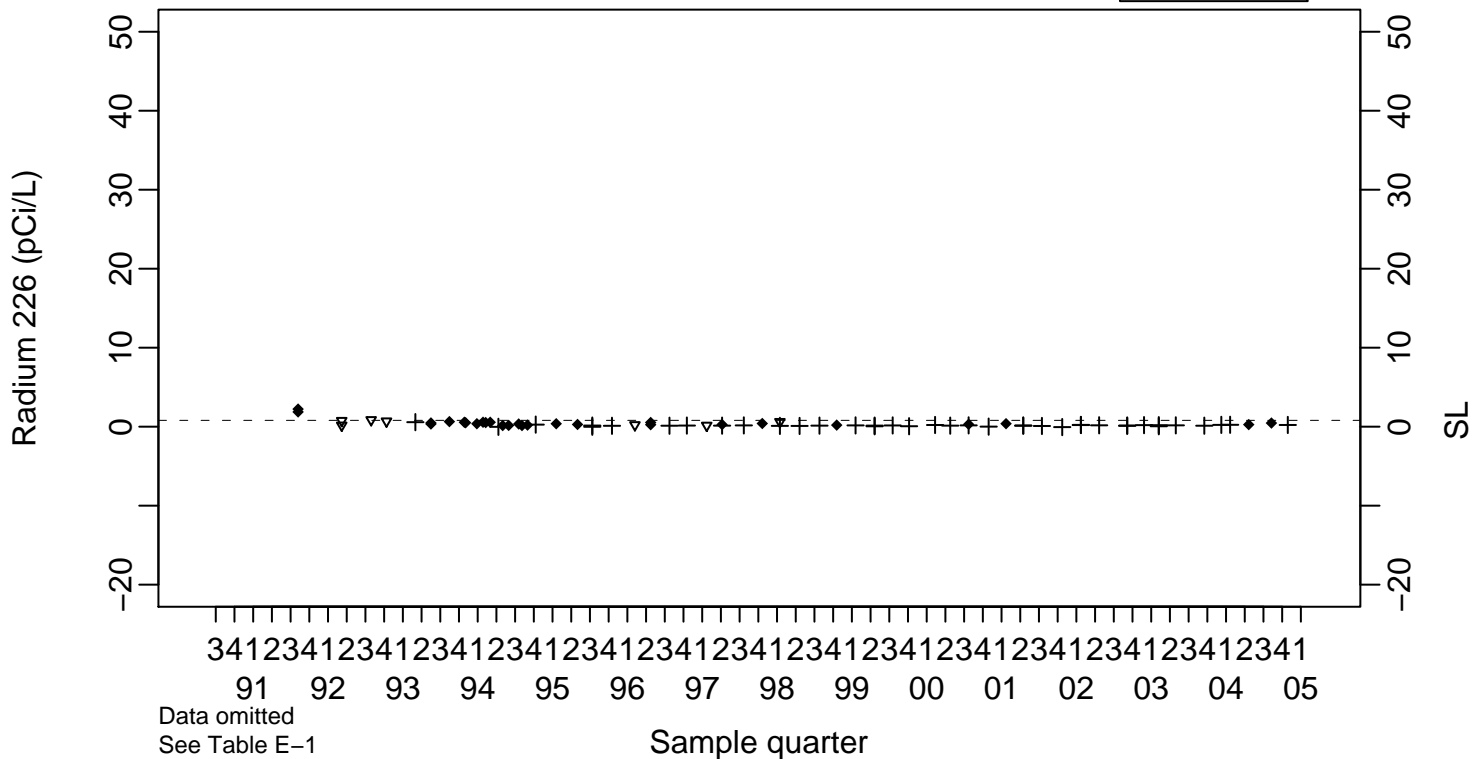


Pit 7 Complex Radium 226 (pCi/L)

Compliance Monitoring Point K7-03

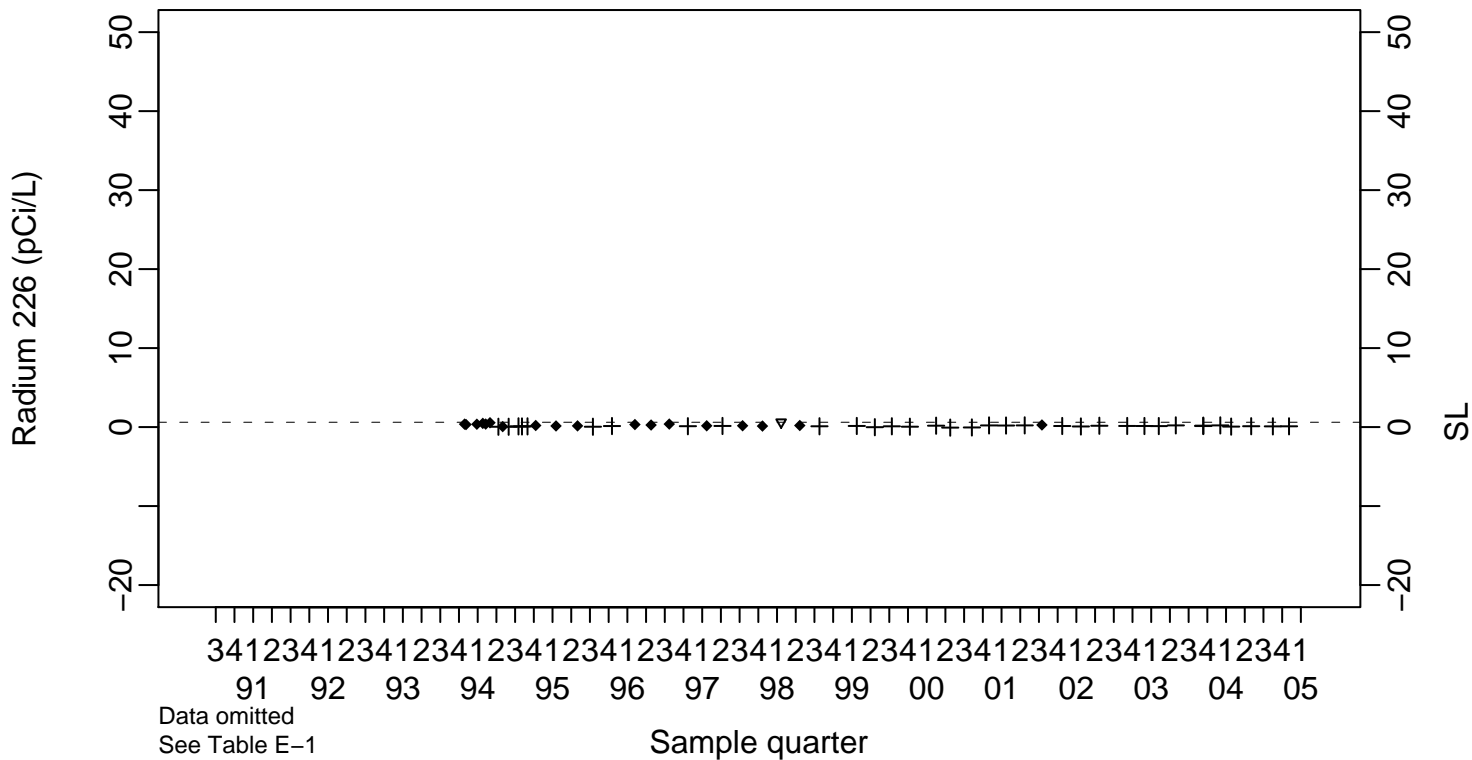
SL=0.8

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.61

Compliance Monitoring Point K7-09

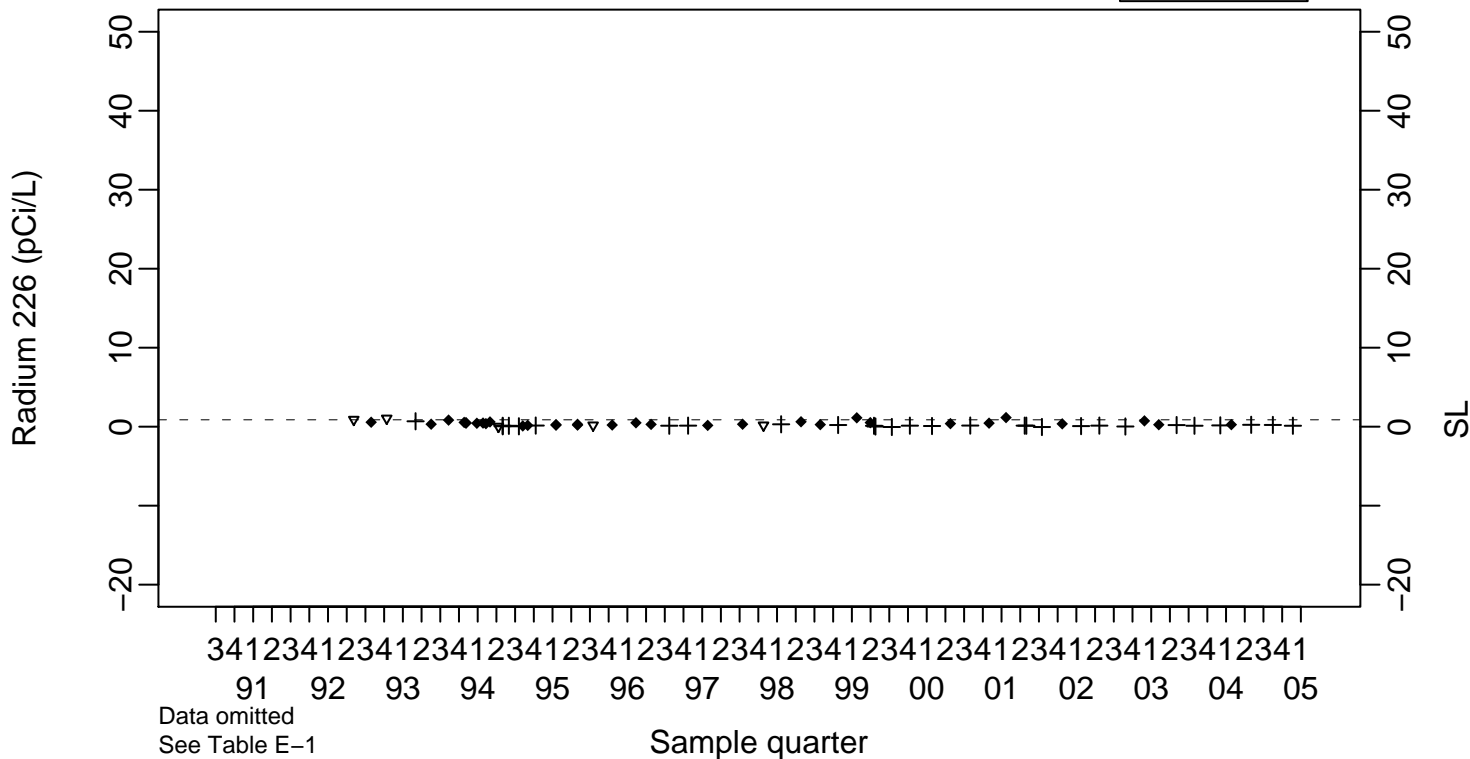


Pit 7 Complex Radium 226 (pCi/L)

Compliance Monitoring Point K7-10

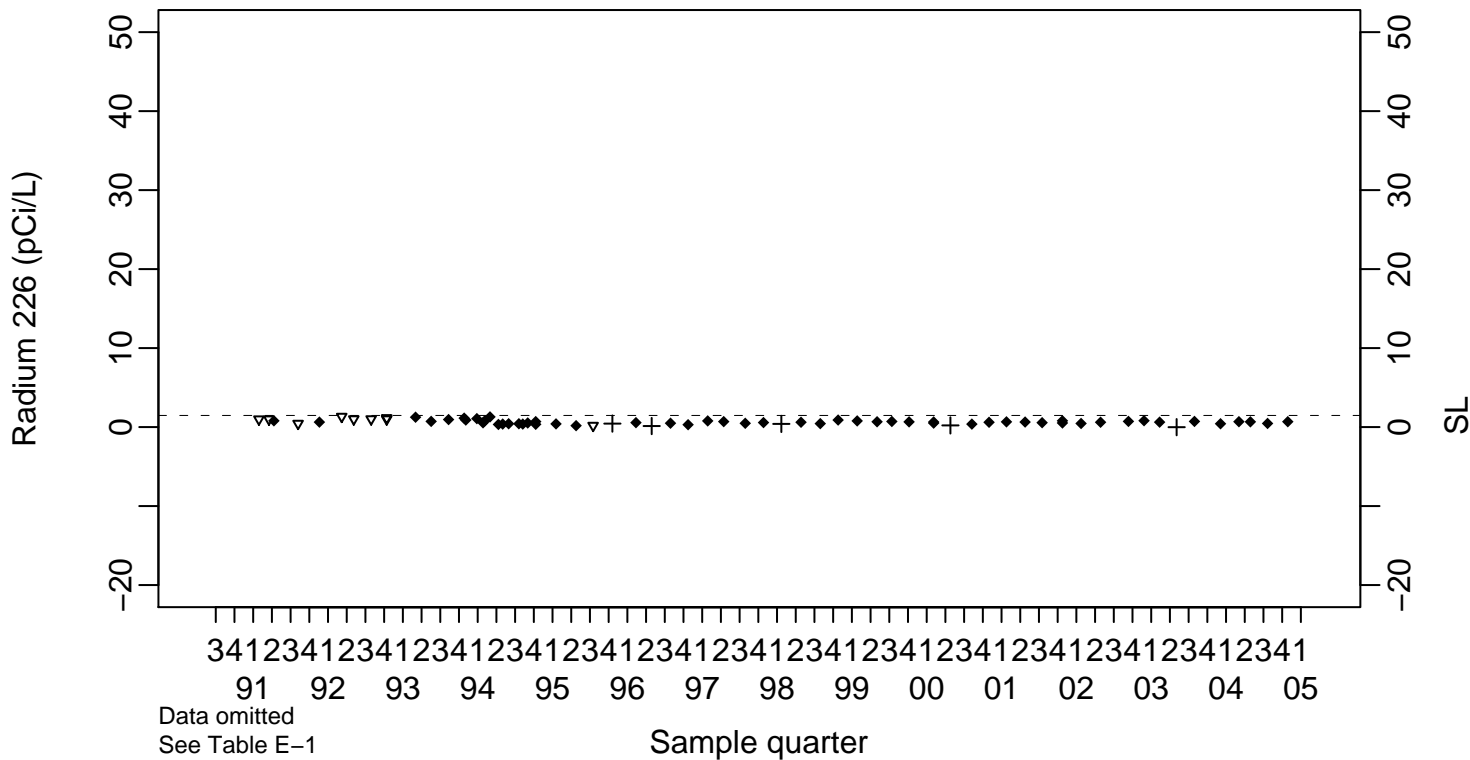
SL=0.87

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=1.47

Compliance Monitoring Point NC7-25

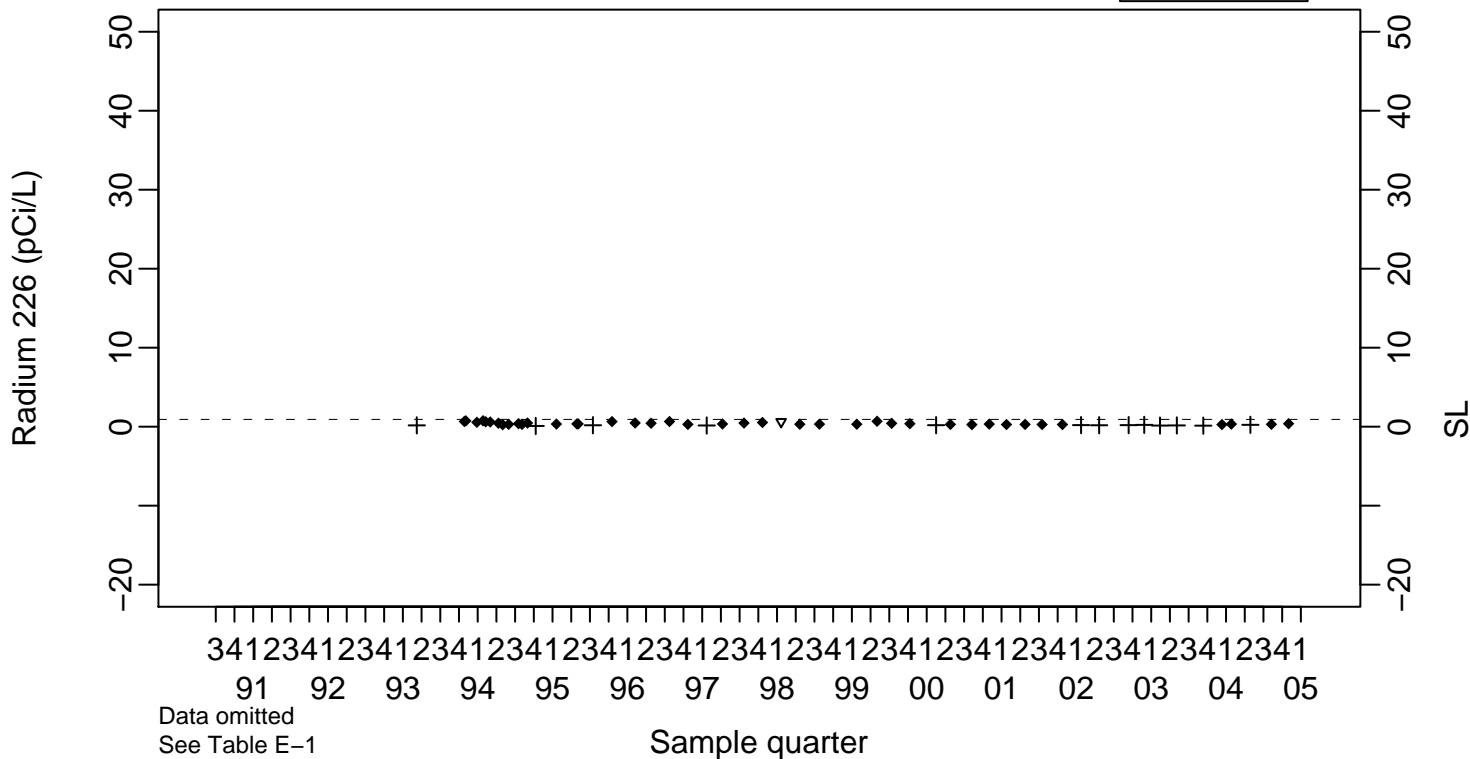


Pit 7 Complex Radium 226 (pCi/L)

Compliance Monitoring Point NC7-26

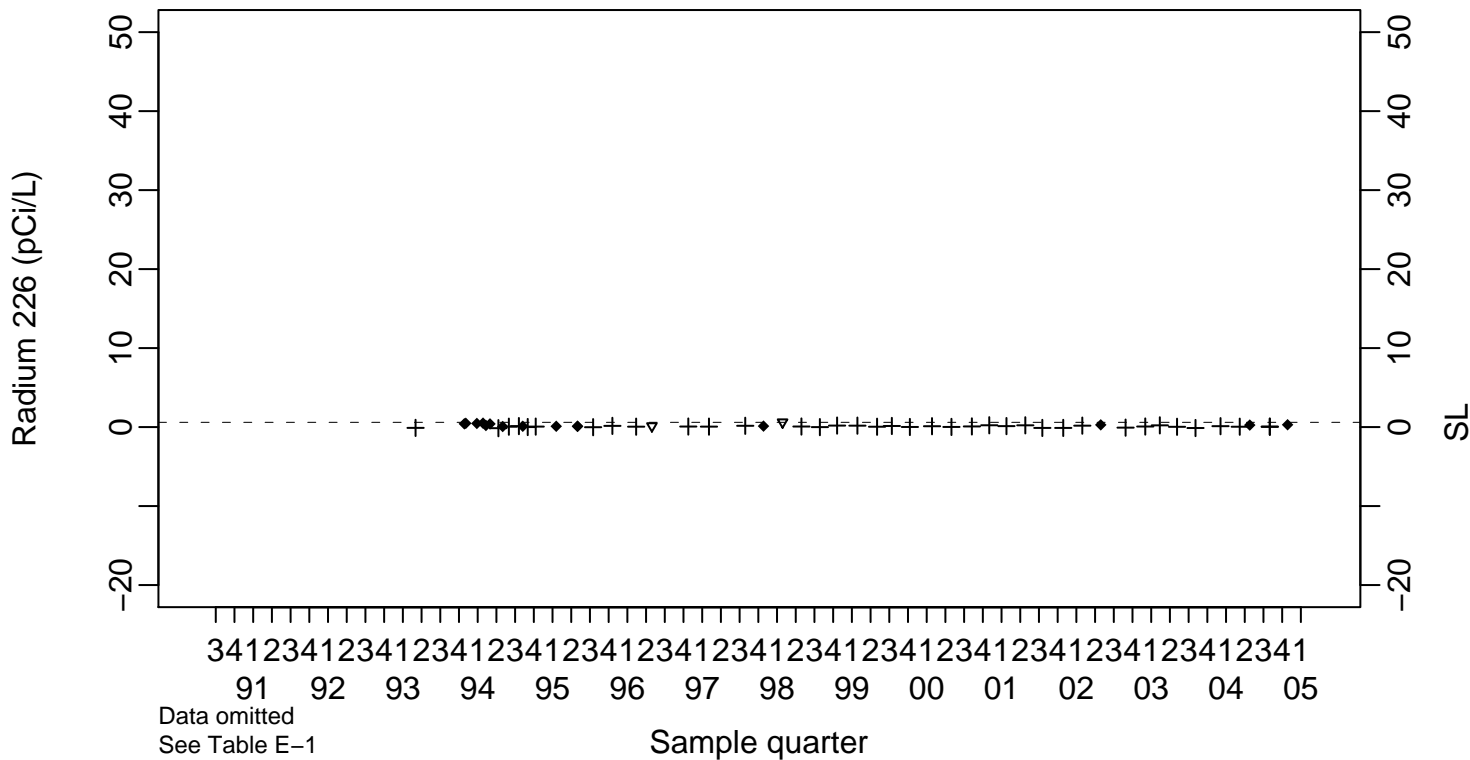
SL=0.92

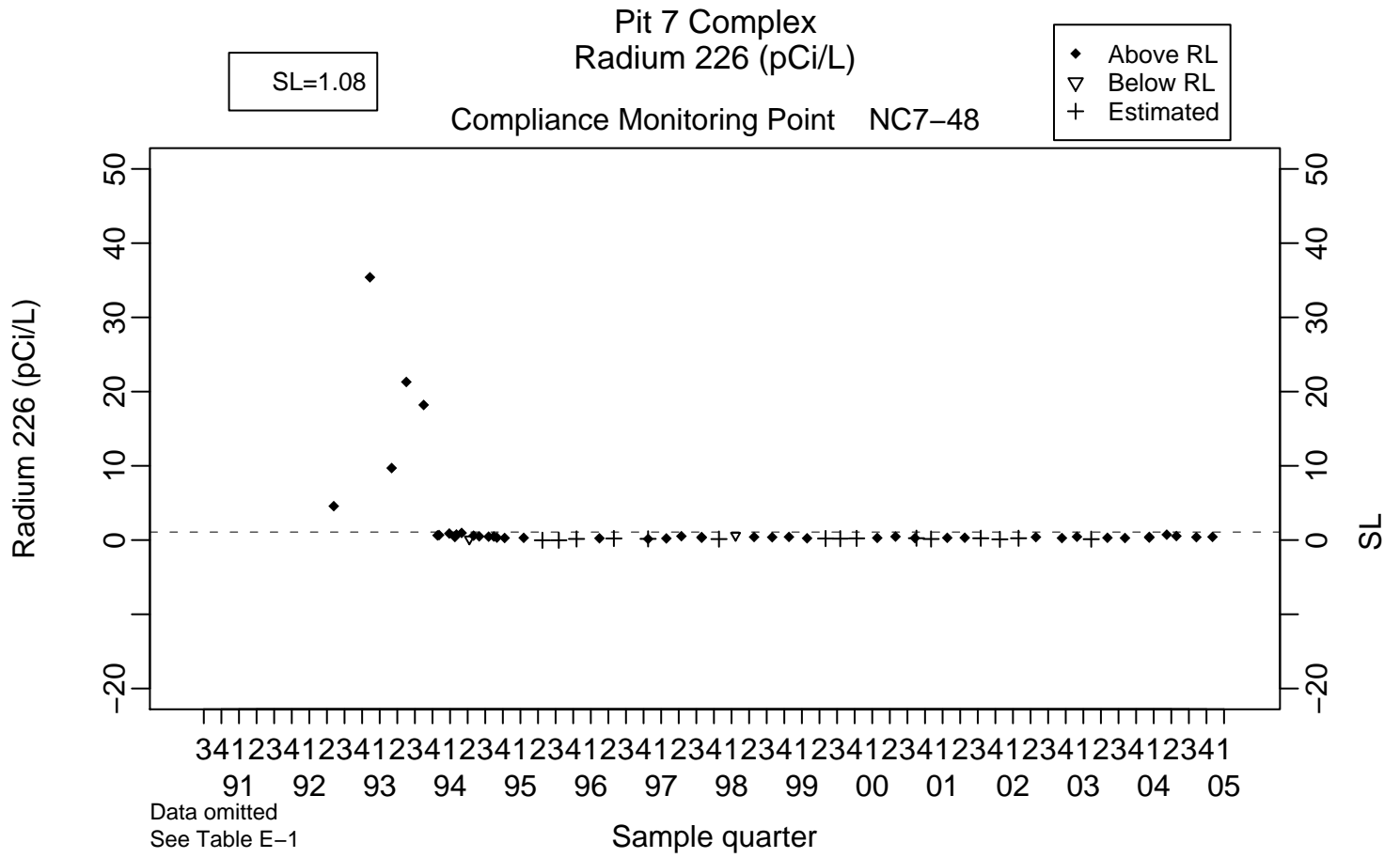
- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-47

SL=0.6



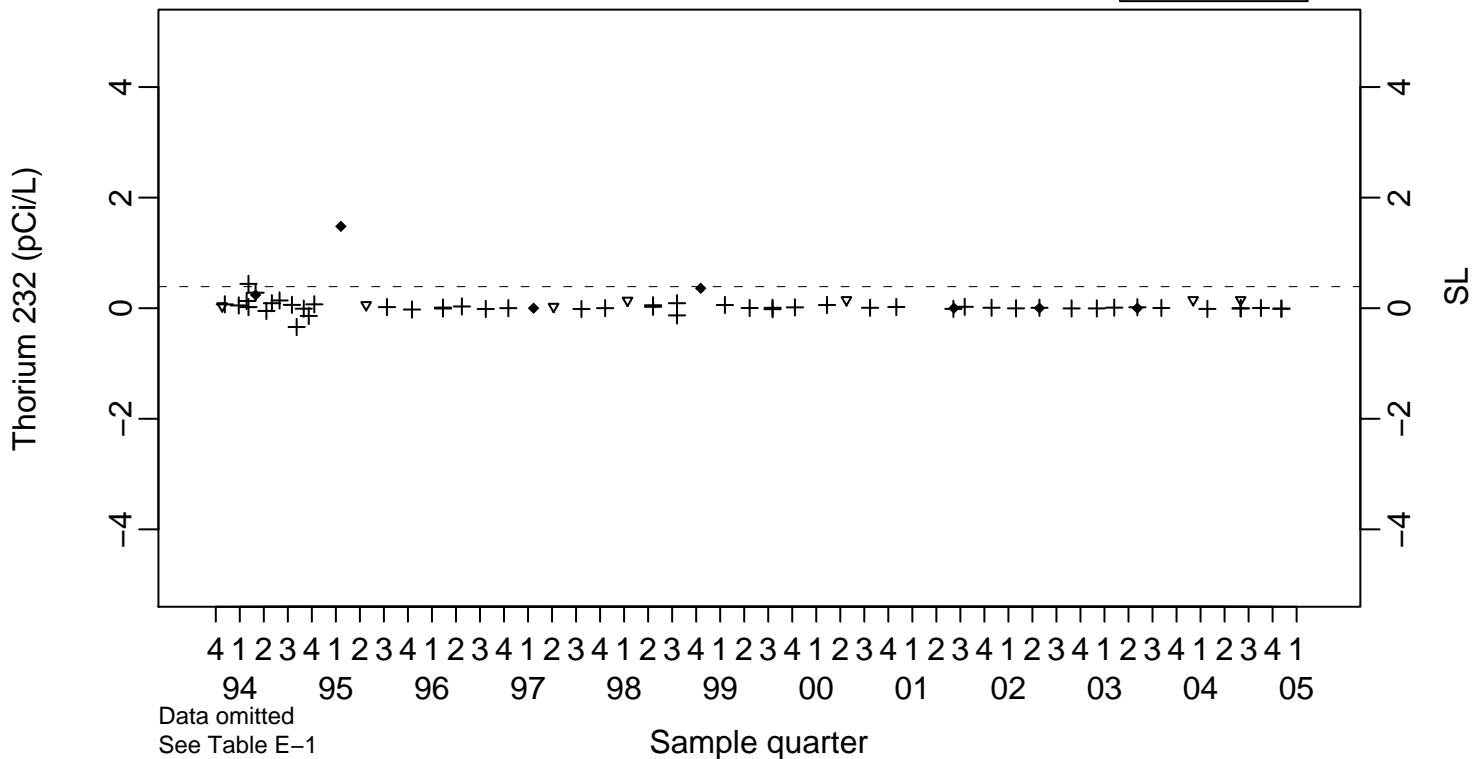


Pit 7 Complex Thorium 232 (pCi/L)

Background Monitoring Point K7-06

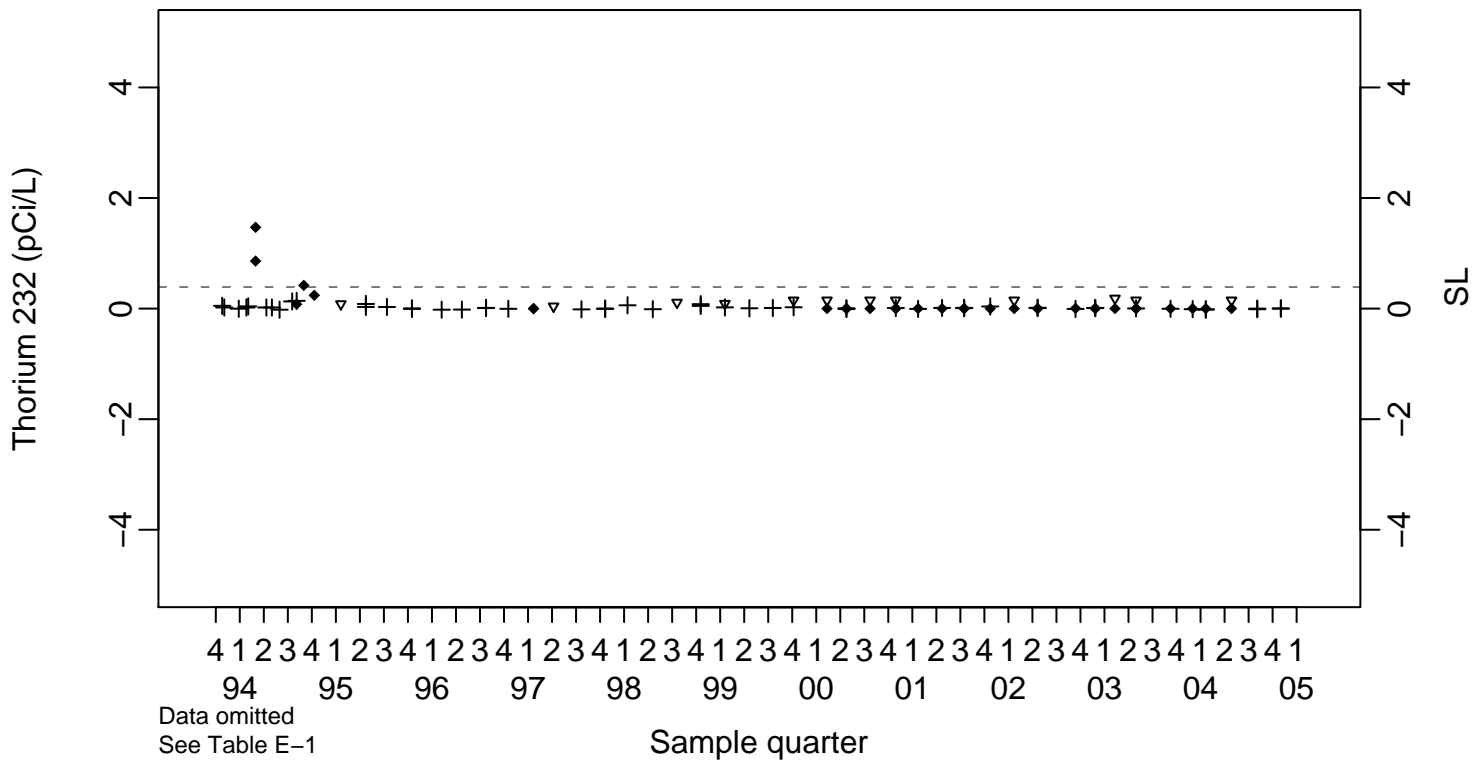
SL=0.39

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point K7-01

SL=0.39

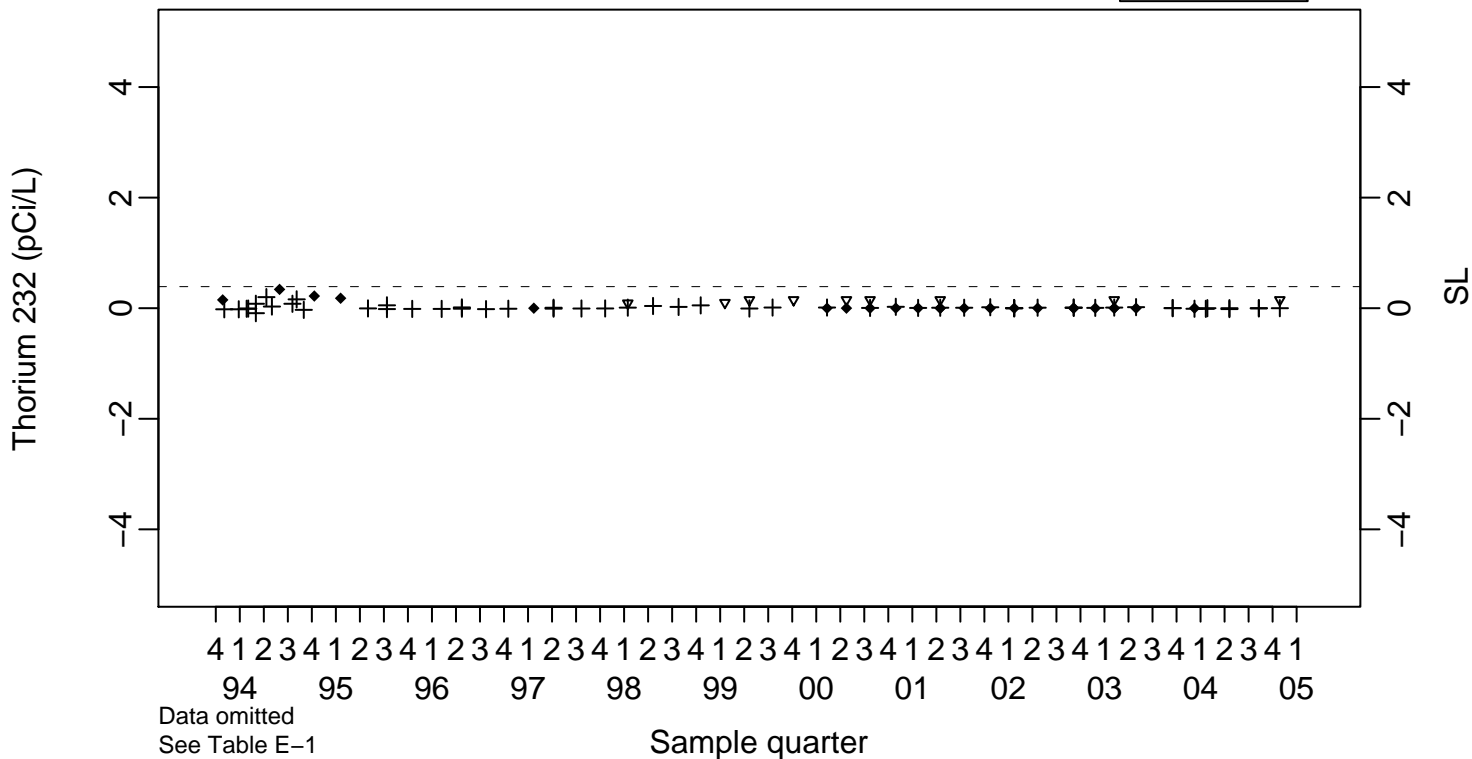


Pit 7 Complex Thorium 232 (pCi/L)

Compliance Monitoring Point K7-03

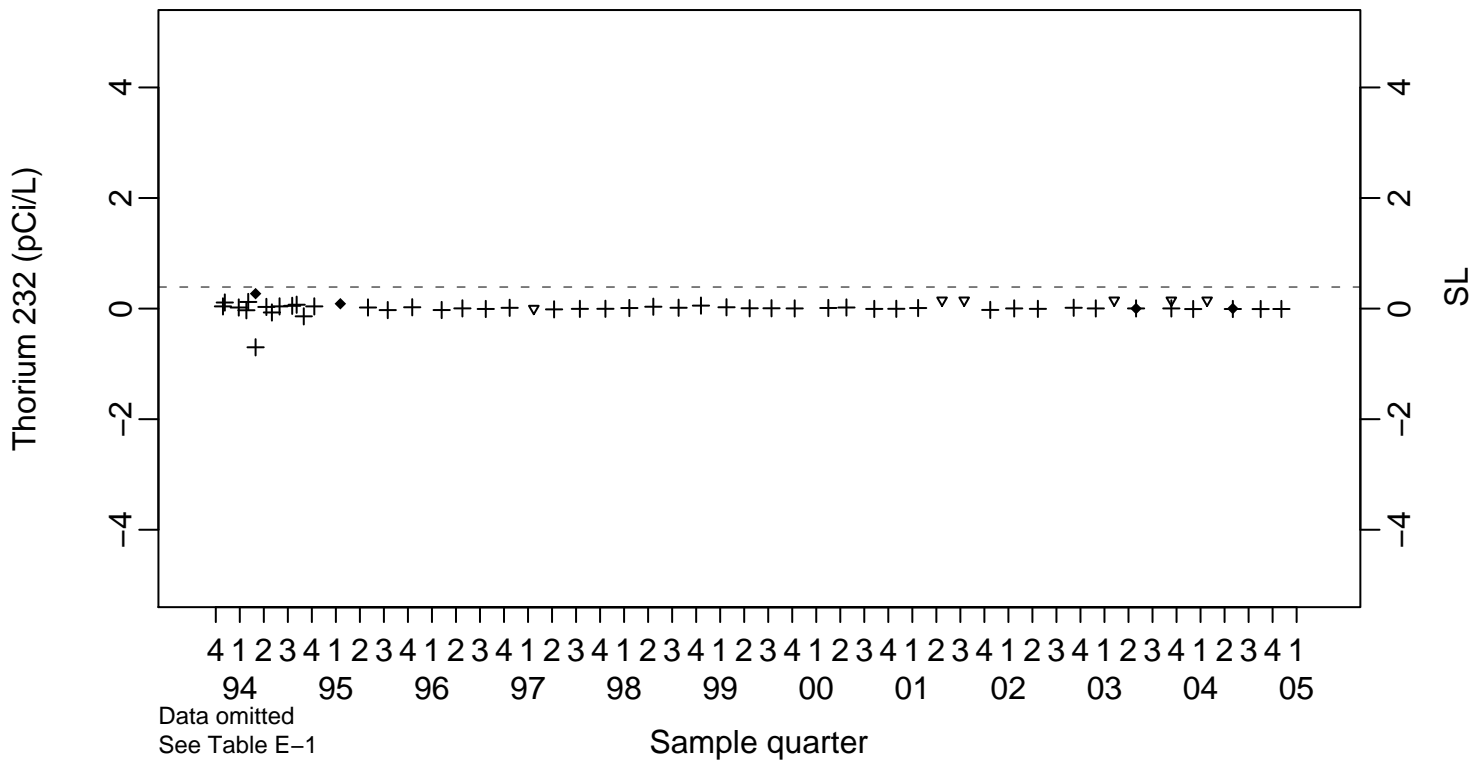
SL=0.39

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.39

Compliance Monitoring Point K7-09

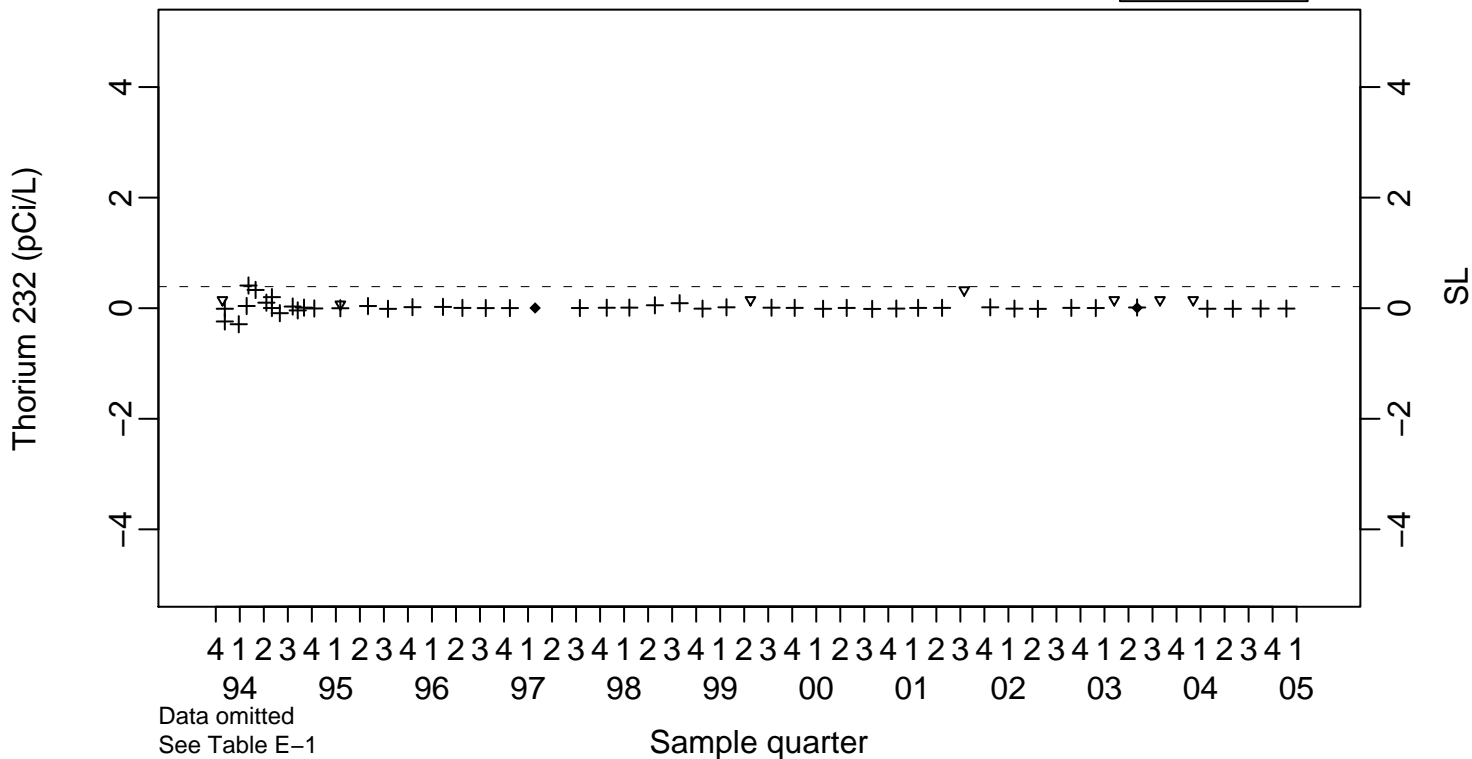


Pit 7 Complex Thorium 232 (pCi/L)

Compliance Monitoring Point K7-10

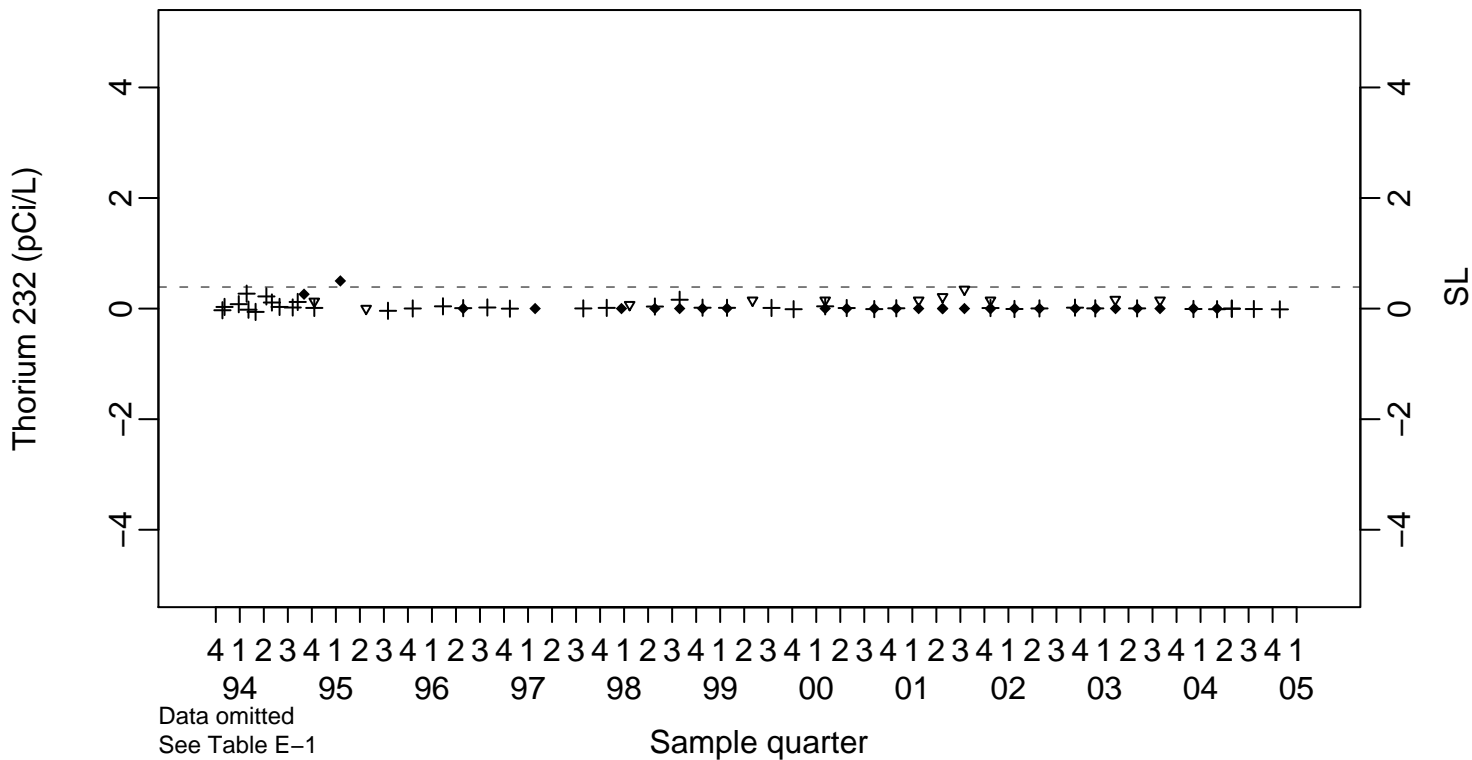
SL=0.39

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.39

Compliance Monitoring Point NC7-25

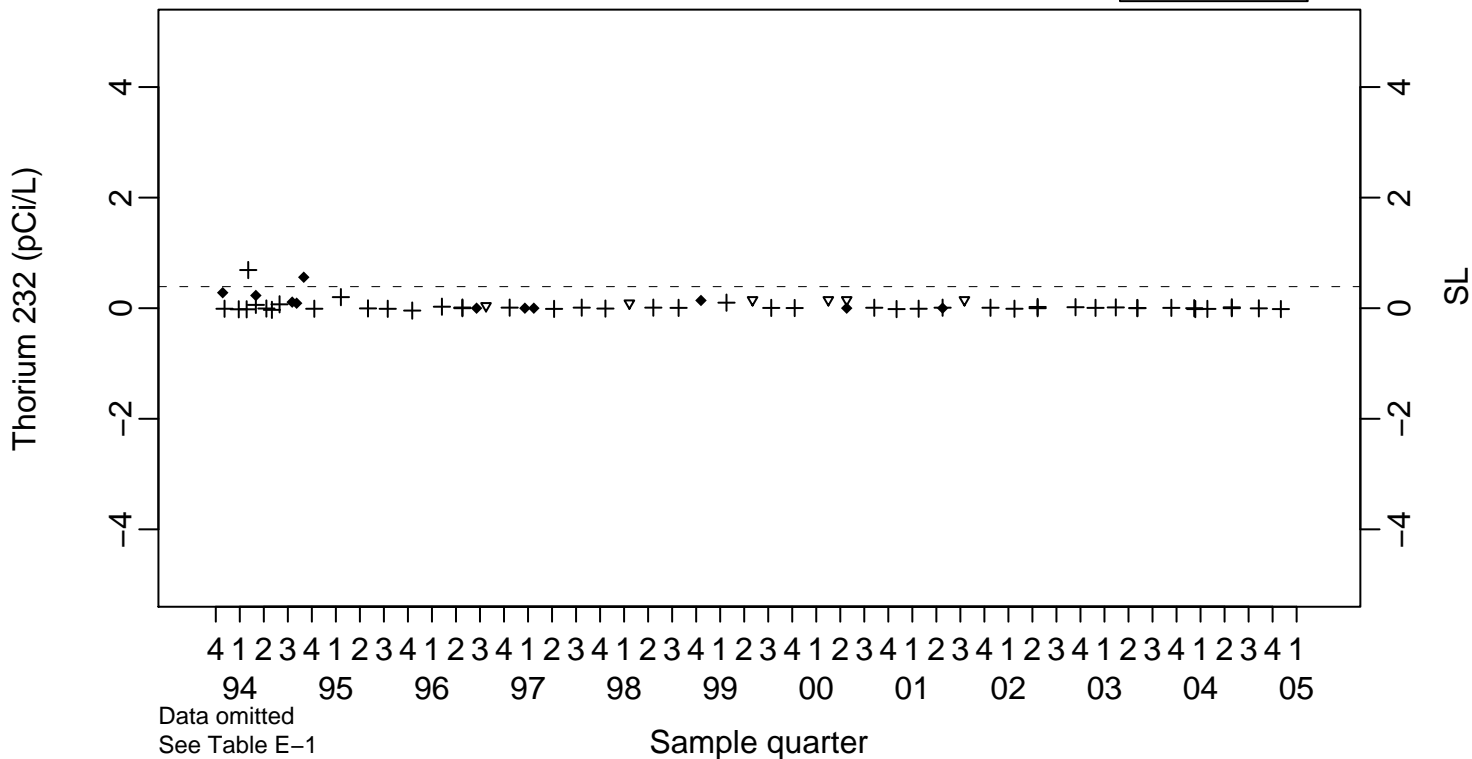


Pit 7 Complex Thorium 232 (pCi/L)

Compliance Monitoring Point NC7-26

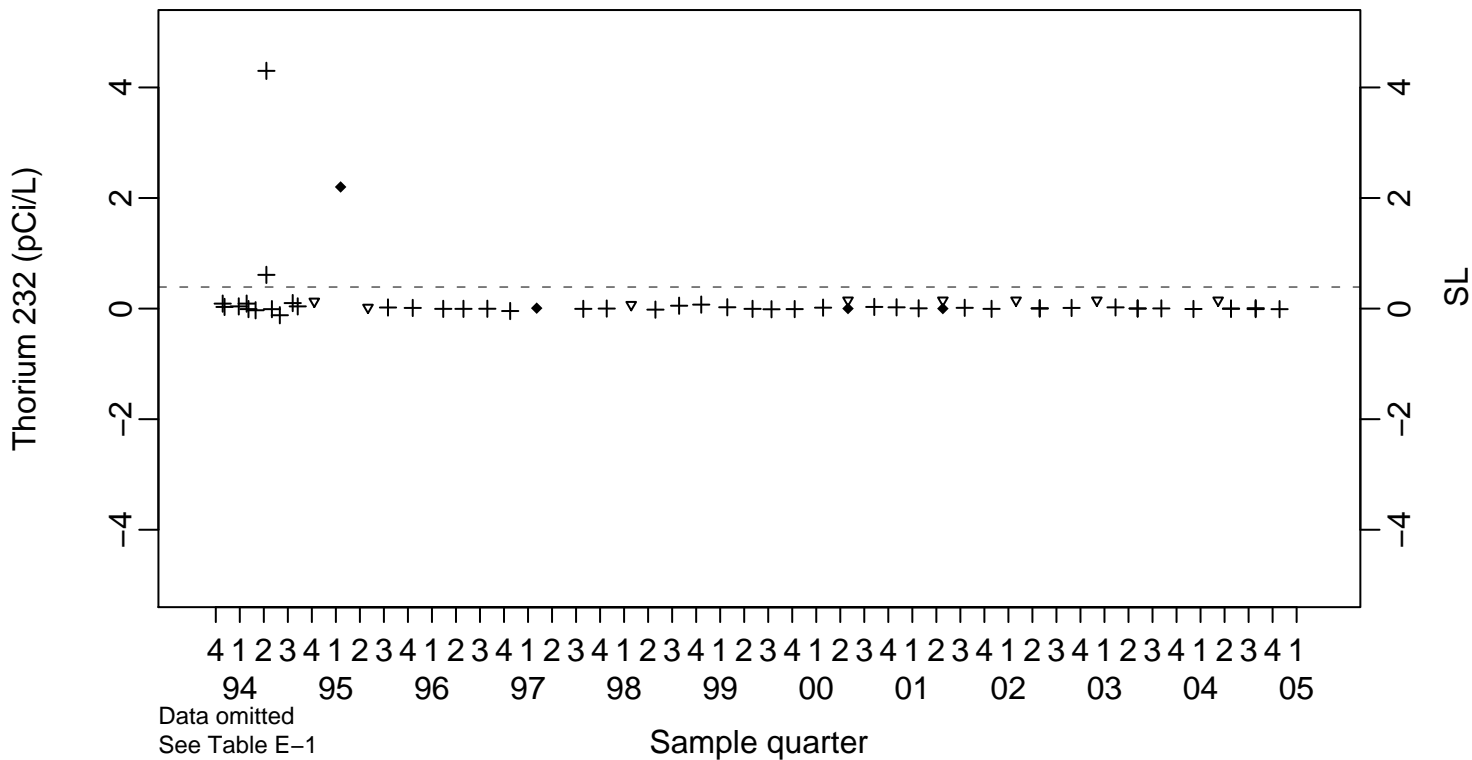
SL=0.39

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.39

Compliance Monitoring Point NC7-47

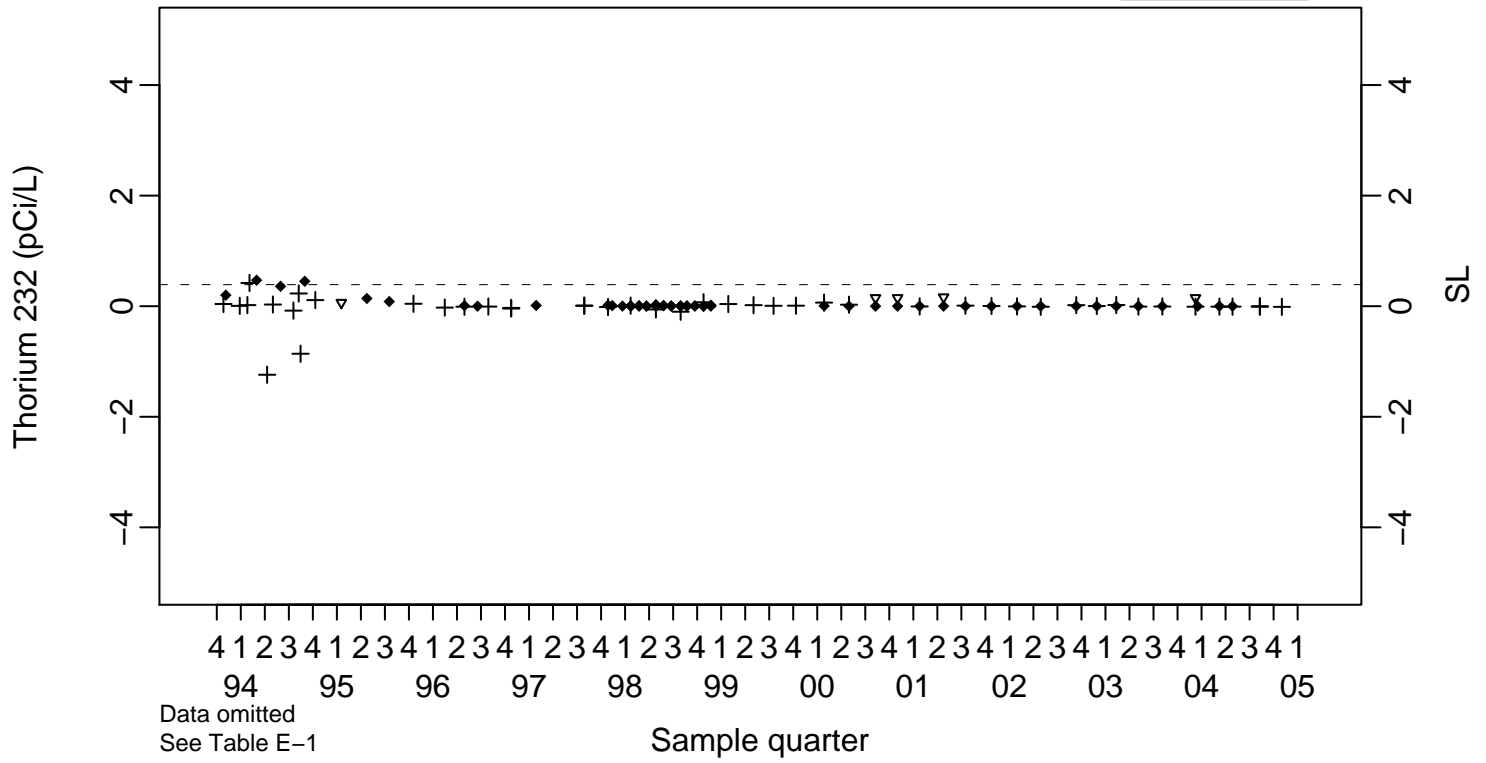


Pit 7 Complex Thorium 232 (pCi/L)

Compliance Monitoring Point NC7-48

SL=0.39

- ◆ Above RL
- ▽ Below RL
- + Estimated

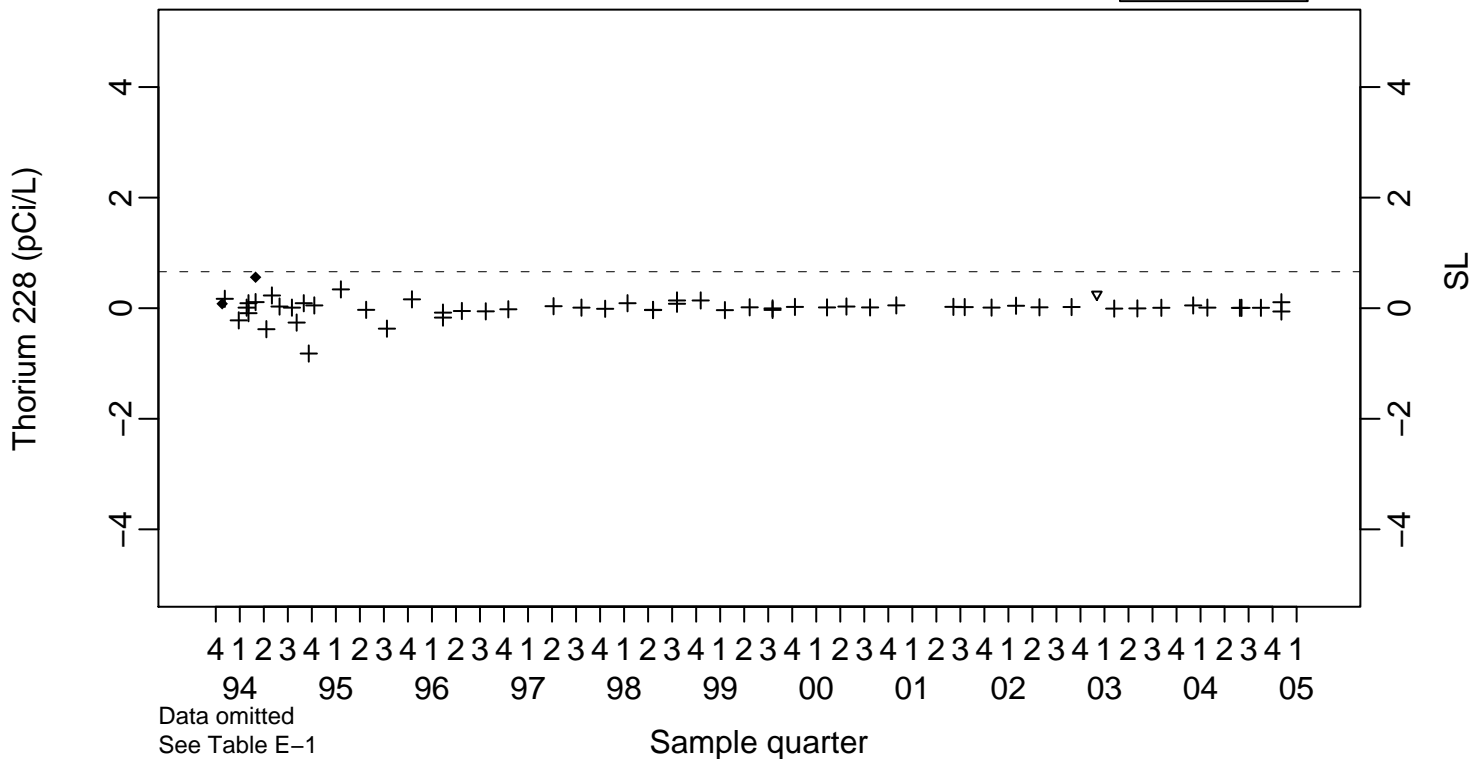


Pit 7 Complex Thorium 228 (pCi/L)

Background Monitoring Point K7-06

SL=0.66

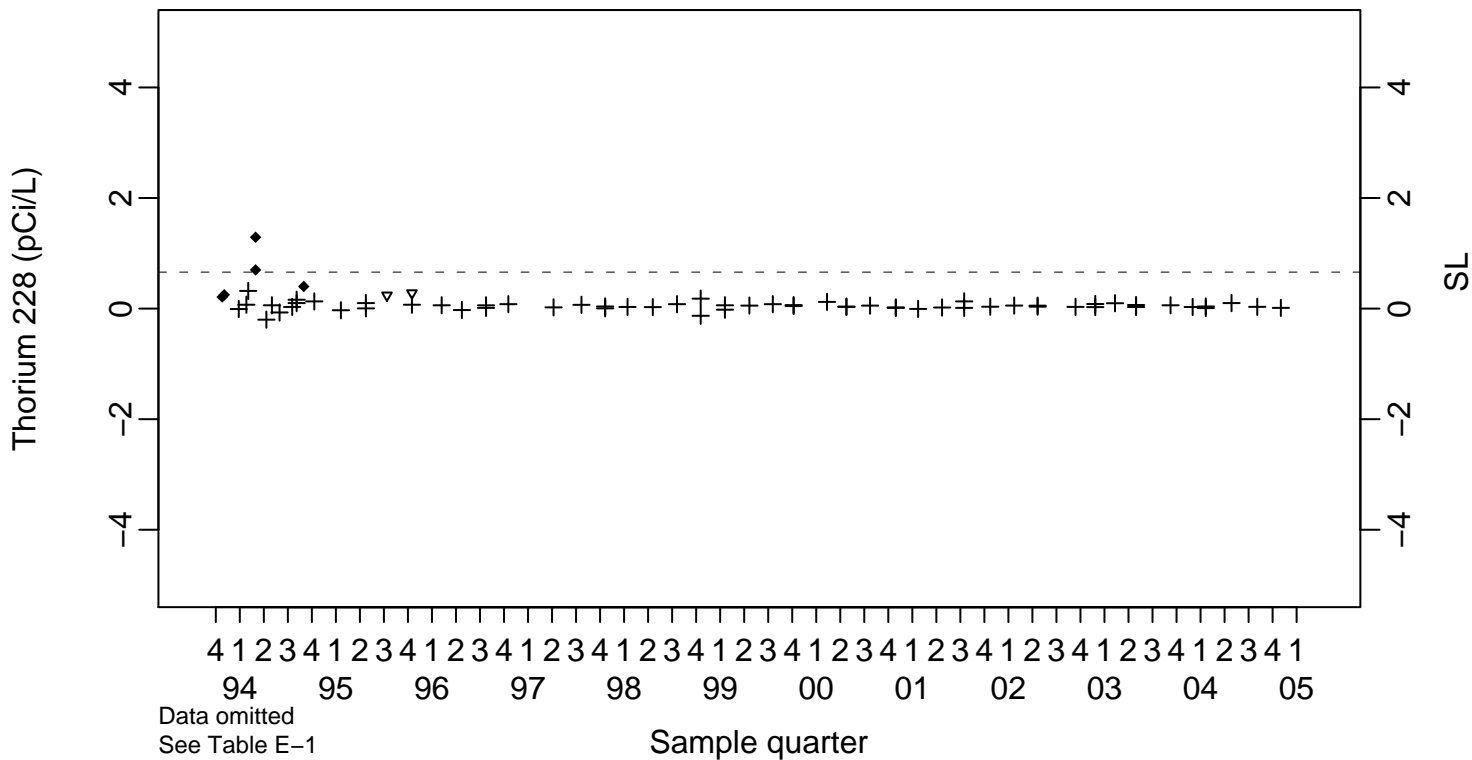
- ◆ Above RL
- ▽ Below RL
- + Estimated



Data omitted
See Table E-1

Compliance Monitoring Point K7-01

SL=0.66



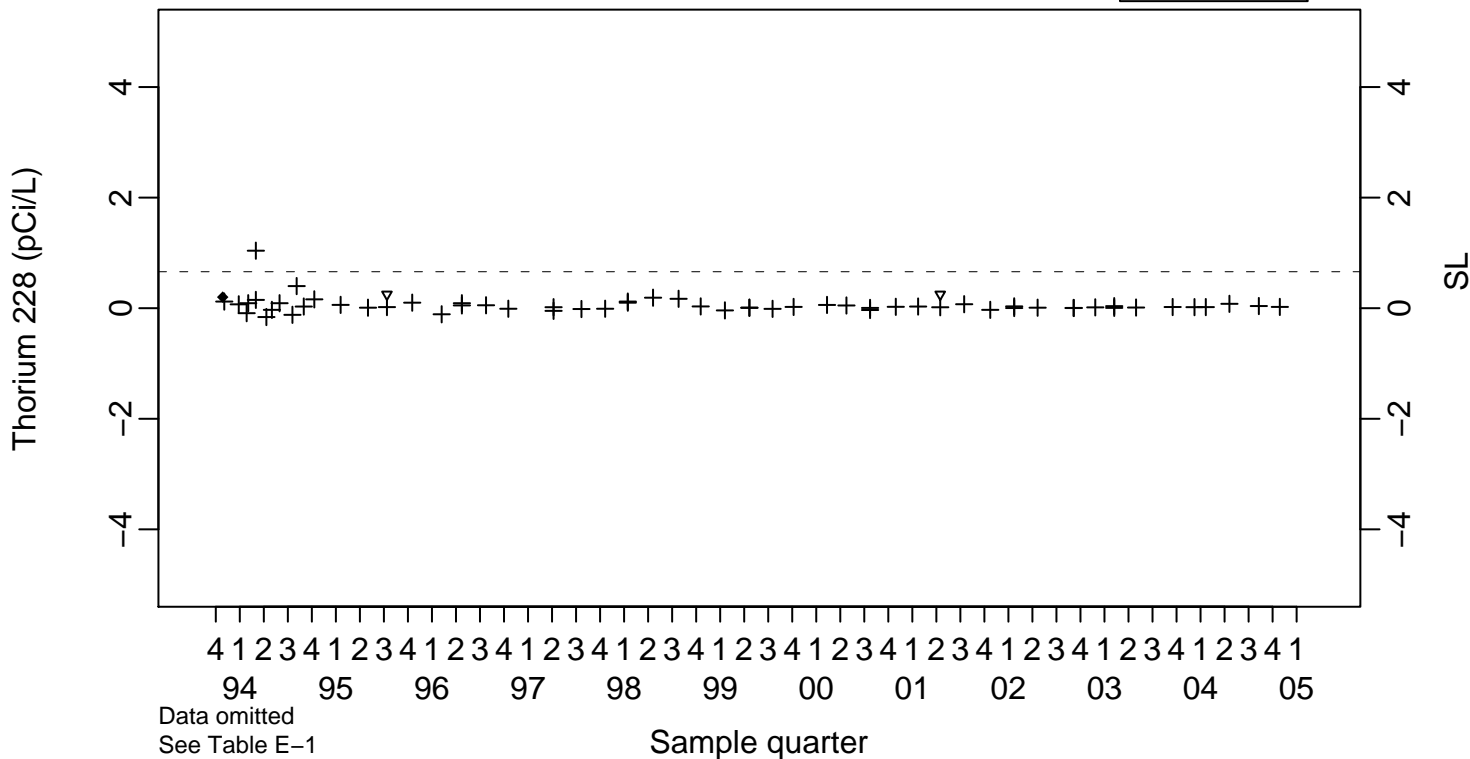
Data omitted
See Table E-1

Pit 7 Complex Thorium 228 (pCi/L)

Compliance Monitoring Point K7-03

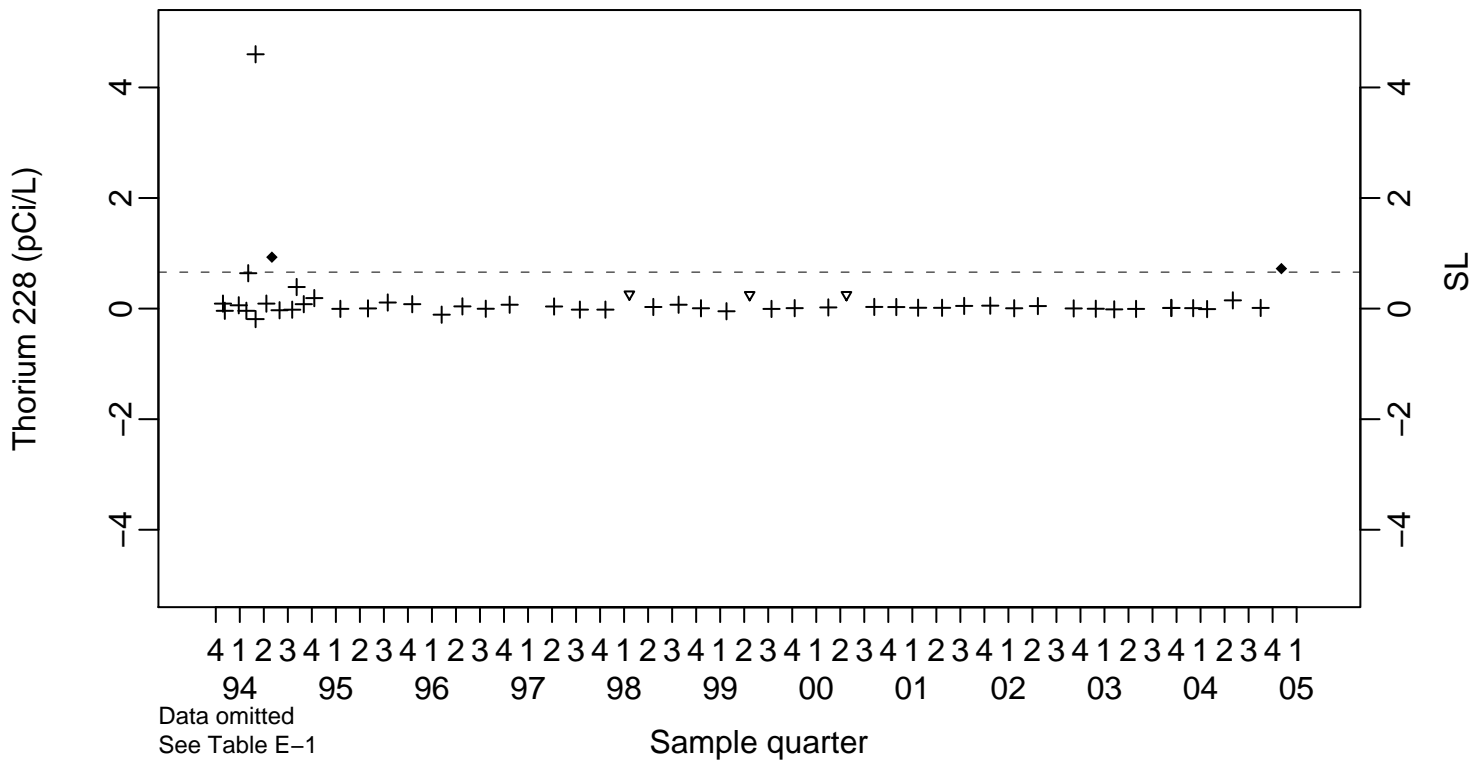
SL=0.66

- ◆ Above RL
- ▽ Below RL
- + Estimated



SL=0.66

Compliance Monitoring Point K7-09

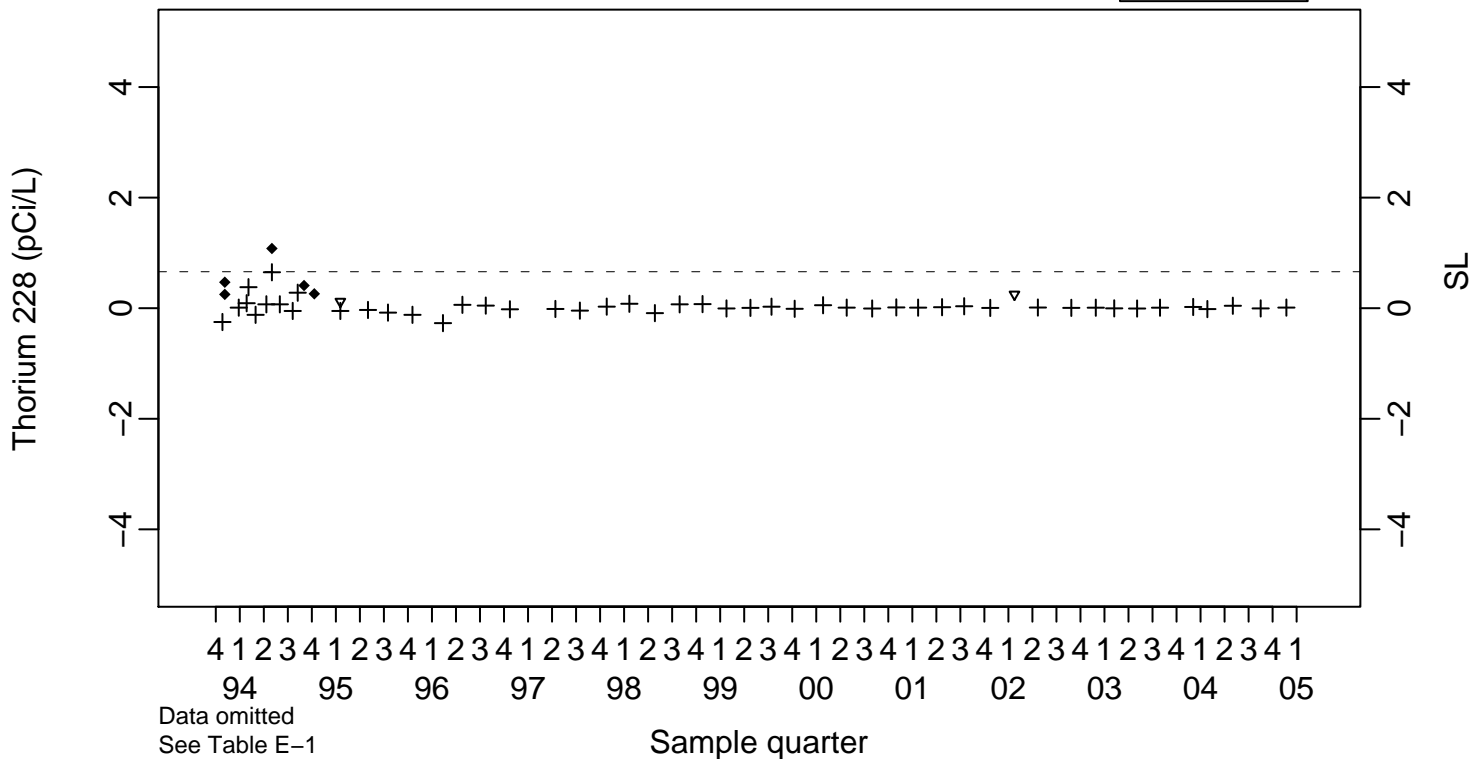


Pit 7 Complex Thorium 228 (pCi/L)

Compliance Monitoring Point K7-10

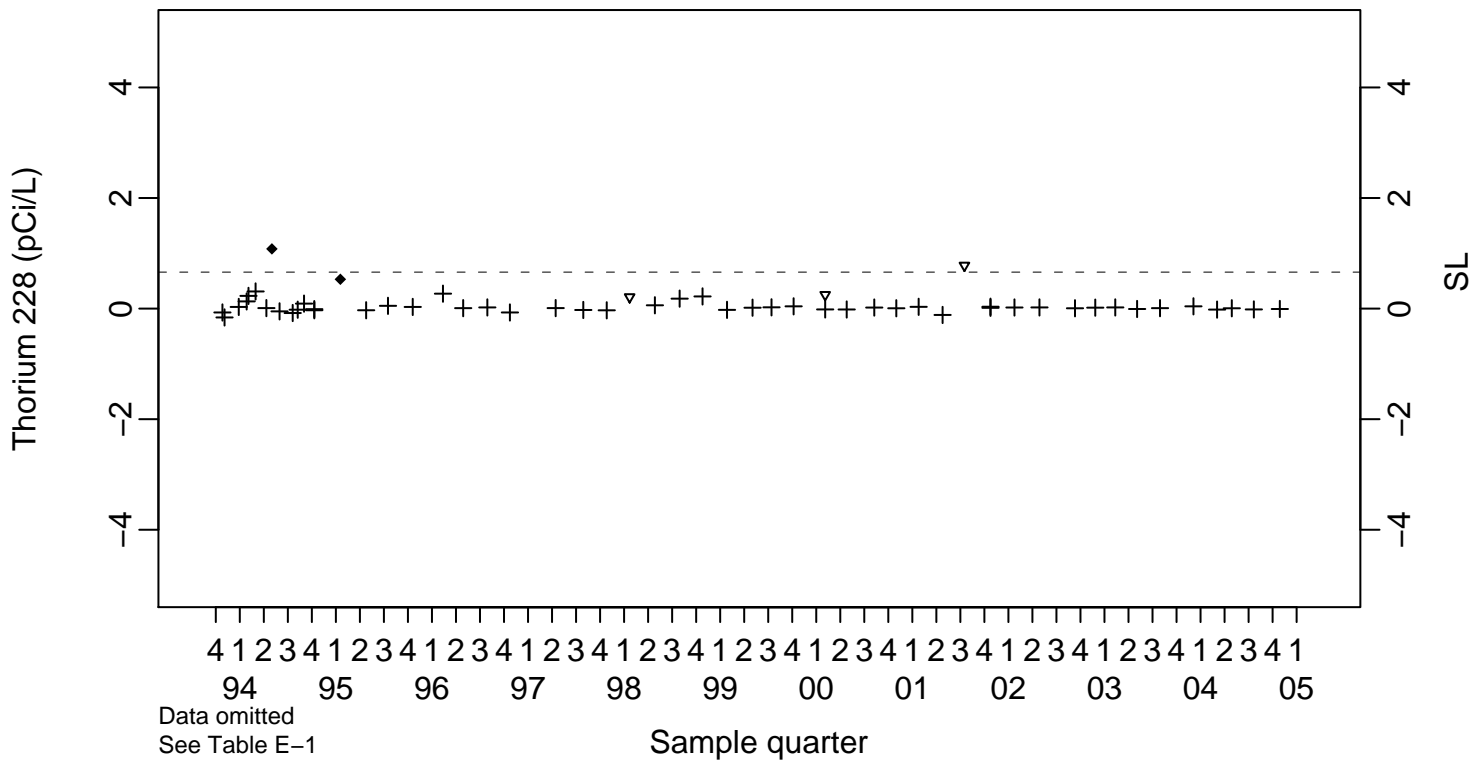
SL=0.66

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-25

SL=0.66

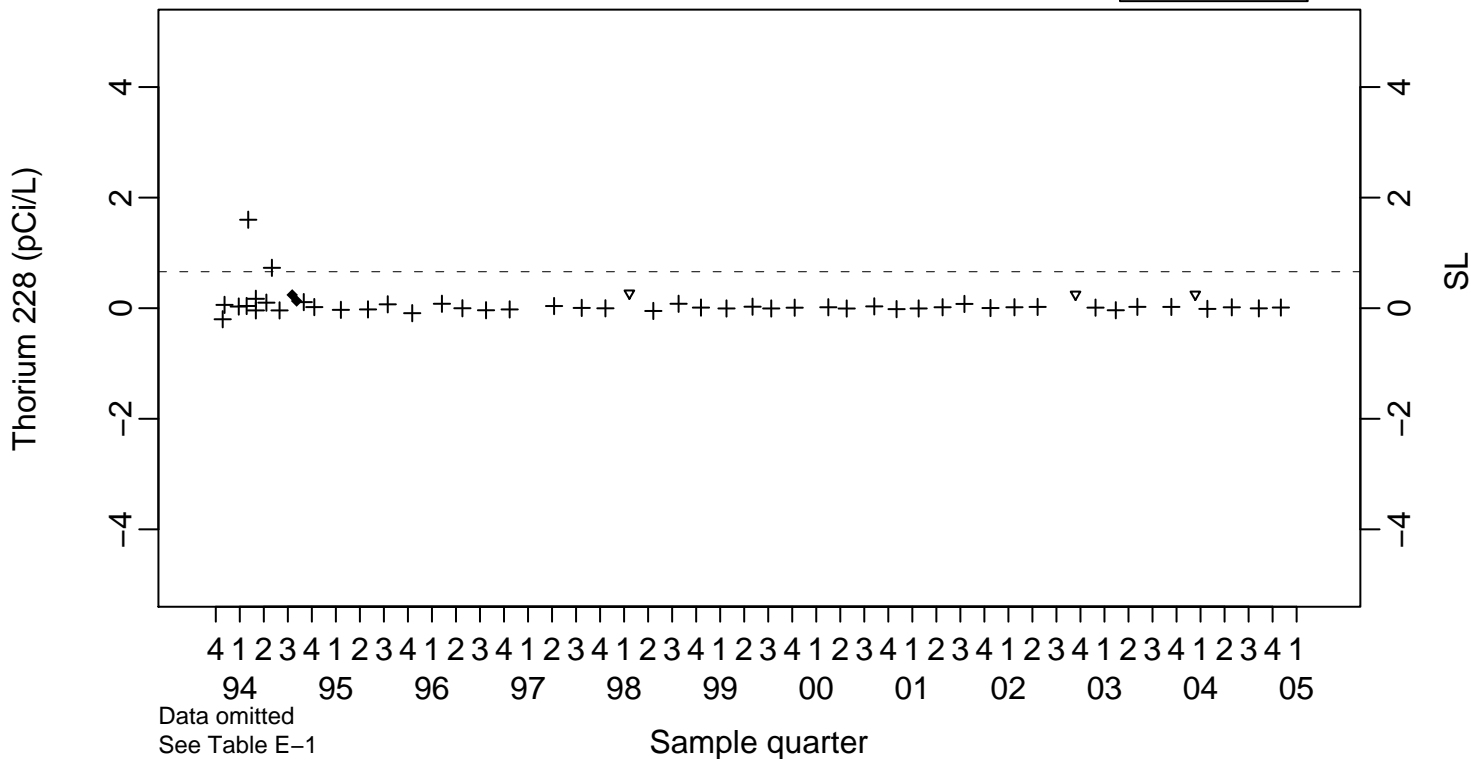


Pit 7 Complex Thorium 228 (pCi/L)

Compliance Monitoring Point NC7-26

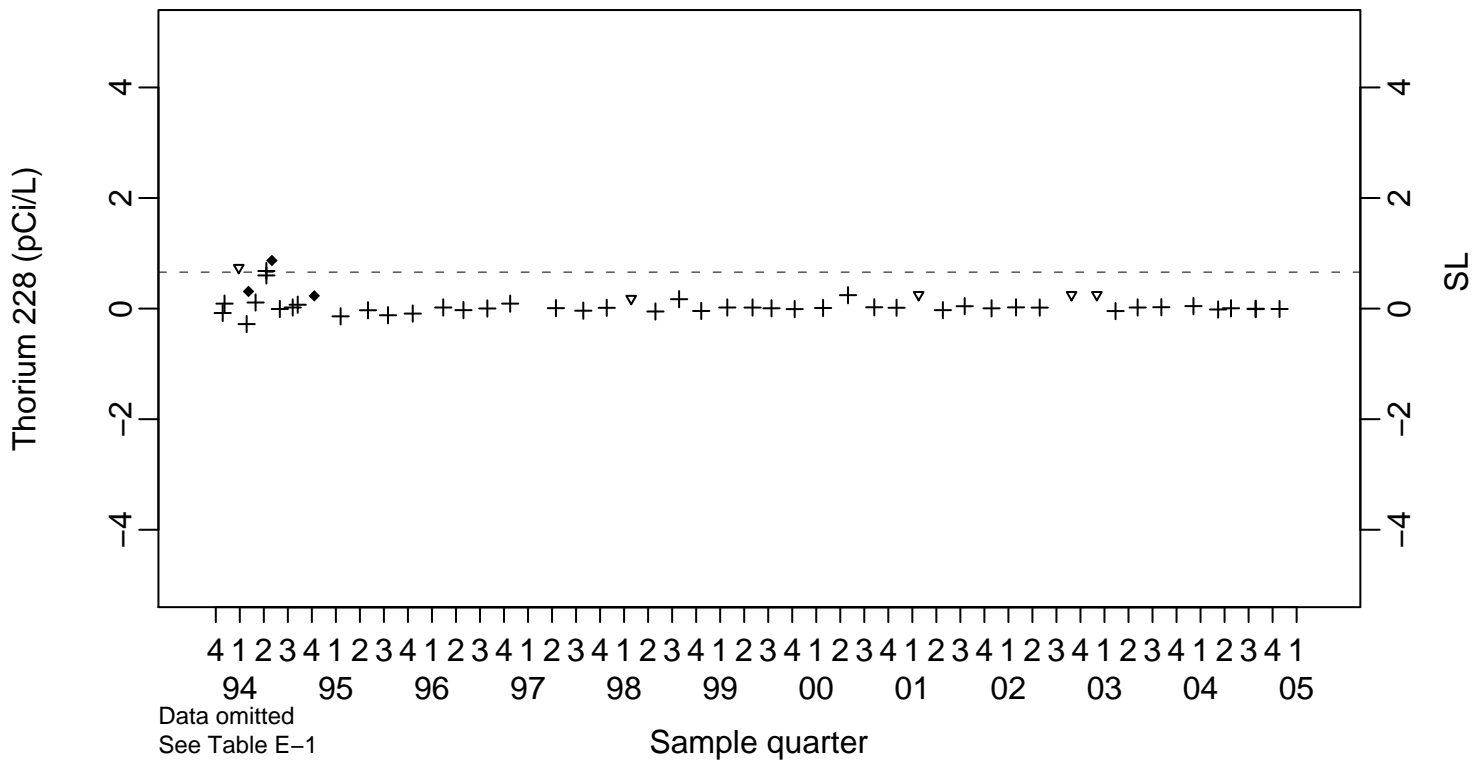
SL=0.66

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-47

SL=0.66

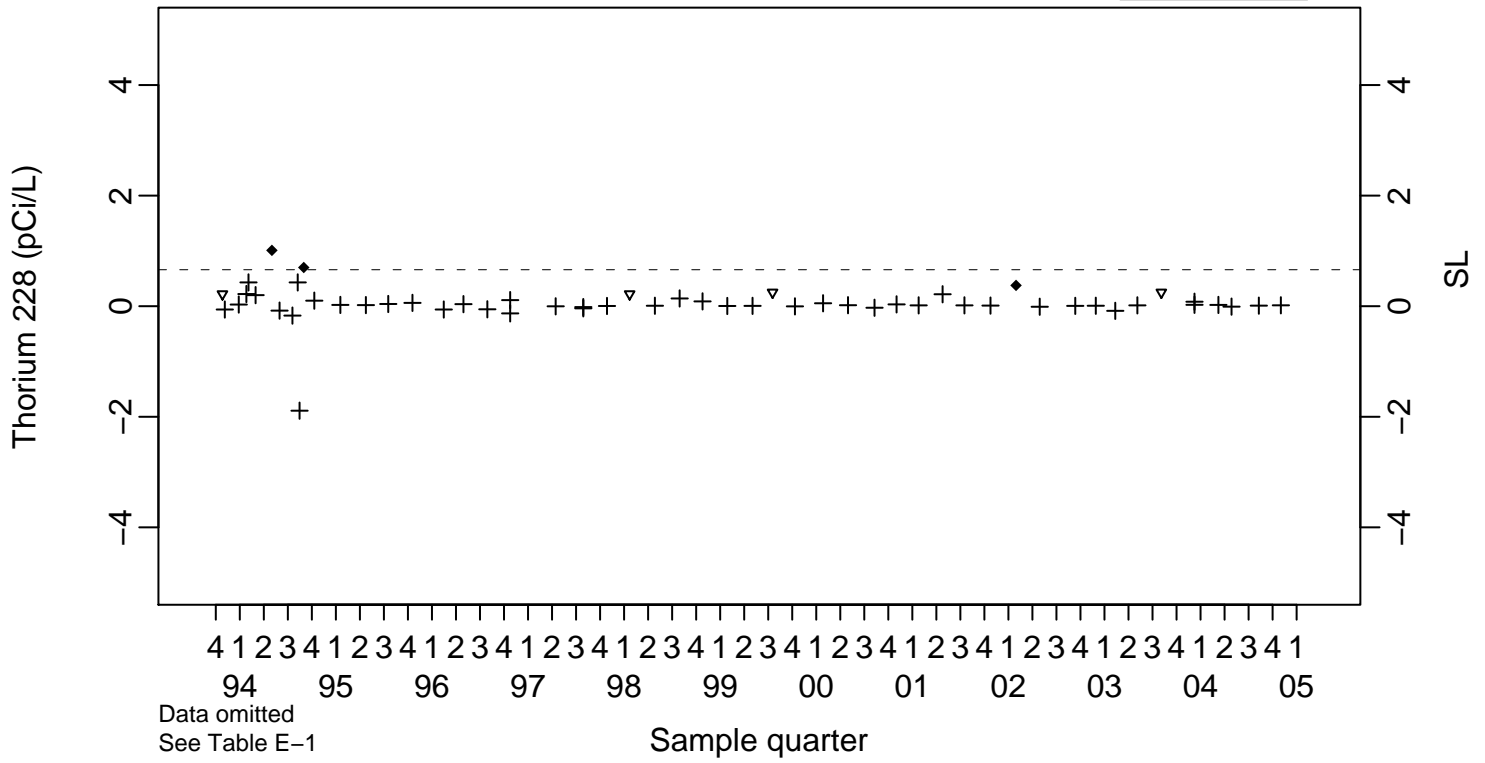


Pit 7 Complex Thorium 228 (pCi/L)

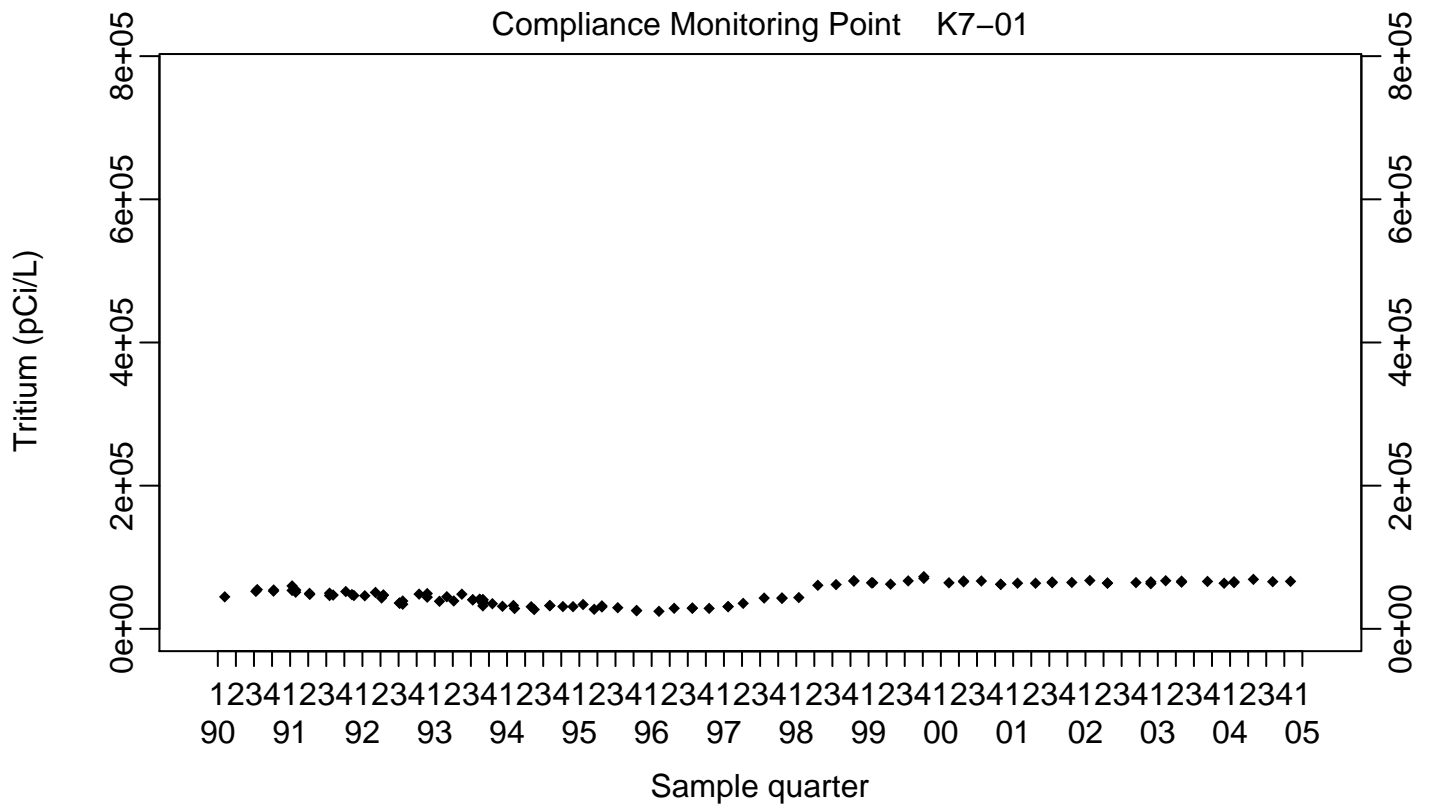
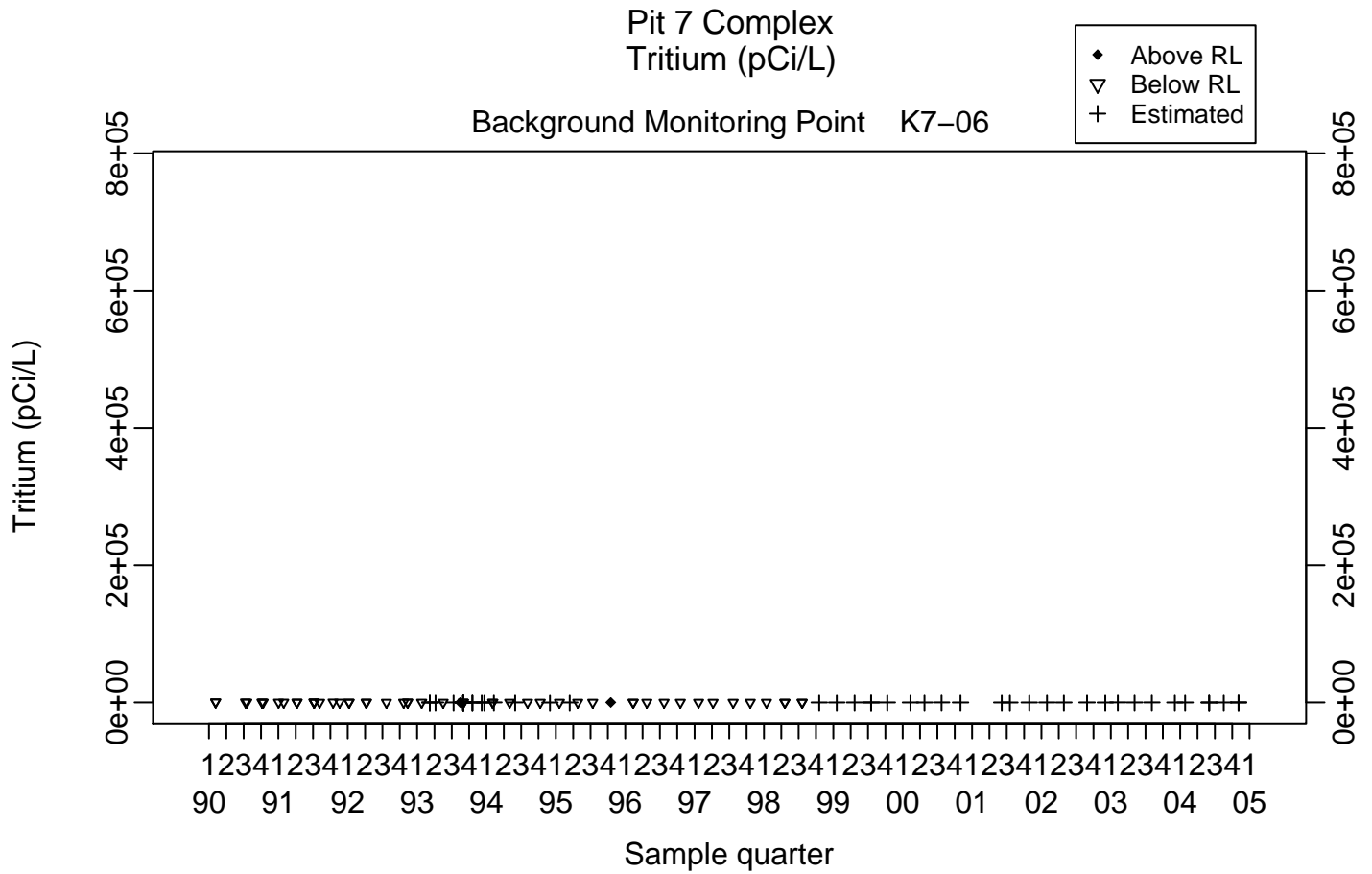
Compliance Monitoring Point NC7-48

SL=0.66

- ◆ Above RL
- ▽ Below RL
- + Estimated



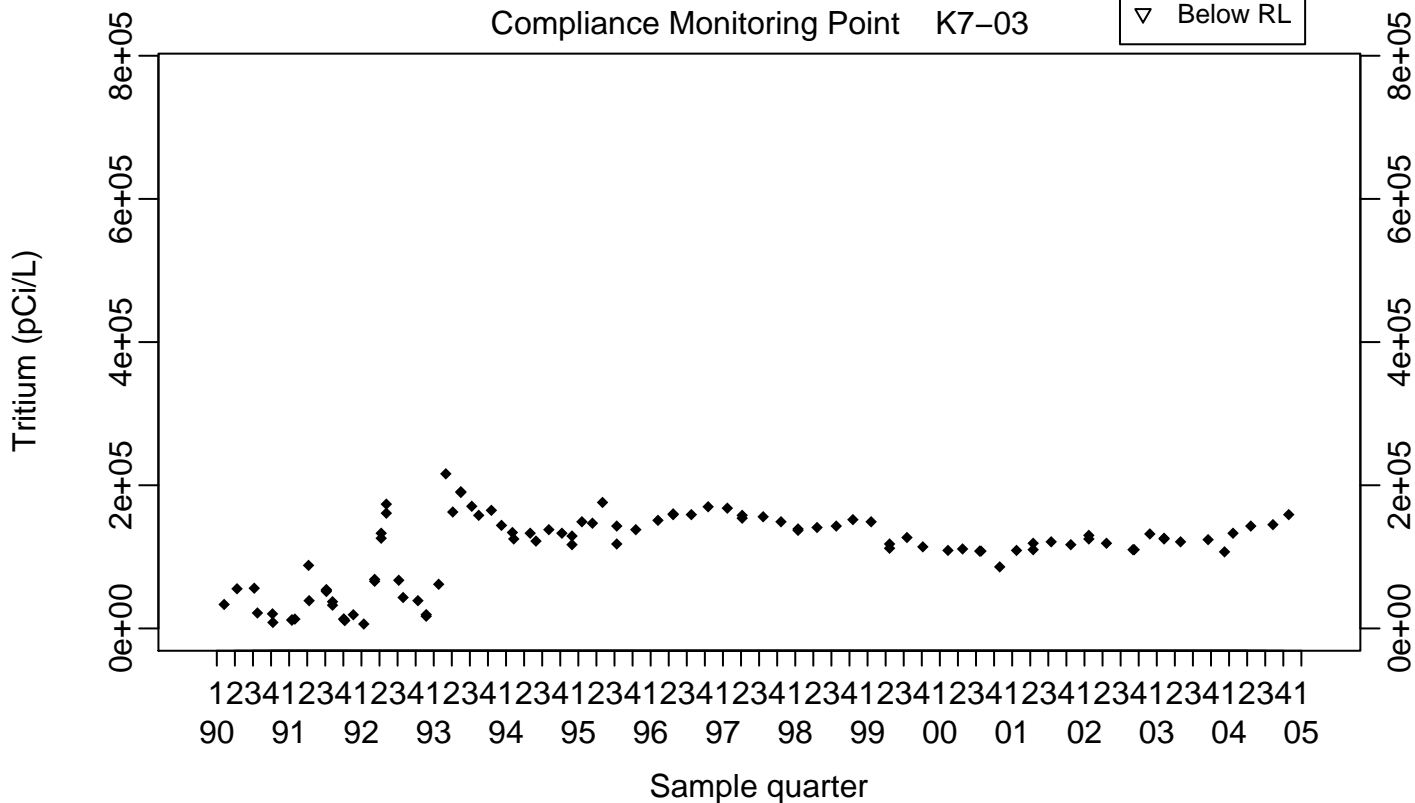
Data omitted
See Table E-1



Pit 7 Complex Tritium (pCi/L)

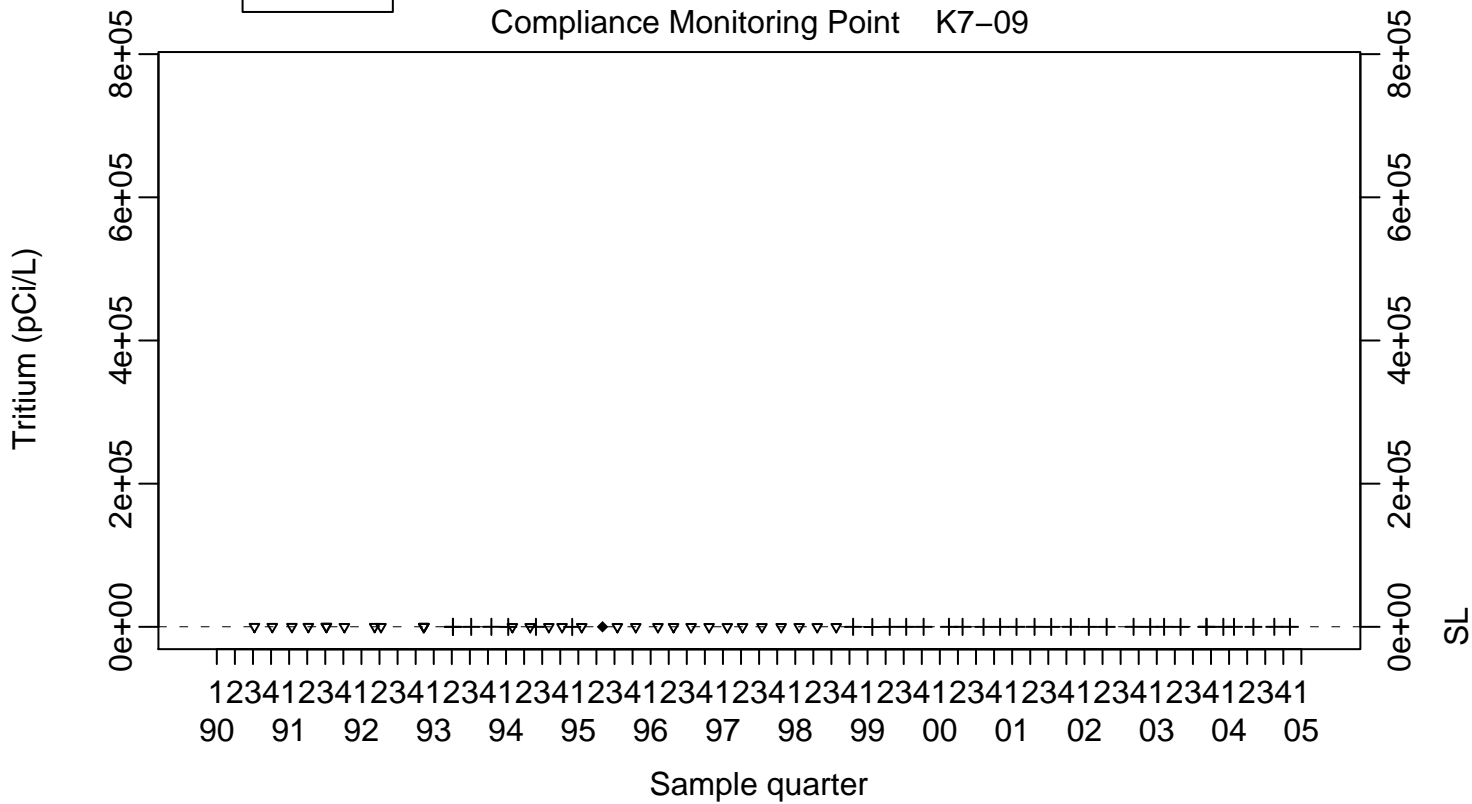
Compliance Monitoring Point K7-03

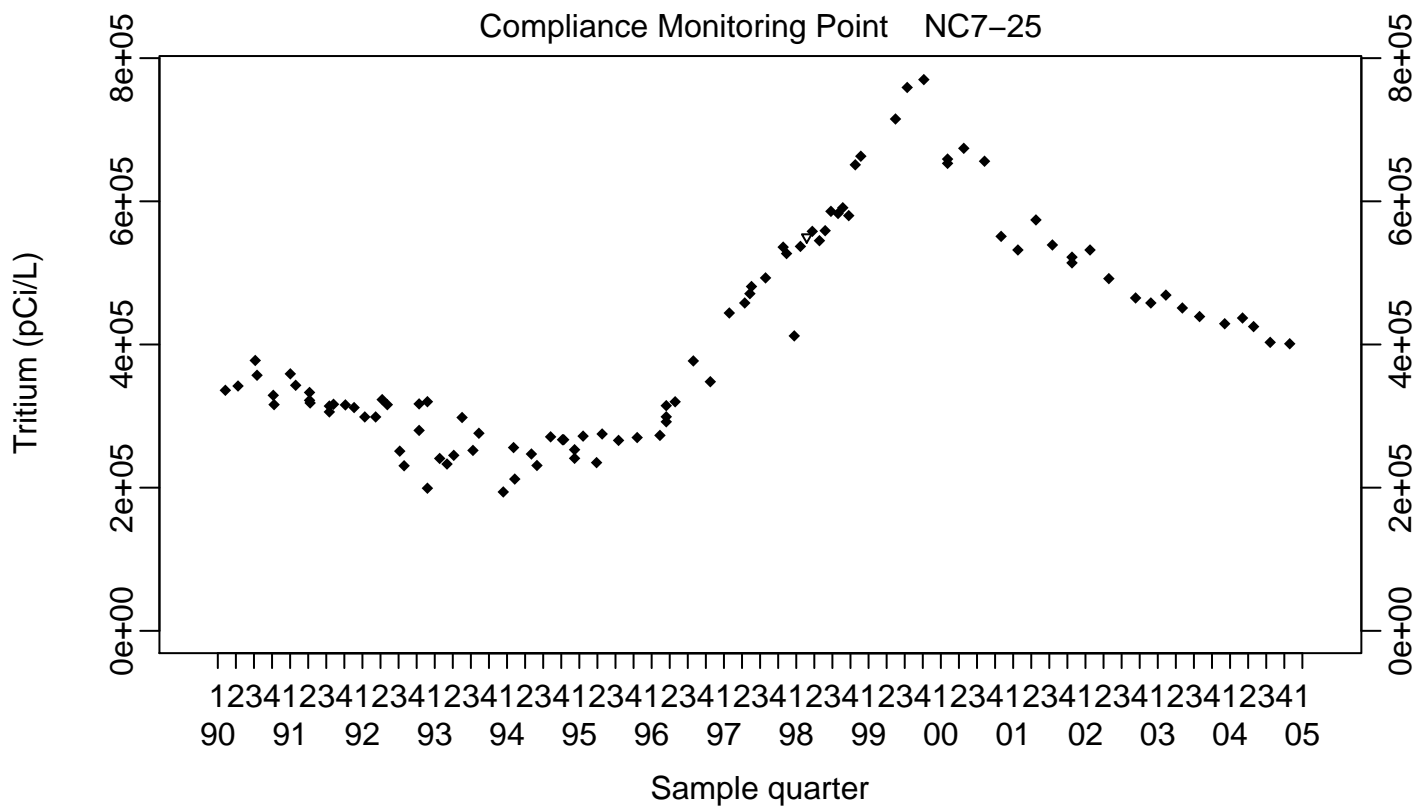
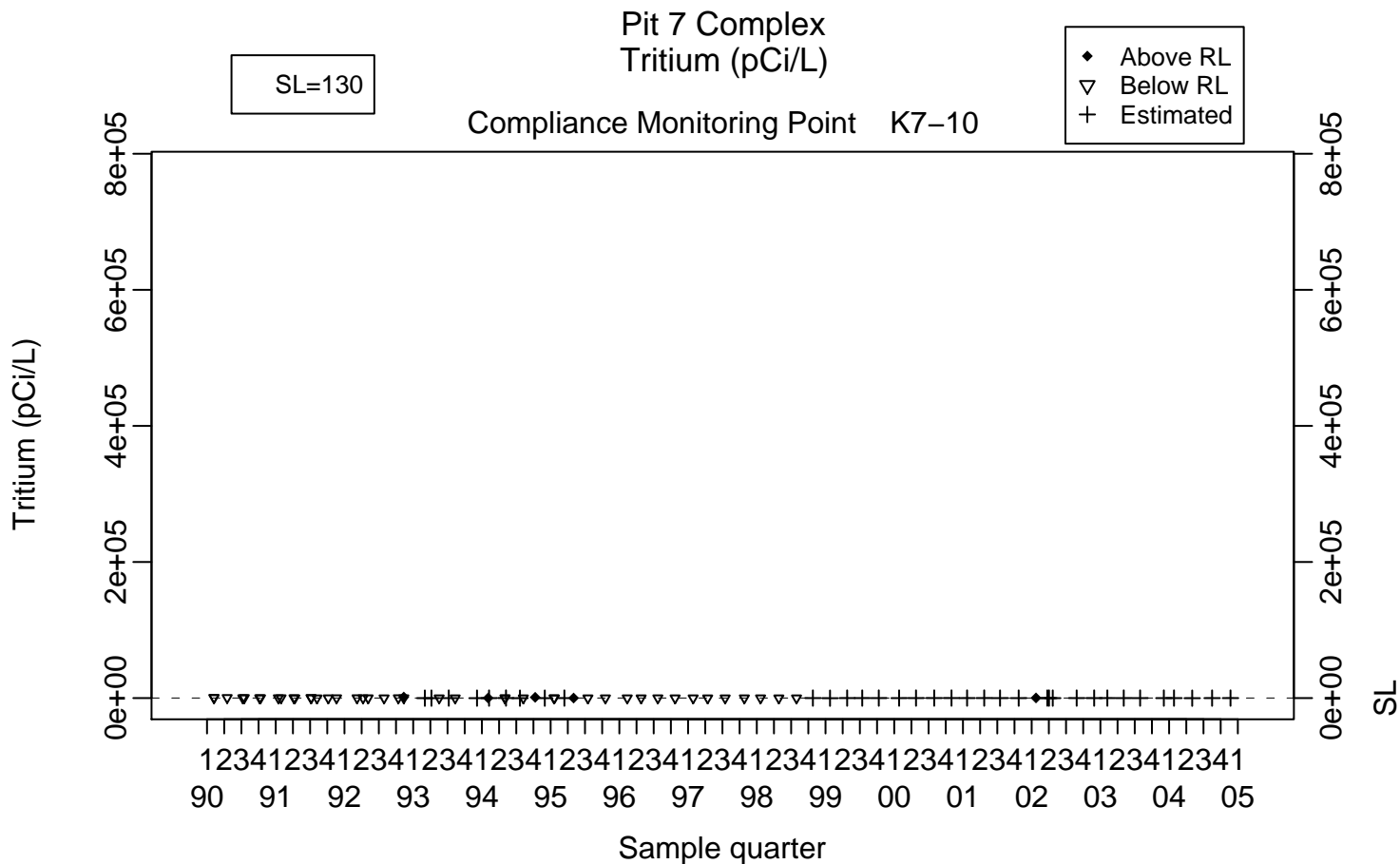
◆ Above RL
▽ Below RL



SL=130

Compliance Monitoring Point K7-09

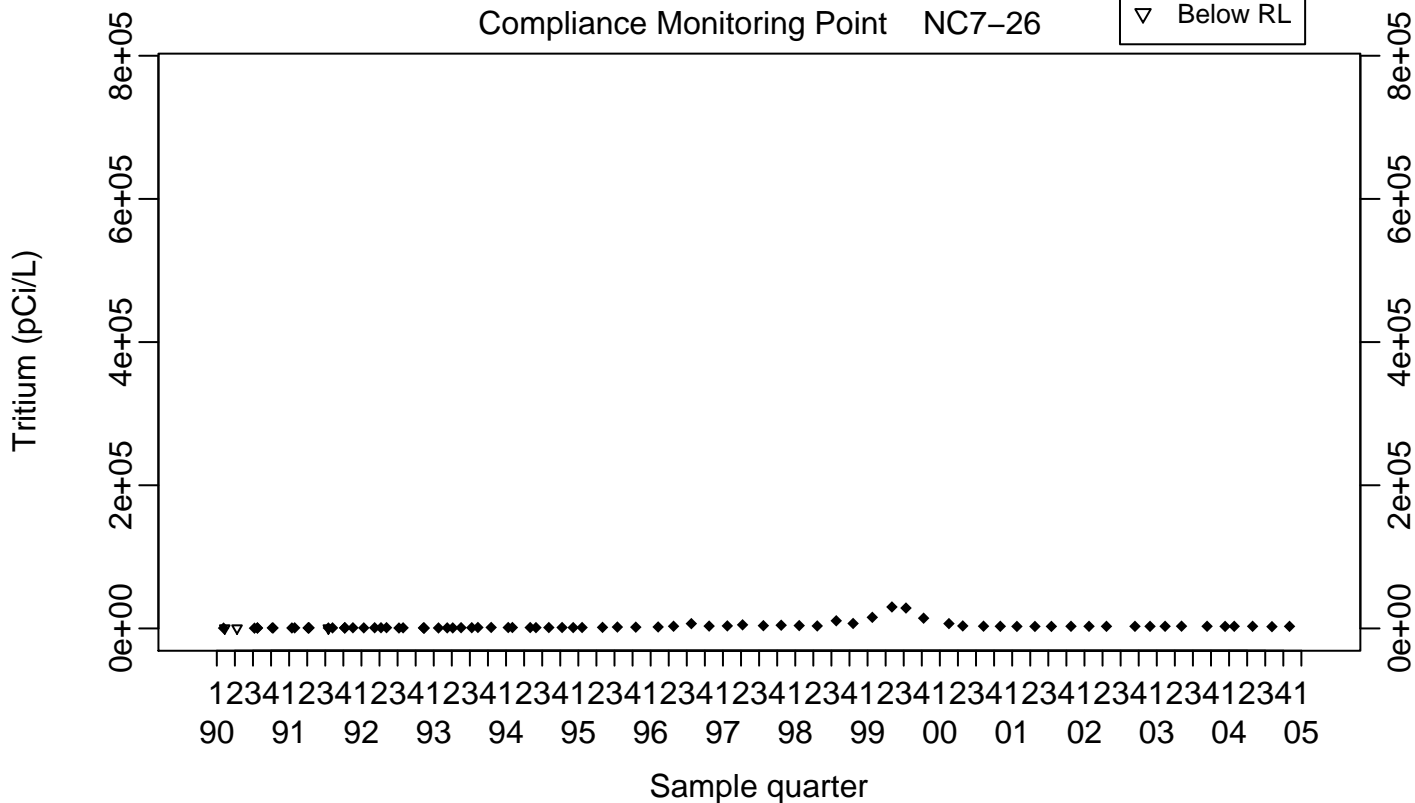




Pit 7 Complex Tritium (pCi/L)

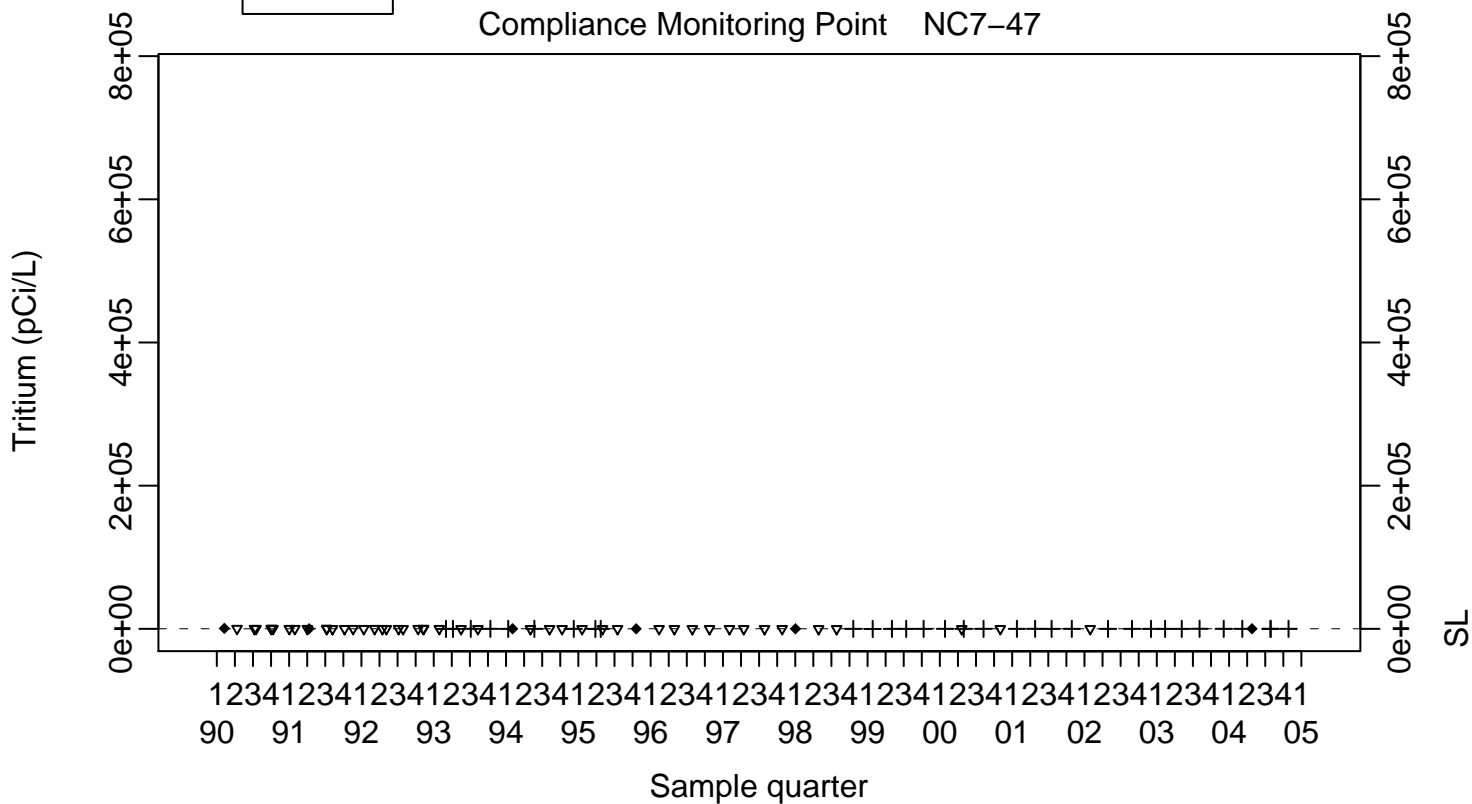
Compliance Monitoring Point NC7-26

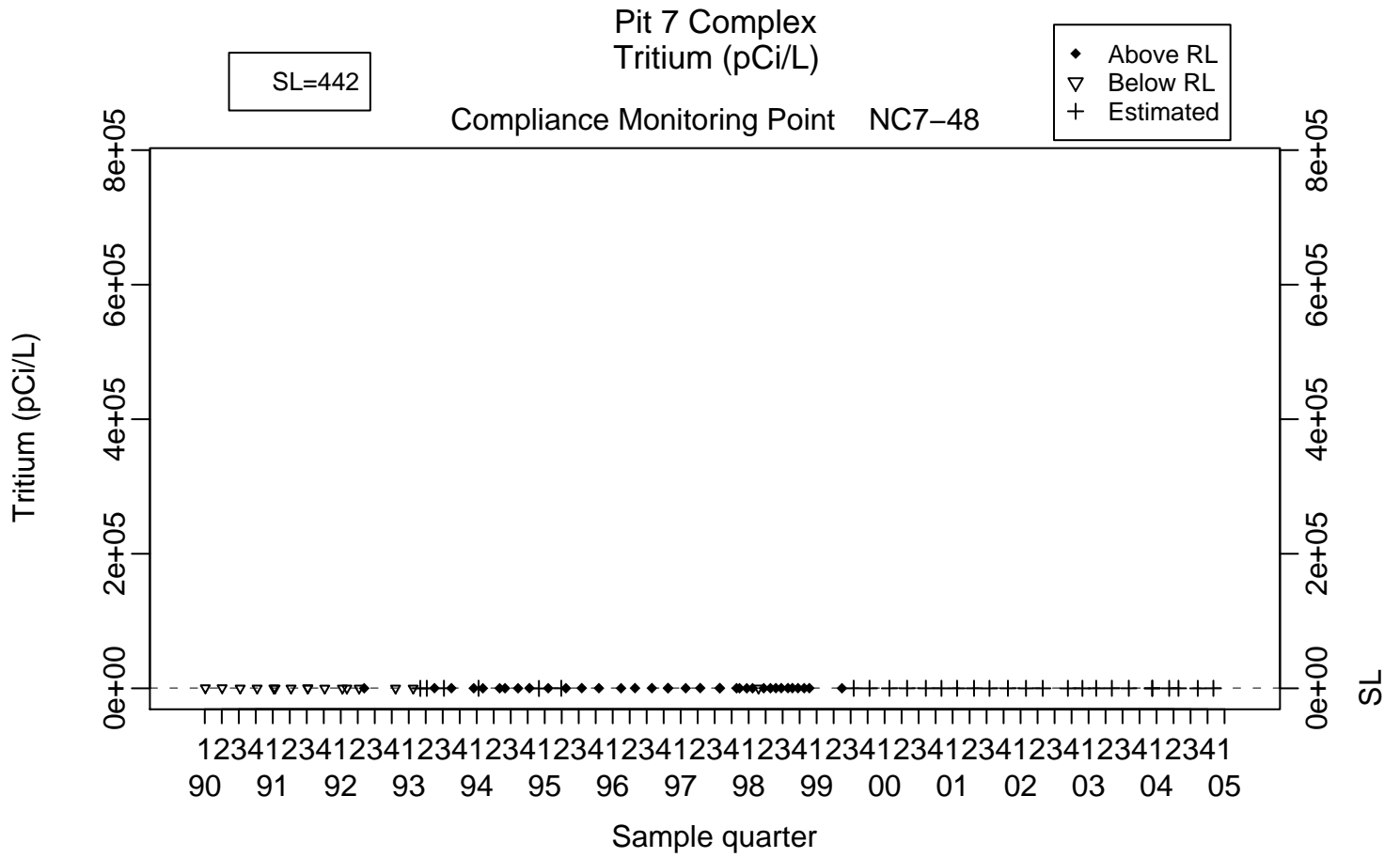
◆ Above RL
▽ Below RL



SL=130

Compliance Monitoring Point NC7-47

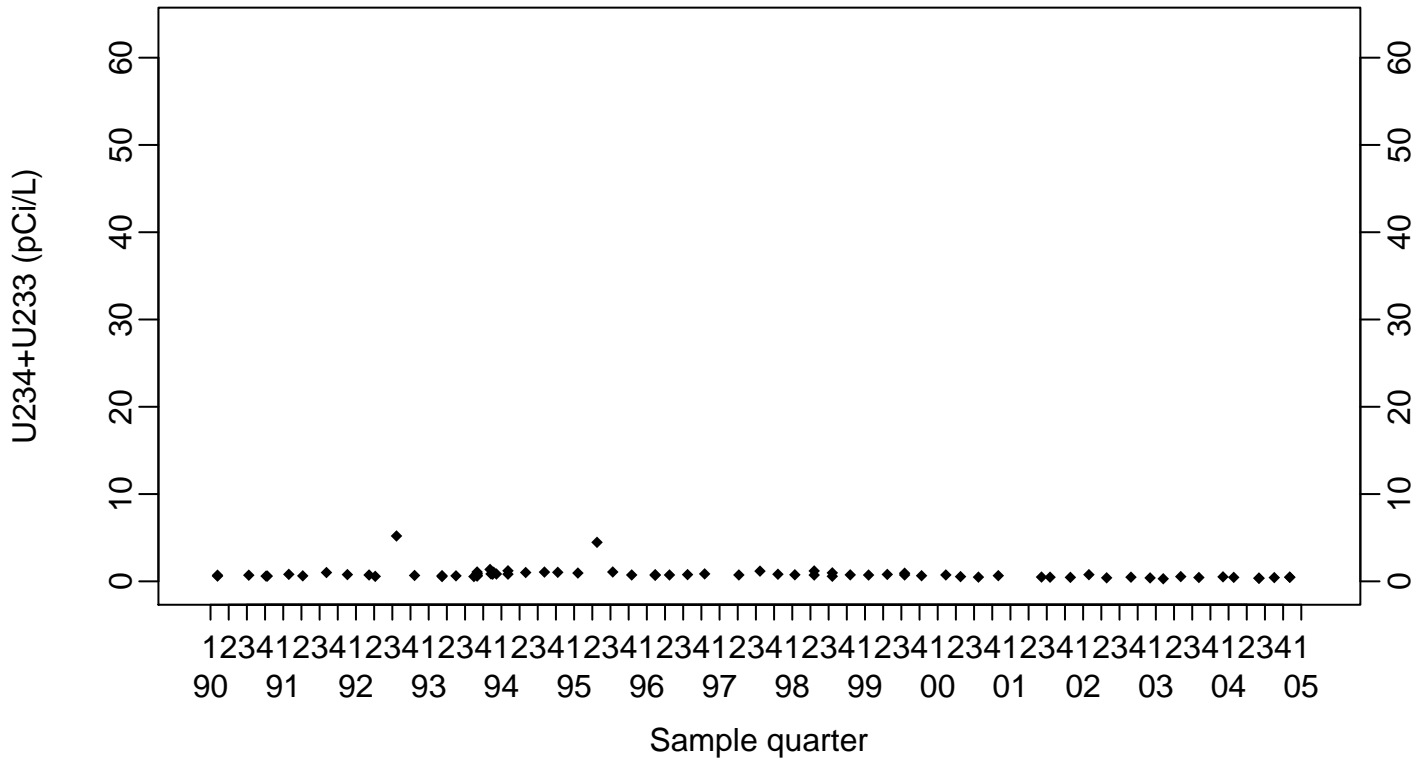




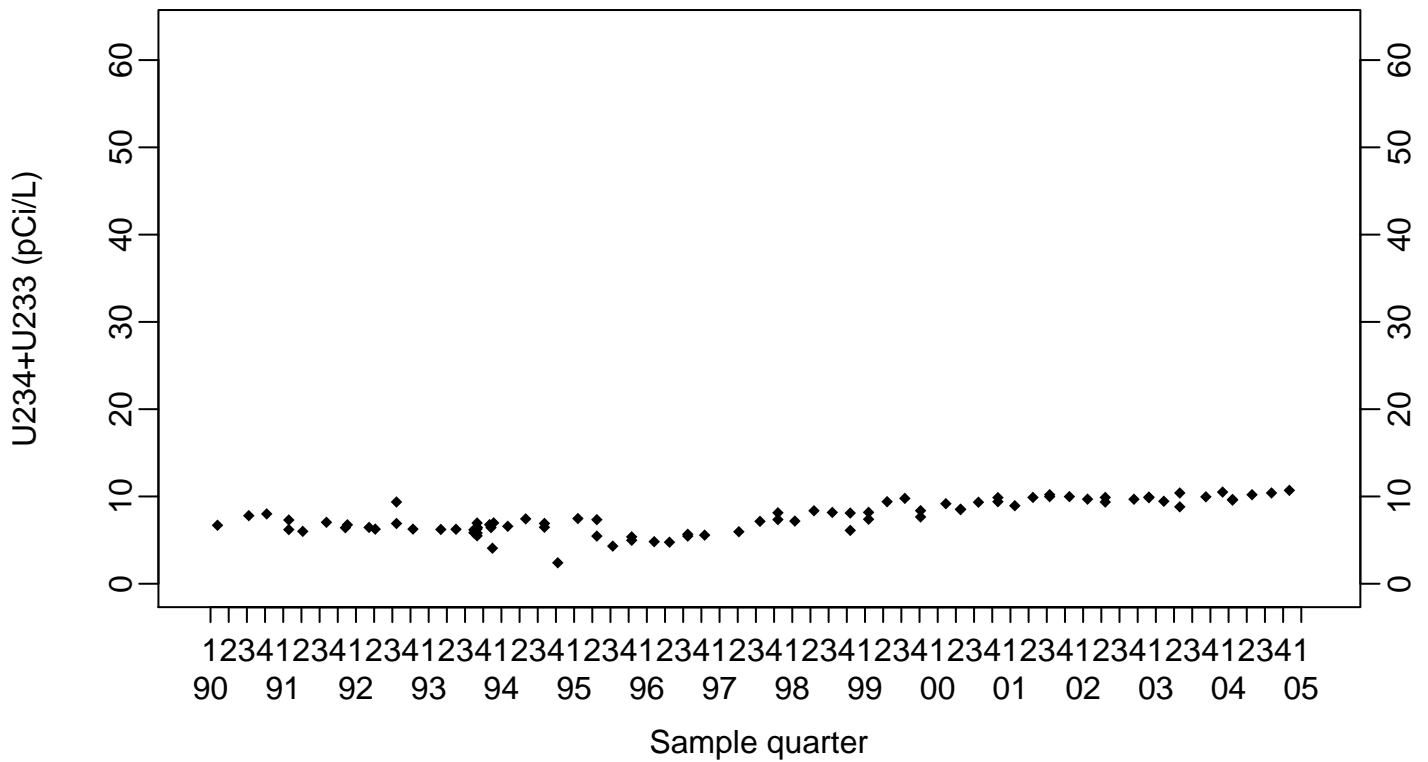
Pit 7 Complex U234+U233 (pCi/L)

Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



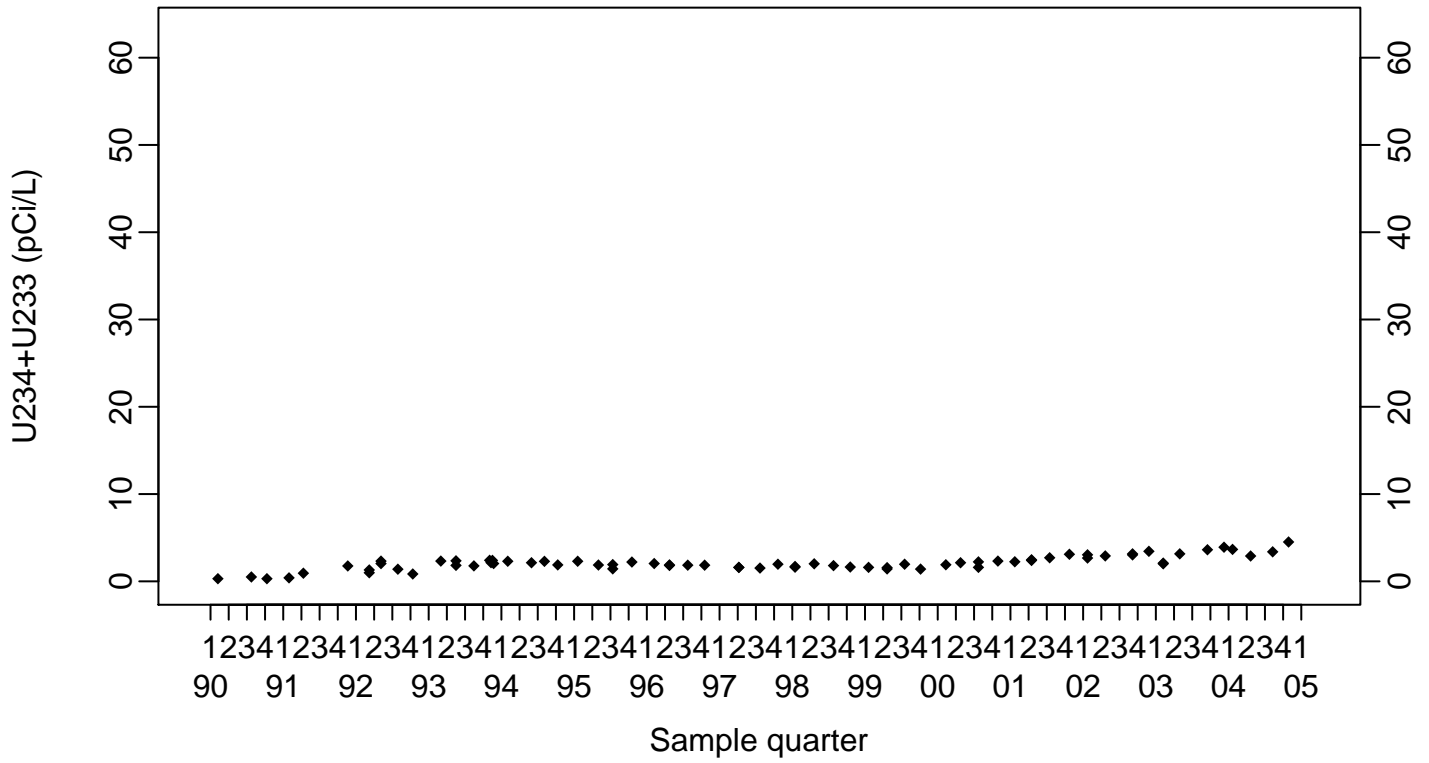
Compliance Monitoring Point K7-01



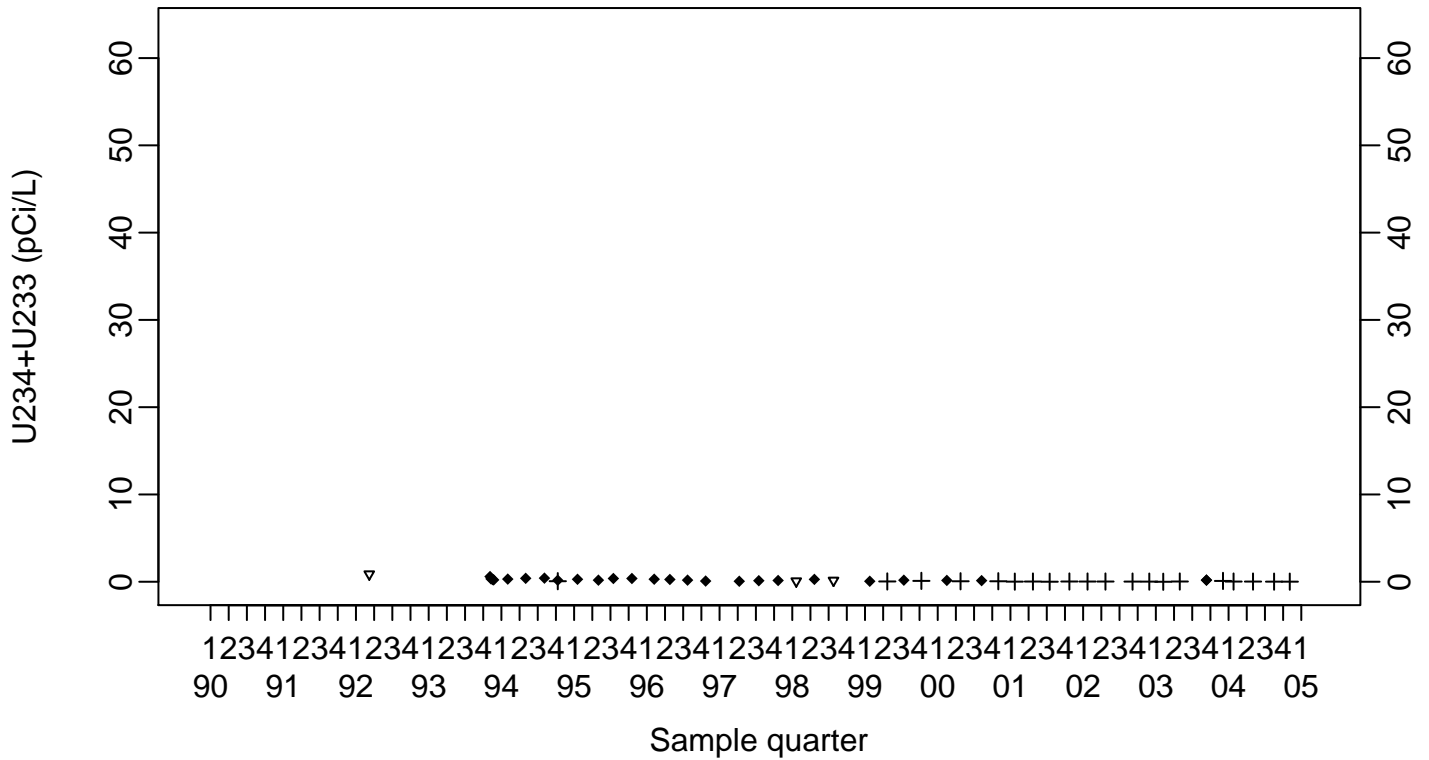
Pit 7 Complex U234+U233 (pCi/L)

Compliance Monitoring Point K7-03

◆ Above RL
▽ Below RL



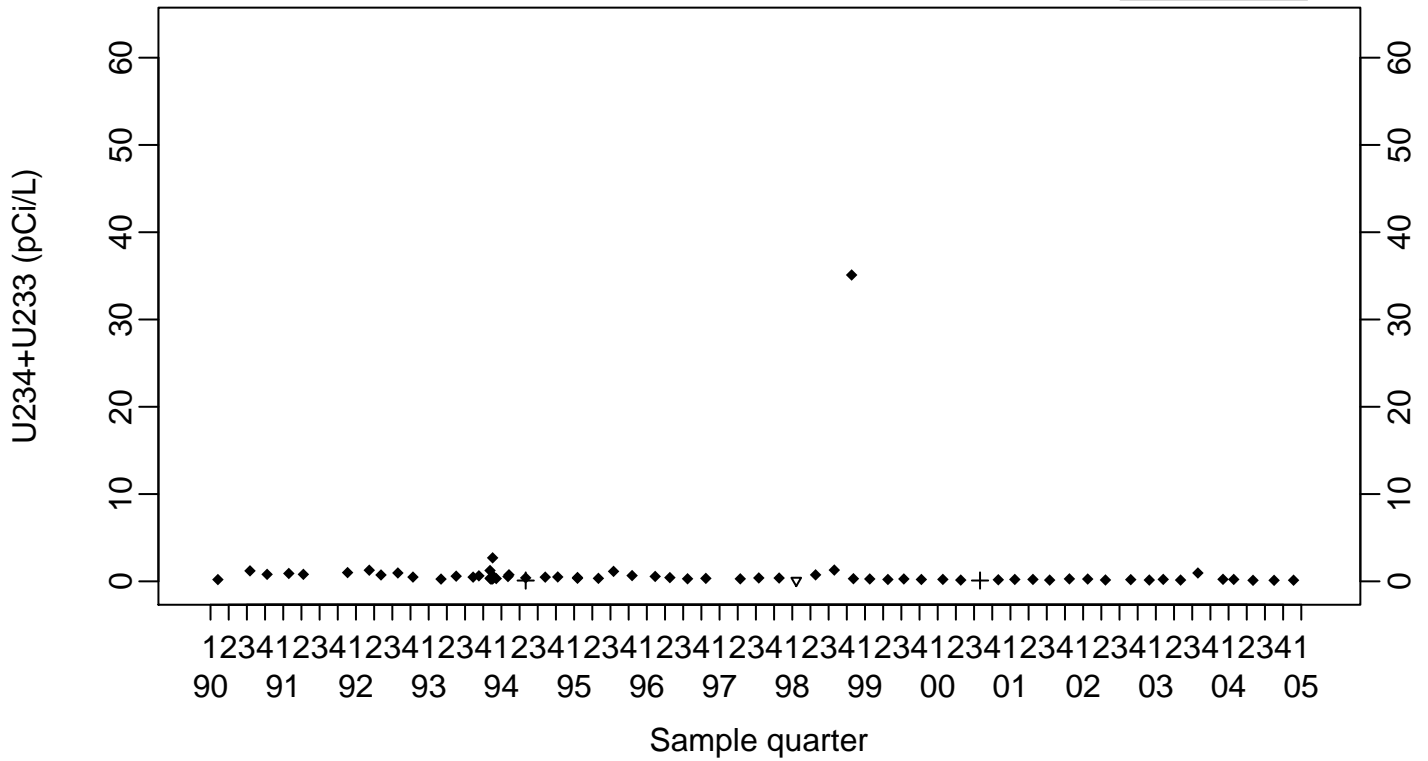
Compliance Monitoring Point K7-09



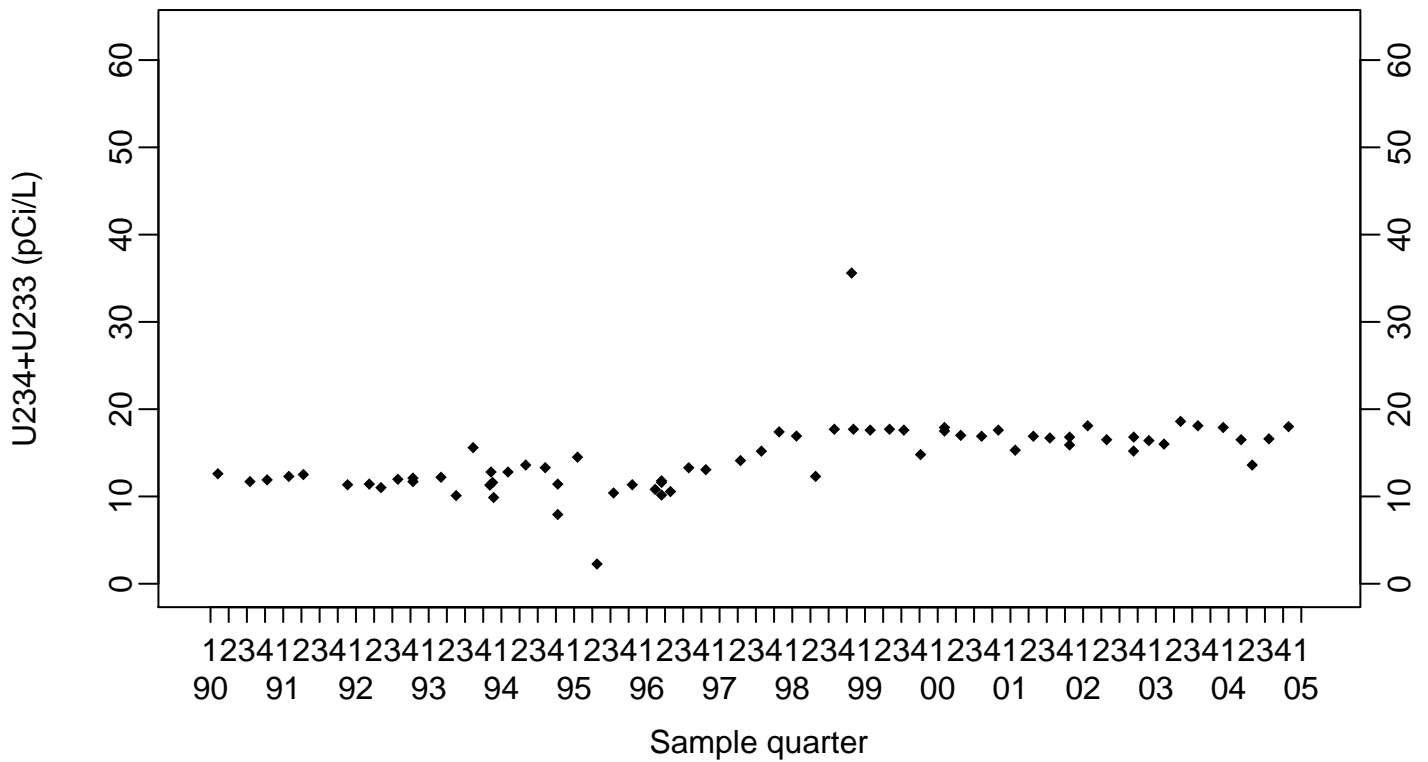
Pit 7 Complex U234+U233 (pCi/L)

Compliance Monitoring Point K7-10

- ◆ Above RL
- ▽ Below RL
- + Estimated



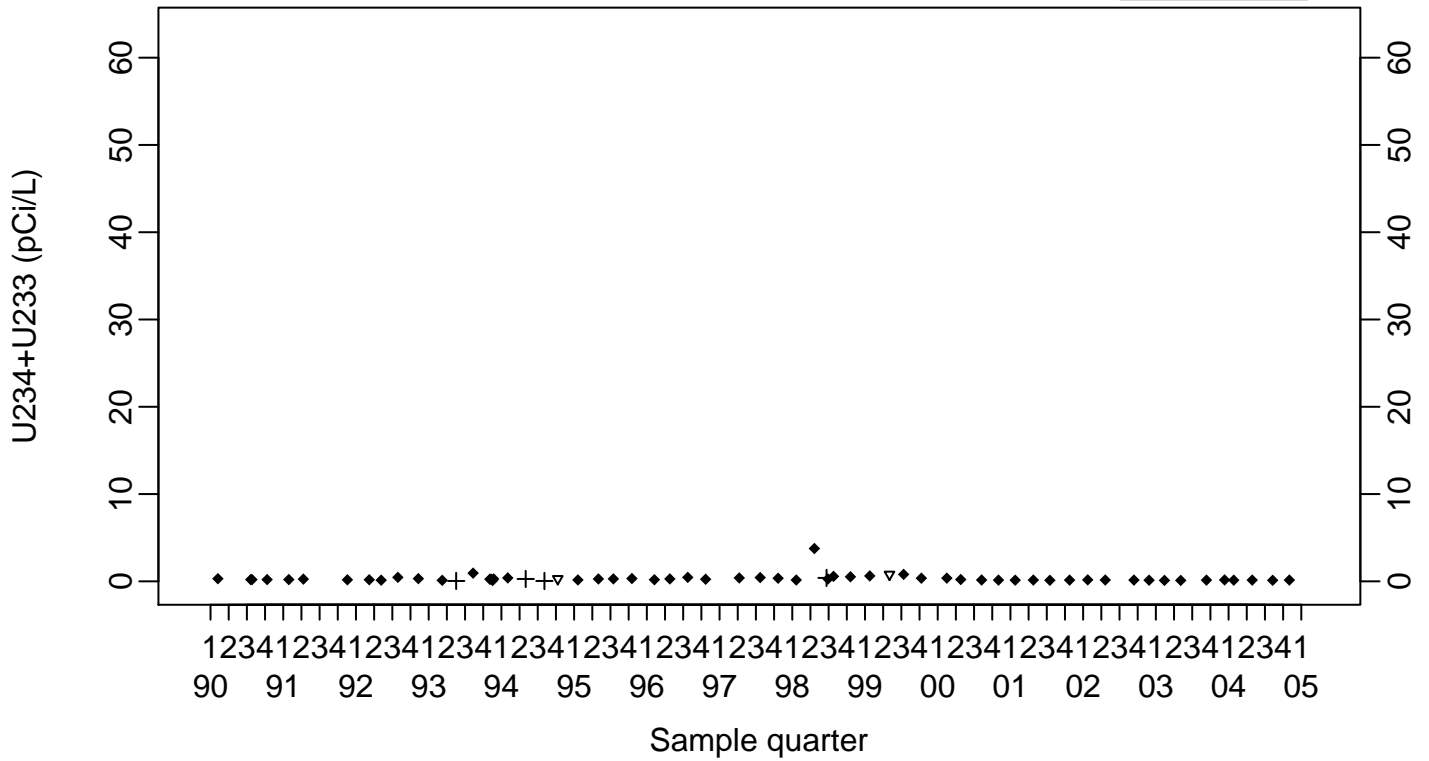
Compliance Monitoring Point NC7-25



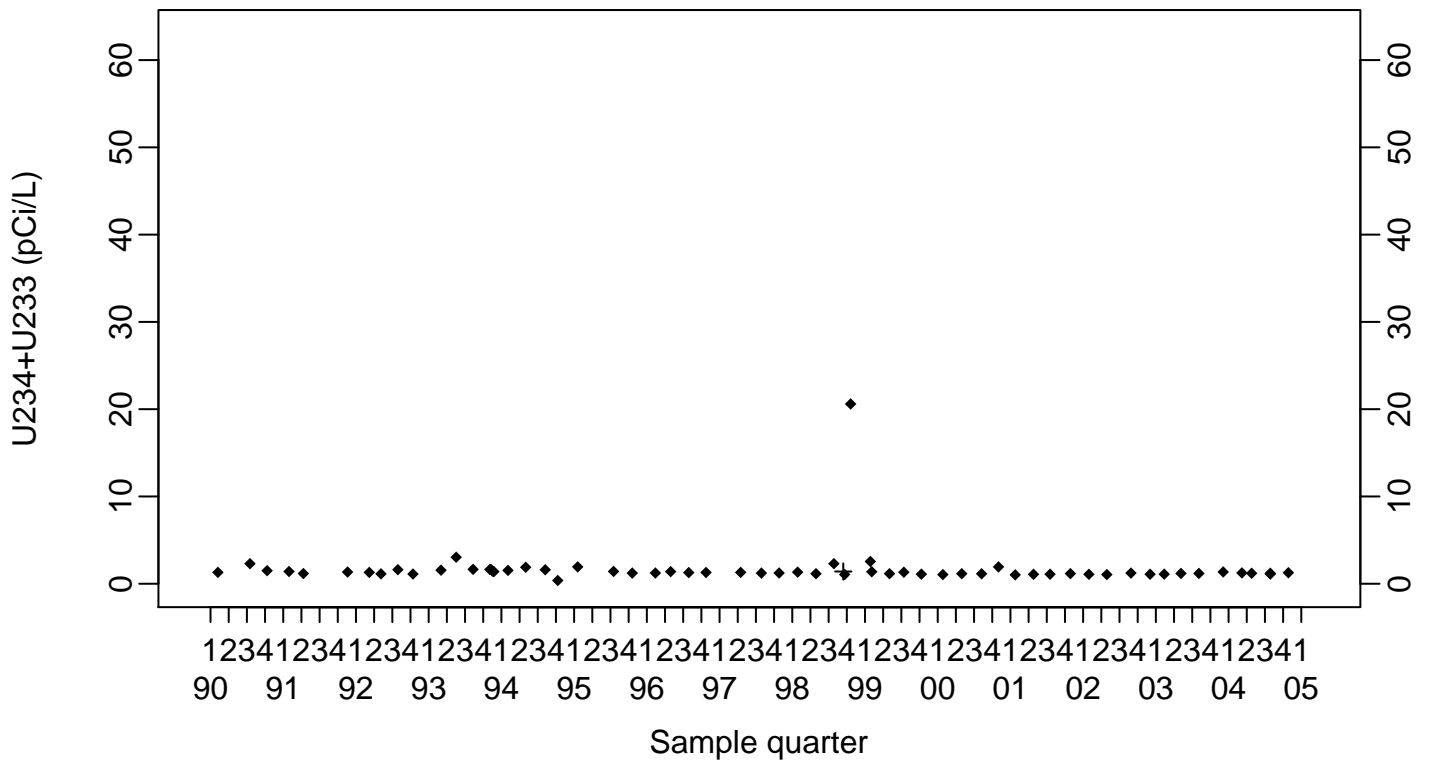
Pit 7 Complex U234+U233 (pCi/L)

Compliance Monitoring Point NC7-26

- ◆ Above RL
- ▽ Below RL
- + Estimated



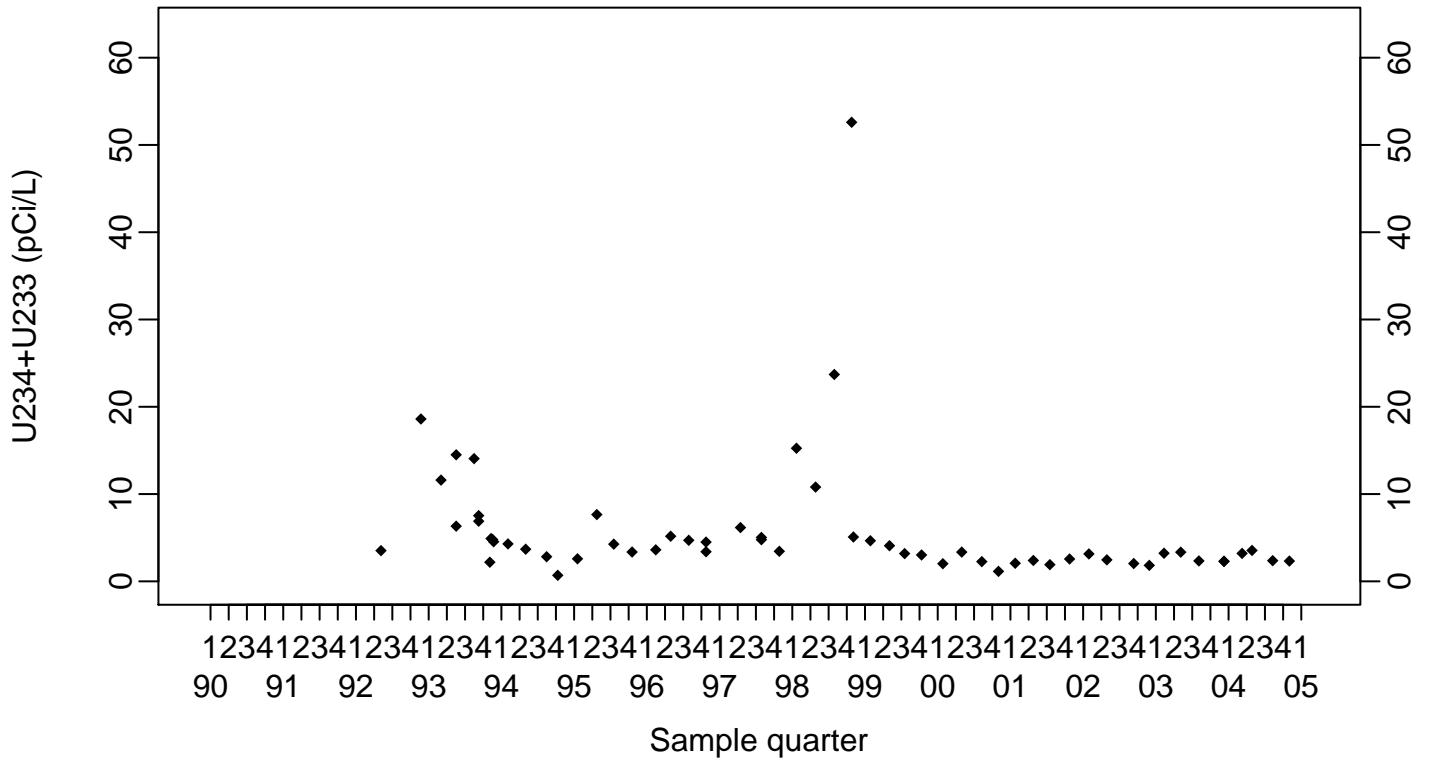
Compliance Monitoring Point NC7-47



Pit 7 Complex
U234+U233 (pCi/L)

Compliance Monitoring Point NC7-48

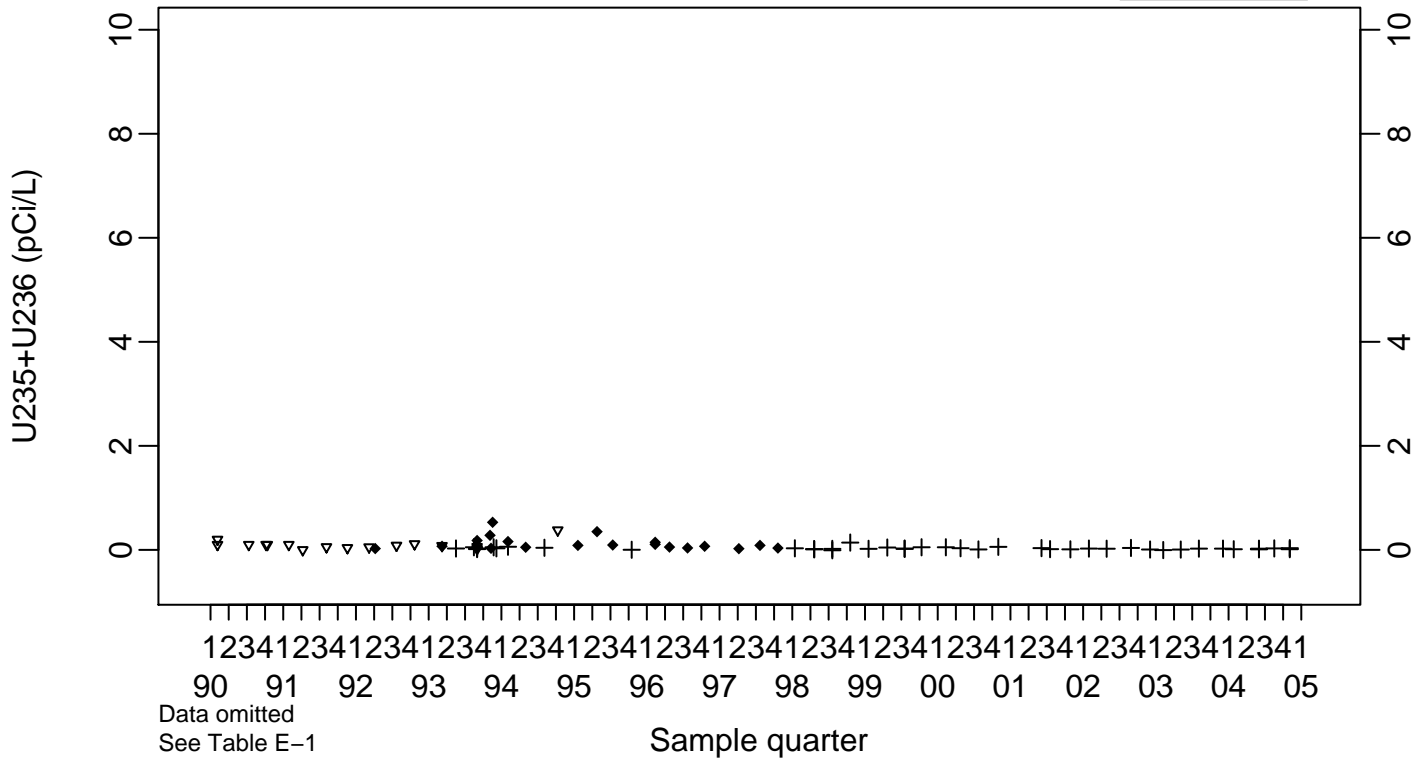
◆ Above RL
▽ Below RL



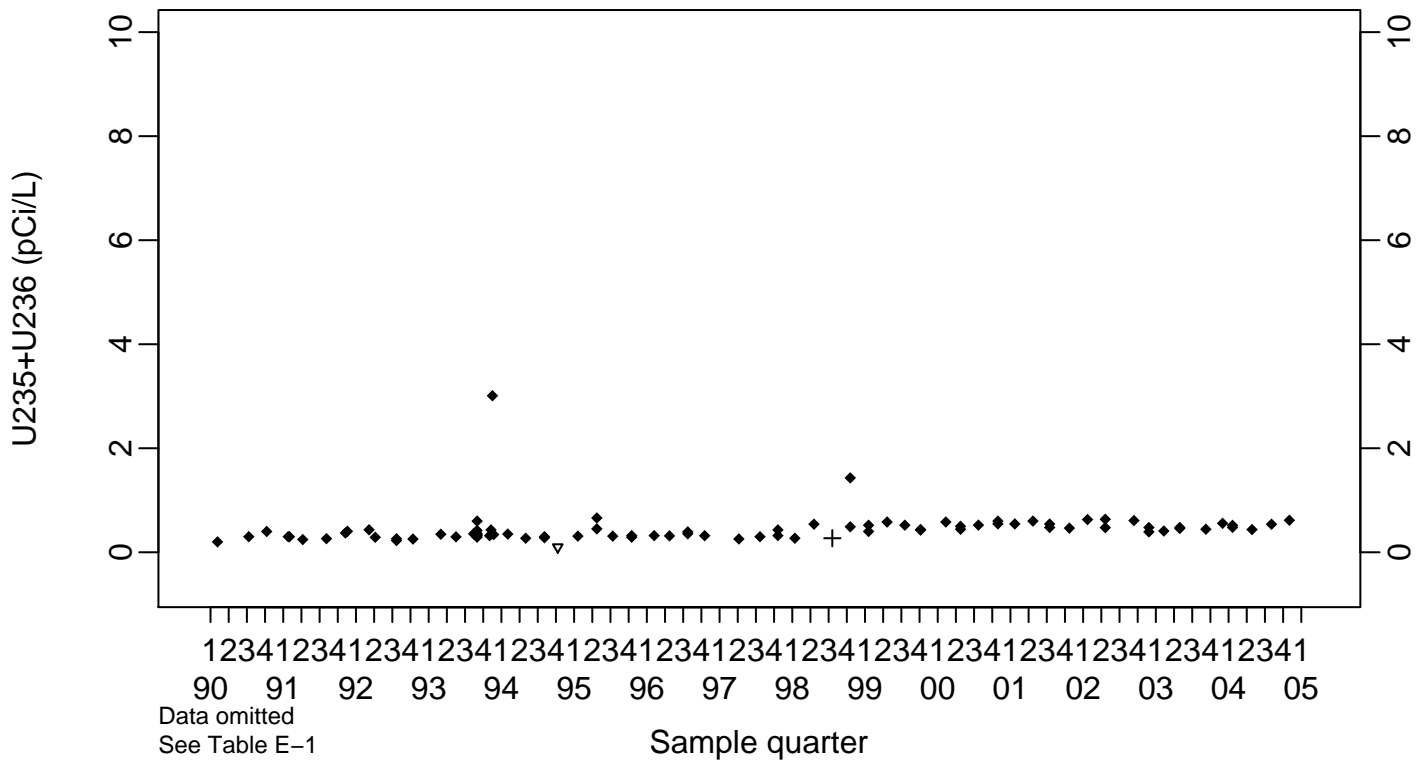
Pit 7 Complex U235+U236 (pCi/L)

Background Monitoring Point K7-06

- ◆ Above RL
- ▽ Below RL
- + Estimated



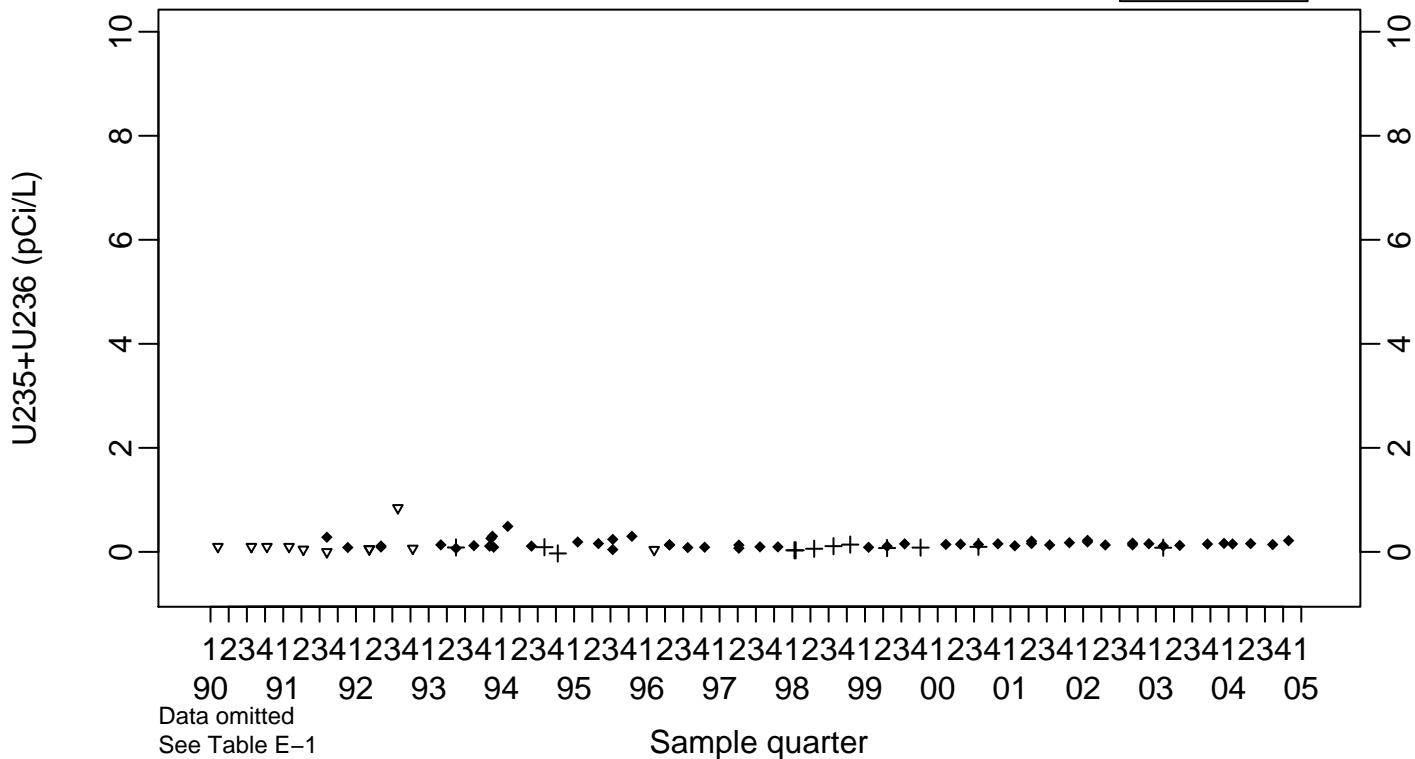
Compliance Monitoring Point K7-01



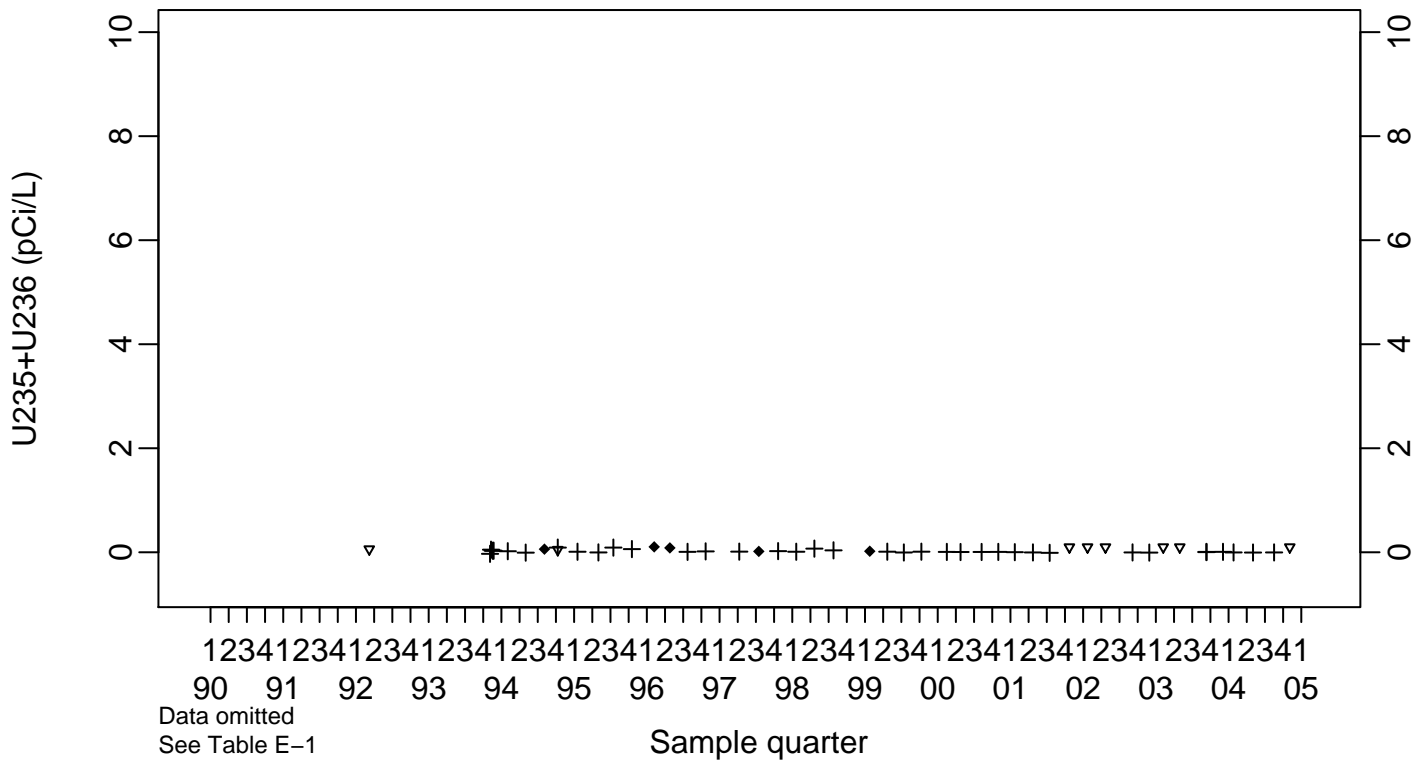
Pit 7 Complex
U235+U236 (pCi/L)

Compliance Monitoring Point K7-03

◆	Above RL
▽	Below RL
+	Estimated



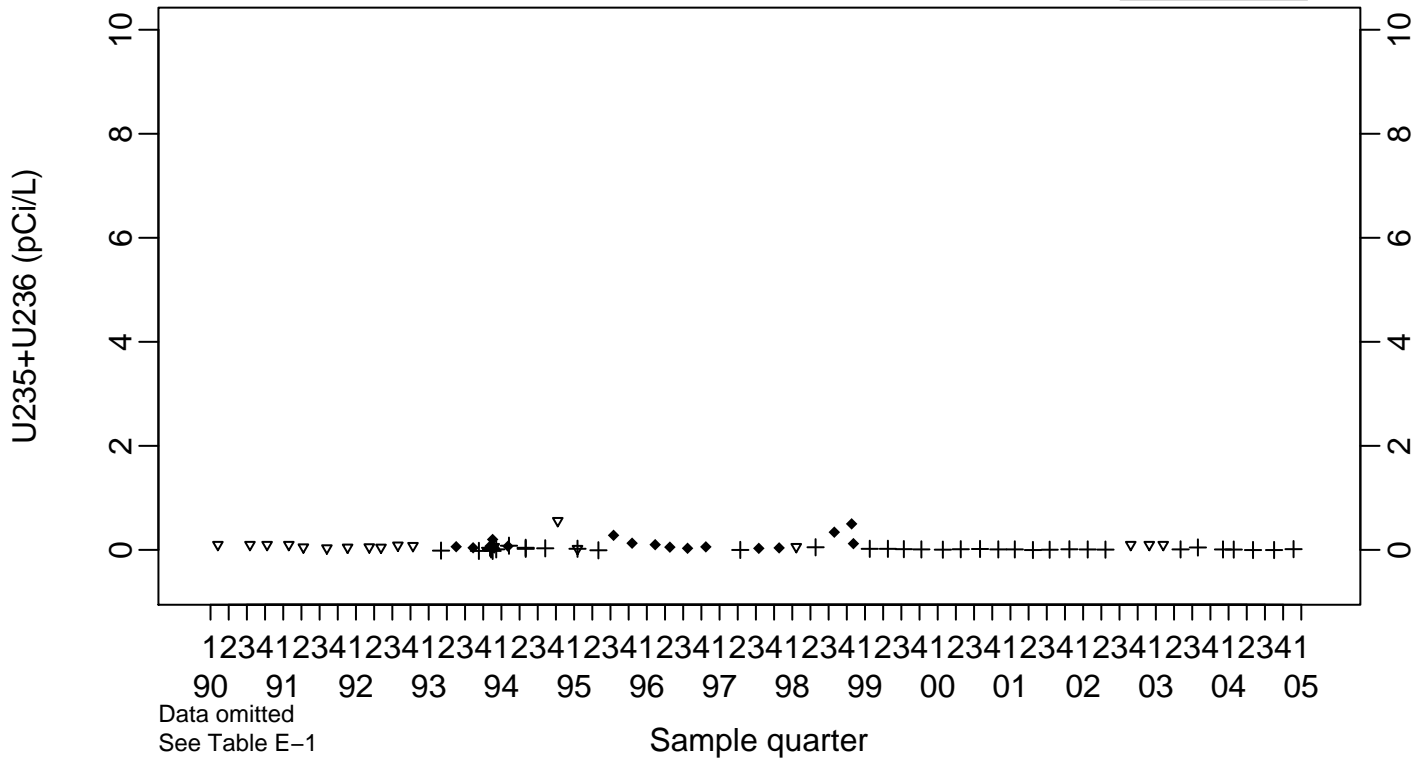
Compliance Monitoring Point K7-09



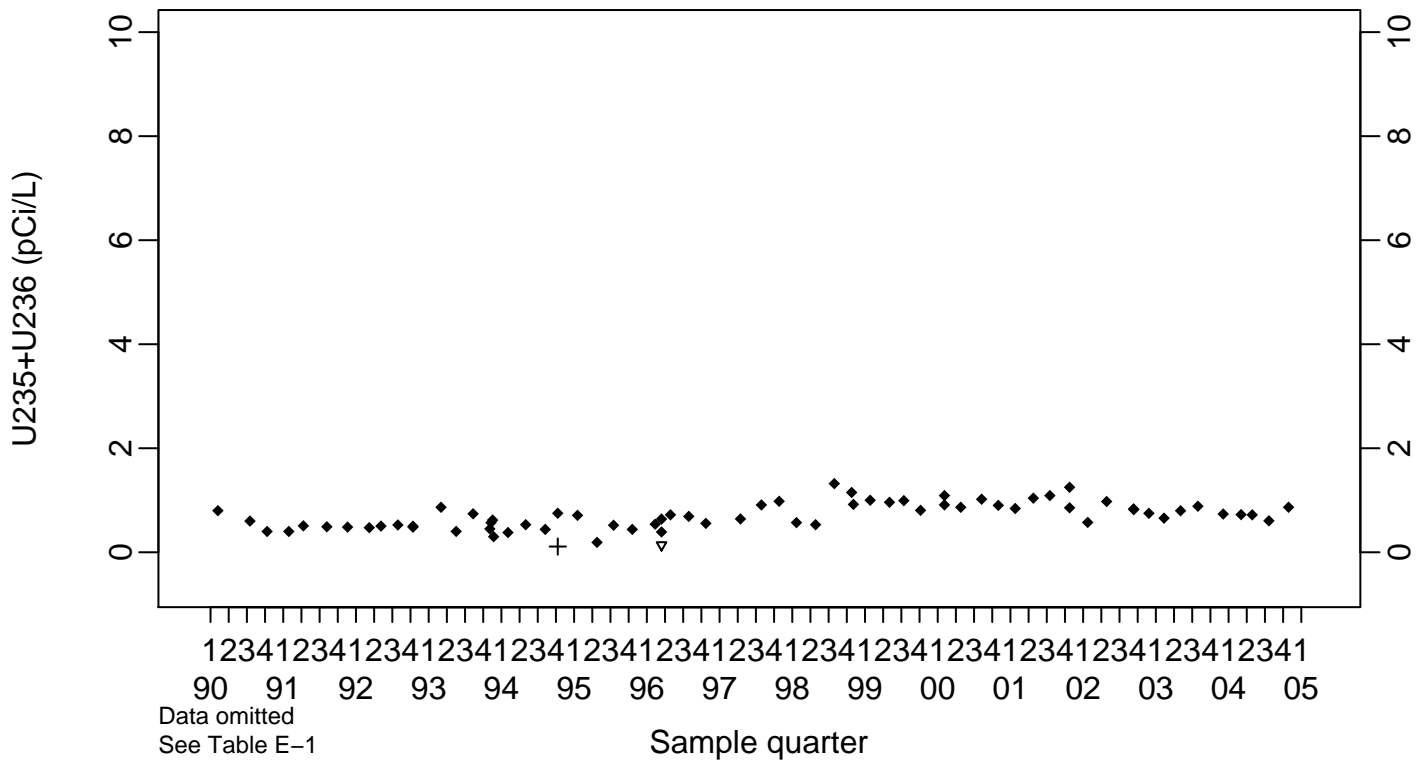
Pit 7 Complex U235+U236 (pCi/L)

Compliance Monitoring Point K7-10

- ◆ Above RL
- ▽ Below RL
- + Estimated



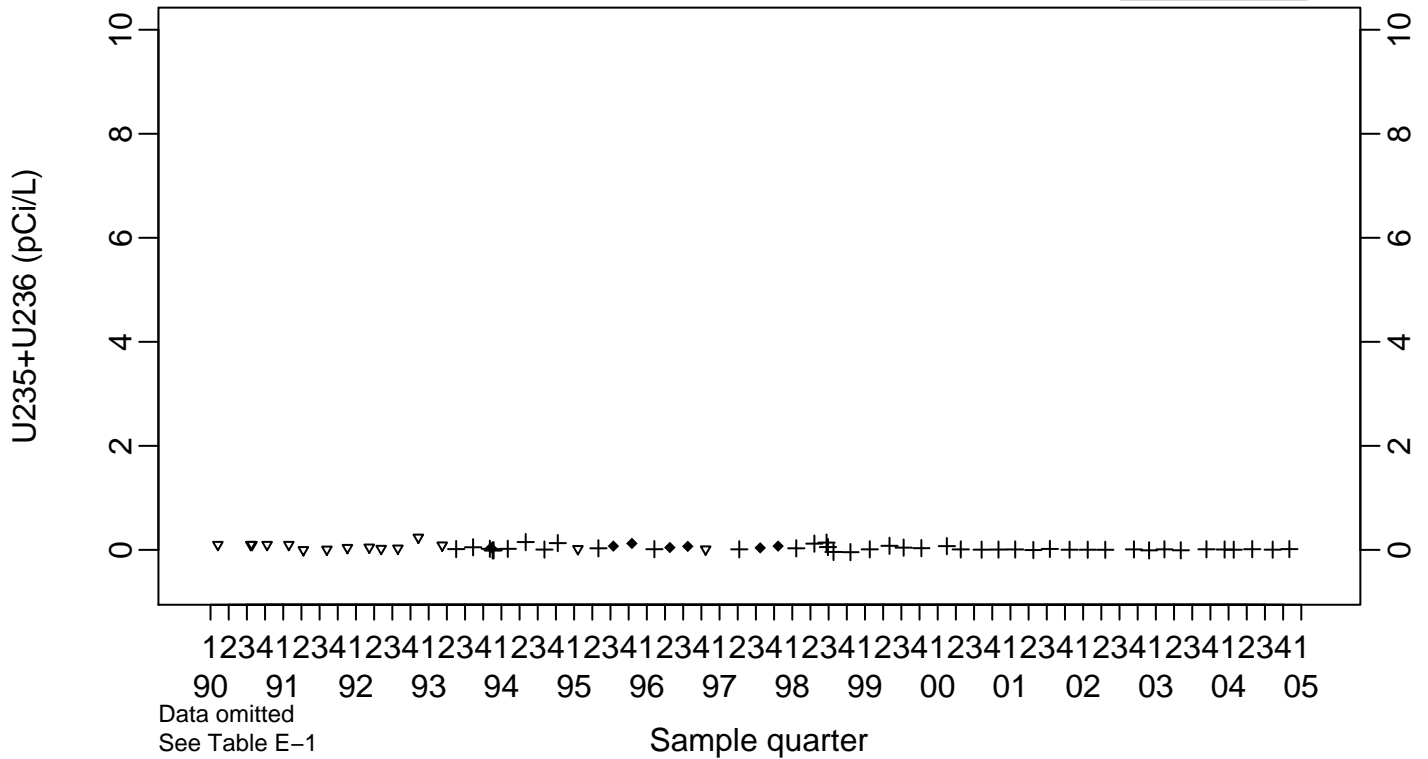
Compliance Monitoring Point NC7-25



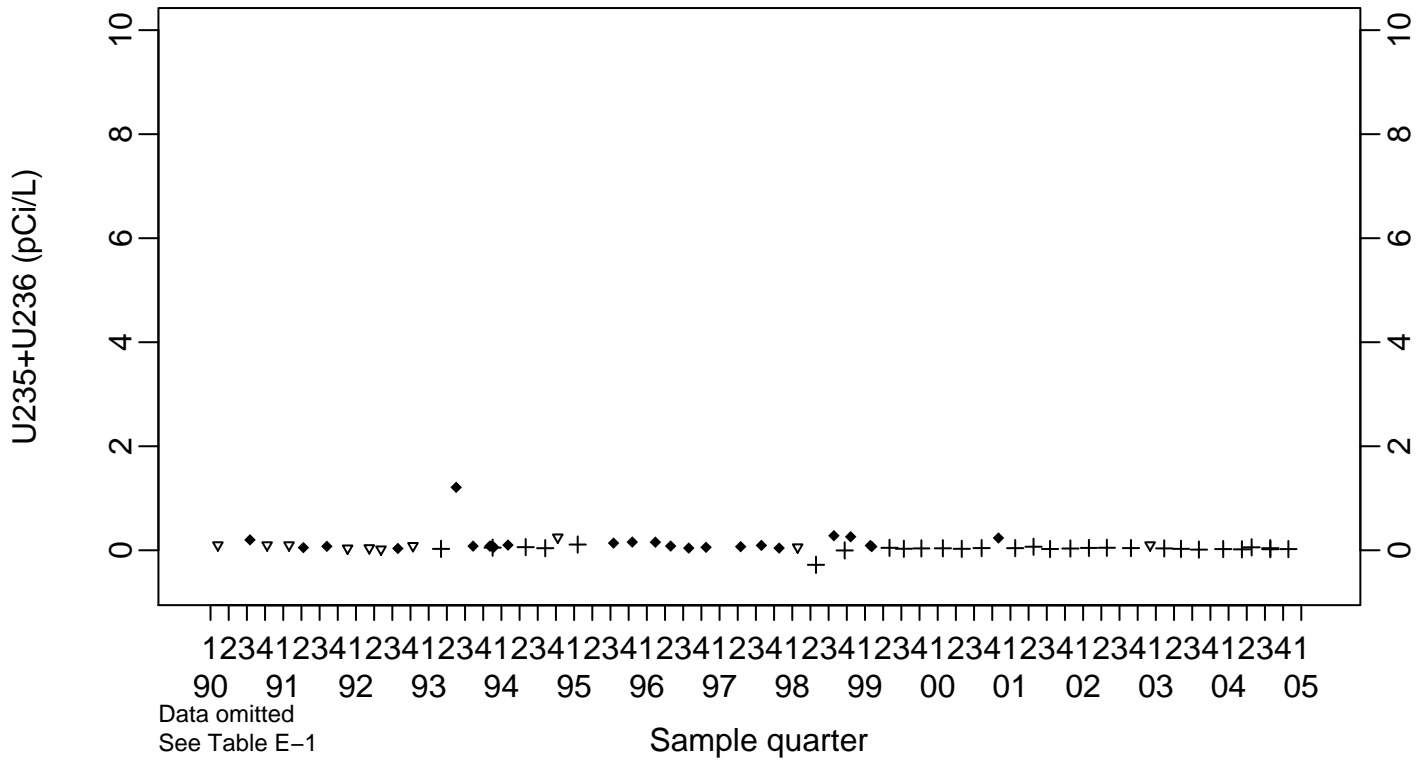
Pit 7 Complex
U235+U236 (pCi/L)

Compliance Monitoring Point NC7-26

- ◆ Above RL
- ▽ Below RL
- + Estimated



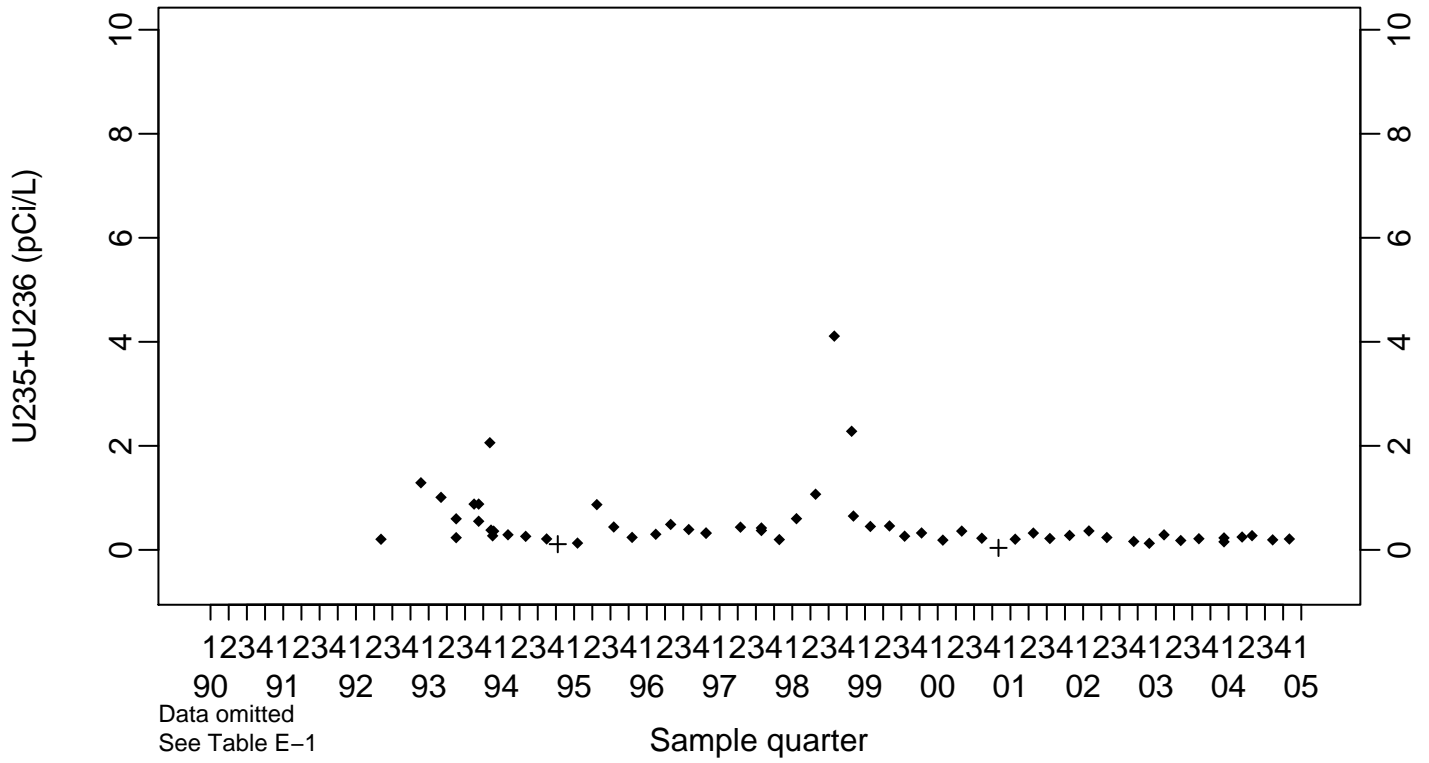
Compliance Monitoring Point NC7-47



Pit 7 Complex
U235+U236 (pCi/L)

Compliance Monitoring Point NC7-48

◆ Above RL
+ Estimated

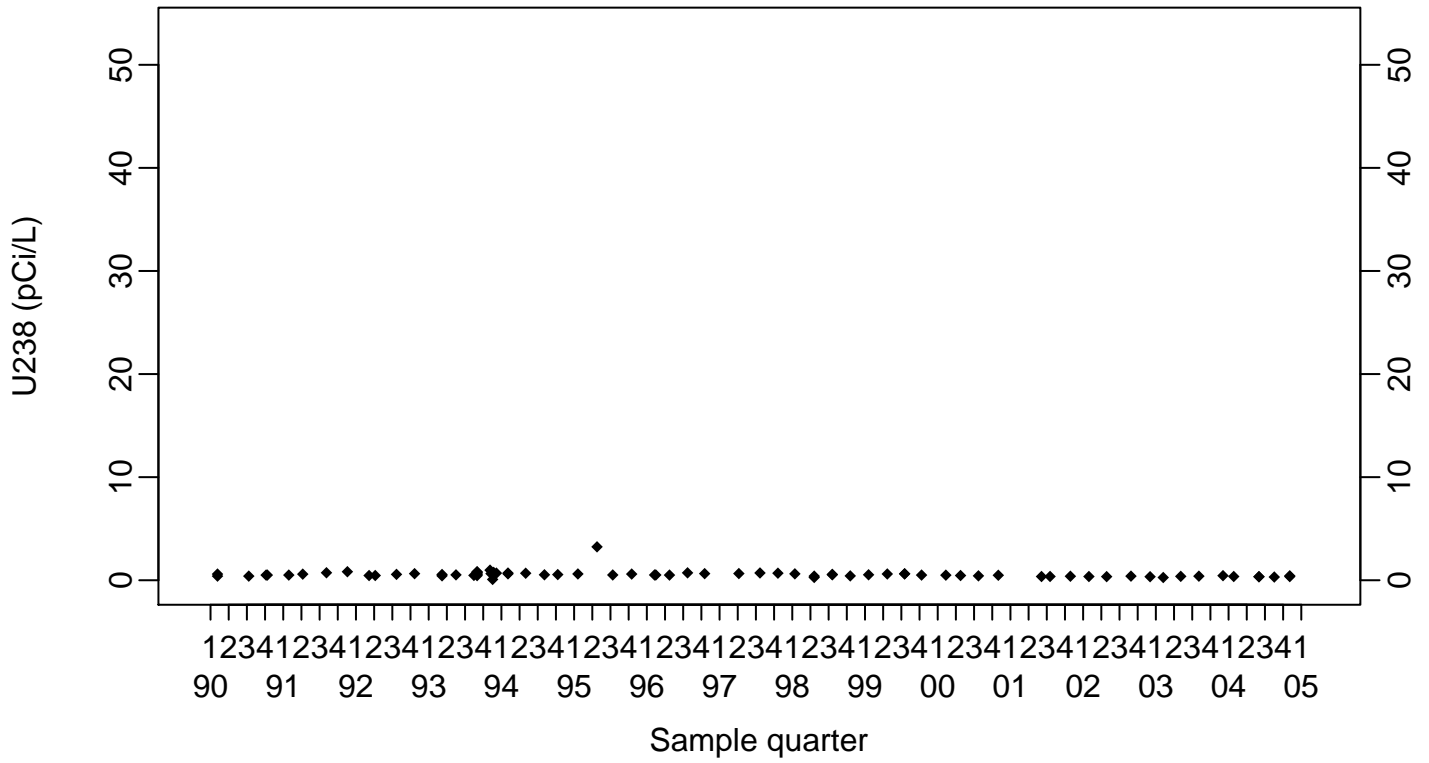


Data omitted
See Table E-1

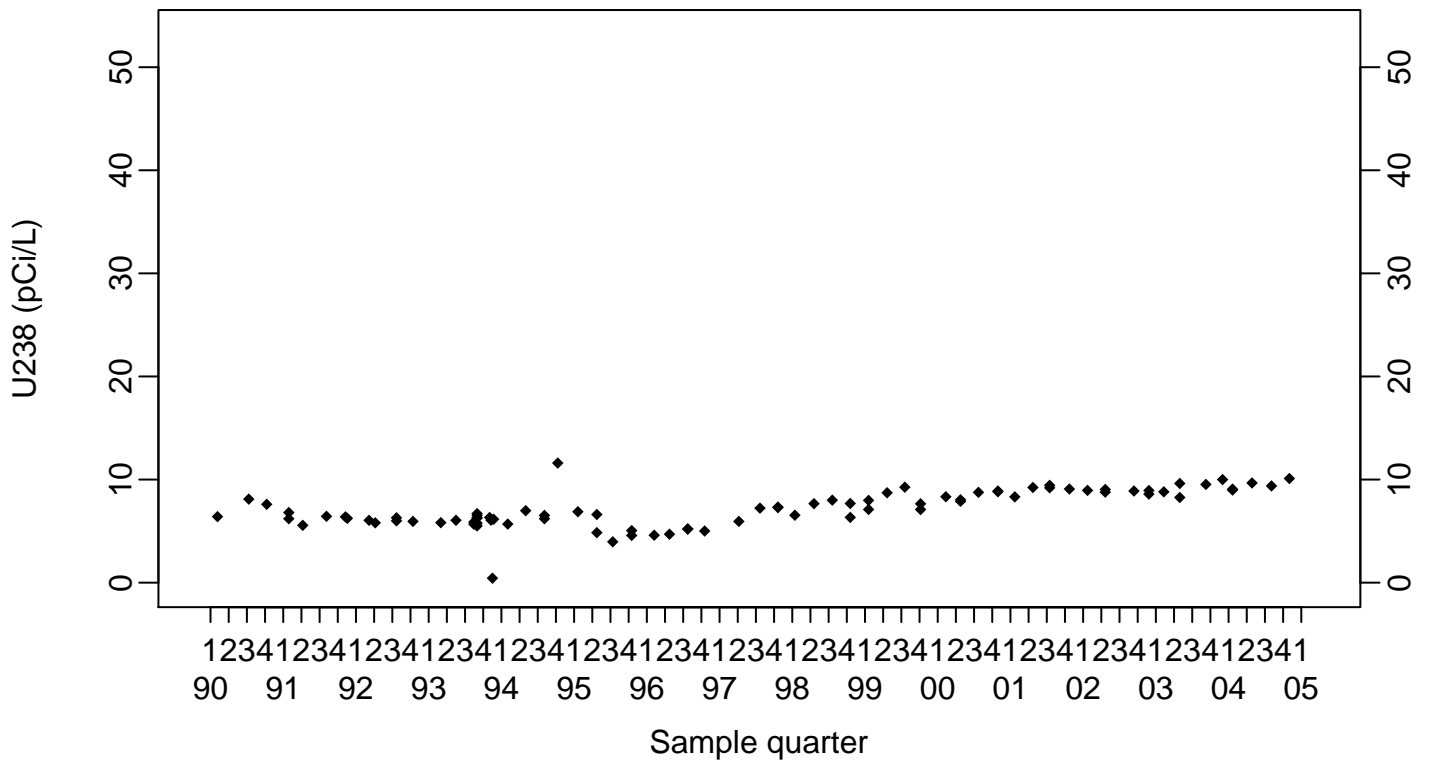
Pit 7 Complex U238 (pCi/L)

Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



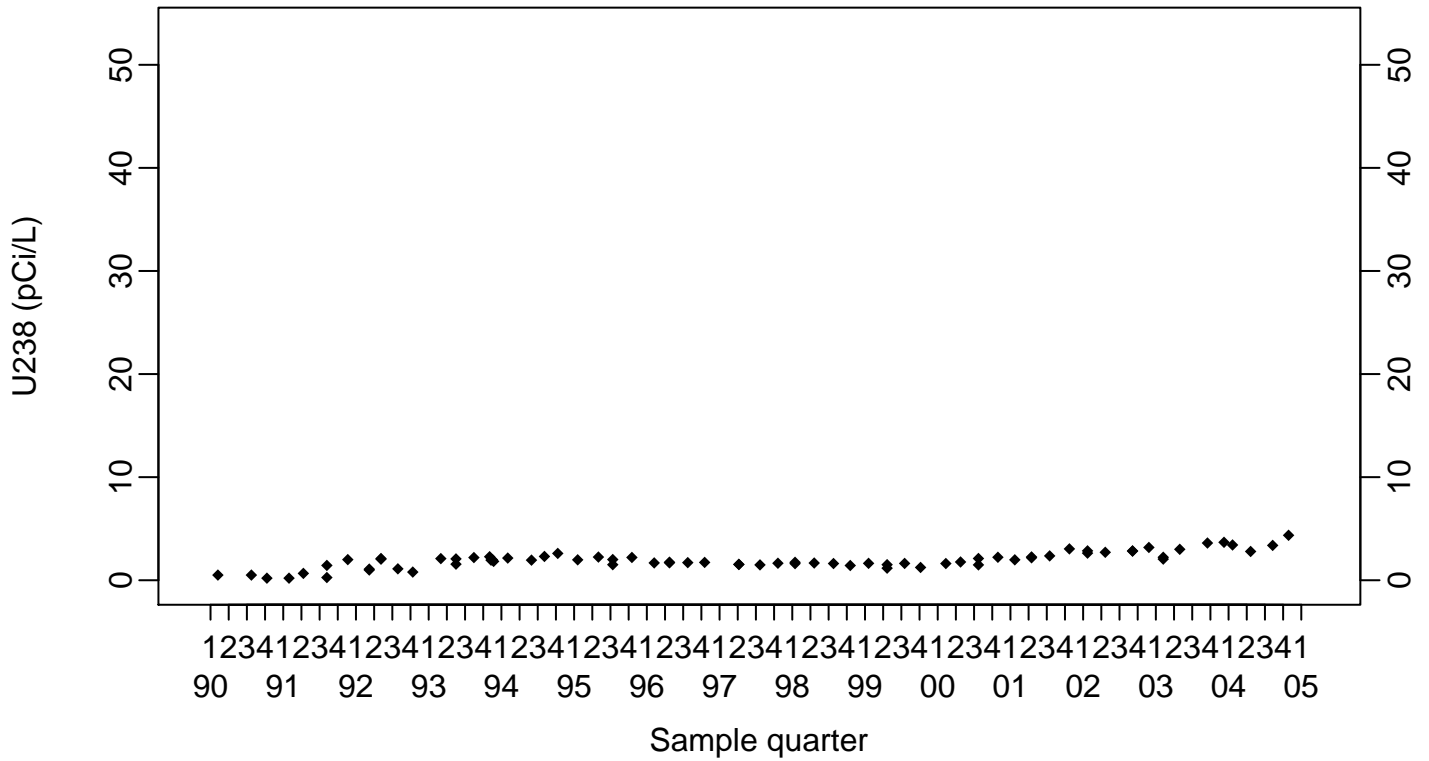
Compliance Monitoring Point K7-01



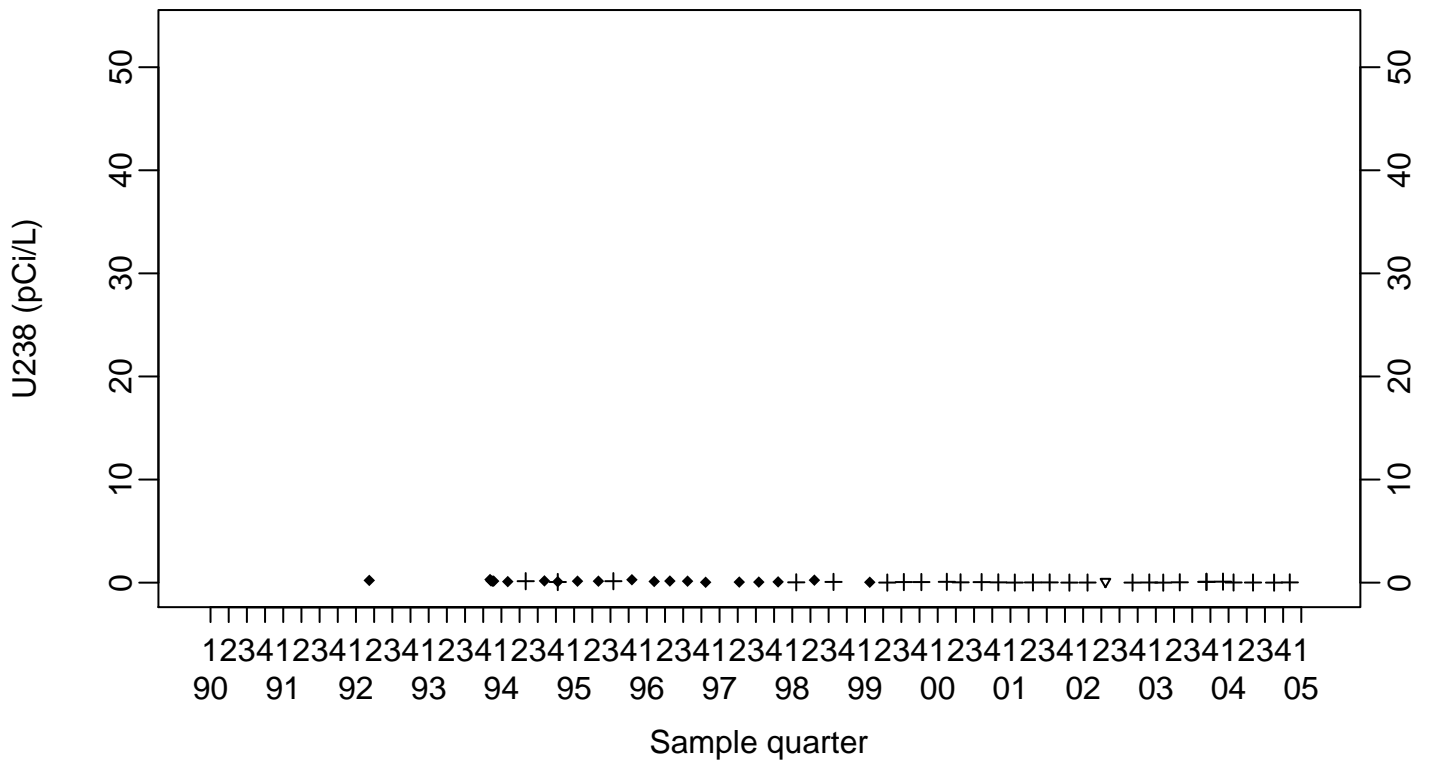
Pit 7 Complex U238 (pCi/L)

Compliance Monitoring Point K7-03

◆ Above RL
▽ Below RL



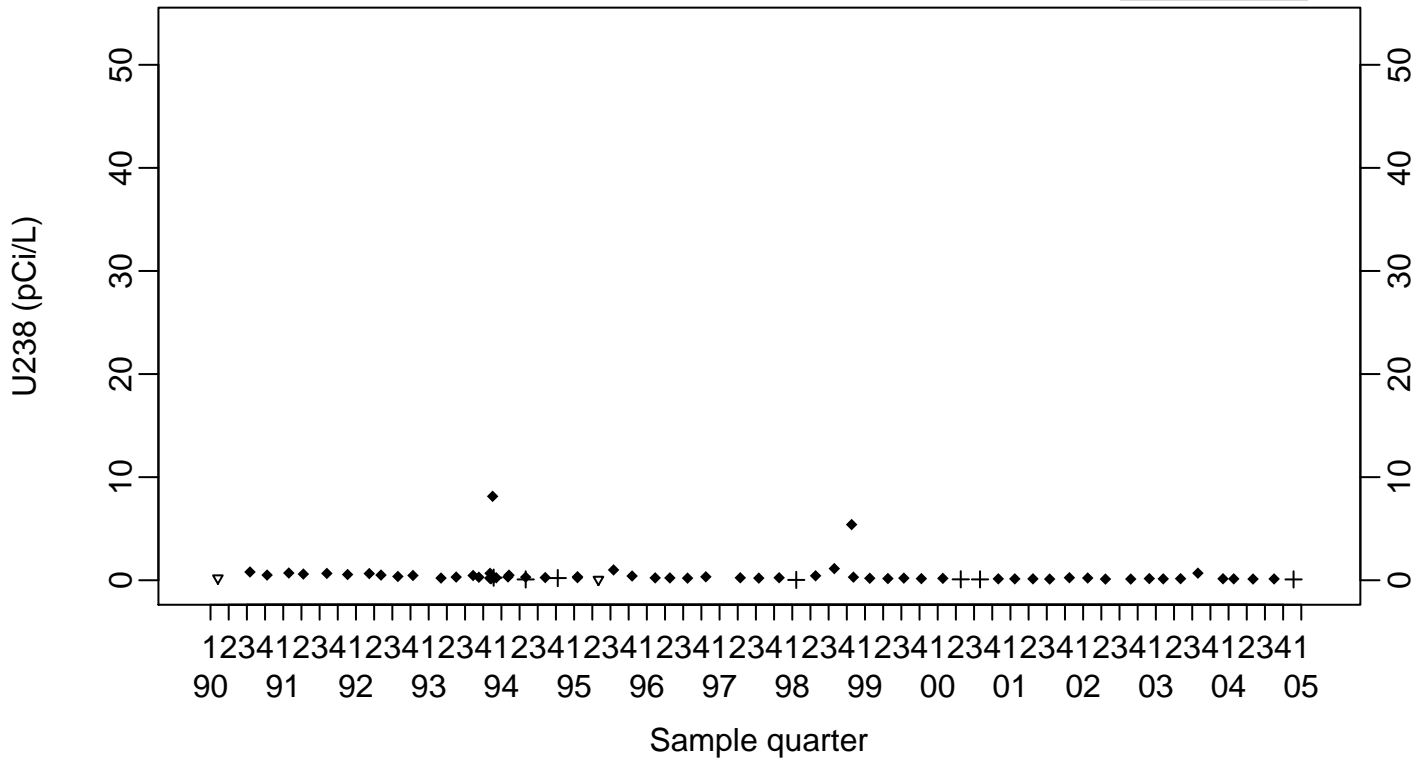
Compliance Monitoring Point K7-09



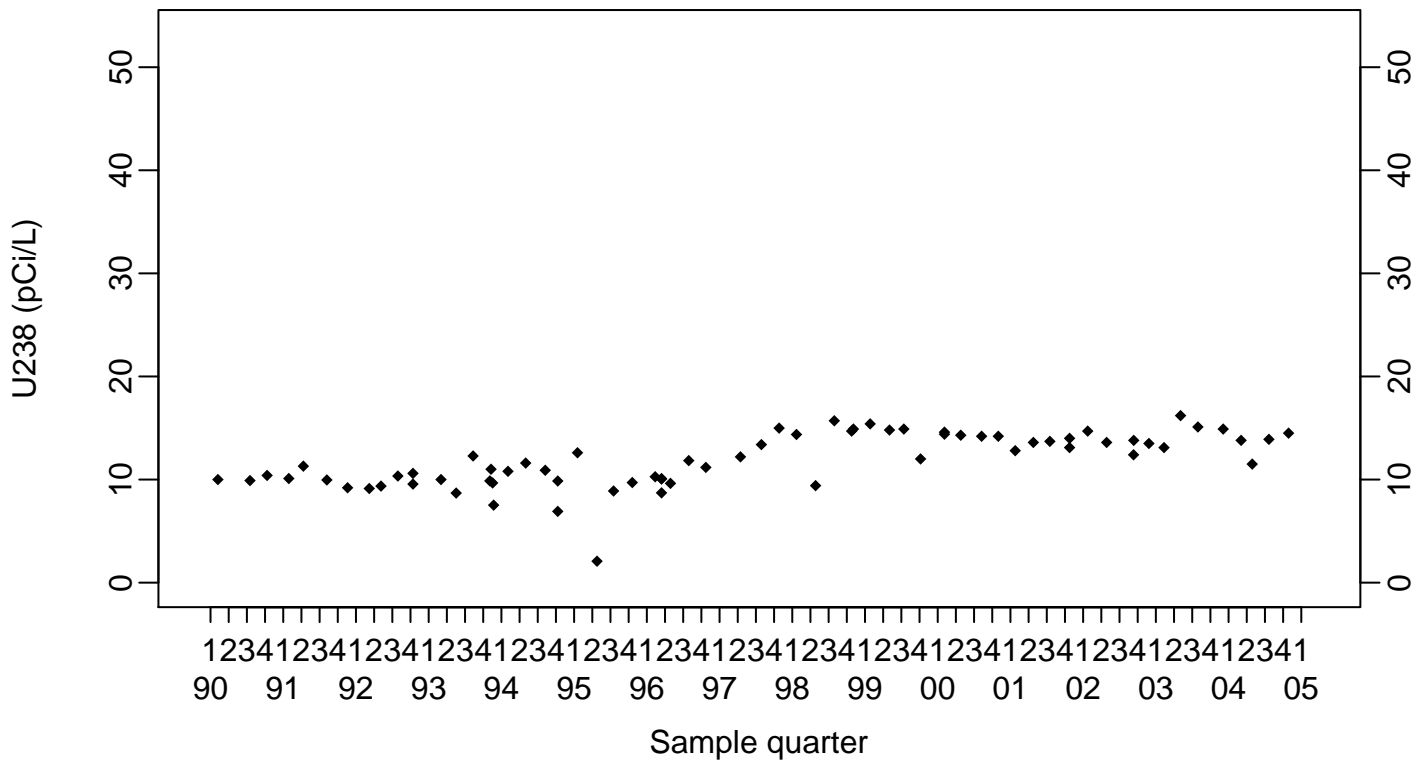
Pit 7 Complex
U238 (pCi/L)

Compliance Monitoring Point K7-10

- ◆ Above RL
- ▽ Below RL
- + Estimated



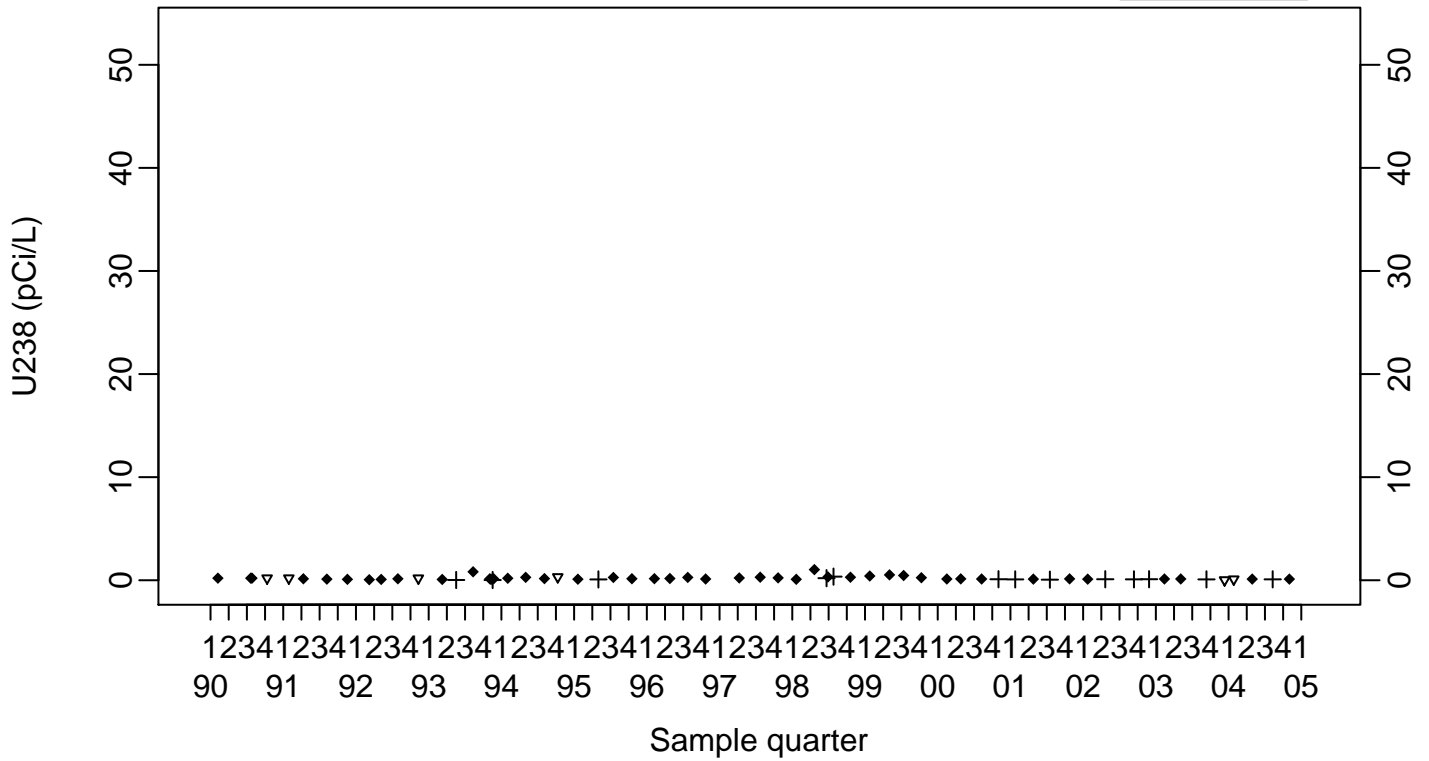
Compliance Monitoring Point NC7-25



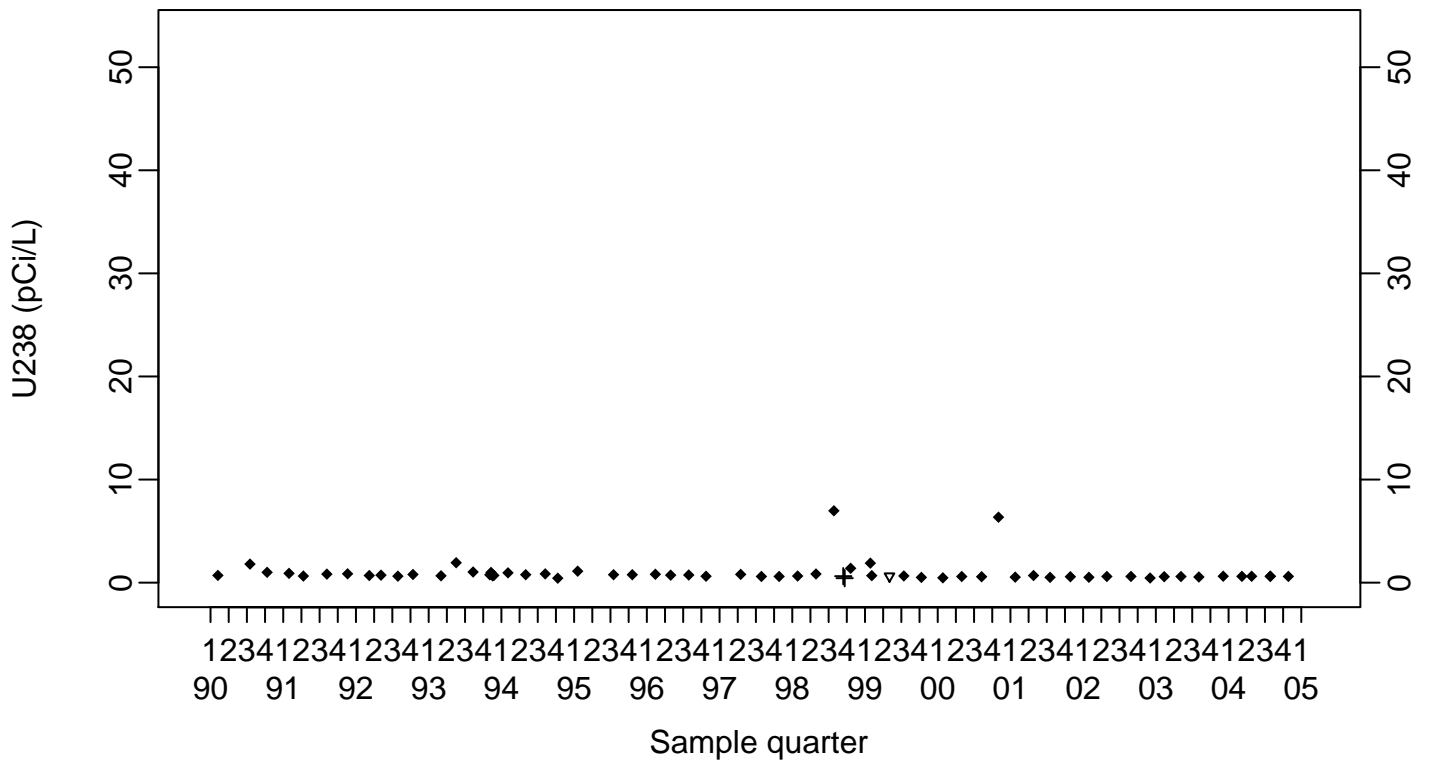
Pit 7 Complex
U238 (pCi/L)

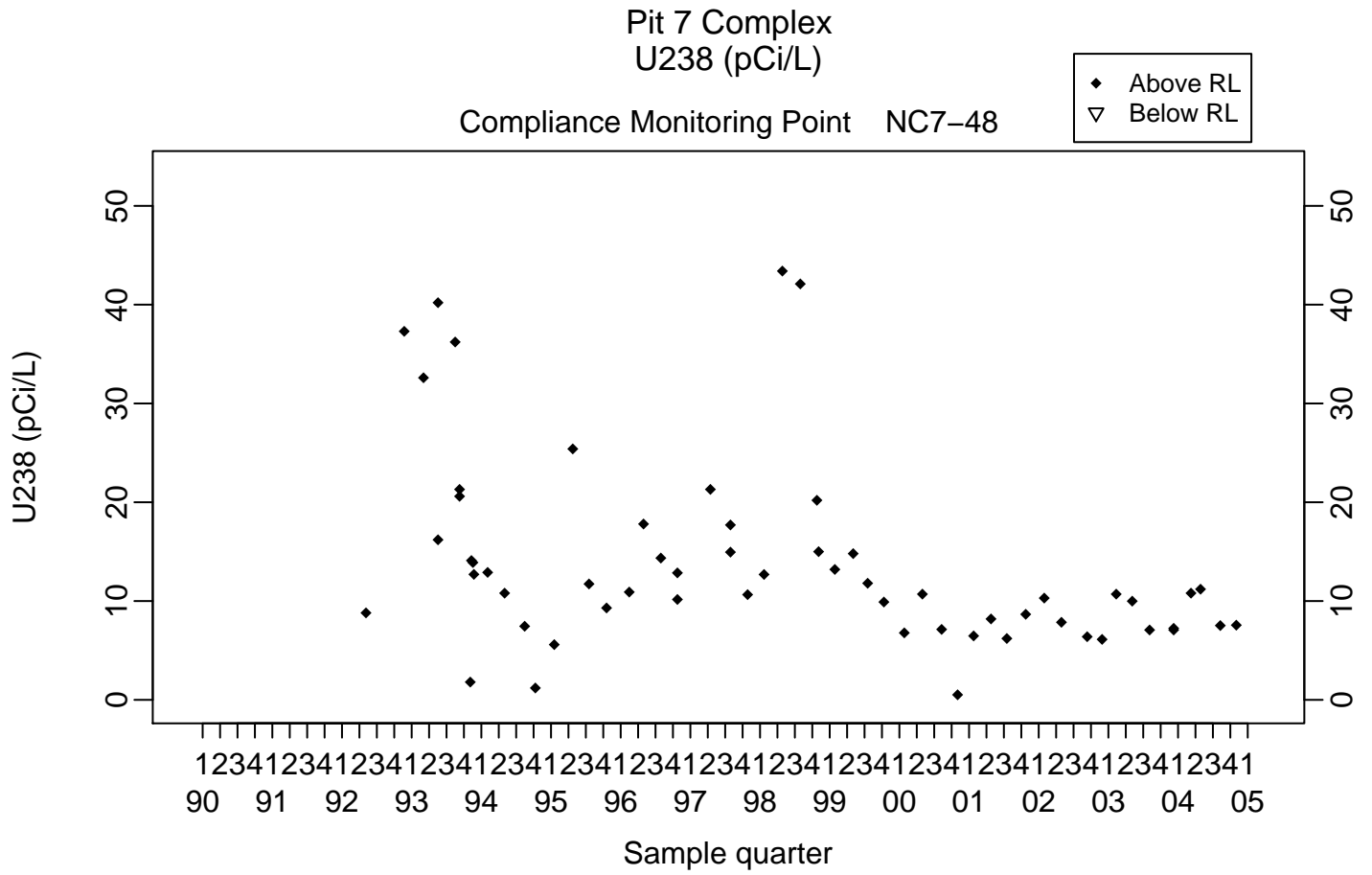
Compliance Monitoring Point NC7-26

- ◆ Above RL
- ▽ Below RL
- + Estimated



Compliance Monitoring Point NC7-47



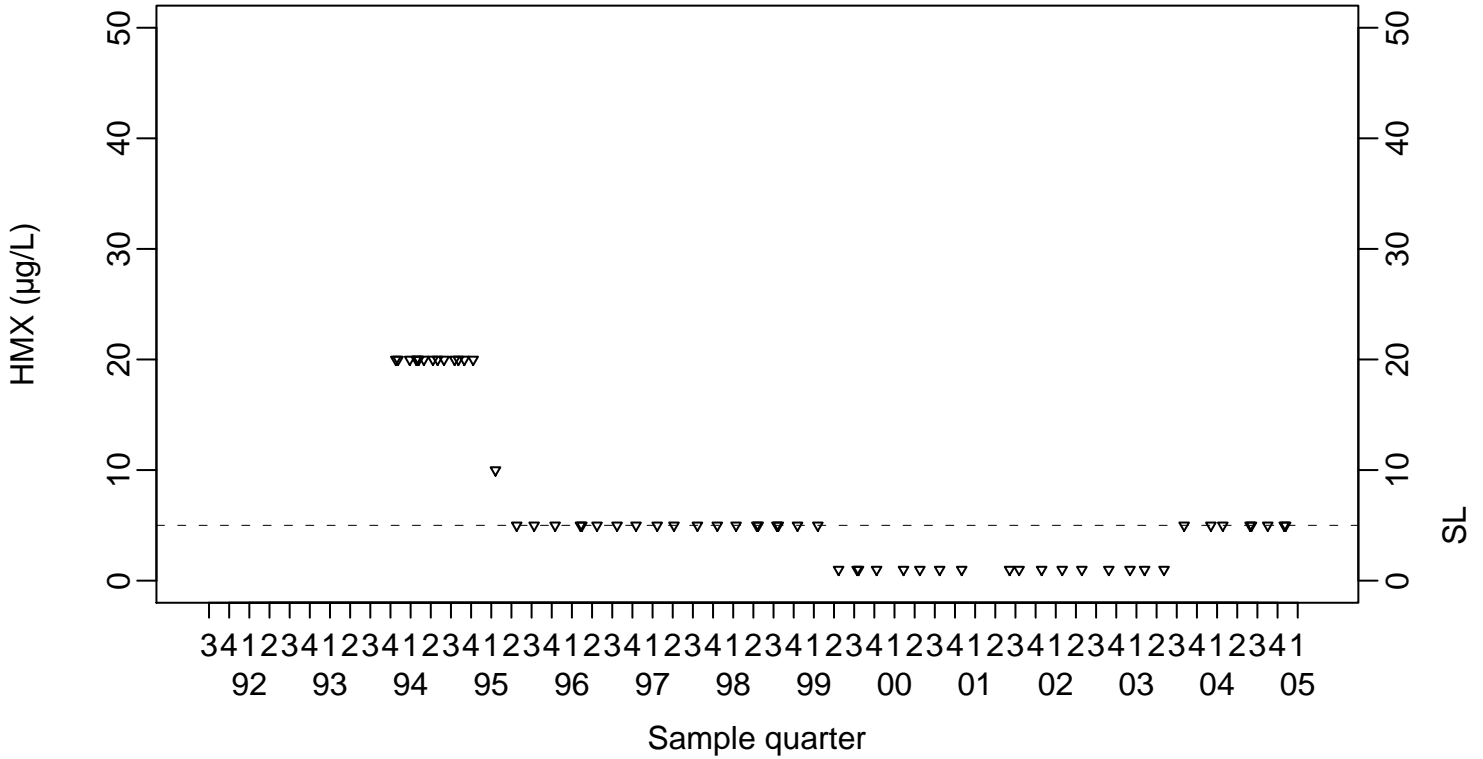


Pit 7 Complex HMX ($\mu\text{g/L}$)

SL=5

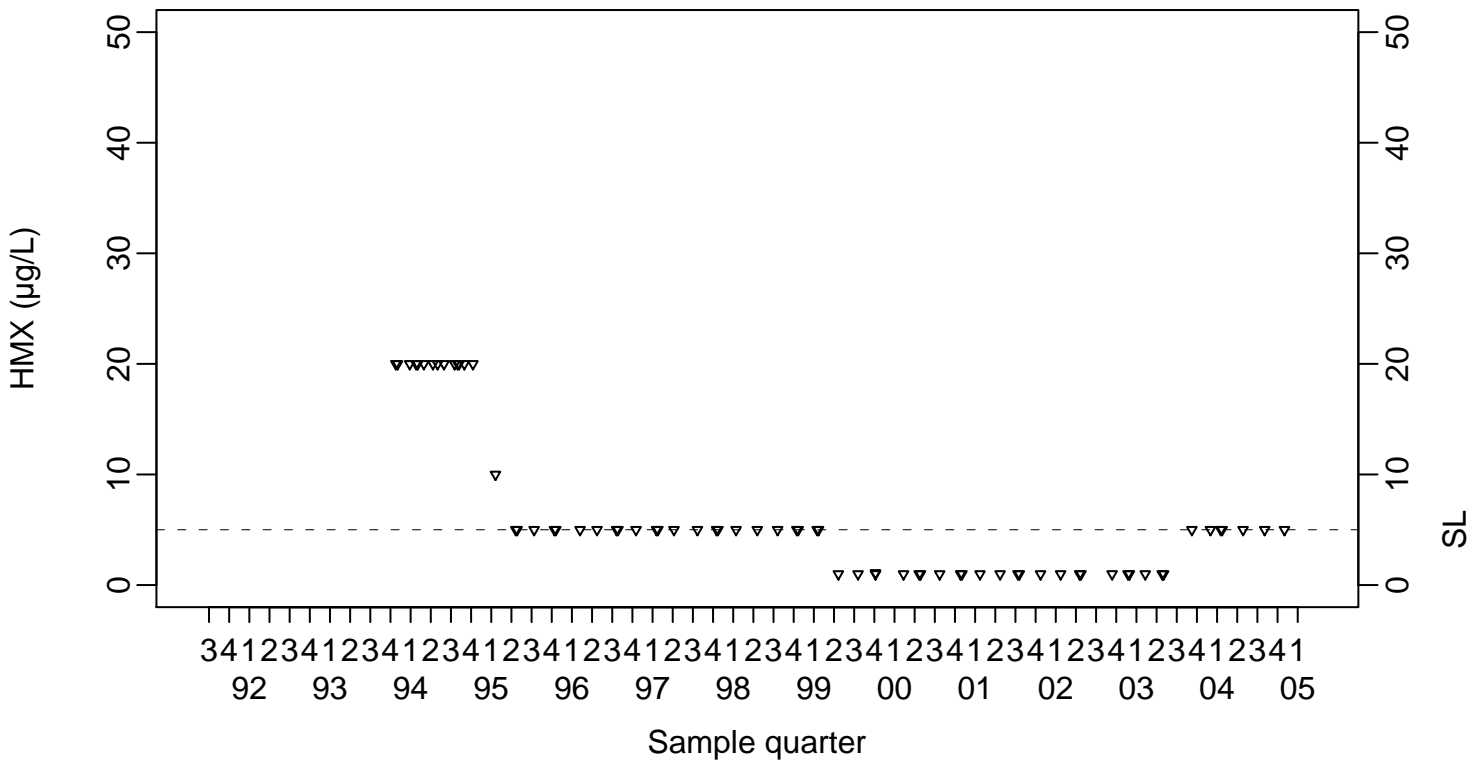
Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K7-01

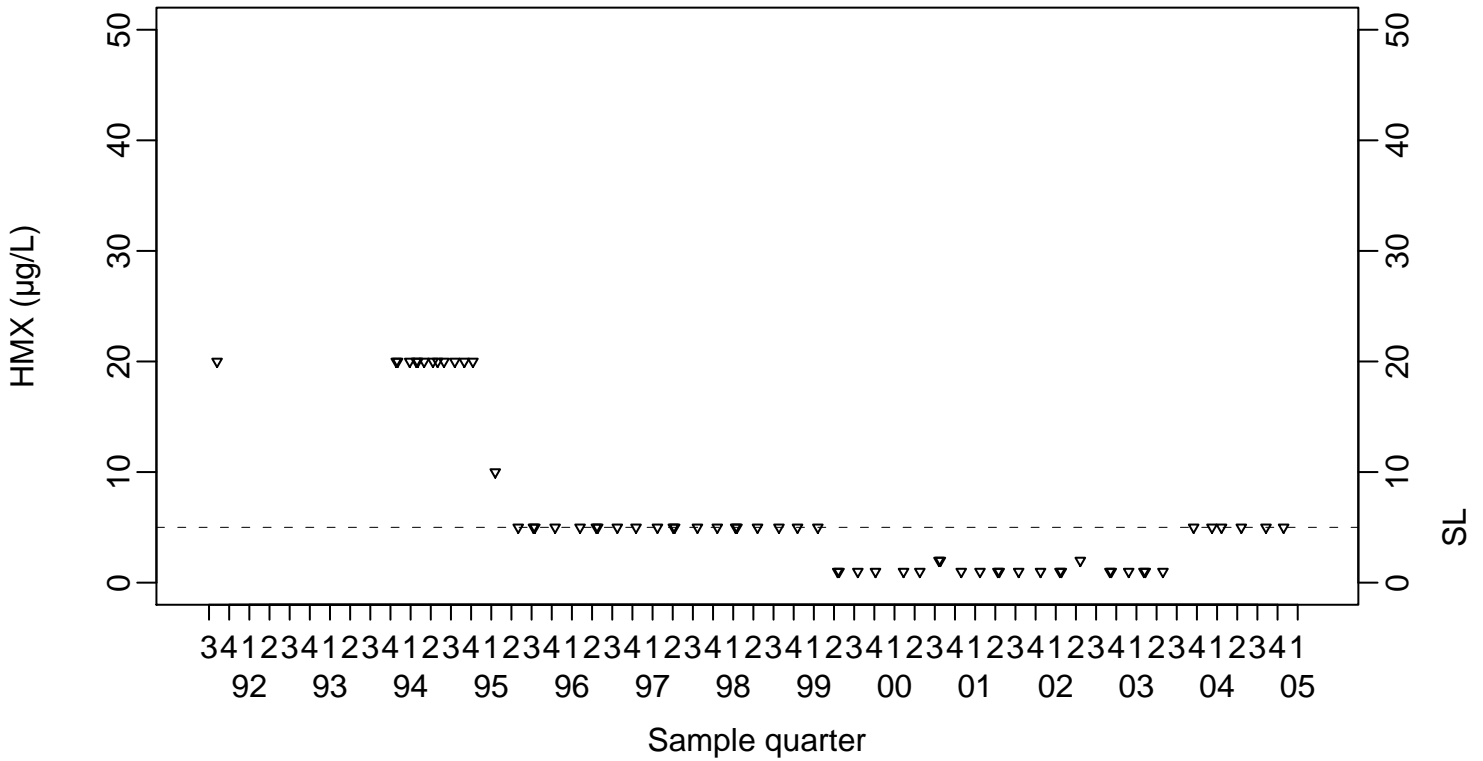


Pit 7 Complex HMX ($\mu\text{g/L}$)

Compliance Monitoring Point K7-03

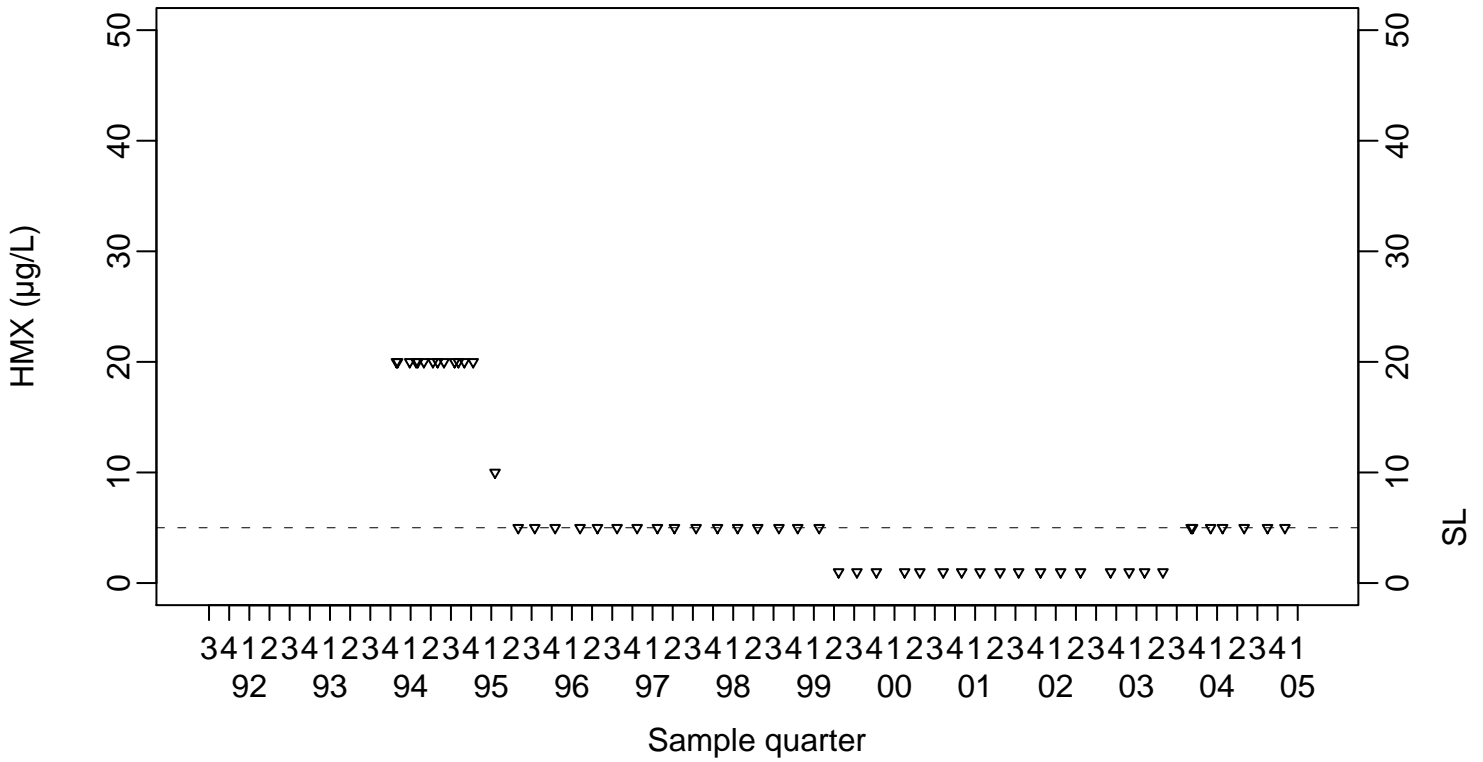
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K7-09

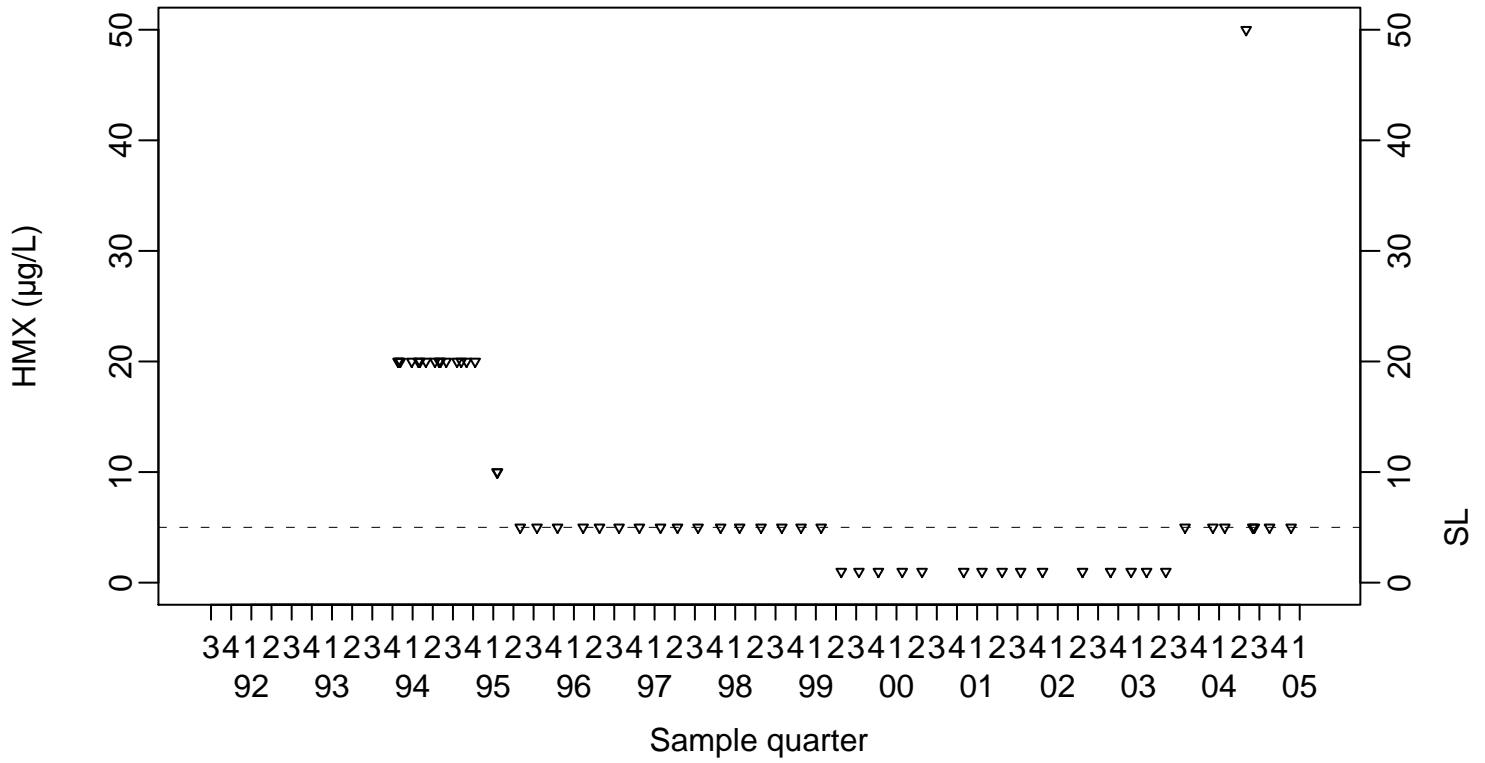


Pit 7 Complex HMX ($\mu\text{g/L}$)

SL=5

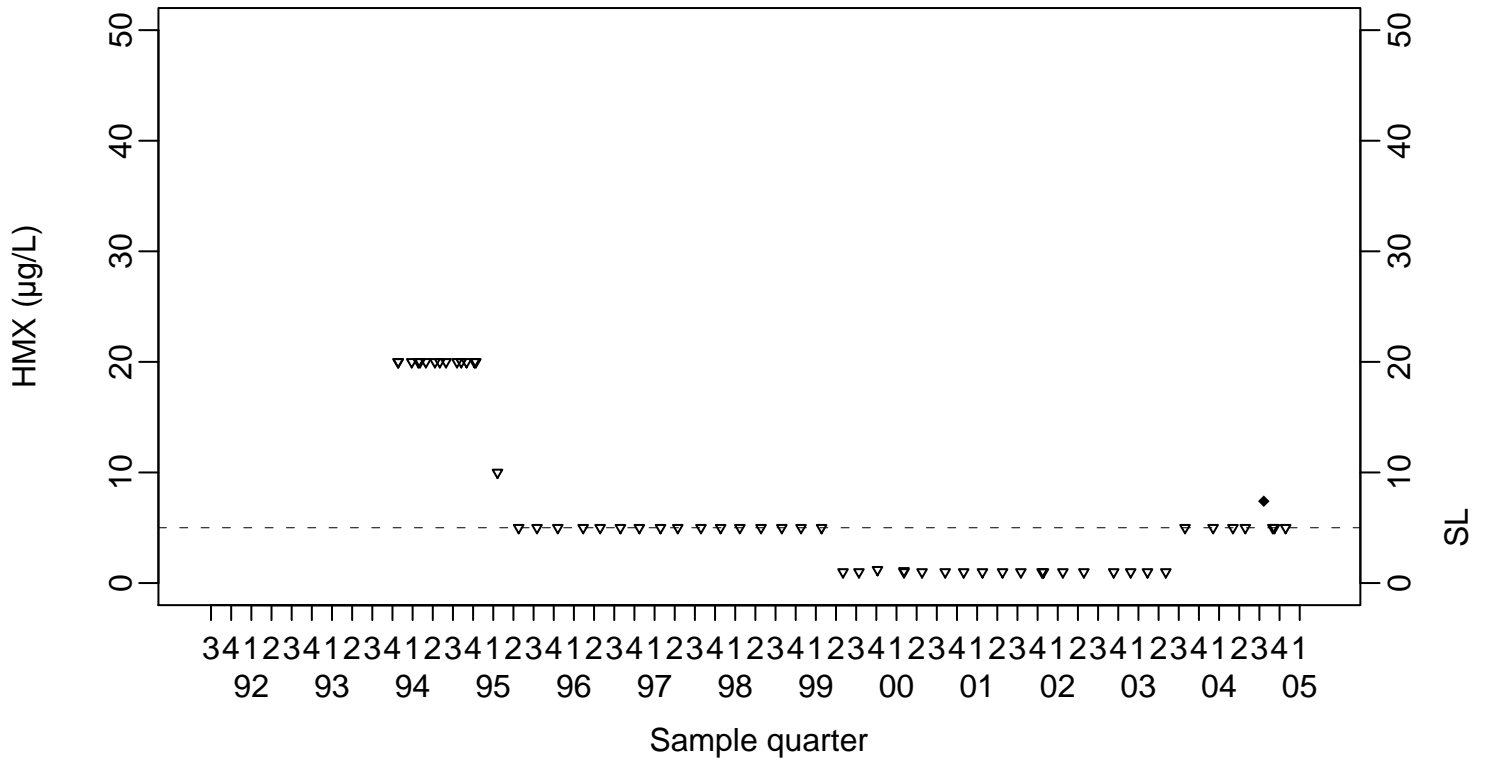
Compliance Monitoring Point K7-10

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point NC7-25

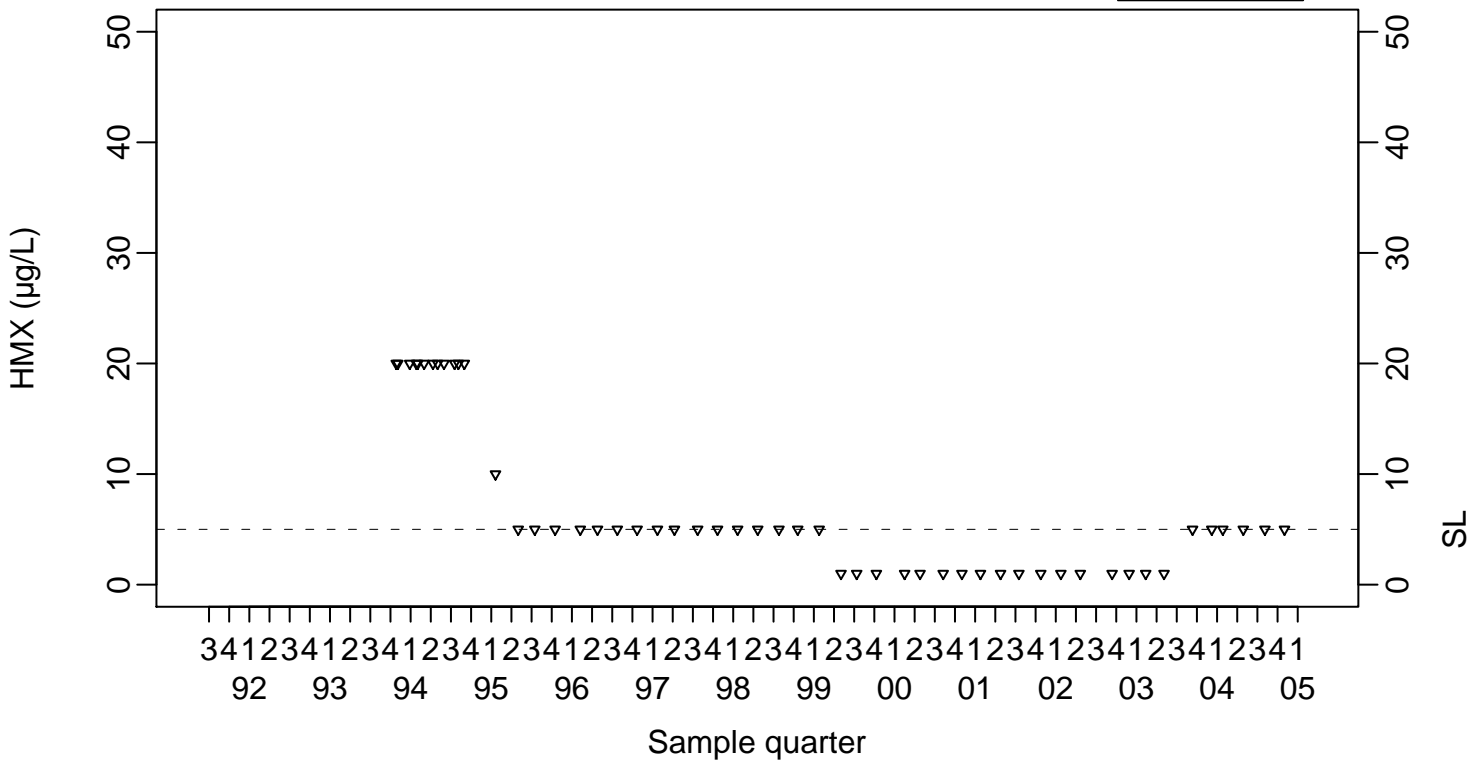


Pit 7 Complex HMX ($\mu\text{g/L}$)

Compliance Monitoring Point NC7-26

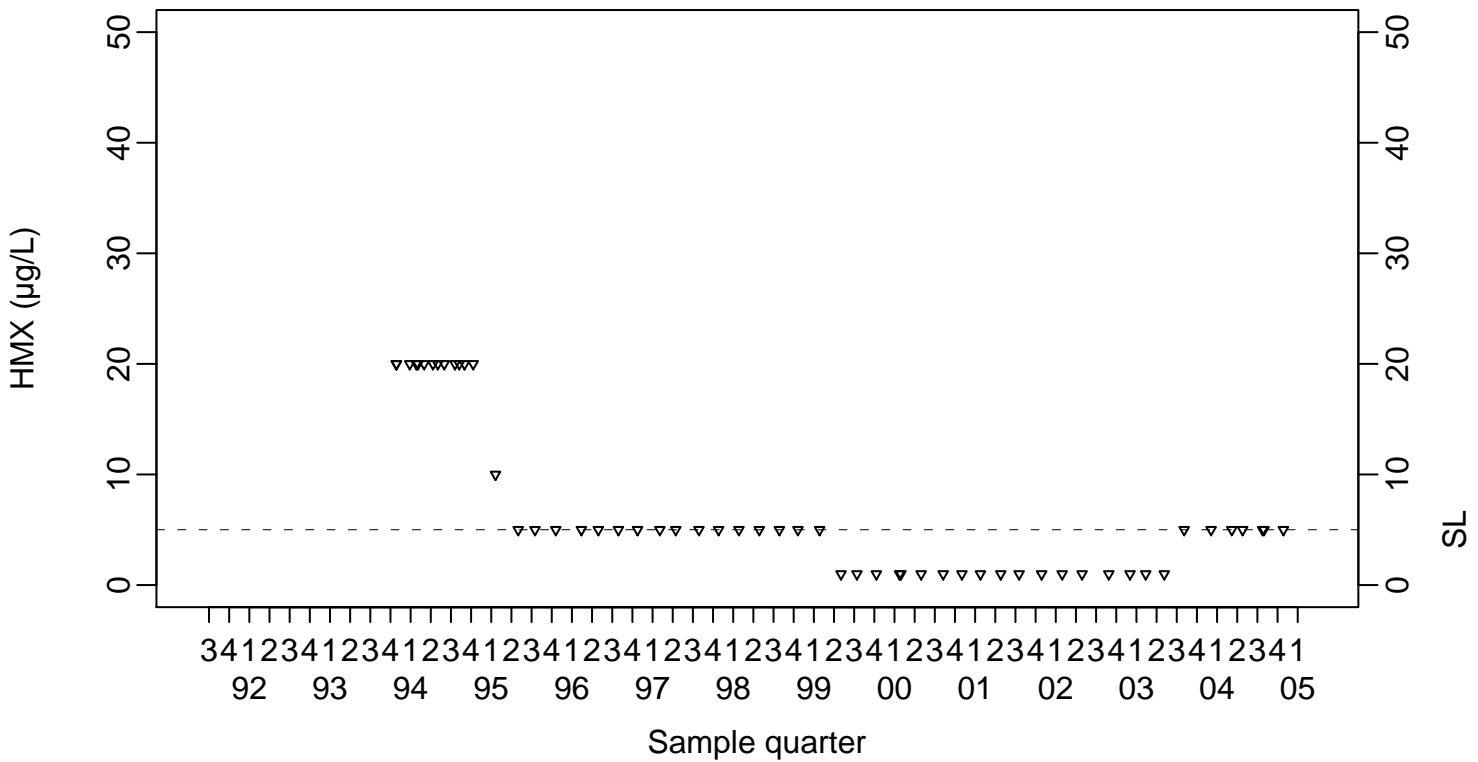
SL=5

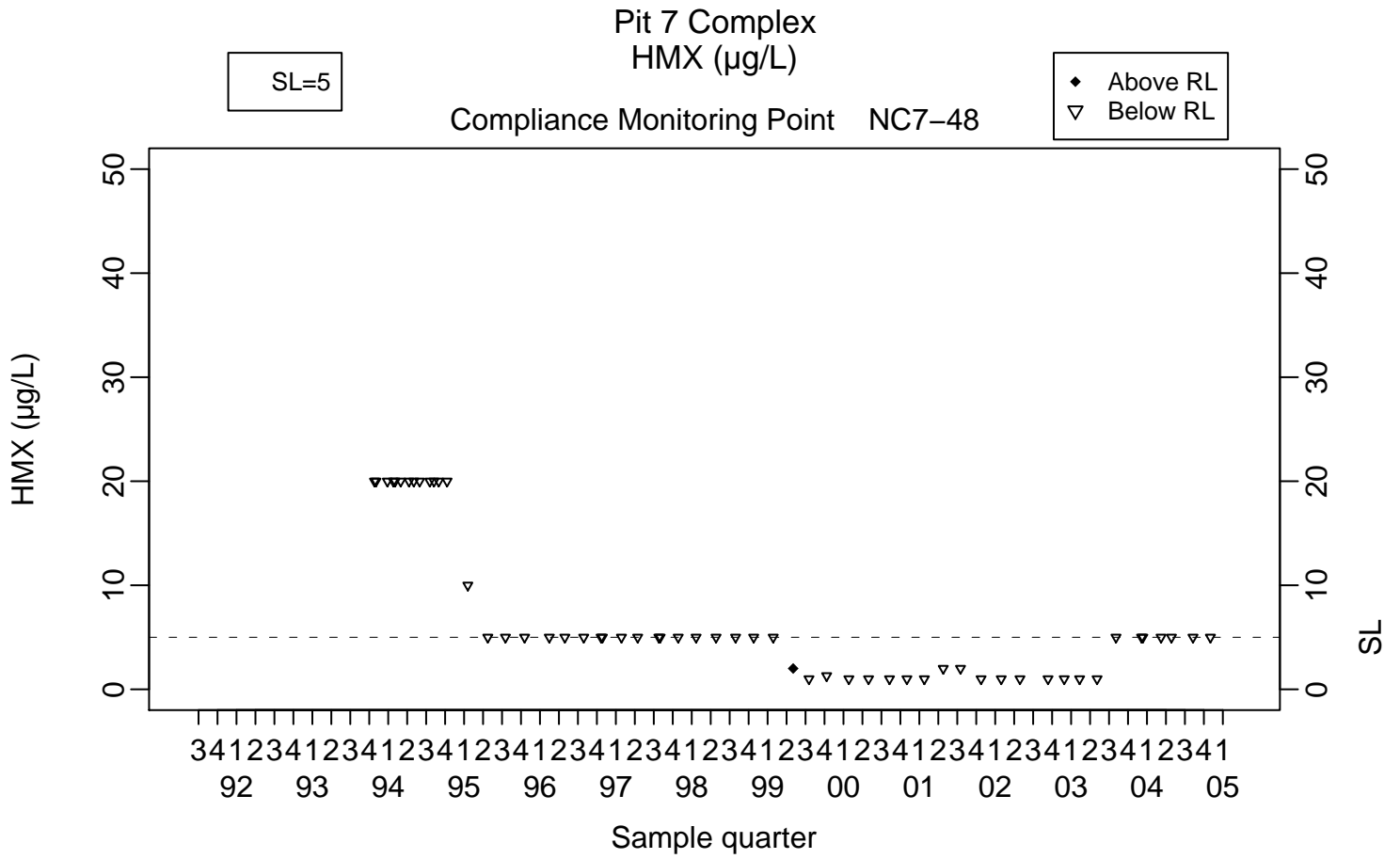
◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point NC7-47



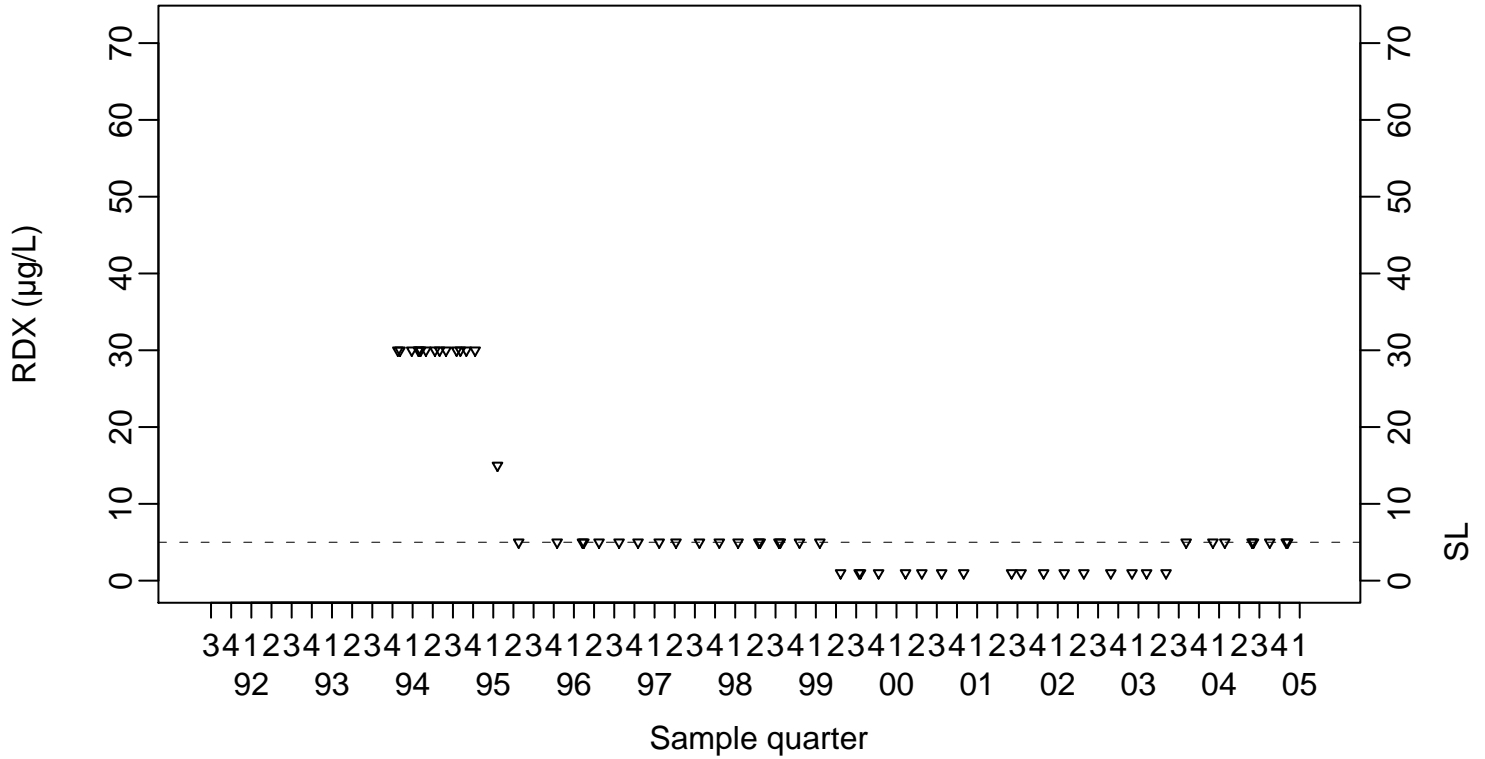


Pit 7 Complex RDX ($\mu\text{g/L}$)

SL=5

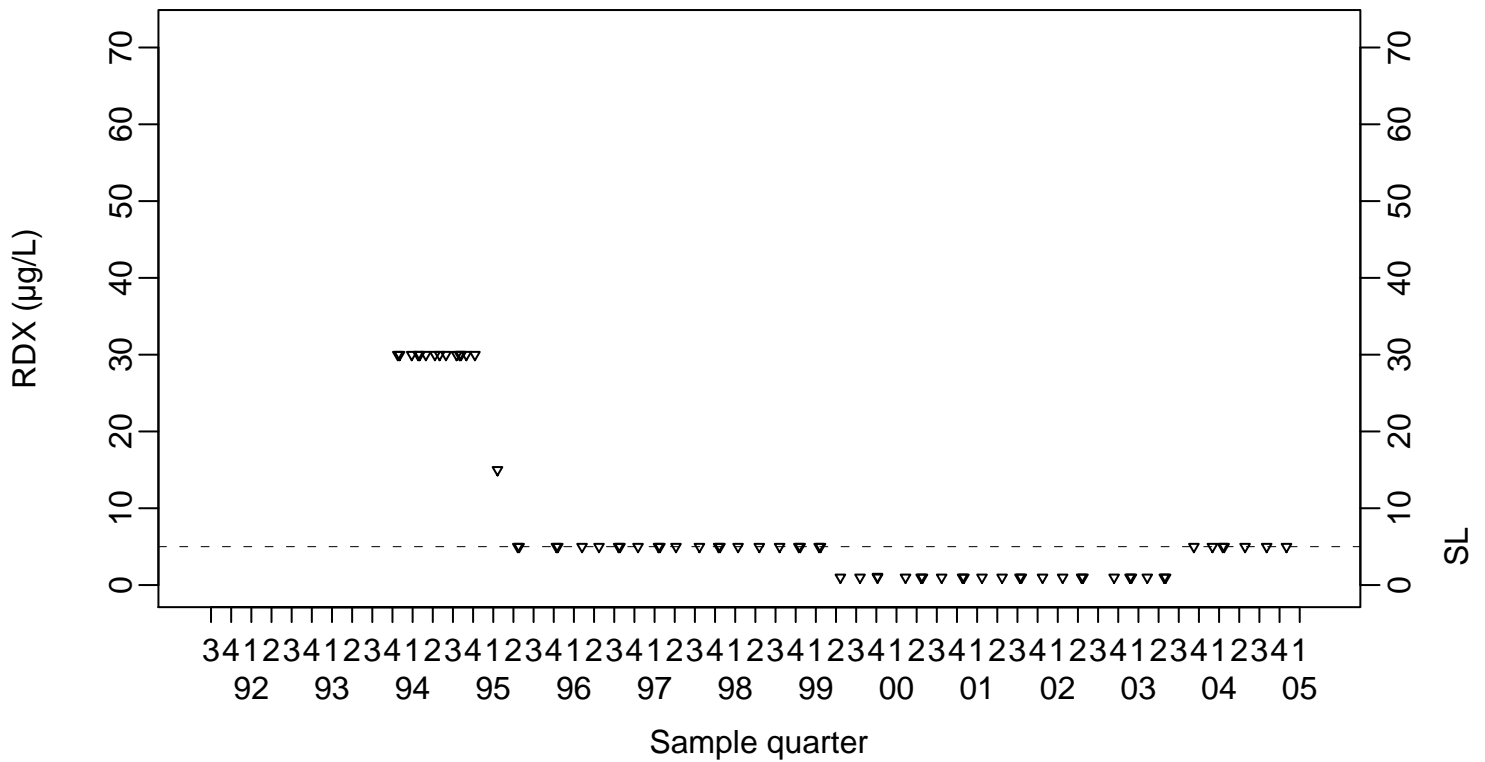
Background Monitoring Point K7-06

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K7-01

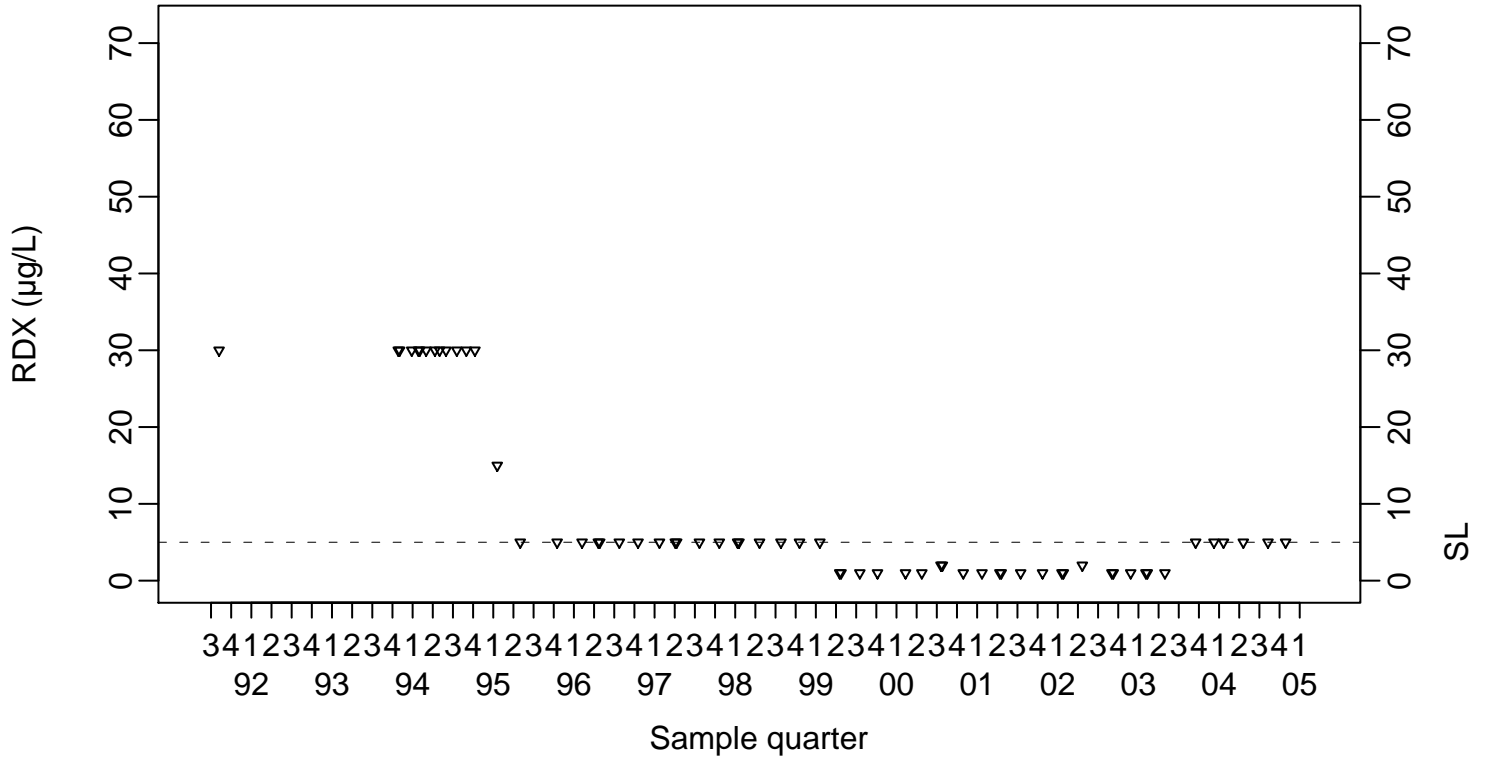


Pit 7 Complex RDX ($\mu\text{g/L}$)

Compliance Monitoring Point K7-03

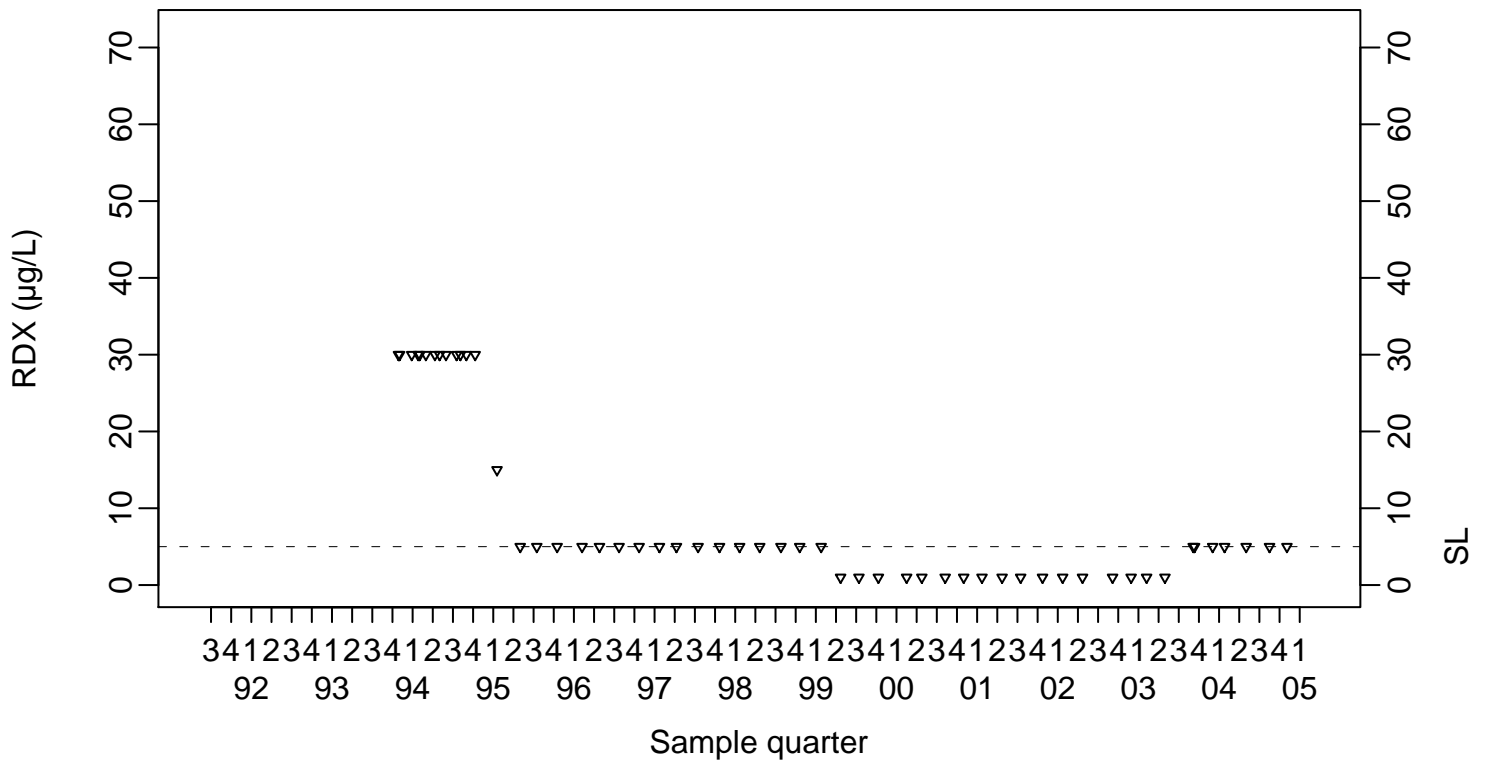
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point K7-09

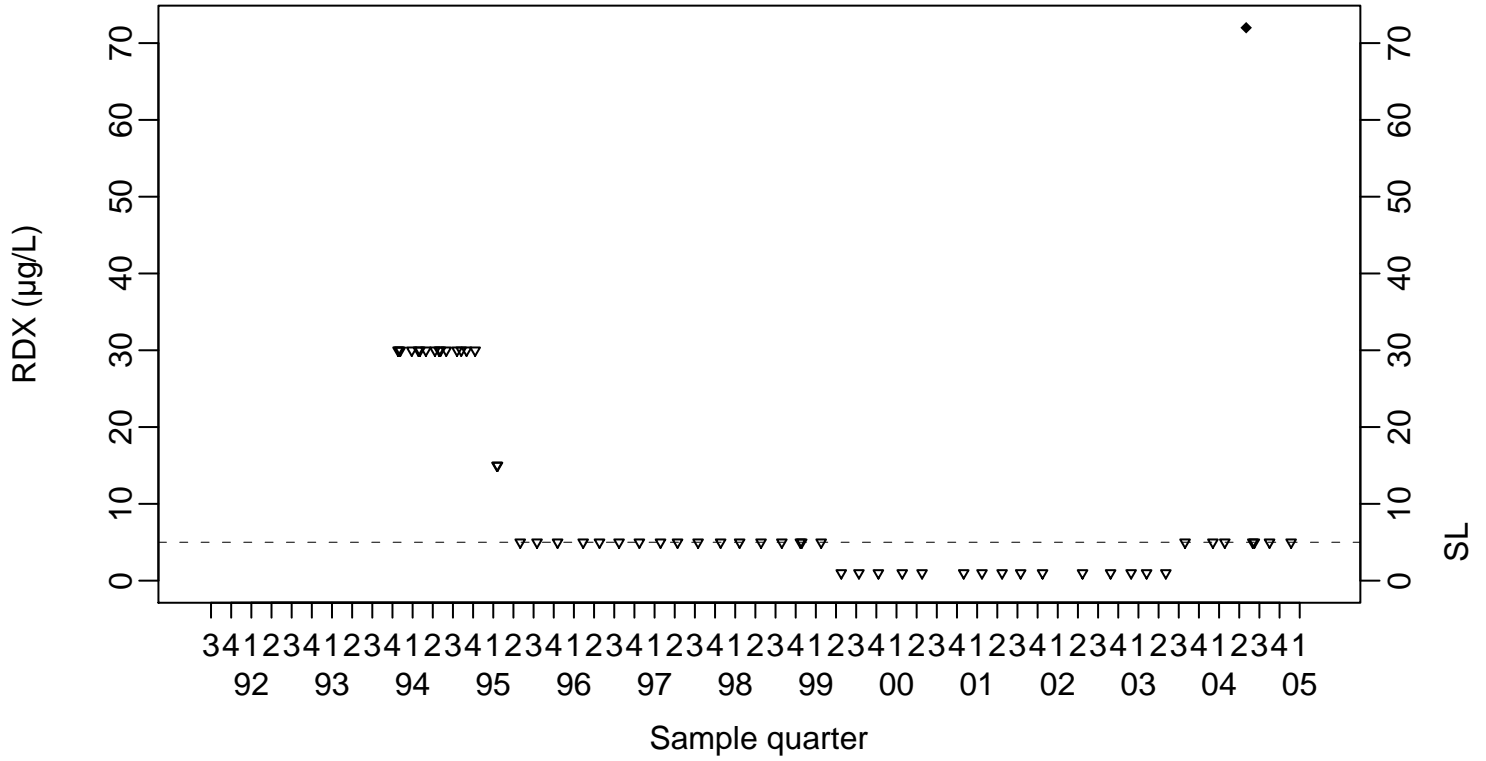


Pit 7 Complex RDX ($\mu\text{g/L}$)

SL=5

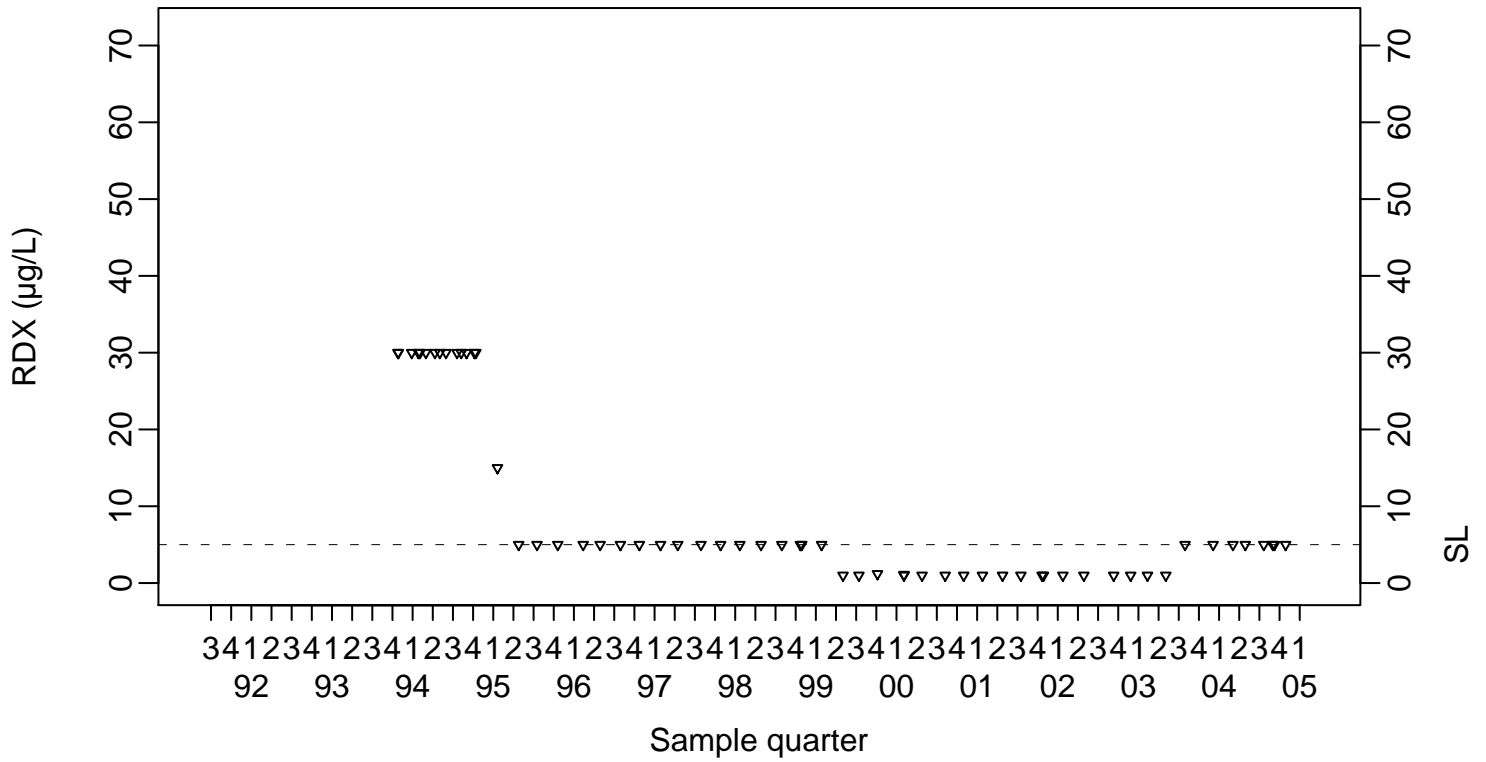
Compliance Monitoring Point K7-10

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point NC7-25

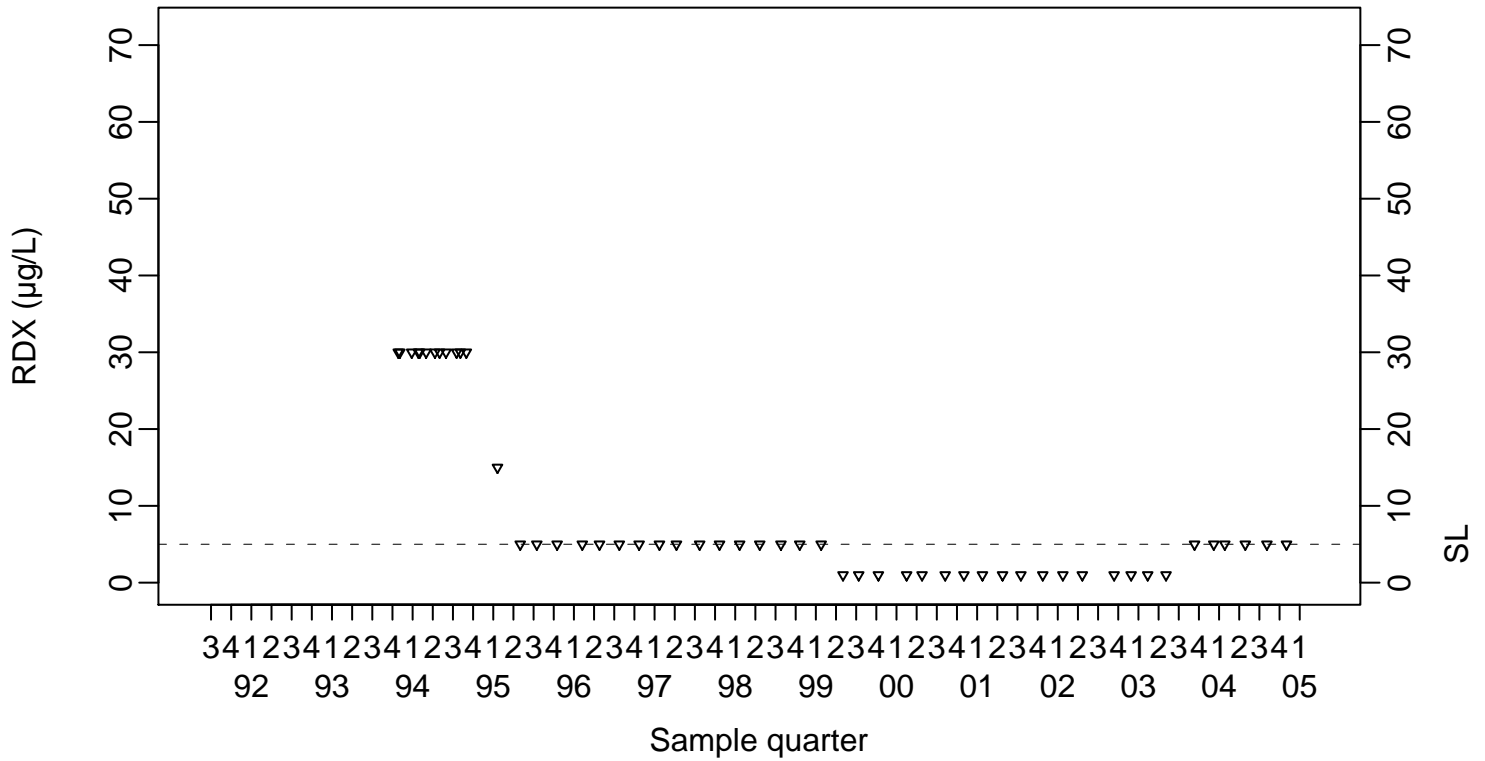


Pit 7 Complex RDX ($\mu\text{g/L}$)

Compliance Monitoring Point NC7-26

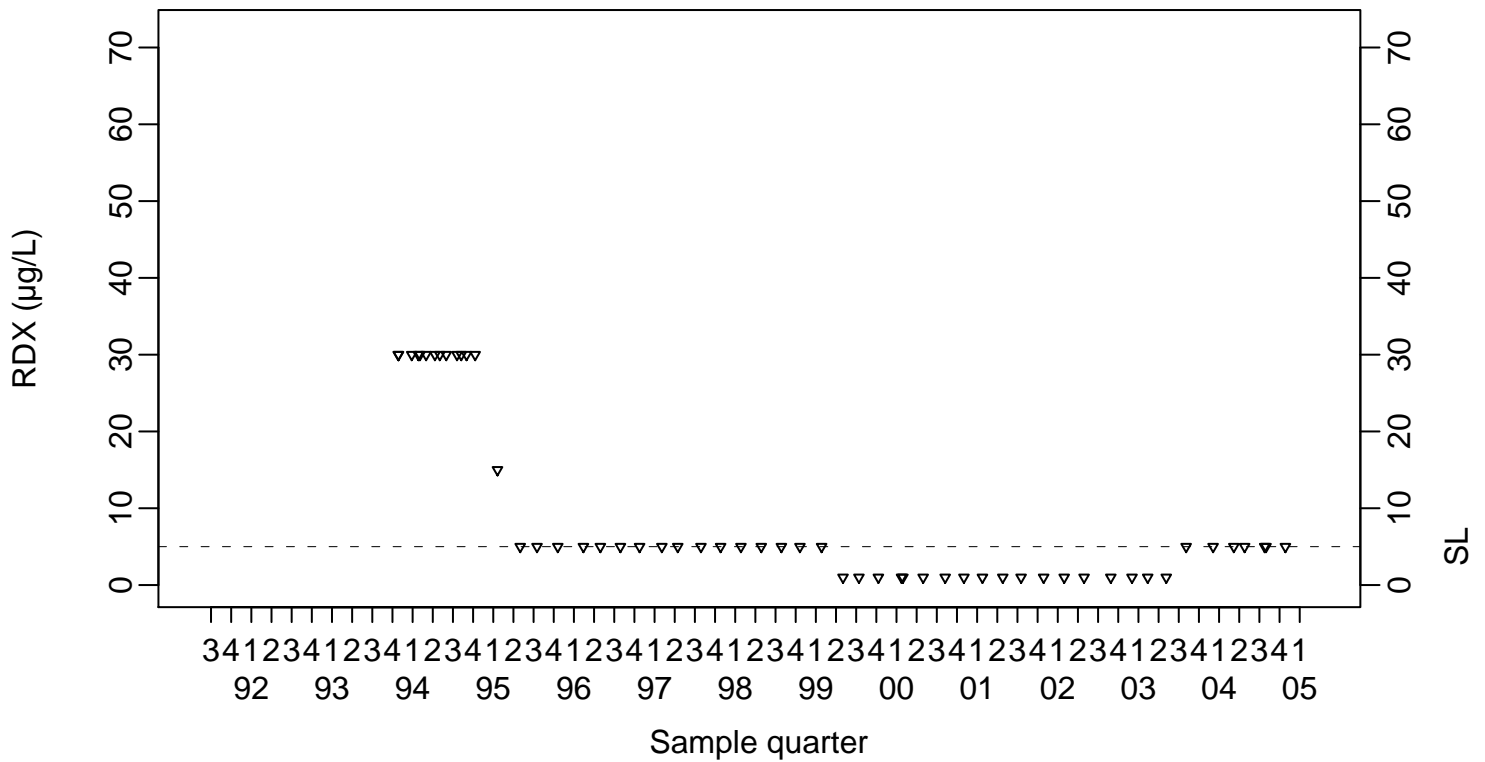
SL=5

◆ Above RL
▽ Below RL



SL=5

Compliance Monitoring Point NC7-47

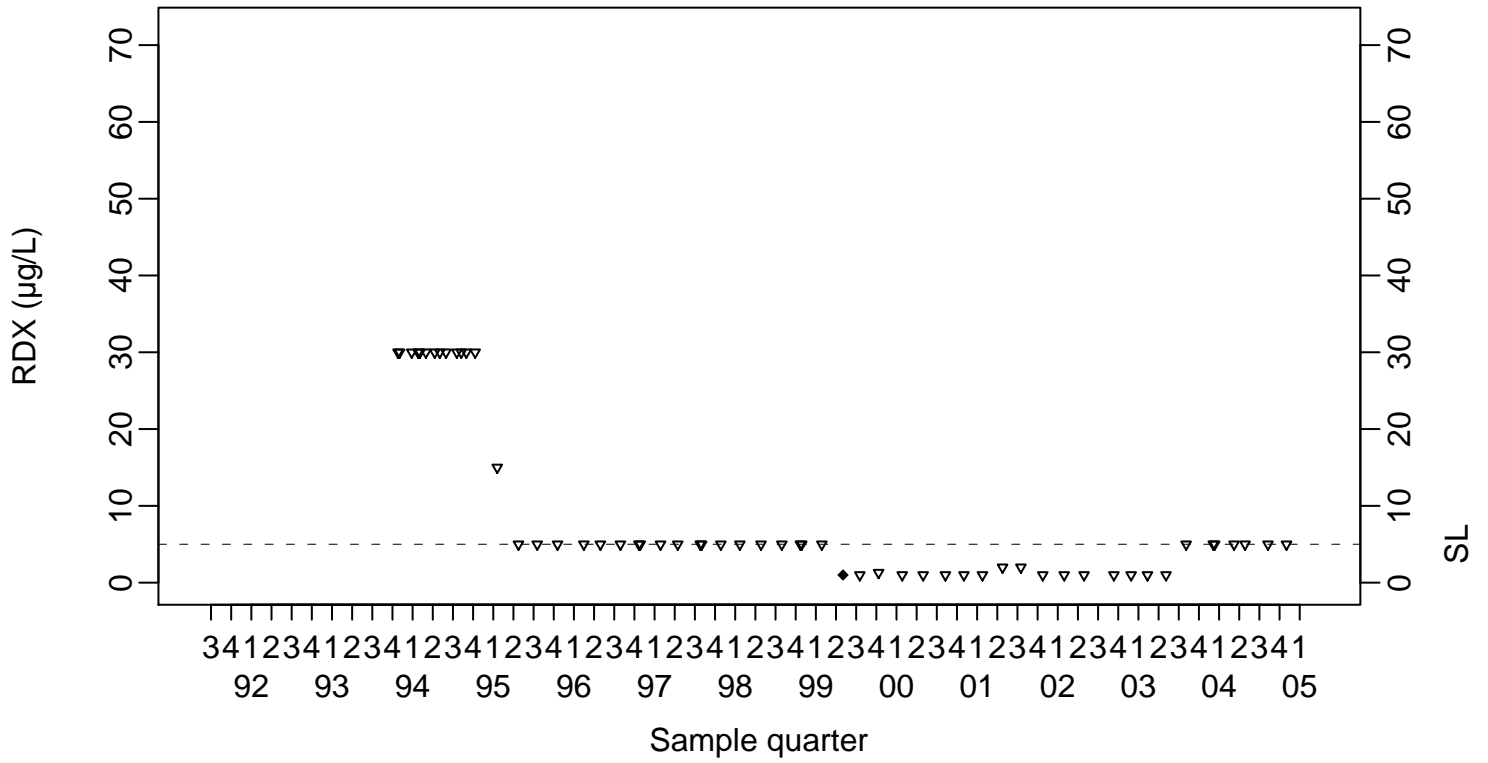


Pit 7 Complex RDX ($\mu\text{g/L}$)

SL=5

Compliance Monitoring Point NC7-48

◆ Above RL
▽ Below RL



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