ATTACHMENT A-1

STATISTICAL EVALUATION OF BACKGROUND DATA

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ATTACHMENT A-1

STATISTICAL EVALUATION OF BACKGROUND DATA

1.0 INTRODUCTION

This attachment characterizes background soil concentrations for inorganics and background-sensitive organics based on a distributional analysis of the Remedial Investigation (RI) and historical background samples. Distributional analysis of the background data is described in Section 2, with resulting 95% upper tolerance limits (UTLs) presented in Table A-4. Section 3 discusses assumptions arising from combining two geological stratum.

In general the background sample sets, RI and historical, offer substantial statistical power, both with respect to characterizing background and for identifying any on-site exceedances of background.

2.0 BACKGROUND DISTRIBUTIONS

For inorganics, the background datasets include samples taken from both alluvium and weathered claystone. These same strata also occur across the geologically complex study areas on the site. For the purpose of comparing site levels to background both geological strata are included in the background data set. The background data set therefore combines samples from both the RI and historical background sampling programs, and from both stratum including alluvium and claystone. Samples are included from the depth interval of 0 to less than 10 feet below ground surface. This sample depth range comprises the majority of samples collected for background and is consistent with the depth range evaluated in the risk assessments (0 to 5 feet bgs).

Distribution analysis and UTL estimation for background datasets involved consideration of several statistical descriptors and graphical evidence, as consistent with principles in both CalEPA (1997) and USEPA (2002) background guidance. This analysis is summarized for each chemical in Figure Set A1-1 through A1-22. UTLs are presented in Table A-4 with type of UTL formula identified. The formula used for each UTL was generally chosen to match the best fitting parametric distribution, Normal or Lognormal, whenever such a fit was reasonable when viewed graphically and/or with a Shapiro-Wilks p-value of > 0.01. In cases of poor distribution fit the data maximum was chosen as the estimate of the UTL parameter. The non-parametric formula for the 95th percentile UTL, is reliable only when there is a large enough sample size, to interpolate an estimate between two of the higher order statistics. With sample sizes less than 40, interpolation is not possible and the non-parametric formula defaults always to the data maximum. Since sample sizes were 42 or lower, the non-parametric UTL interpolation could not be applied.

In producing all graphical and quantitative summaries of the data (including the UTL), non-detect results were replaced by the value of MDL, except in a few cases, noted below. In some cases, the MDLs were too high to provide any information regarding the sample result and so had to be discarded. For samples with duplicate analyses, only the maximum detected result was used in the analysis.

The distribution fit and rationale for the UTL estimates are described below for each metal and each of the two background sensitive organics.

Methods and Indicators

A population distribution estimated for a given chemical is characterized by multiple descriptors, namely location, spread, and shape. Therefore, assessing the goodness of fit of this distribution to observed data, assessing evidence for outliers, or identifying multiple populations, likewise often involves weighing multiple evidence. Graphical depiction is helpful in the data evaluation and is discussed below.

Figure A1-1 through Figure A1-22 show the background data histogram and quantile-quantile plot (Q-Q plot) from the view of a normal distribution assumption (top panels) and the view of a lognormal assumption (lower panels). The Shapiro-Wilk goodness-of-fit test p value for each assumption is shown with the Q-Q plot. The p value of the goodness-of-fit test indicates the probability that any observed departures from normality/lognormality are attributable to simple random error and therefore are not cause to reject normality/lognormality. Therefore, in a goodness-of-fit test, higher p values generally indicate a better fit. However, as in any case where the null hypothesis (normality in this case) is not rejected, the p values are influenced by the size of the data set, and should generally be interpreted under consideration of sample size.

Figures A1-1 through A1-22 were constructed using datasets with small updates in the data not reflected in the original data sets used to calculate UTLs in the Draft RI (e.g. removal of 1 duplicate sample in historic data set for most metals). Therefore these Figures show, in some cases, very small alterations (usually at a third significant figure) of the UTL derived in the Draft and Draft Final RI versions. Because the Draft RI UTL differences were small and resulted in lower UTLs (more conservative), the UTLs were not modified for the Draft Final RI. The exception to this is for Chromium, where historic background data was not incorporated into the original data sets used to calculate the UTL. The addition of this historic data (all detections except one low non-detect) improved the fit of the normal distribution for Chromium and resulted in a value for UTL of 64 mg/kg, as compared to 47 mg/kg which had been estimated based only on the RI background data. The new Chromium value was considered to have relatively low uncertainty and due to its large difference was incorporated into the Draft Final RI for the distribution mapping in Section 5 of the RI report. Earlier screening data analysis such as the mapping in Appendix B and COPC selection utilized the lower, more conservative Draft RI Chromium UTL.

The panel in the third column of each Figure presents statistical indicators, which are also useful for assessing distribution assumption and ultimately estimation of the UTL: sample size, percent detected, data maximum, range order of magnitude, coefficient of variation (CV = sample standard deviation / sample mean), and the parameter estimates for normal and lognormal fits to the data. The normal and lognormal parameters are both stated in terms of the estimated mean and standard deviation of the population of a particular metal. However, the estimated mean and standard deviation use different (optimal) formulas depending on which distribution is being assumed. These estimates of mean and standard deviation are therefore only accurate if the particular assumption of normality or lognormality is appropriate. The purpose of these indicators is described below.

The above mentioned distribution assumptions, normality and lognormality, are generally reasonable for characterizing naturally occurring metals populations because of natural processes of soil movement and mixing. Natural metals distributions are widely observed to be normal or to have a low to moderate skewness that is well approximated by a lognormal (CalEPA 1997). Comparing the populations parameters estimated by either normal or lognormal methods may sometimes provide an idea of the reasonableness of each assumption, as well as the sensitivity of the distributional analysis to this assumption (for example in the case of extremely skewed lognormals which may imply estimates of mean or UTL well above the maximum in the data set. CalEPA also states that samples from such distributions generally range by no more than one order of magnitude and that the sample coefficients of variation (CV, standard deviation/mean) are also no greater than one. Substantial departures from these traits, referred to here as natural population indicators, are used here to indicate the presence of multiple populations in the sample, for example distinct soil types or an impacted versus non-impacted population.

Aluminum

Background data for aluminum are fit well by a normal distribution ($p = 0.81$, $N = 17$), see Figure A1-1. Therefore the normal UTL was selected.

Antimony

Background data for antimony have a high amount uncertainty due to the low frequency of detection, see Figure A1-2. Both parametric distributions, normal and lognormal, poorly fit the sample data. The data maximum was selected for the UTL (4.0 mg/kg) since it represents the upper tail of the population in a manner that is not sensitive to the actual concentration of these censored data.

Arsenic

Background data for arsenic was graphically well fit by a lognormal distribution (see Figure A1-3) and therefore the UTL was estimated using the lognormal parametric formula.

Barium

The distribution analysis for barium excluded a suspected outlier over 1200 mg/kg, that was nearly an order of magnitude above the next highest point. With this outlier excluded, background barium was well fit by a lognormal distribution ($p = 0.64$, $N = 41$), see Figure A1-4, and therefore UTL was estimated using the lognormal parametric formula.

Beryllium

The distribution analysis for beryllium excluded 25 non-detect samples (all historic background data) that provided no information because detection limits were high, 0.75 mg/kg and 1.0 mg/kg. The remaining data were comprised of detections well below these limits, see Figure A1 – 5, and were well fit by a lognormal distribution ($p = 0.43$, $N = 17$). Therefore the parametric lognormal formula was chosen to estimate the UTL.

Cadmium

Background data for cadmium appeared approximately lognormal (see Figure A1-6) but with an abundance of censored data at relatively low detection limits that caused a gap in its data distribution between the lowest hits and these censored data. A parametric UTL estimate was deemed inappropriate in light of the poor distribution fit, and the data maximum was assigned as the UTL.

Chromium

Background data for chromium had a strong fit to a normal distribution (see Figure A1-7). Therefore the normal parametric UTL was selected.

Cobalt

The distribution analysis for cobalt included 12 censored points which dramatically reduced the goodness-of-fit p value, see Figure A1-8. It is expected that with censored data methods, the data would appear appropriately lognormal and therefore the lognormal UTL was chosen rather than the data maximum. It is expected that the current UTL of 20 mg/kg is conservatively low and that with censored data methods, the UTL would increase.

Copper

The distribution analysis for copper excluded 6 extremely low censored concentrations (two less than 1 mg/kg and 4 less than 0.0082 mg/kg), which appeared inconsistent with the remaining data, all of which were detected concentrations of 5 mg/kg and greater (see Figure A1-9). These low outliers would substantially distort the distribution and UTL estimation. One high outlier at 54 mg/kg was also excluded. The remaining data had a reasonably fit to the lognormal distribution which provided a lower, more conservative, UTL than the data maximum.

Lead

Background data for lead also had low outliers including seven points that were censored (non-detects) at detection limits over two orders of magnitude lower than the detection limits for other NDs. These low outliers were excluded (see Figure A1-10). The parametric fit of either normal or lognormal was poor without application of specialized censored data methods. Therefore, the data maximum was assigned as the UTL.

Magnesium

Background data for magnesium were well fit by either a normal or lognormal distribution ($p = 0.77$ and 0.89, $N = 17$), see Figure A1-11. The UTL for the lognormal distribution was selected.

Manganese

Background data for manganese were well fit by either a normal or lognormal distribution (both having $p = 0.4$, $N = 17$), see Figure A1-12. Since these two fits are statistically indistinguishable, the more conservative UTL, based on the normal distribution, was selected.

Mercury

The distribution analysis for mercury excluded 25 censored data at the detection limit of 0.1 mg/kg, which was too high to provide any information to the data set, see Figure A1-13. The remaining mercury background data still had a poor fit to a parametric distribution due largely to the large number of censored data at the low end of the distribution, less than 0.002. Therefore the data maximum was assigned as the UTL.

Molybdenum

The distribution analysis for molybdenum excluded an apparent outlier of 16.3 mg/kg, and assigned 7 extremely low ND values to be represented by their PQL rather than their MDL, see Figure A1-14. Although uncertain due to non-detects, the fitted lognormal distribution provided a reasonable estimate of the UTL and therefore the lognormal UTL was selected.

Nickel

Background data for nickel were well fit by a lognormal distribution (p = 0.53, Figure A1-15) therefore the lognormal UTL was selected .

Selenium

Background data included 27 censored points, which contributed to its poor fit to either normal or lognormal distribution, see Figure A1-16. The data maximum was therefore selected as the UTL.

Thallium

The distribution analysis for thallium excluded 25 non-detect values that reflected censoring at too high of a detection limit (< 5 mg/kg) to provide information along side the remaining data which were either much lower detections (0.23 mg/kg to 0.54 mg/kg) or non-detects with a lower detection limit, see Figure A1-17. The non-detect at a very low MDL also provided unusable information because it was inconsistent with the rest of the data set. With an MDL of 0.00055 mg/kg this results was anomalous compared with the remaining data detected at 0.23 mg/kg to 0.54 mg/kg. If this non-detect point was excluded from the data set the lognormal fit was very good and the lognormal UTL estimated to be 0.65 mg/kg, slightly higher than the data maximum of 0.54 mg/kg. And, similarly, if this point was represented at its PQL rather than MDL, the lognormal fit and UTL were nearly identical (UTL = 0.63 mg/kg), In contrast, however, if the low MDL was included with the remaining data, the distortion was such that the lognormal UTL was 11 mg/kg. With close agreement between the first two alternate approaches the UTL was assigned to be the intermediate value of 0.64 mg/kg.

Tin

Similar to thallium, the distribution analysis for tin excluded seven extremely low non-detect data points with MDLs of 2.8 mg/kg, that appeared inconsistent with the remaining 17 data points, all of which were detected at concentrations of 32 mg/kg and greater. If left in, these low outliers would substantially distort the distribution and UTL estimation. The remaining data had a reasonably fit to the normal distribution (p=0.24, N=10), see Figure A1-18a. . However, a better characterization of the background condition on the site, was deemed to result from consideration of the site-wide ambient levels as described below.

The site study areas also appeared to have tin levels well characterized by normal distributions. Normal distributions reflect a wide-spread and random distribution and aren't likely to appear in populations influenced by contamination. The site-wide ambient distribution of 547 data points had such a strong fit graphically, that it was deemed a more realistic estimate of the background UTL than that provided by the 10 background data points. Therefore, the site-wide ambient normal UTL was selected, see Figure A1-18b.

Before deciding on use of the site-wide ambient distribution for tin, graphs were evaluated for similarity of distribution, and for any contradicting evidence such as multiple populations, many outliers, and/or high skewness, any of which would potentially indicate a higher "impacted" population in addition to a lower background or site ambient population. The only secondary population appeared to be a small low-level population (Figure A1-18b) which consisted of a limited number of concentrations found entirely within the 0 to 1 foot depth interval of the Administration Building study area. The deeper soil intervals at the Administration Building, both 1 to 10 feet and 10 feet and below, were identical to the remaining populations of soil data on the site study areas, suggesting that the lower population is representative of imported fill rather than background conditions. It made little difference whether these few 0 to 1 foot samples for the Administration Building study area surface soil were left in or excluded for the estimation of the site-wide ambient UTL since the samples were so few (roughly 4% of the data). Without (or with) these points, the site-wide ambient tin data were well fit by a normal distribution with a UTL of 66 mg/kg.

The site-wide ambient UTL of 66 mg/kg implies only very rare exceedances of the background UTL by individual samples. In contrast the UTL of 47 mg/kg arising from the 10 background – only samples, implies very wide-spread tin exceedances across the site. Either background levels are higher for all study areas than for the defined background locations, or there is an unusually uniform dispersion of tin contamination. With a uniform mechanism of dispersion of contamination such as wind blow dust, we would expect to find higher levels near the surface than at depth. Yet this is not the case. A depth-specific look at tin distributions is shown by study areas using box plots indicated that only the Burial Cells study area, and possibly the Remaining Onsite Soils study area, has tin concentrations which are slightly higher for surface soil layers. For the remaining ten soil study areas, surface soil tin concentrations are similar to or slightly lower than subsurface concentrations.

<u>Vanadium</u>

Background data for vanadium were well fit by a lognormal distribution ($p = 0.25$), see Figure A1-19. Therefore the lognormal parametric UTL was selected.

<u>Zinc</u>

Background data for zinc were graphically well fit by a lognormal distribution ($p=0.31$), see Figure A1-20. Therefore the lognormal parametric UTL was selected.

Avian Dioxin TEQ

Although the background data set for Avian Dioxin TEQ could be reasonably fit by both a normal (p=0.17) or lognormal distribution (p=0.65), see Figure A1-21a, the UTL associated with either distribution varied markedly (9.3 pg/g for the normal versus 20 pg/g for the lognormal). These estimates were considered to be non-robust, due to the small size of the background data set (N=7), and therefore not necessarily reliable. The evaluation of sitewide ambient levels (Figure A1-21b) resulted in a very strong fit by a lognormal distribution (p=0.37, N=133) and a lower value for the UTL (16 pg/g). Restricting sample depths to intervals less than 10 feet resulted in a reduced, though still significant fit (p=0.24), but a much higher value for the UTL (28 pg/g). Therefore sample depths were not restricted.

Mammalian Dioxin TEQ

As with the Avian Dioxin TEQ, the seven background concentrations for Mammalian Dioxin TEQ were fit by either a normal (p=0.59) or lognormal (p=0.79), see Figure A1-22a, but resulted in markedly different UTL estimates (10 pg/g for the normal and 18 pg/g for the lognormal). Again, these estimates were considered to be non-robust due to the small sample size (N=7) and therefore not necessarily reliable. The evaluation of sitewide ambient levels (figure A1-22b) resulted in a very strong fit by a lognormal distribution (p=0.40, N=133) and a lower value for the UTL (14 pg/g). Restricting sample depths to intervals less than 10 feet resulted in a reduced, though still significant fit (p=0.18), but a much higher value for the UTL (22 pg/g). Therefore sample depths were not restricted

3.0 Discussion

Alluvium and weathered claystone comprise the soil for site study areas within the top 10 feet, the depth interval of interest to assess exposure in the risk assessments. Although study areas differ in their relative contribution from these two geological stratum, the above UTLs were defined so as to provide representative background for the aggregate strata. This section evaluates the assumption of aggregation and its implications for uncertainty in the UTL.

Earlier RI/FS submittals (Iinterim Progess Reports (IPR) May 2005 and November 2005) evaluated metals concentrations in the two stratum separately to determine whether differences were substantial enough to warrant keeping metals separated between the two stratum. These reports found that potential differences between strata could be observed for a subset of the metals, however the added uncertainty caused by reducing the background data sets into smaller subsets did not support the use of these stratum specific sets for comparison to the site data sets. The RI background locations were therefore revisited to collect subsurface samples, as part of the Phase II sampling program. Due to the generally deep alluvium at these locations, only four of the subsurface samples (<10’) were taken from claystone. The remainder of this section updates the stratum analsysis for the addition of the Phase II RI samples.

In general, the strategy of combining stratum is strengthened by addition of Phase II RI background samples. For the UTL estimation, many distribution fits improved (higher p values) even when sample size increased reflecting that Phase II data tended to blend or be intermediary to historic claystone and historic and RI alluvium concentrations. In some cases however the comparison of alluvium and claystone samples continued to indicate uncertain results due to censoring and/or confounding of differences between RI and historical background data, such that statistical results were difficult to interpret. Therefore, this comparison is presented in more detail below along with implications for the aggregate UTLs.

The following discussion is based on a descriptive comparison using box plots as well as statistical judgment. Statistical tests were not attempted because, as will be discussed, interaction with an additional factor (or factors) casts uncertainty on interpretation of any differences found or not found, at least for most of the cases involved. On the other hand, a descriptive graphic such as box plots, condenses information in a quickly comparable format so that potential differences due to stratum can be identified even though not tested conclusively.

The descriptive nature of box plots also allows them to be used to display all sample results available for both historical and RI data sets. Outliers that had been excluded during the UTL estimation (Section 2) were included in these stratigraphy box plots so that non-representativeness could be assessed relative to stratum. In addition, the three cases with high detection limits for historical background (Berylium, Mercury, and Thallium), normally conveying no useful information, were also represented since these metals were inconclusive regarding stratum effect because of these and other censored data, regardless whether the high non-detects were included or not.

Figures A1-23(a,b) show metals concentrations divided by stratum, alluvium or claystone. Figures A1-24(a,b), which show metals concentrations divided by stratum and sampling program (RI or historical), explore cases where there is an interaction between these two factors, such as the observation “alluvium higher than claystone” for the RI background data but the opposite observation, “alluvium less than claystone”, for the historical background data. Any kind of interaction, along with unequal sample sizes contributed by each program (i.e. alluvium dominated by RI data and claystone dominated by historical data) complicates and confounds the interpretation of any statistical comparison of differences in stratum. For example, Zinc appears to have lower concentrations in Alluvium than in Claystone when the historic and RI background data sets are combined (Figure A1-23a.) However, when these data sets are viewed separately (Figure A1-24a), this trend is seen only in the historic data, where the only relatively high zinc values appear for historic claystone. RI claystone zinc values are relatively low and in fact lower than the RI alluvium zinc values. Thus a conclusion of stratum differences from viewing Figure A1-23a, in which the larger and higher historic claystone data set combines with and dominates the smaller and lower RI claystone data set, is not necessarily accurate or robust (repeatable over different sampling sets), as can be seen in Figure A1-24a.

Consistent trends are observed for some metals as described below. These trends may or may not be strong enough to differentiate from a random occurrence (i.e. be statistically significant). However, consistency among two distinct sampling programs adds a qualitative weight of evidence to their effect.

Three metals have alluvium distributions that are potentially shifted upward from those of claystone: Barium, Cadmium, and Copper (Figure A1-23a). For these metals a UTL defined specifically for alluvium may be higher than that indicated above for the aggregate soil layer. Even when broken into smaller (less powerful) data sets (Figure A1-24a), these trends appear to hold., The trend for Barium is observed more clearly without the outlier and with log transformation (Figure A1-25). The trend for Cadmium is determined exclusively from the RI data set, since the nearly 100% censoring of the historic data set adds no information to the evaluation of stratum differences (Figure A1-24a).

Arsenic and magnesium alluvium concentrations may be shifted downward from their corresponding claystone concentrations (Figure A1-23a and A1-24a). A UTL developed specifically for alluvium might therefore be lower than that developed for the aggregate comparison. Interaction with sampling program may still be present for Arsenic, since the effect is seen most strongly for historic data and very weakly (and likely insignificantly) for the RI data set (see log-transformation in Figure A1-25).

Aluminum, Cobalt, Mangenese, and Nickel concentrations are not likely influenced by stratigraphy (Figure A1-24a,b). Chromium, Vanadium, and Zinc show conflicting evidence for a potential stratigraphic effect, but interpretation is not warranted since there also appears to be a substantial interaction (in fact inconsistency) with sampling programs (Figure A1-24a,b). For the remaining metals Antimony, Beryllium, Cobalt, Lead, Mercury, Molybdenum, Selenium, Sliver, Thallium, and Tin, censoring levels are too high to allow testing of potential stratum differences (Figure A1-24a,b). Statements made for Aluminum, Iron, Magnesium, Manganese, and Tin are derived from their appearance in only the RI data set.

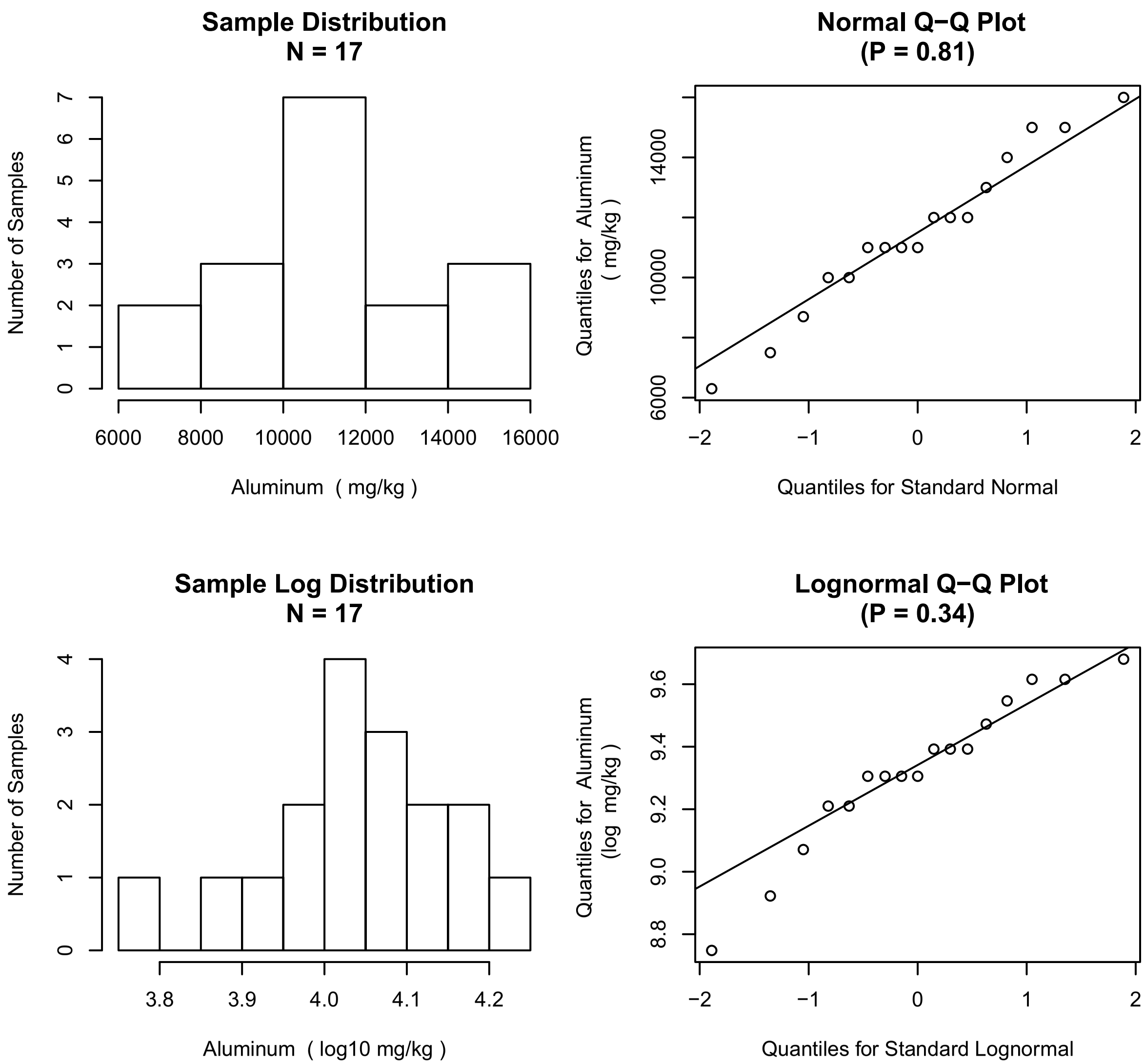
4.0 REFERENCES

Cal/EPA, 1997. Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities, Final Policy. Prepared by Human and Ecological Risk Division, Department of Toxic Substances Control, Cal/EPA.

USEPA, 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. EPA 540-R-01-003. September 2002

FIGURES

Figure A1−1
Distribution Analysis for Aluminum (0 to <10 Feet)
Casmalia Resources Superfund Site

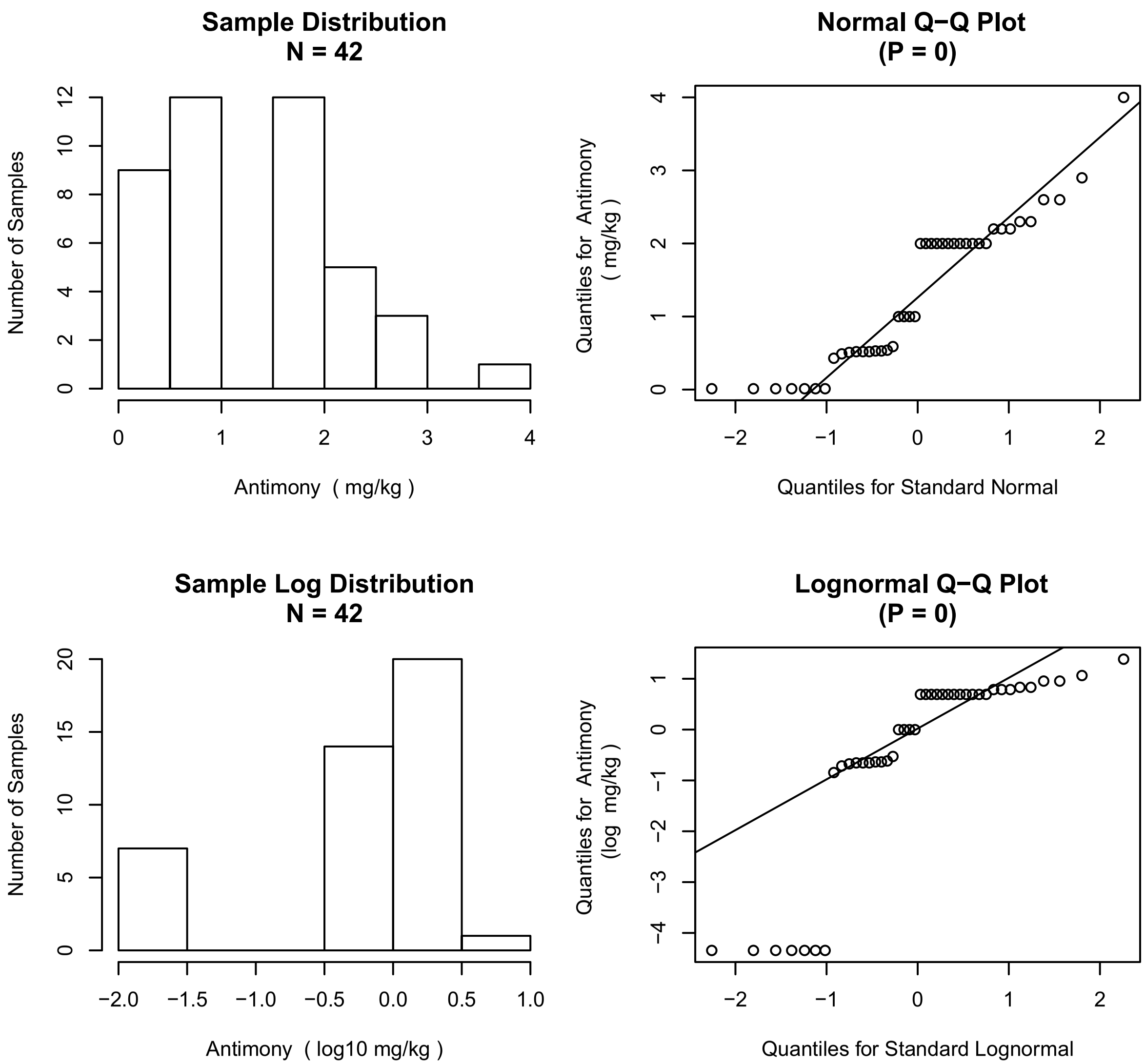


Aluminum

N (17), Percent Detected (100%)
Range OM (0.4) CV (0.2)
Detected Max (16000 mg/kg)

Parameters for Normal(11500,2626.55)
UTL for Normal (18030.29)
Parameters for Lognormal(11538.4, 2879.74)
UTL for Lognormal (20627.74)

Figure A1−2
Distribution Analysis for Antimony (0 to <10 Feet)
Casmalia Resources Superfund Site



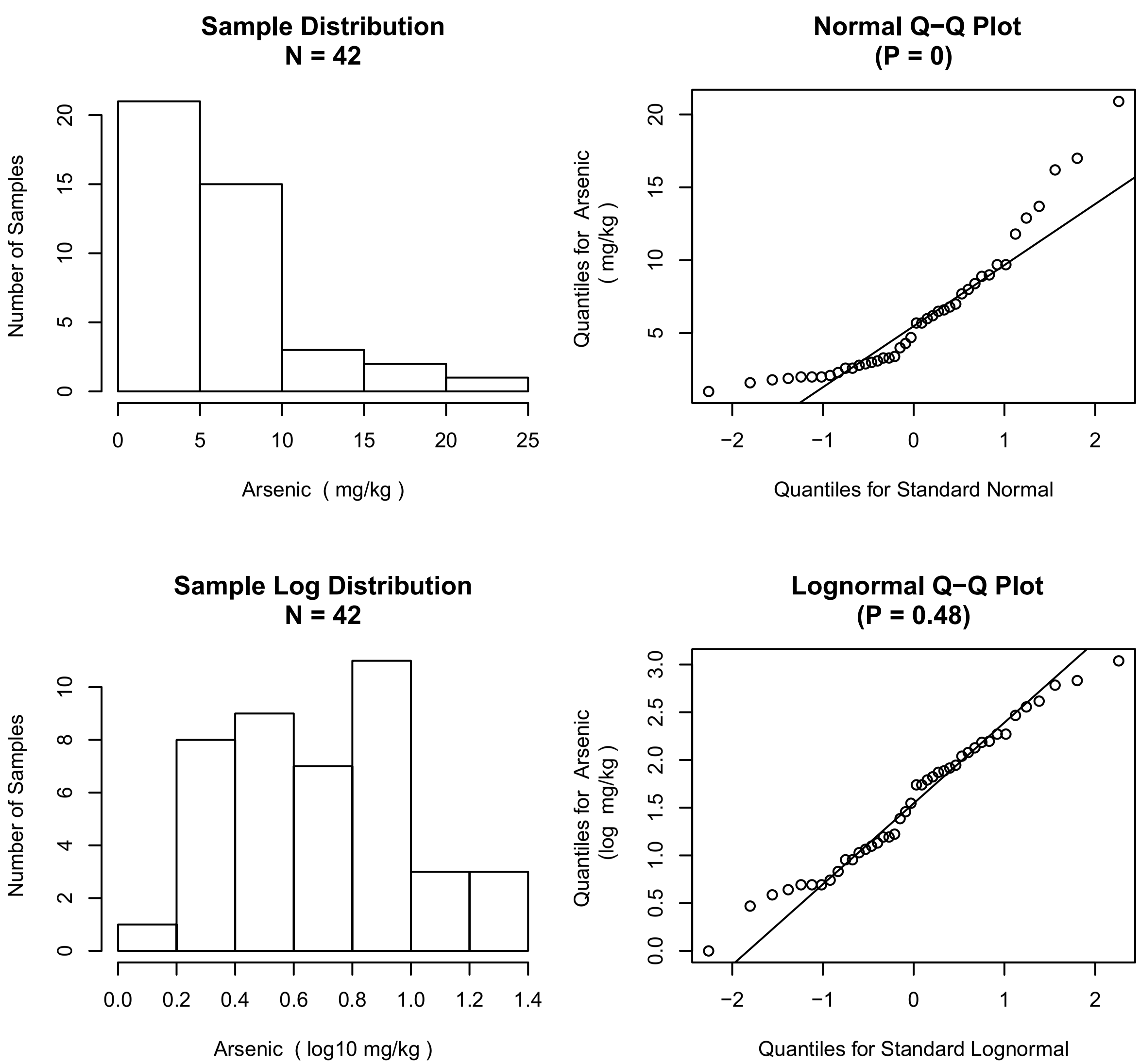
Antimony

N (42), Percent Detected (28.57%)
Range OM (2.49) CV (0.7)
Detected Max (4 mg/kg)

Parameters for Normal(1.35,1.01)
UTL for Normal (3.47)
Parameters for Lognormal(3.42, 18.69)
UTL for Lognormal (30.75)

Includes 30 points censored at:
<0.013,<0.013,<0.013,<0.013,<0.013,<0.013,<0.013,<0.013,<0.43,<0.49,<0.51
<0.52,<0.52,<0.52,<0.53,<0.53,<0.54,<1,<1,<1,<1
<2,<2,<2,<2,<2,<2,<2,<2,<2

Figure A1−3
Distribution Analysis for Arsenic (0 to <10 Feet)
Casmalia Resources Superfund Site



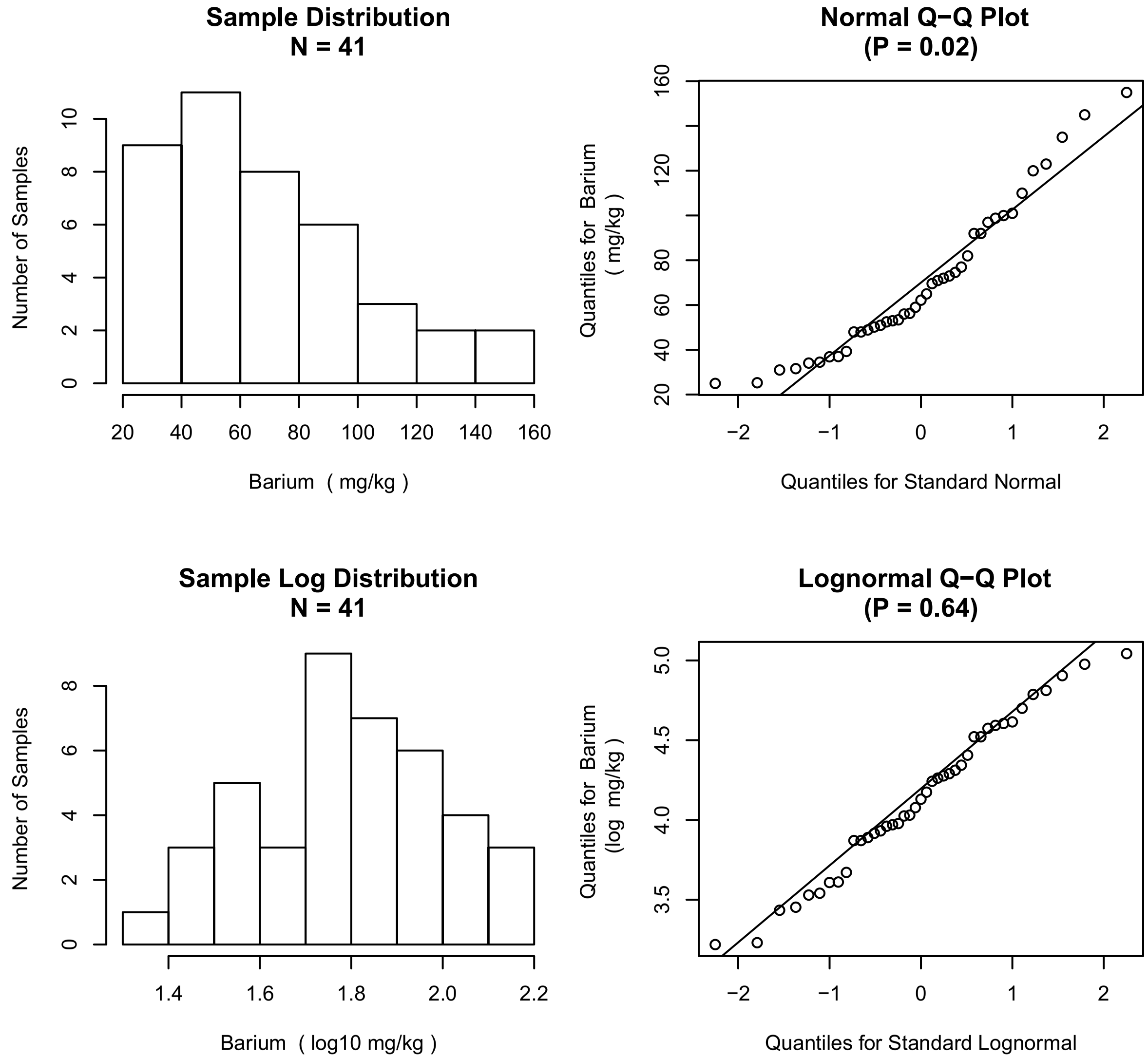
Arsenic

N (42), Percent Detected (97.62%)
Range OM (1.32) CV (0.8)
Detected Max (20.9 mg/kg)

Parameters for Normal(6.22,4.66)
UTL for Normal (16.06)
Parameters for Lognormal(6.3, 5.39)
UTL for Lognormal (22.88)

Includes 1 point censored at:
<1

Figure A1−4
Distribution Analysis for Barium (0 to <10 Feet)
(1 outlier at 1220 excluded)
Casmalia Resources Superfund Site

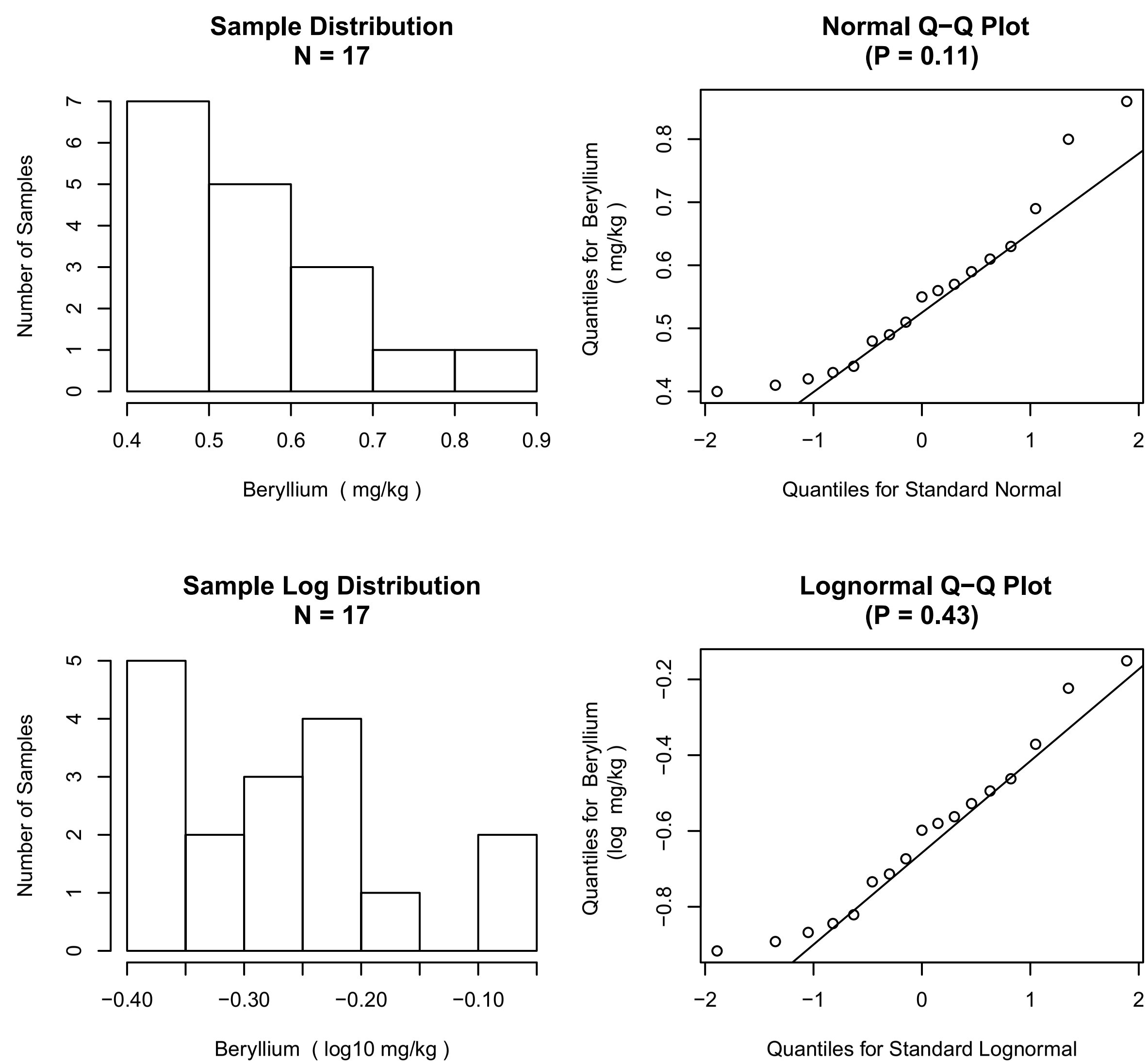


Barium

N (41), Percent Detected (100%)
Range OM (0.79) CV (0.5)
Detected Max (155 mg/kg)

Parameters for Normal(70.4,33.51)
UTL for Normal (141.38)
Parameters for Lognormal(70.76, 35.99)
UTL for Lognormal (174.22)

Figure A1−5
Distribution Analysis for Beryllium (0 to <10 Feet)
Casmalia Resources Superfund Site

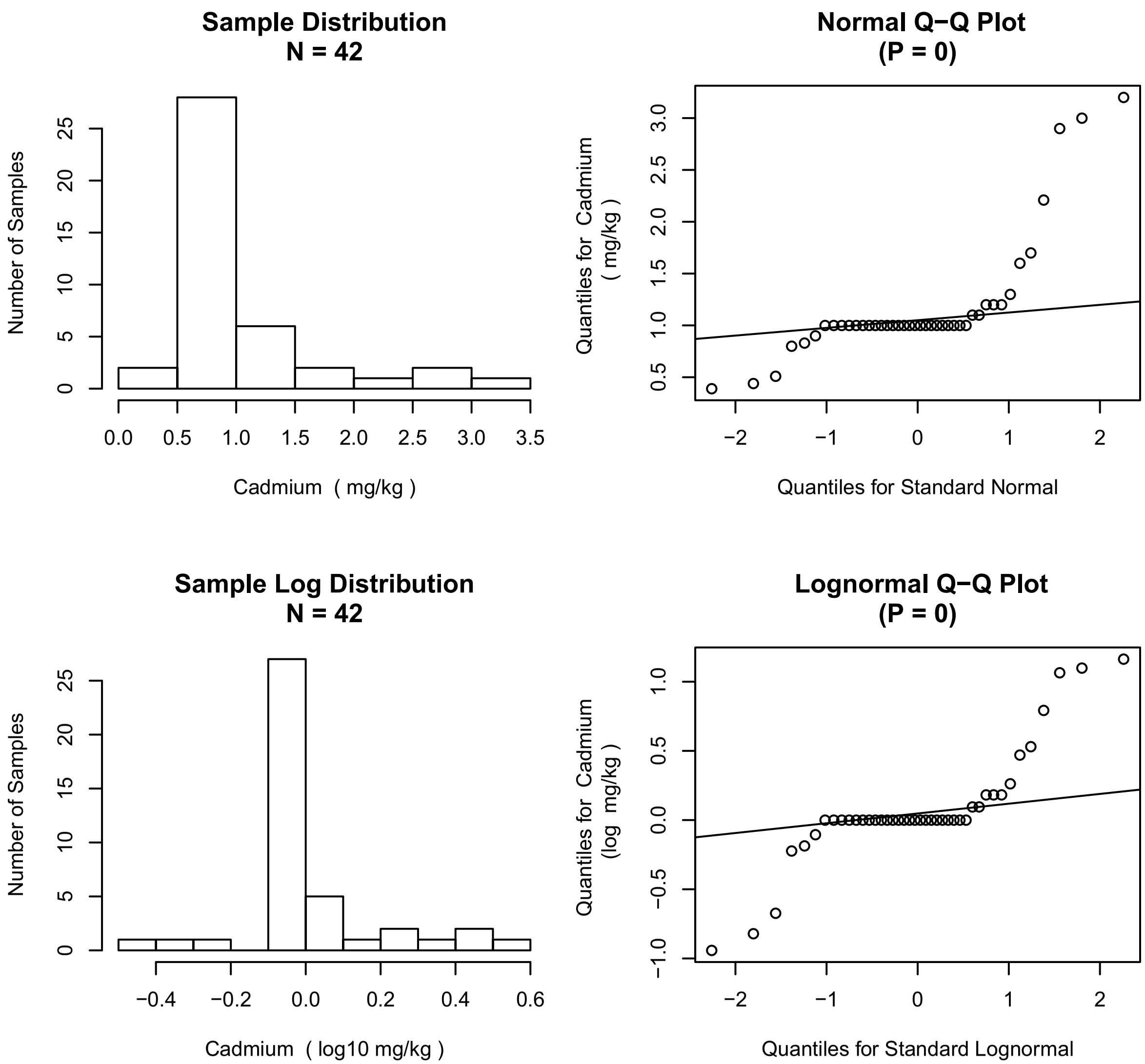


Beryllium

N (17), Percent Detected (100%)
Range OM (0.33) CV (0.2)
Detected Max (0.86 mg/kg)

Parameters for Normal(0.56,0.13)
UTL for Normal (0.89)
Parameters for Lognormal(0.56, 0.13)
UTL for Lognormal (0.95)

Figure A1−6
Distribution Analysis for Cadmium (0 to <10 Feet)
Casmalia Resources Superfund Site



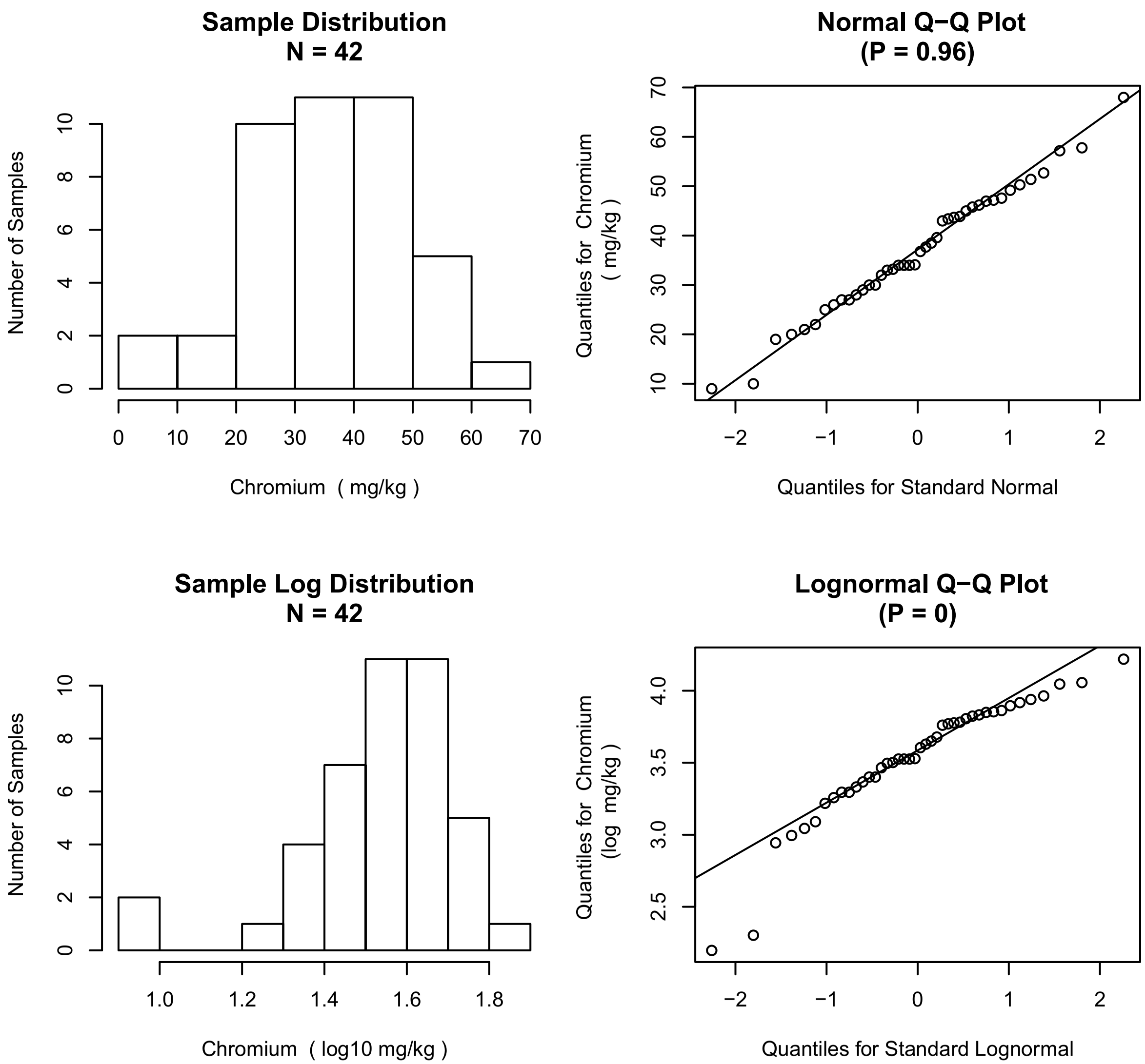
Cadmium

N (42), Percent Detected (42.86%)
Range OM (0.91) CV (0.5)
Detected Max (3.2 mg/kg)

Parameters for Normal(1.18,0.6)
UTL for Normal (2.44)
Parameters for Lognormal(1.17, 0.5)
UTL for Lognormal (2.56)

Includes 24 points censored at:
<1,<1,<1,<1,<1,<1,<1,<1,<1,<1
<1,<1,<1,<1,<1,<1,<1,<1,<1,<1
<1,<1,<1,<1

Figure A1−7
Distribution Analysis for Chromium (0 to <10 Feet)
Casmalia Resources Superfund Site

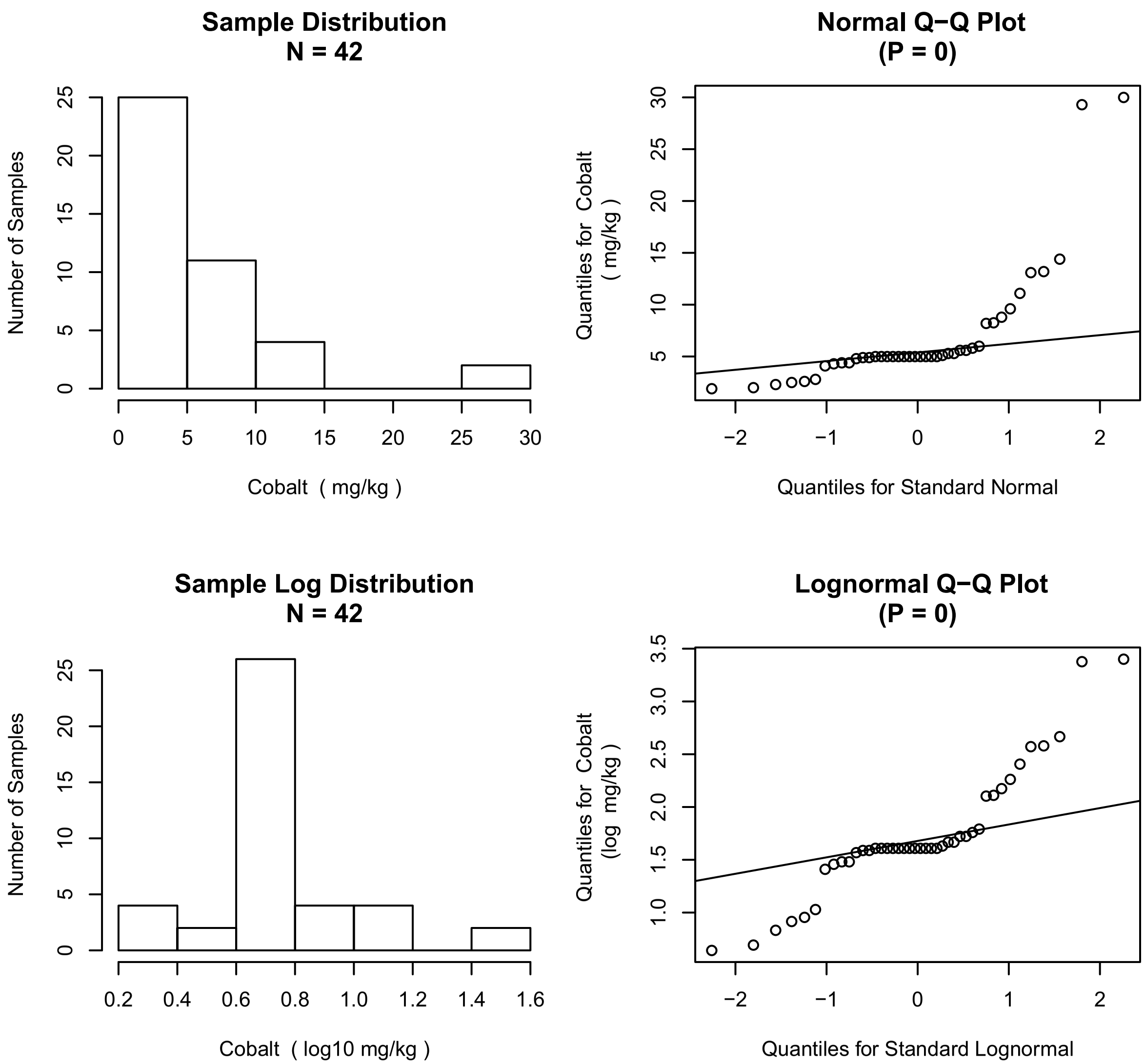


Chromium

N (42), Percent Detected (100%)
Range OM (0.88) CV (0.3)
Detected Max (68 mg/kg)

Parameters for Normal(36.89,12.79)
UTL for Normal (63.9)
Parameters for Lognormal(37.44, 16.46)
UTL for Lognormal (83.27)

Figure A1−8
Distribution Analysis for Cobalt (0 to <10 Feet)
Casmalia Resources Superfund Site



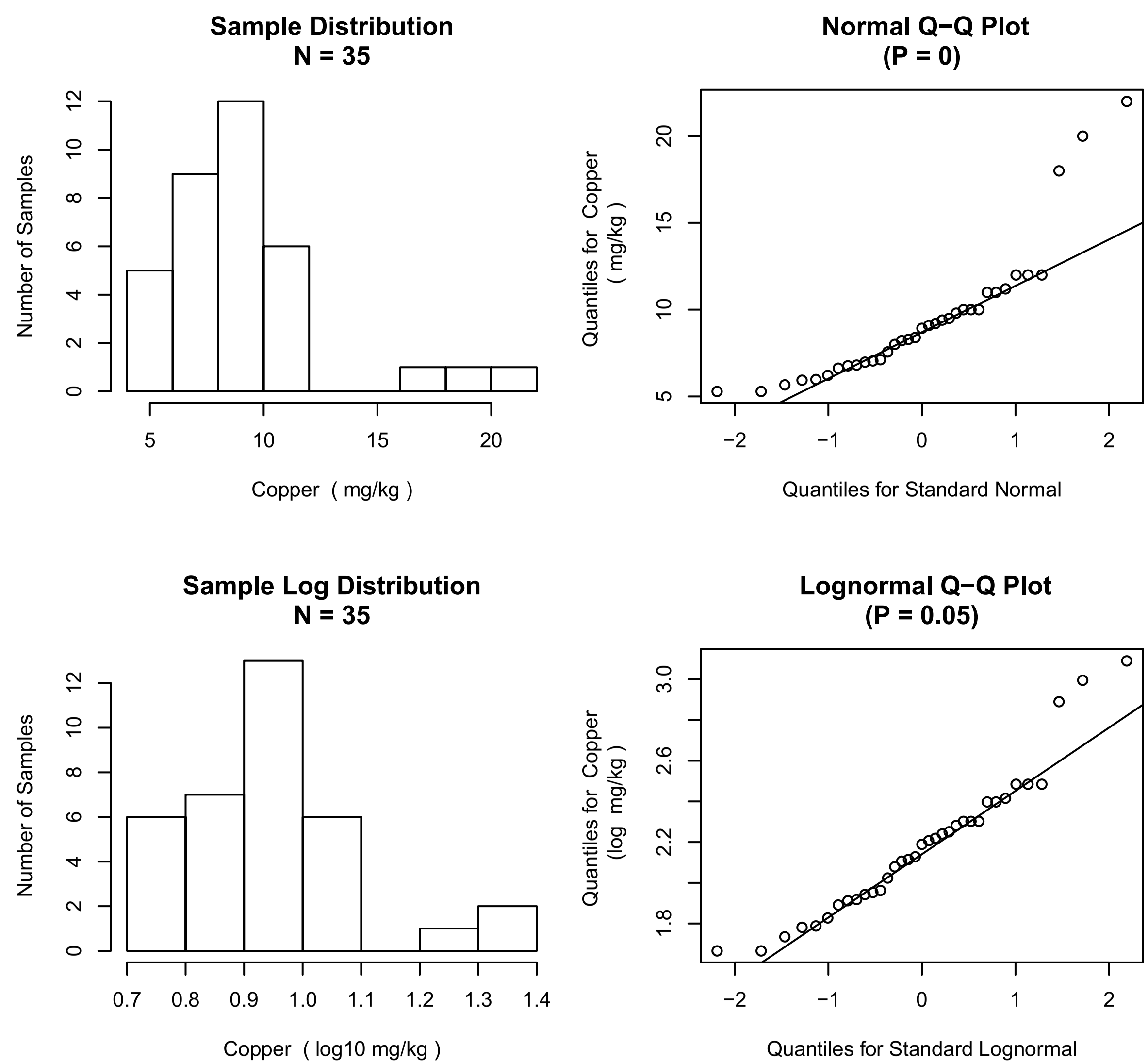
Cobalt

N (42), Percent Detected (71.43%)
Range OM (1.2) CV (0.9)
Detected Max (30 mg/kg)

Parameters for Normal(6.92,5.89)
UTL for Normal (19.36)
Parameters for Lognormal(6.71, 4.36)
UTL for Lognormal (19.7)

Includes 12 points censored at:
<5,<5,<5,<5,<5,<5,<5,<5,<5,<5
<5,<5

Figure A1−9
Distribution Analysis for Copper (0 to <10 Feet)
(1 outlier at 54 excluded)
(6 low outliers excluded)
Casmalia Resources Superfund Site



Copper

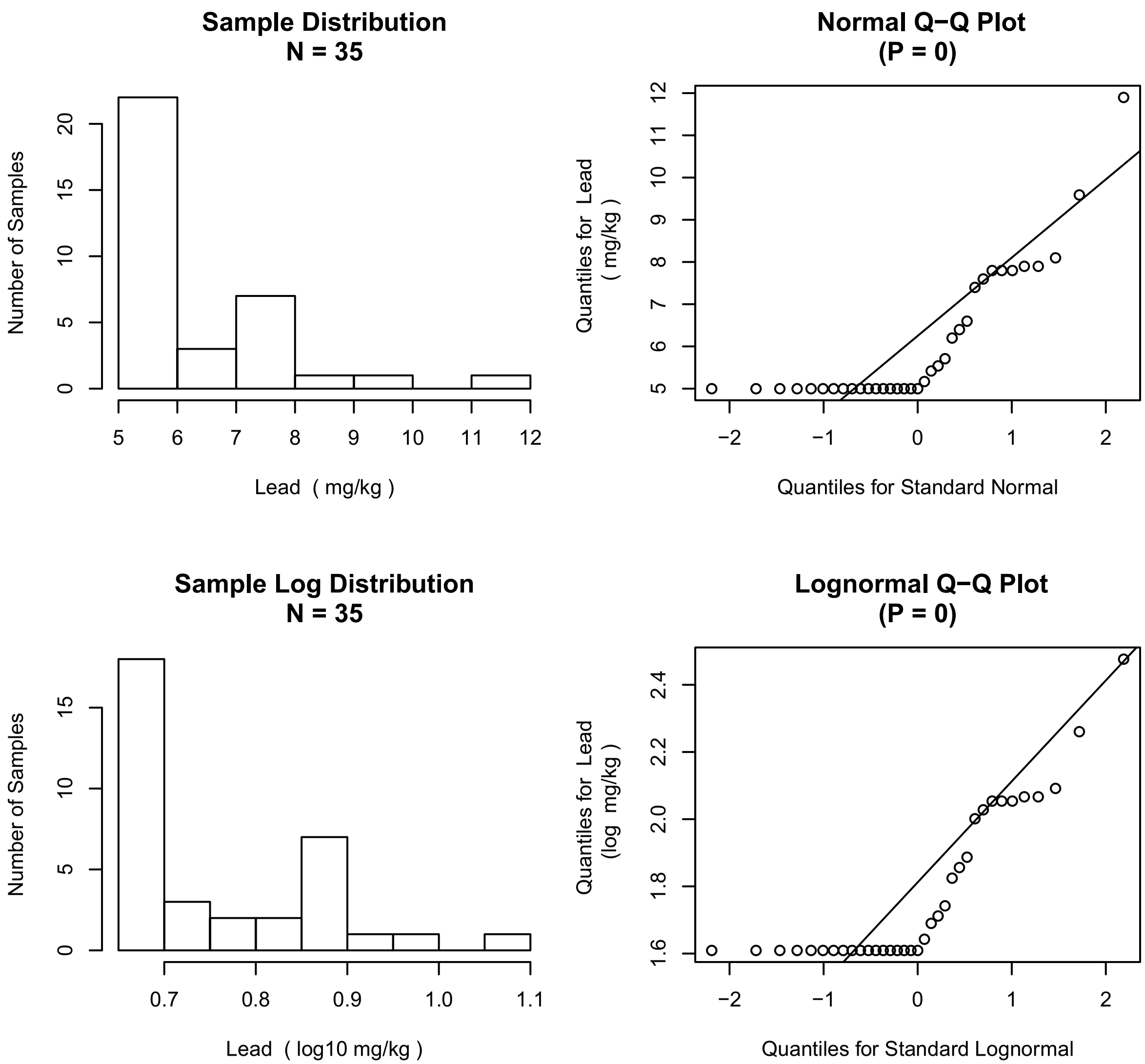
N (35), Percent Detected (100%)
Range OM (0.62) CV (0.4)
Detected Max (22 mg/kg)

Parameters for Normal(9.47,3.85)
UTL for Normal (17.8)
Parameters for Lognormal(9.43, 3.37)
UTL for Lognormal (18.82)

Figure A1−10
Distribution Analysis for Lead (0 to <10 Feet)

(7 low outliers excluded)

Casmalia Resources Superfund Site



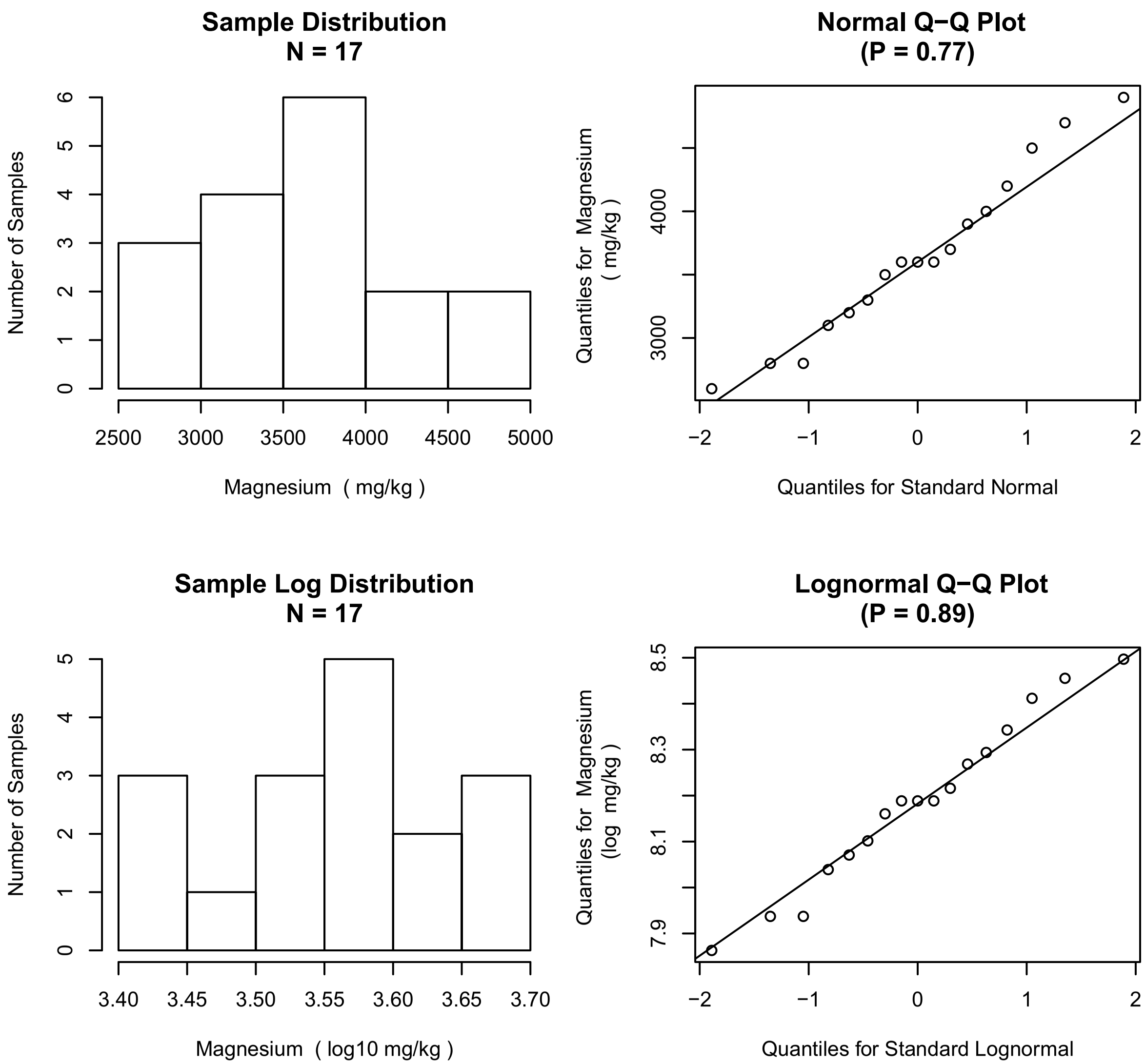
Lead

N (35), Percent Detected (22.86%)
Range OM (0.38) CV (0.3)
Detected Max (11.9 mg/kg)

Parameters for Normal(6.14,1.65)
UTL for Normal (9.72)
Parameters for Lognormal(6.13, 1.46)
UTL for Lognormal (9.93)

Includes 27 points censored at:
<5,<5,<5,<5,<5,<5,<5,<5,<5,<5
<5,<5,<5,<5,<5,<5,<5,<6.4,<6.6,<7.4
<7.6,<7.8,<7.8,<7.8,<7.9,<7.9,<8.1

Figure A1−11
Distribution Analysis for Magnesium (0 to <10 Feet)
Casmalia Resources Superfund Site

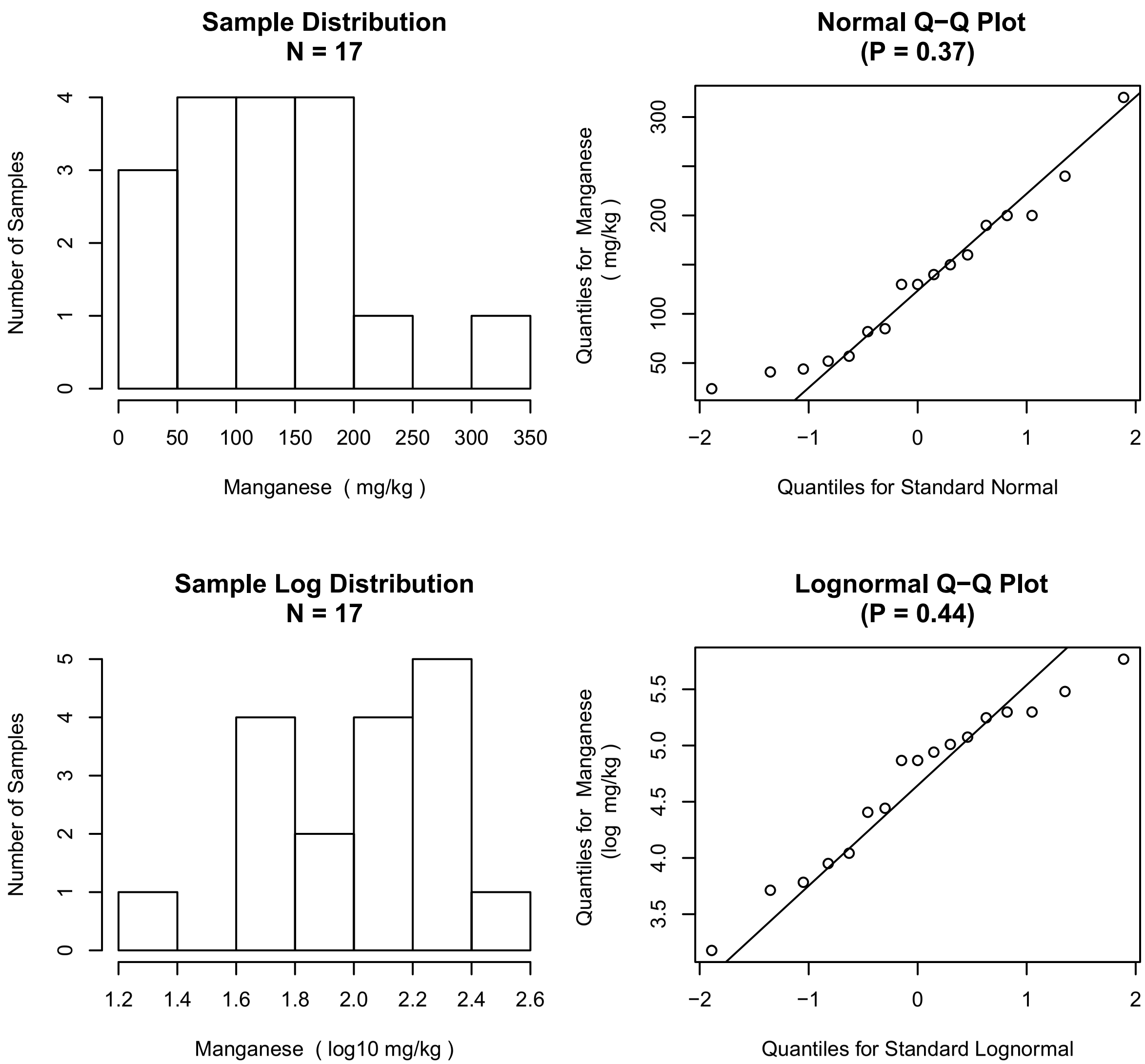


Magnesium

N (17), Percent Detected (100%)
Range OM (0.28) CV (0.2)
Detected Max (4900 mg/kg)

Parameters for Normal(3647.06,665.32)
UTL for Normal (5301.21)
Parameters for Lognormal(3650.86, 672.99)
UTL for Lognormal (5656.14)

Figure A1−12
Distribution Analysis for Manganese (0 to <10 Feet)
Casmalia Resources Superfund Site

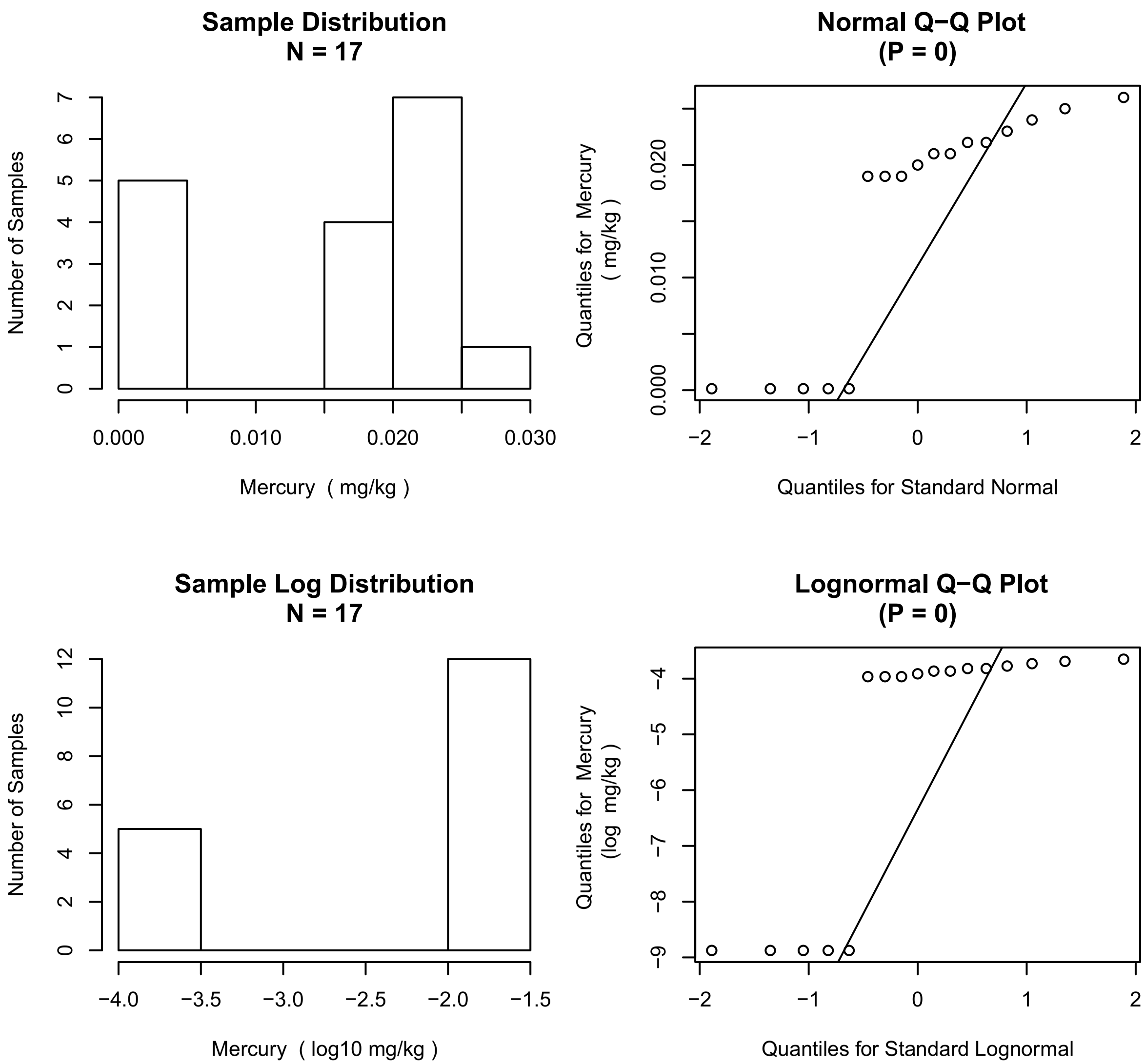


Manganese

N (17), Percent Detected (100%)
Range OM (1.12) CV (0.6)
Detected Max (320 mg/kg)

Parameters for Normal(132.06,81.1)
UTL for Normal (333.68)
Parameters for Lognormal(138.49, 114.85)
UTL for Lognormal (644.05)

Figure A1−13
Distribution Analysis for Mercury (0 to <10 Feet)
Casmalia Resources Superfund Site



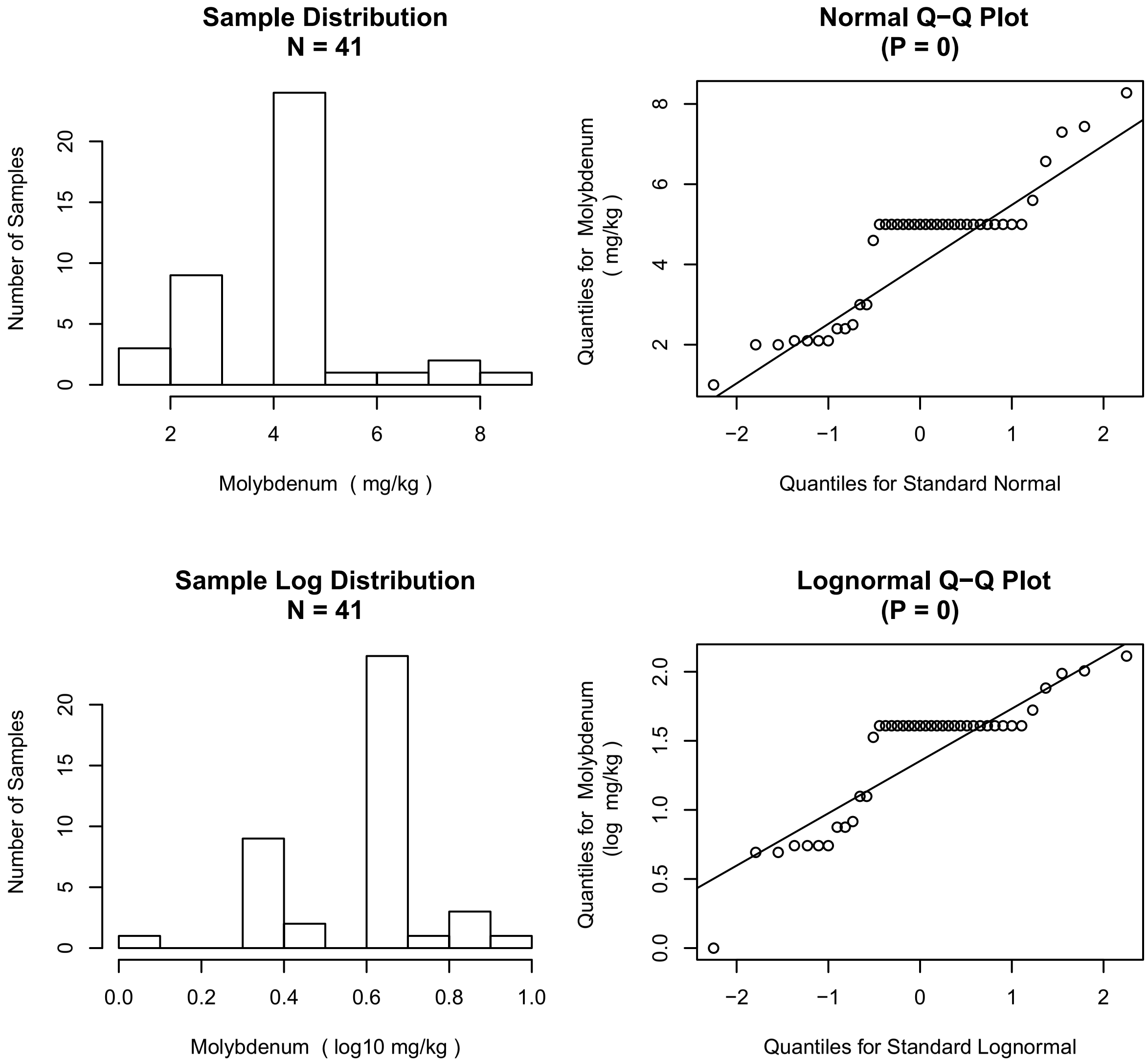
Mercury

N (17), Percent Detected (35.29%)
Range OM (2.27) CV (0.7)
Detected Max (0.026 mg/kg)

Parameters for Normal(0.02,0.01)
UTL for Normal (0.04)
Parameters for Lognormal(0.08, 1.34)
UTL for Lognormal (1.78)

Includes 11 points censored at:
0014,<0.00014,<0.00014,<0.00014,<0.00014,<0.019,<0.019,<0.019,<0.022,<0
<0.024

Figure A1−14
Distribution Analysis for Molybdenum (0 to <10 Feet)
(1 outlier at 16.3 excluded)
Casmalia Resources Superfund Site



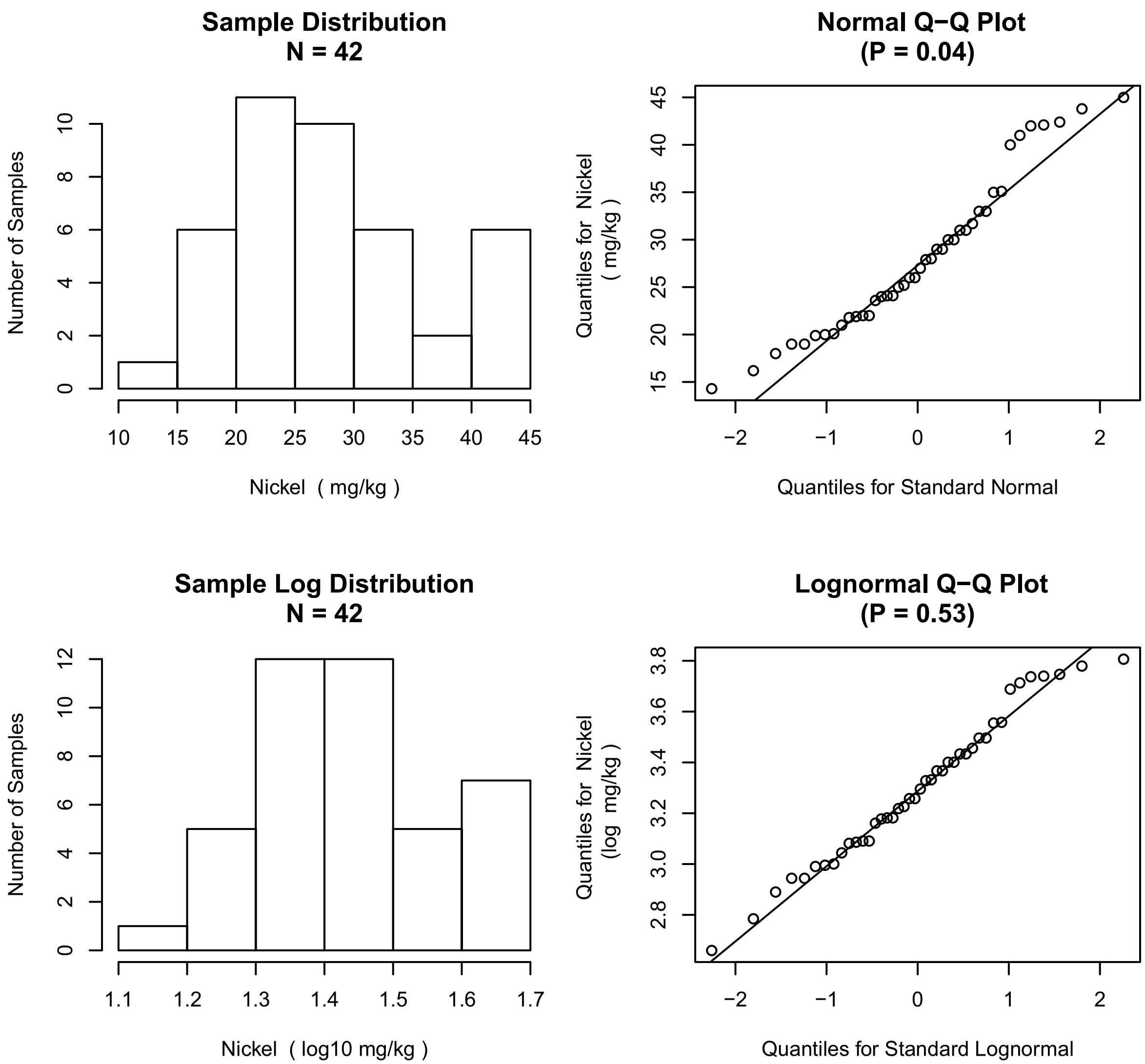
Molybdenum

N (41), Percent Detected (34.15%)
Range OM (0.92) CV (0.4)
Detected Max (8.28 mg/kg)

Parameters for Normal(4.43,1.63)
UTL for Normal (7.89)
Parameters for Lognormal(4.5, 2.15)
UTL for Lognormal (10.63)

Includes 27 points censored at:
<1,<2,<2.1,<2.1,<5,<5,<5,<5,<5,<5
<5,<5,<5,<5,<5,<5,<5,<5,<5,<5
<5,<5,<5,<5,<5,<5,<5
(NDs represented at PQLs)

Figure A1−15
Distribution Analysis for Nickel (0 to <10 Feet)
Casmalia Resources Superfund Site

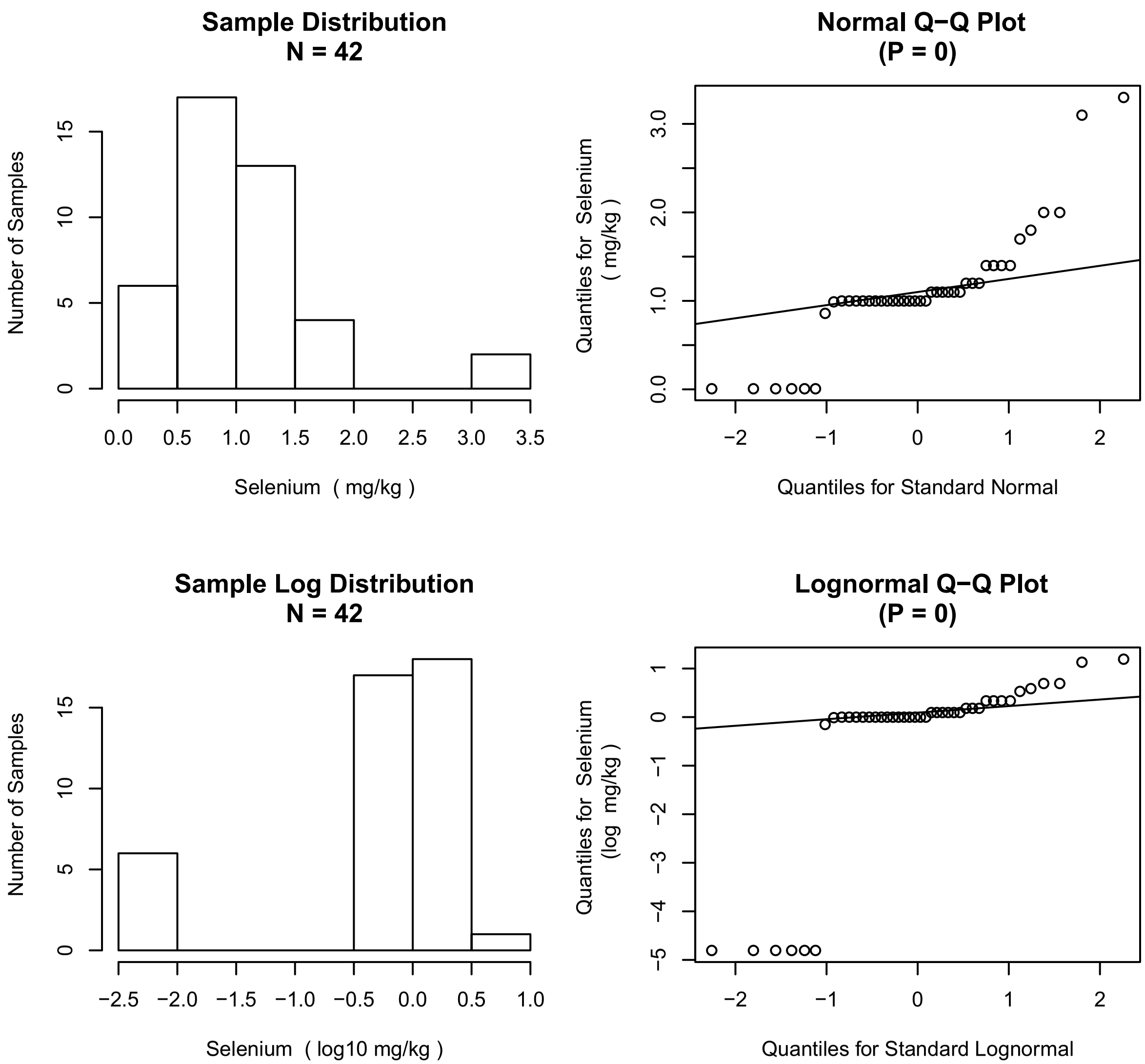


Nickel

N (42), Percent Detected (100%)
Range OM (0.5) CV (0.3)
Detected Max (45 mg/kg)

Parameters for Normal(28.1,8.14)
UTL for Normal (45.28)
Parameters for Lognormal(28.13, 8.26)
UTL for Lognormal (49.53)

Figure A1−16
Distribution Analysis for Selenium (0 to <10 Feet)
Casmalia Resources Superfund Site



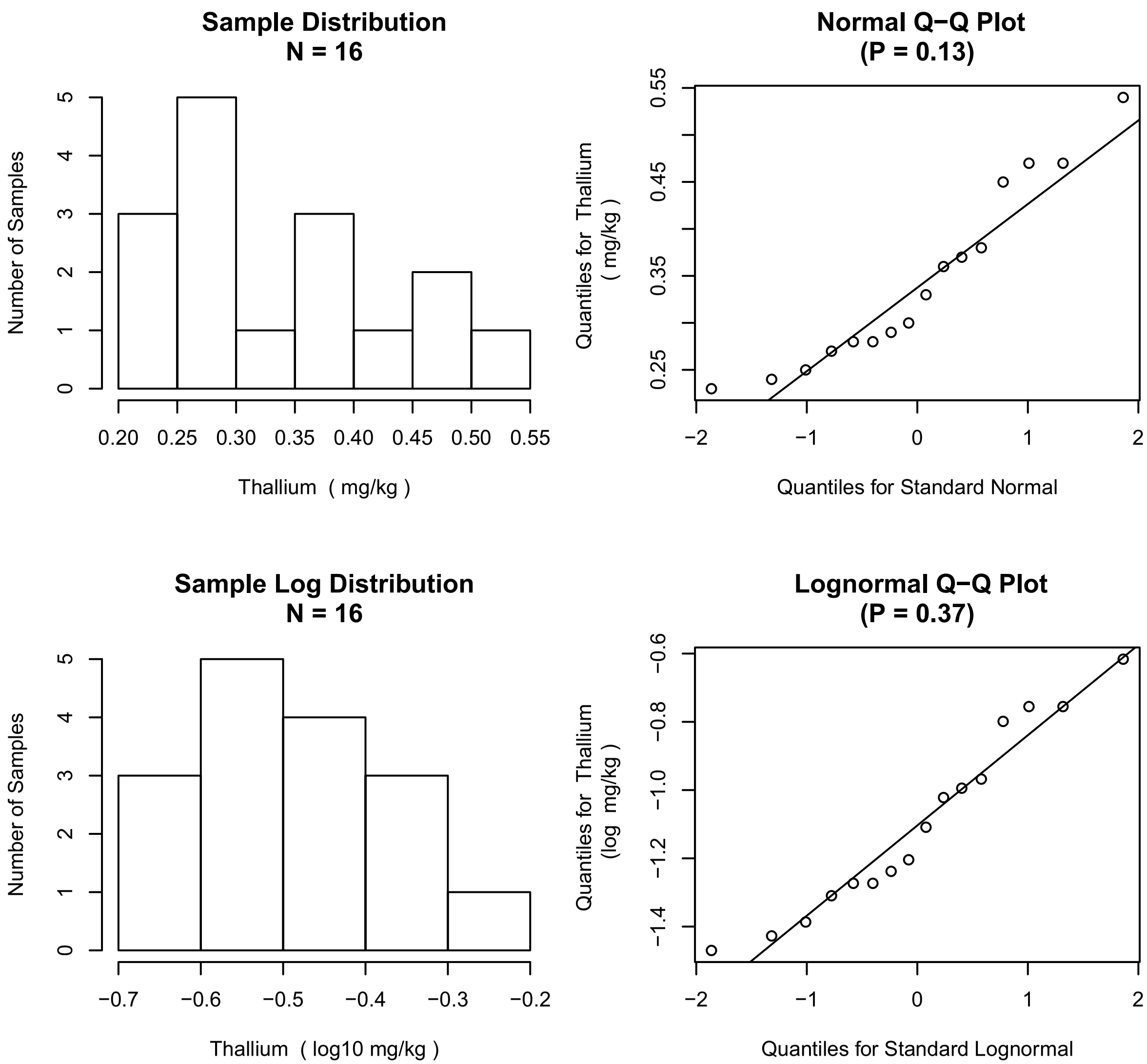
Selenium

N (42), Percent Detected (38.1%)
Range OM (2.6) CV (0.6)
Detected Max (3.3 mg/kg)

Parameters for Normal(1.11,0.68)
UTL for Normal (2.55)
Parameters for Lognormal(2.99, 14.69)
UTL for Lognormal (26.43)

Includes 26 points censored at:
<0.0082,<0.0082,<0.0082,<0.0082,<0.0082,<0.0082,<0.86,<0.99,<1,<1
<1,<1,<1,<1,<1,<1,<1,<1,<1,<1
<1,<1,<1,<1.1,<1.1,<1.1

Figure A1−17
Distribution Analysis for Thallium (0 to <10 Feet
(1 low outliers excluded)
Casmalia Resources Superfund Site



Thallium

N (16), Percent Detected (100%)
Range OM (0.37) CV (0.3)
Detected Max (0.54 mg/kg)

Parameters for Normal(0.34,0.09)
UTL for Normal (0.58)
Parameters for Lognormal(0.34, 0.09)
UTL for Lognormal (0.65)

Figure A1−18a
Distribution Analysis for Tin (0 to 10 Feet)
Casmalia Resources Superfund Site

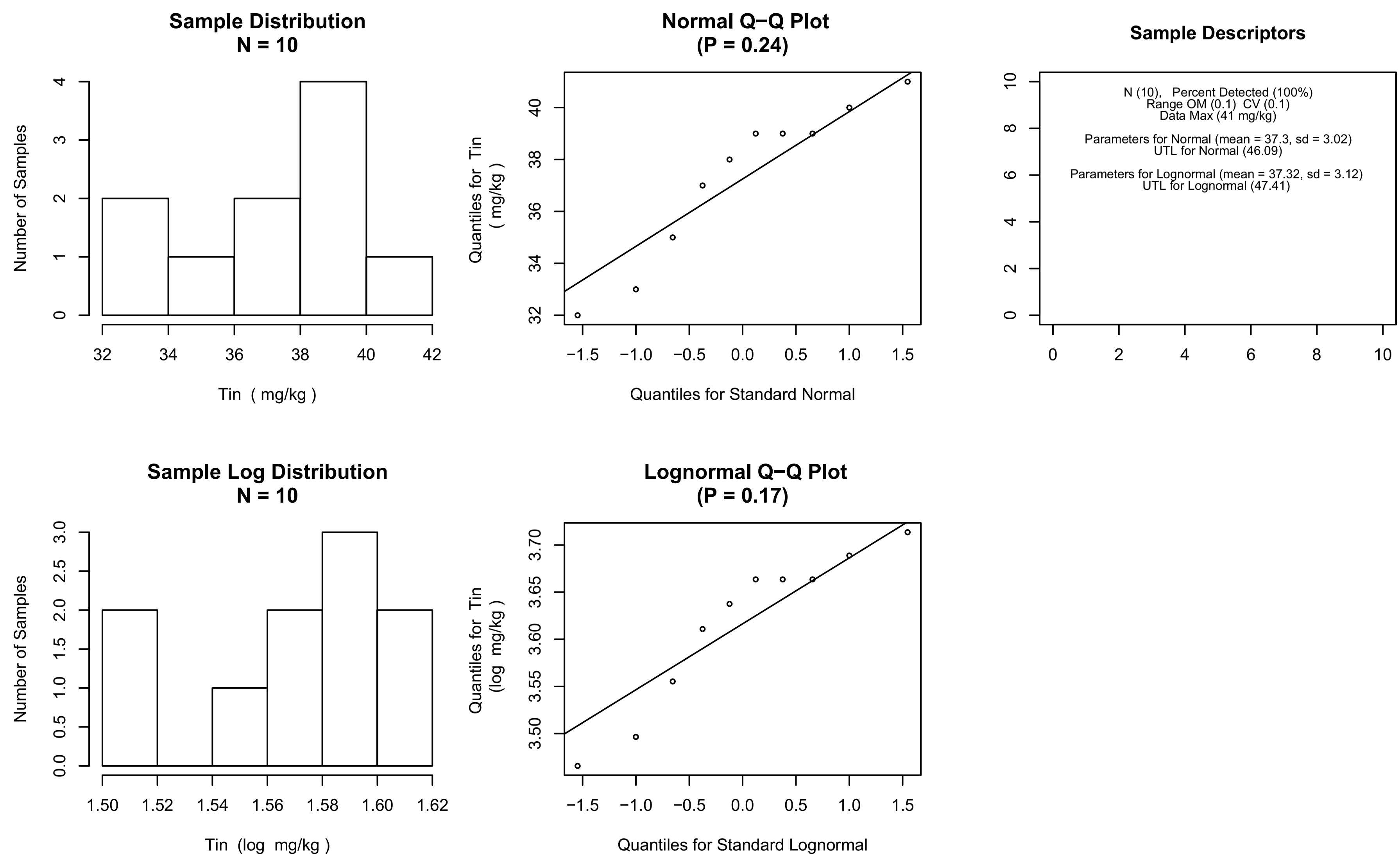


Figure A1−18b
Distribution Analysis for Tin: Site−Wide Ambient (0 to 10 Feet)
(Excluding 3 outliers at 140 or higher)
Casmalia Resources Superfund Site

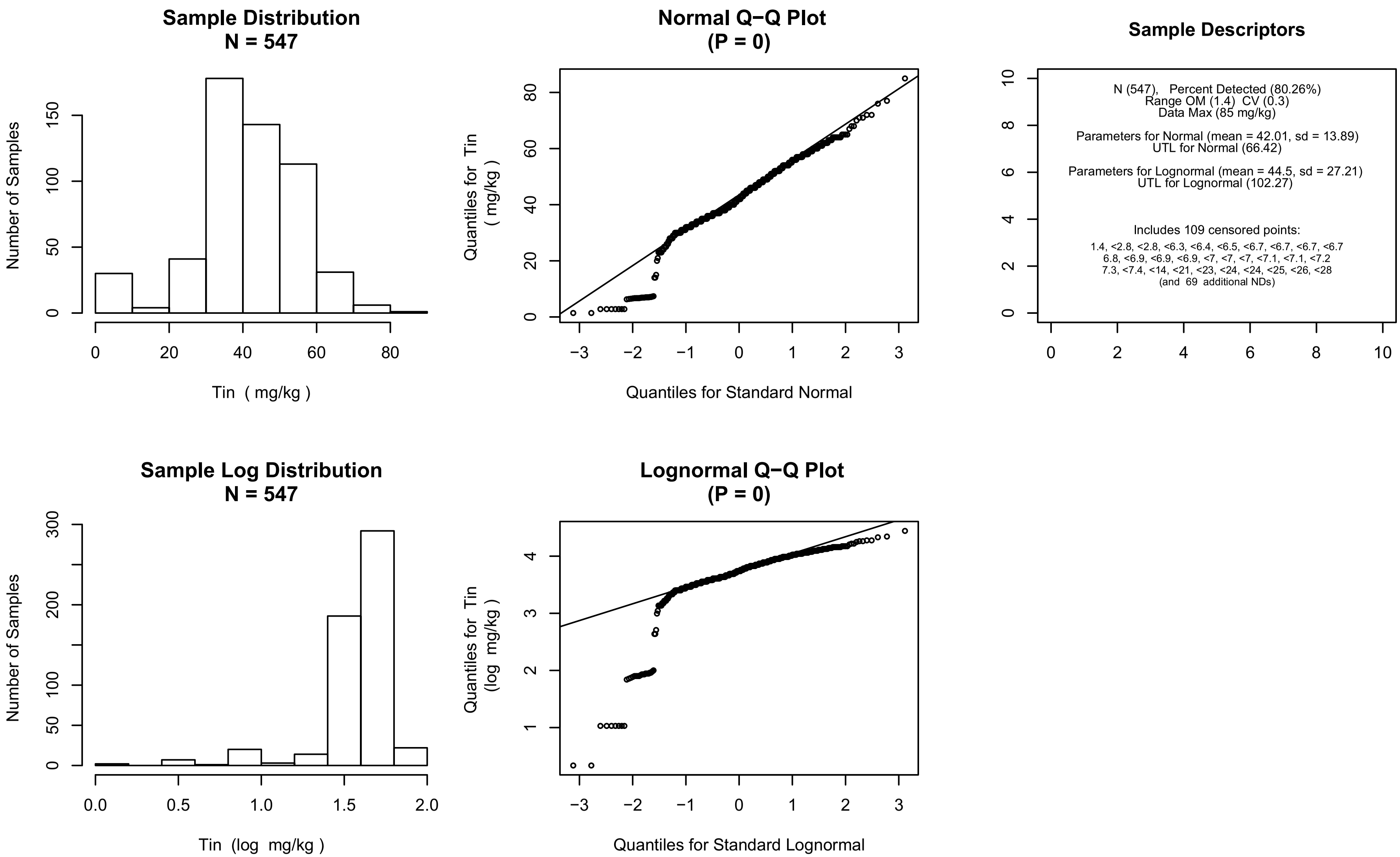
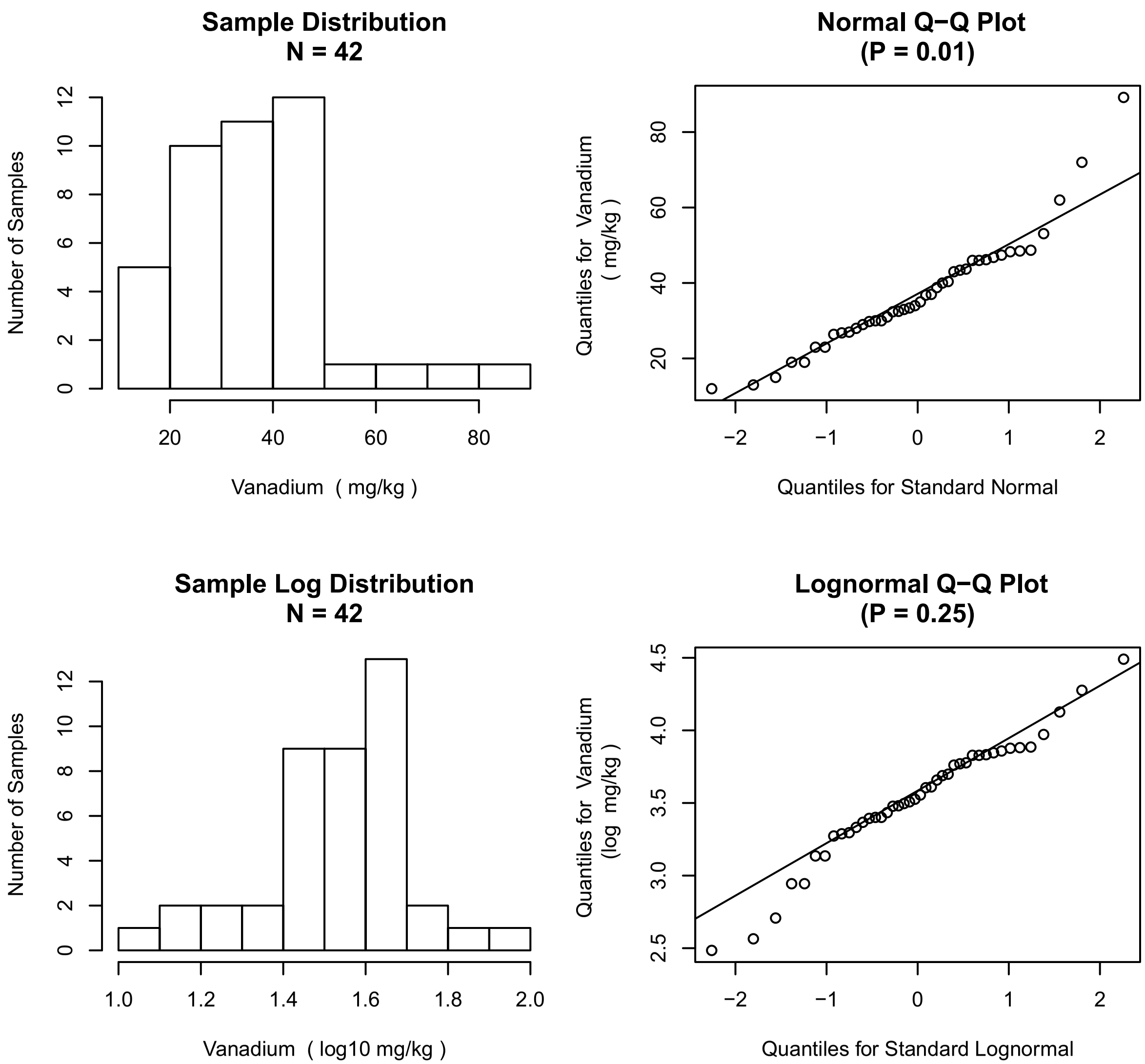


Figure A1−19
Distribution Analysis for Vanadium (0 to <10 Feet)
Casmalia Resources Superfund Site

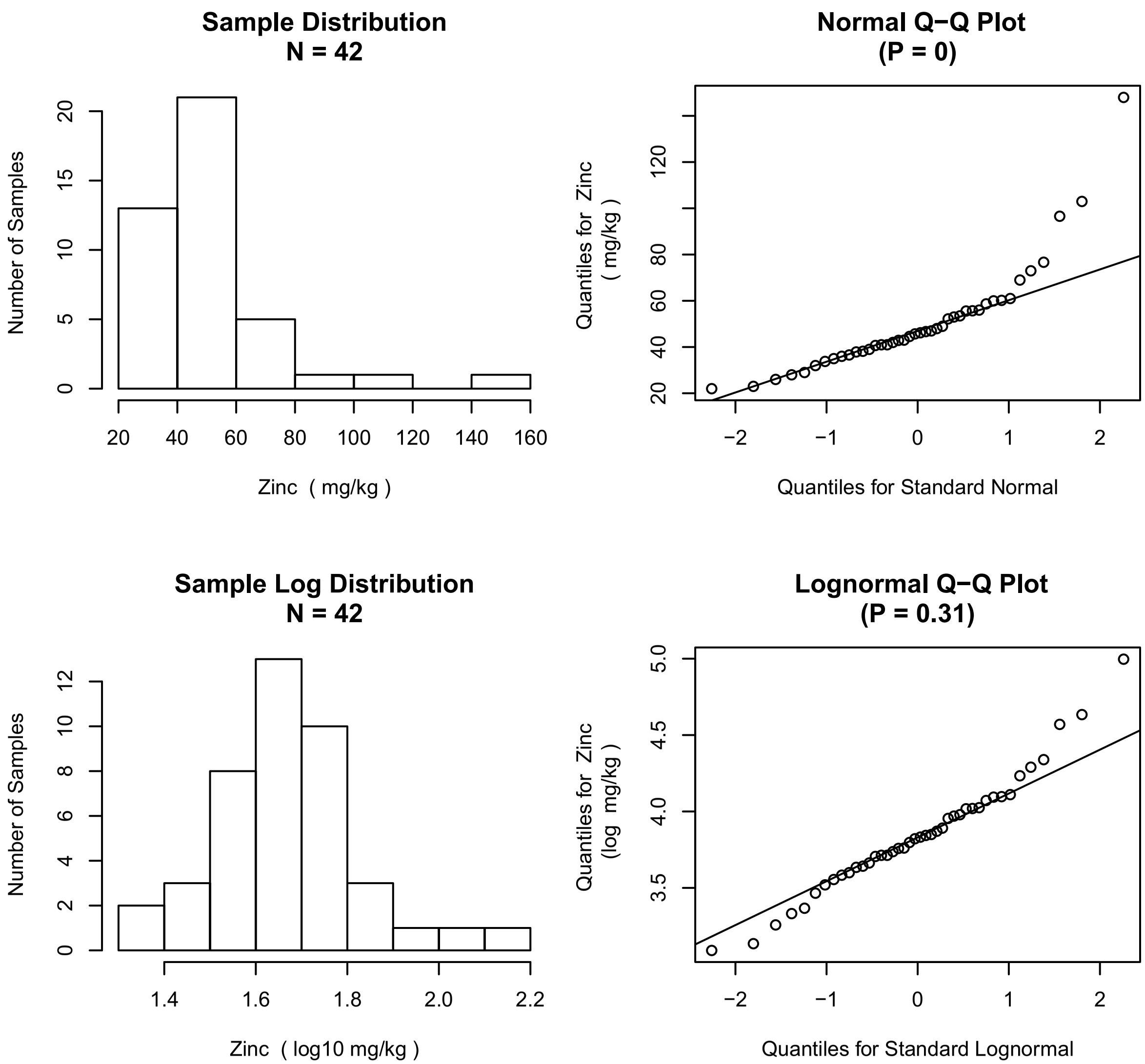


Vanadium

N (42), Percent Detected (100%)
Range OM (0.87) CV (0.4)
Detected Max (89.2 mg/kg)

Parameters for Normal(37.13,15.05)
UTL for Normal (68.9)
Parameters for Lognormal(37.38, 16.31)
UTL for Lognormal (82.72)

Figure A1−20
Distribution Analysis for Zinc (0 to <10 Feet)
Casmalia Resources Superfund Site



Zinc

N (42), Percent Detected (100%)
Range OM (0.83) CV (0.5)
Detected Max (148 mg/kg)

Parameters for Normal(50.63,23.06)
UTL for Normal (99.32)
Parameters for Lognormal(50.41, 20.07)
UTL for Lognormal (105.28)

Figure A1−21a
Distribution Analysis for Avian Dioxin TEQ (All Depths)
Casmalia Resources Superfund Site

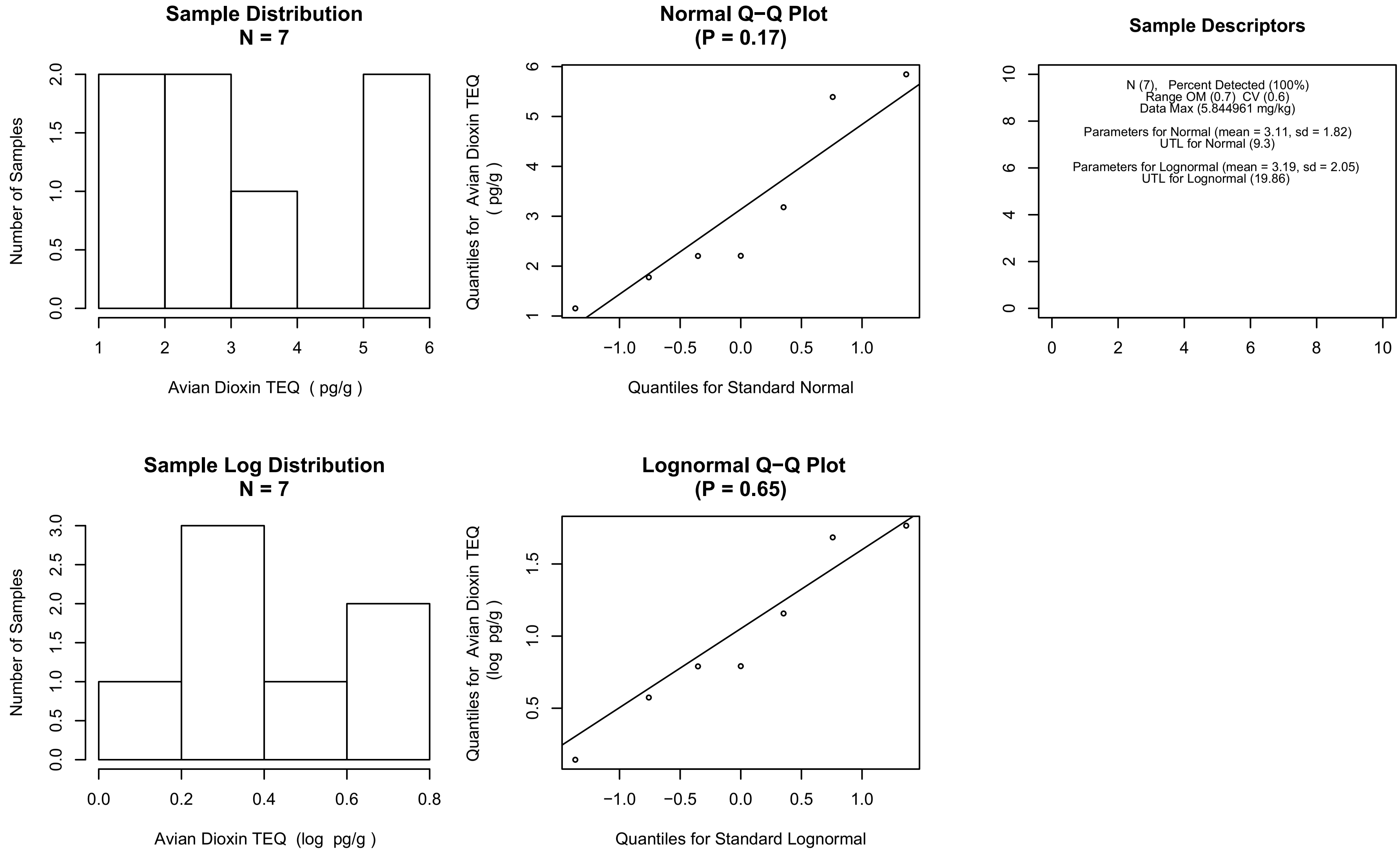


Figure A1−21b
Distribution Analysis for Avian Dioxin TEQ: Site−Wide Ambient Soil

Casmalia Resources Superfund Site

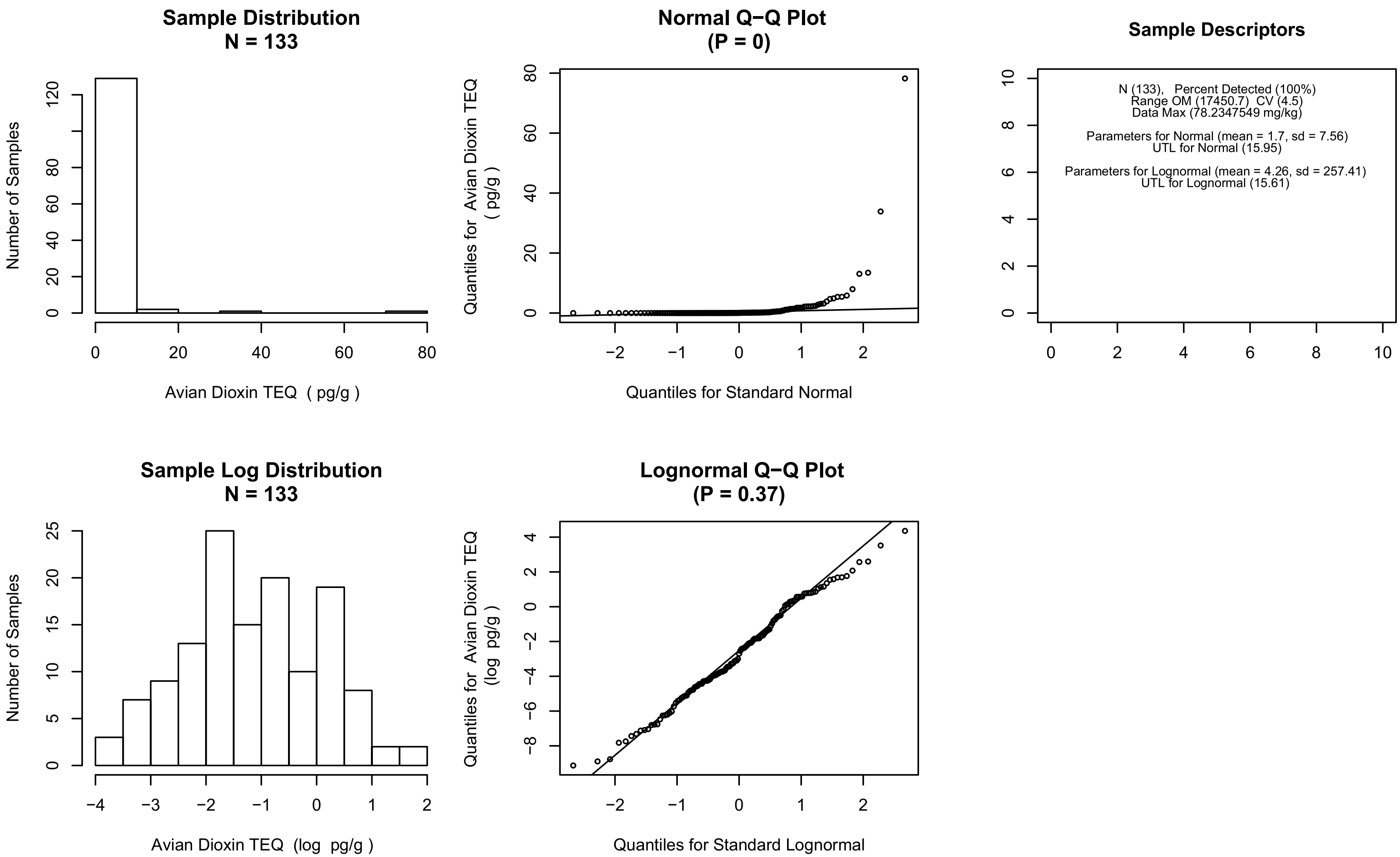


Figure A1−22a
Distribution Analysis for Mammal Dioxin TEQ (All Depths)

Casmalia Resources Superfund Site

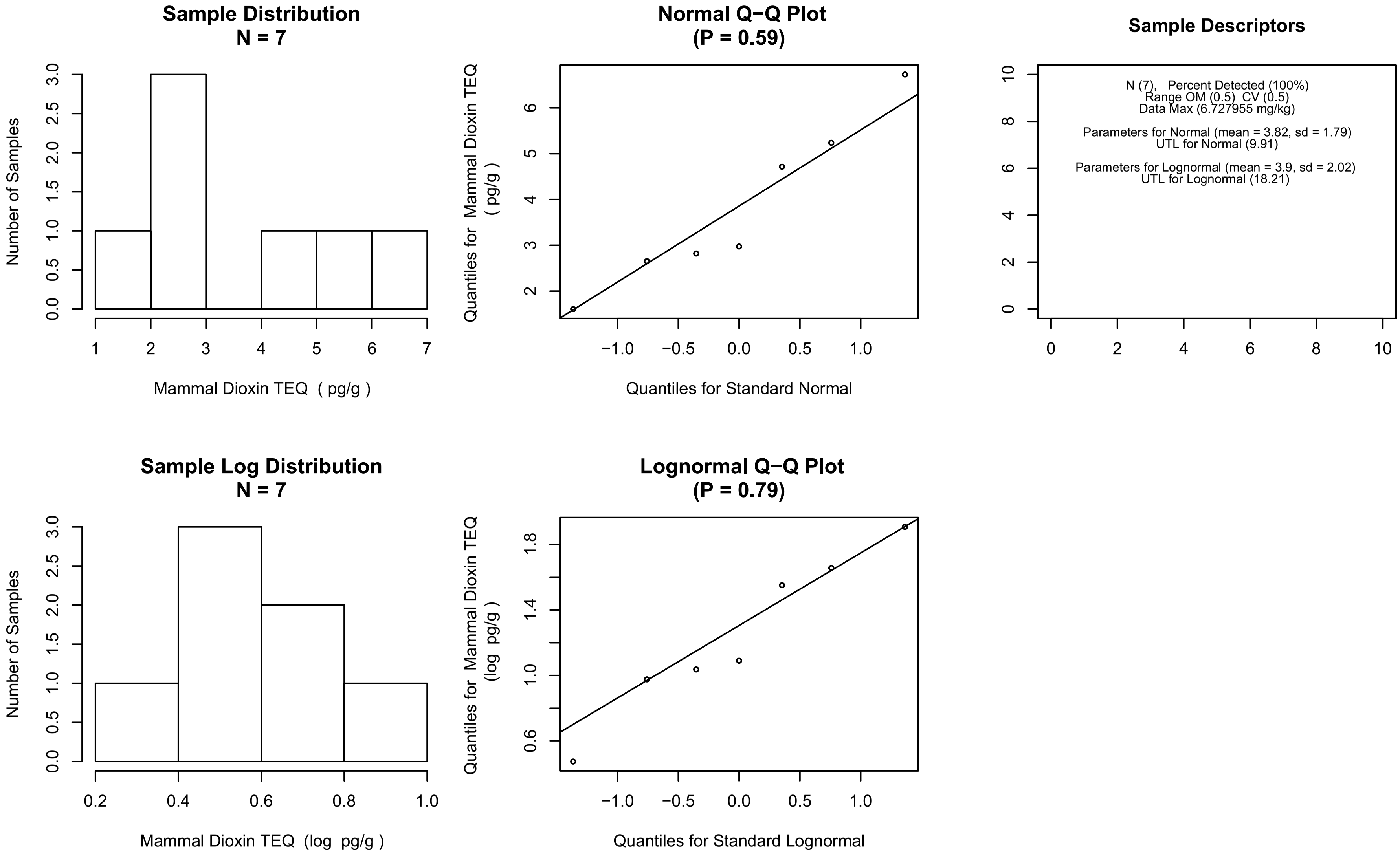


Figure A1−22b

Distribution Analysis for Mammal Dioxin TEQ: Site−Wide Ambient Soil

Casmalia Resources Superfund Site

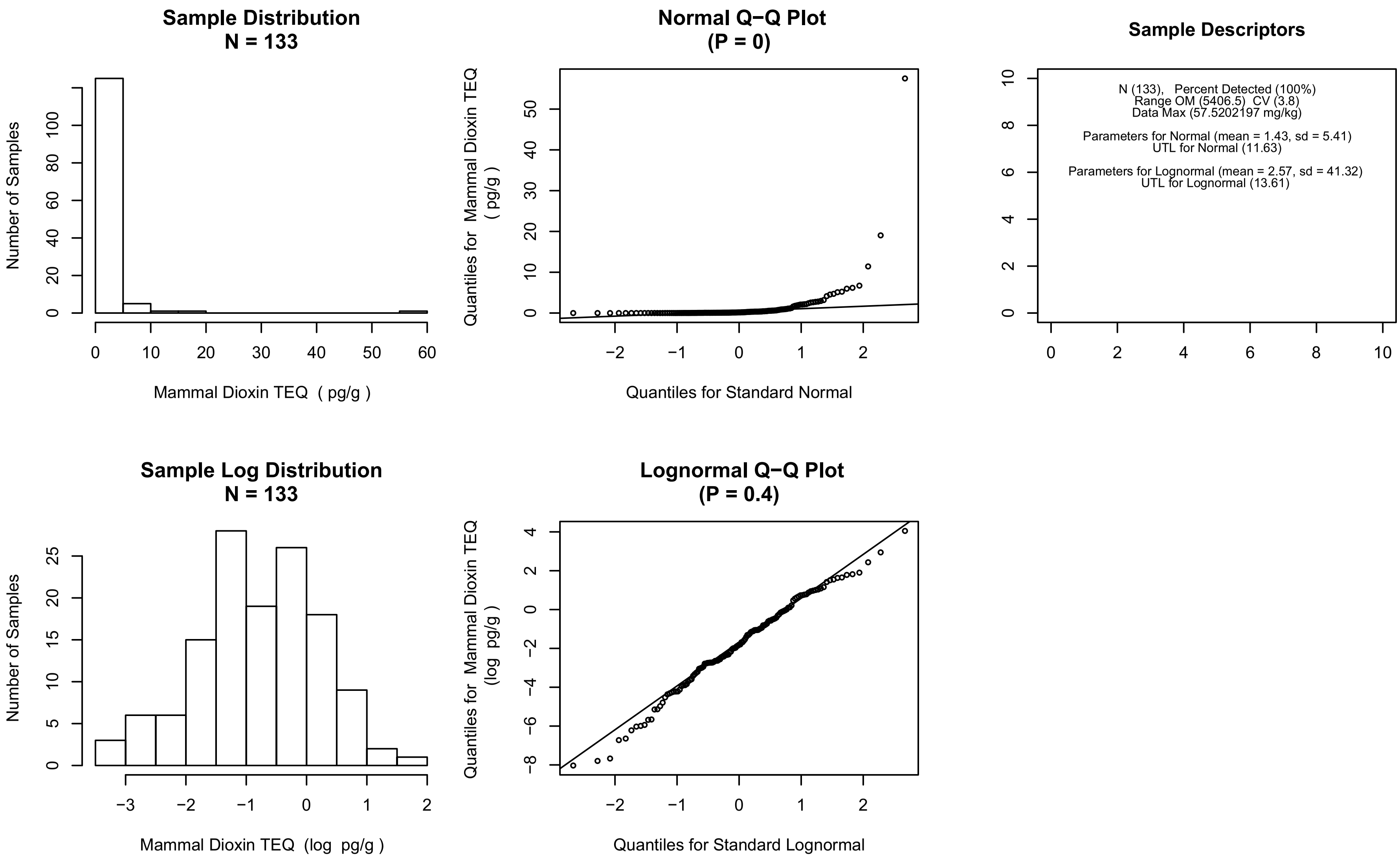


Figure A1−23a
Box Plots for Background Soil Samples By Stratum
Casmalia Resouces Superfund Site

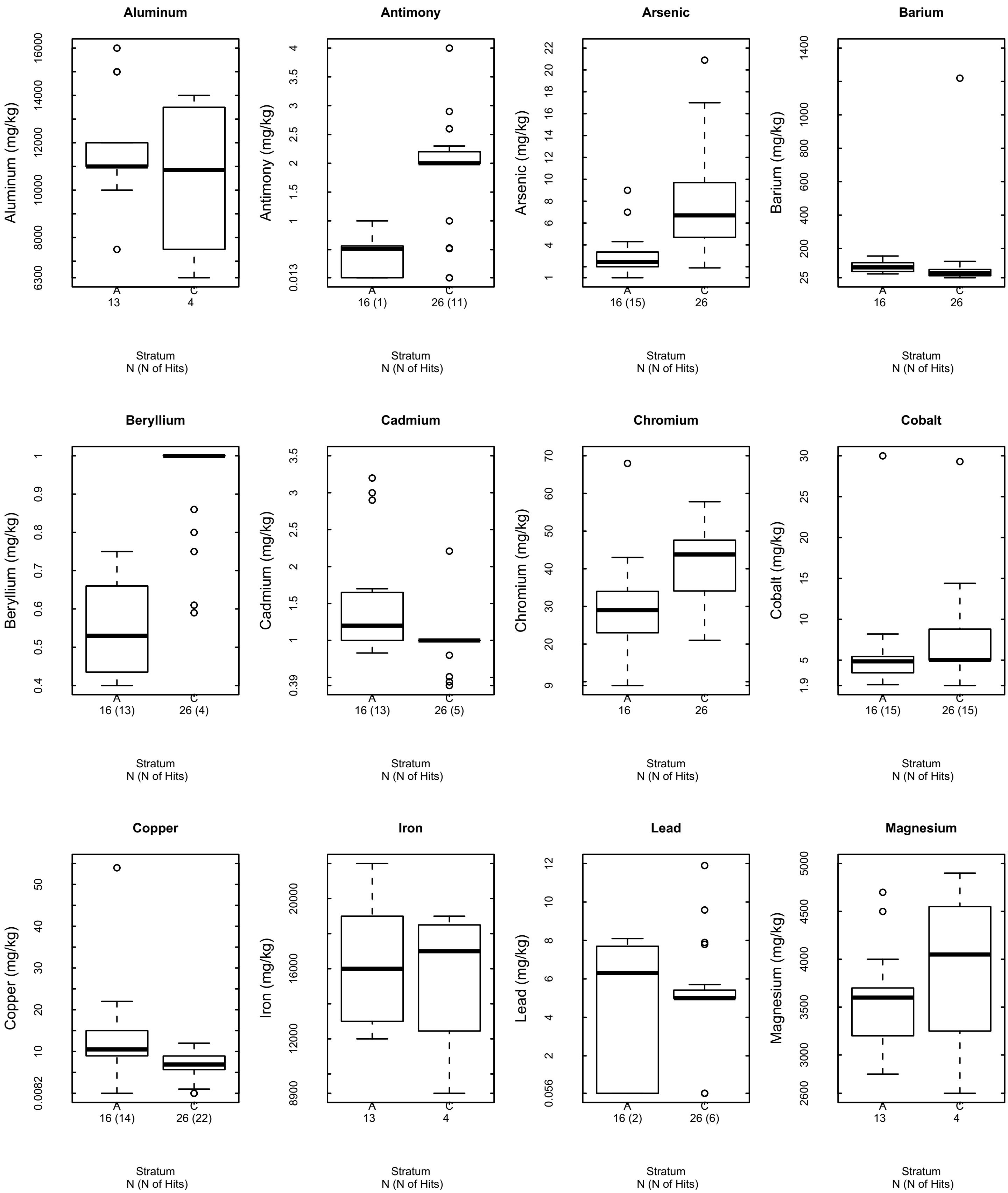


Figure A1−23b
Box Plots for Background Soil Samples By Stratum
Casmalia Resources Superfund Site

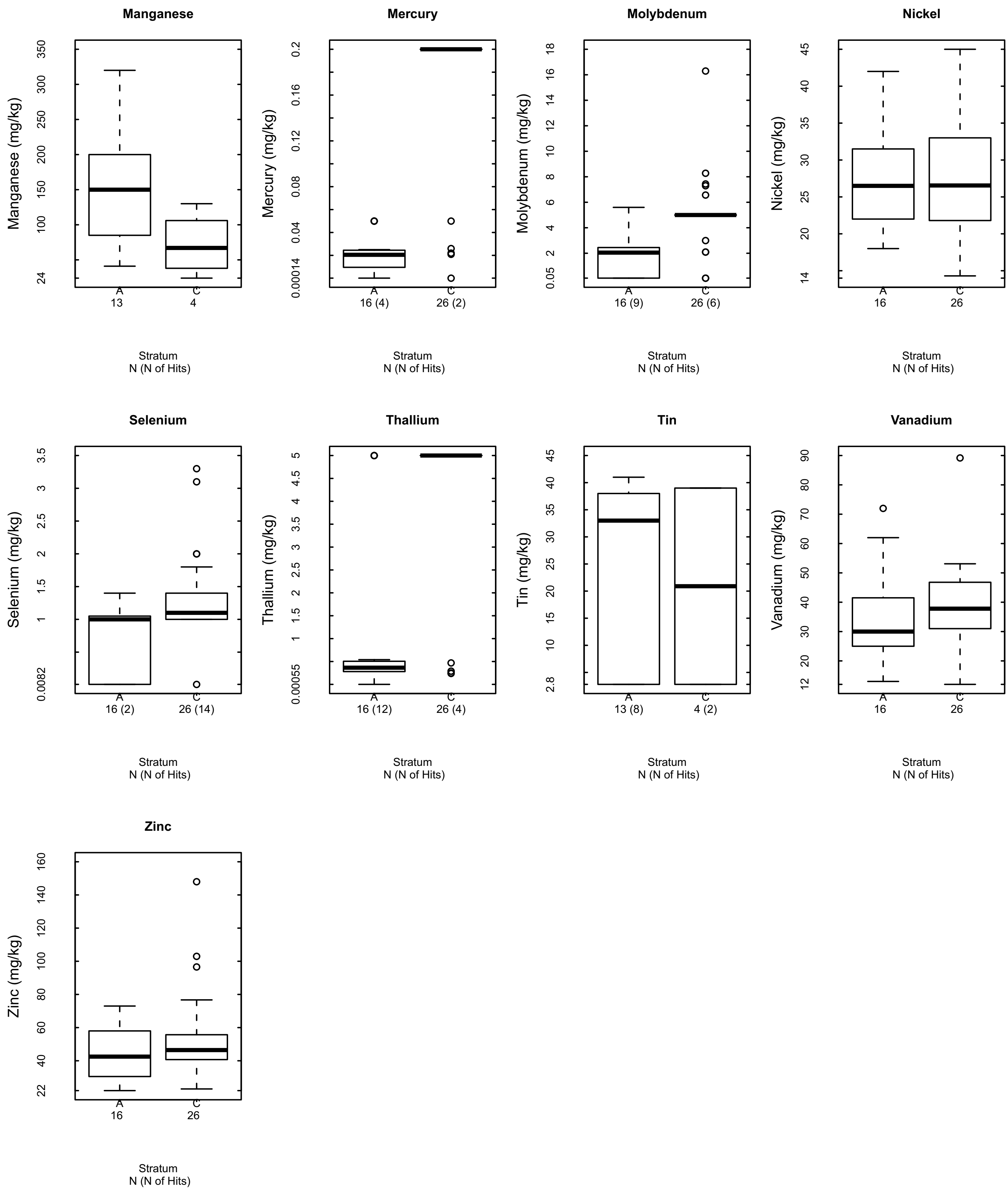


Figure A1−24a
Box Plots for Background Soil Samples By Stratum and Program
Casmalia Resources Superfund Site

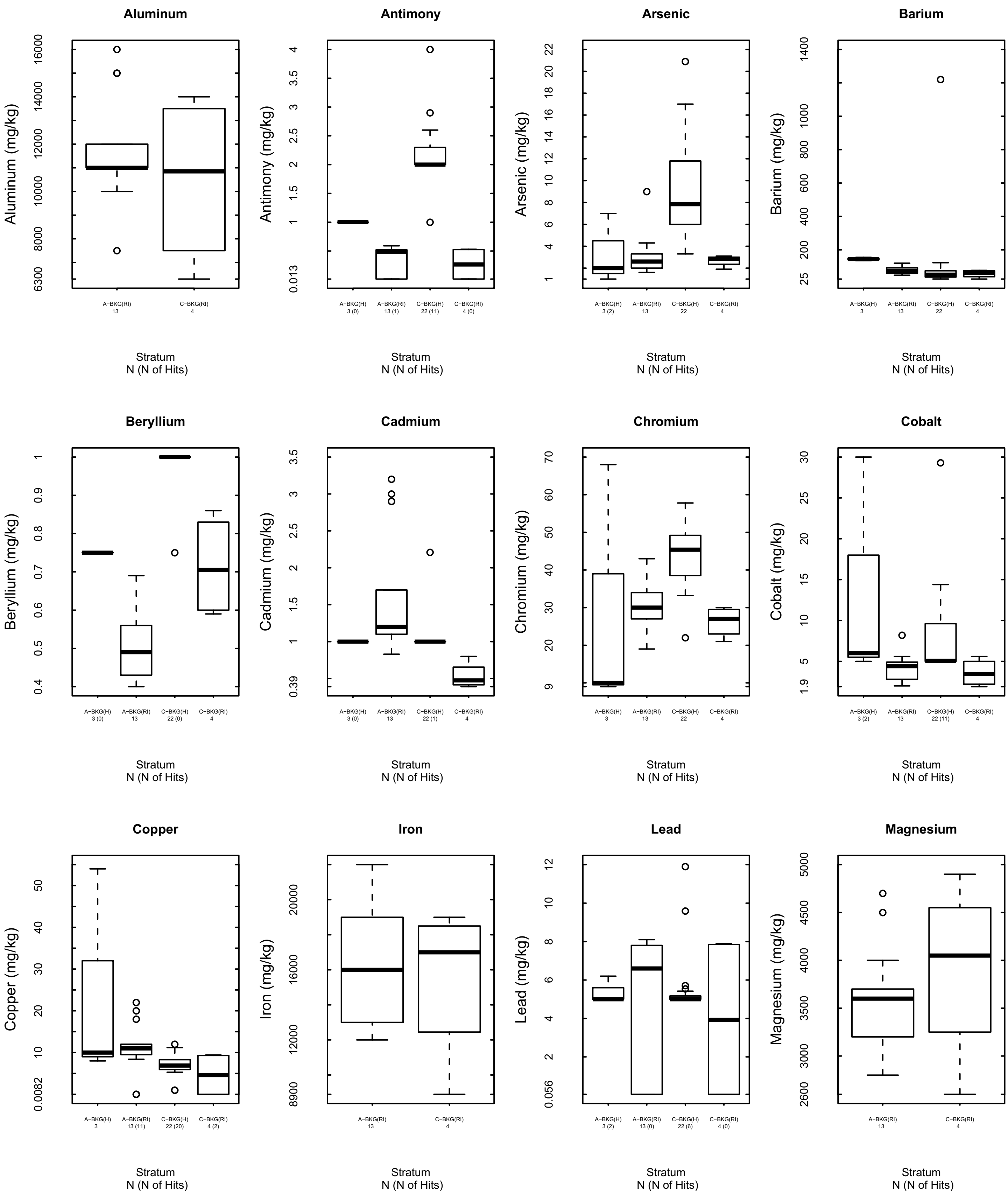


Figure A1−24b
Box Plots for Background Soil Samples By Stratum and Program
Casmalia Resources Superfund Site

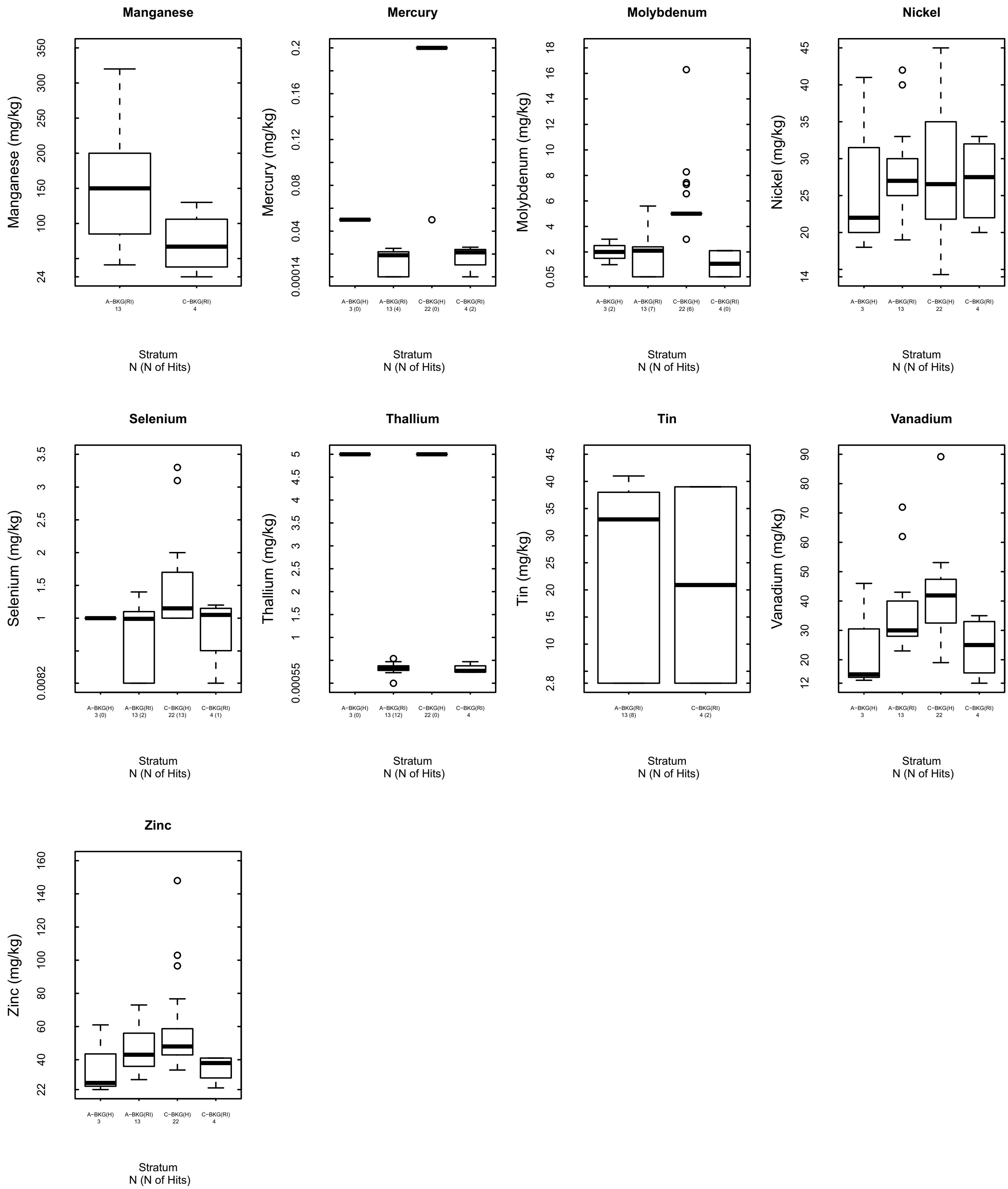


Figure A1−25
Background Barium (x1 Outlier) and Log Transformed Background Barium and Arsenic
Casmalia Resources Superfund Site