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# Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Kauai Test Facility, HI, 1999-2007

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# Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Kauai Test Facility, HI, 1999-2007

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**Abstract**

In 1999, 2002, and 2007, the Environmental Programs and Assurance Department of Sandia National Laboratories (SNL) at the Kauai Test Facility (KTF), HI, has collected soil samples at numerous locations on-site, on the perimeter, and off-site for determining potential impacts to the environs from operations at KTF. These samples were submitted to an analytical laboratory for metal-in-soil analyses. Intercomparisons of these results were then made to determine if there was any statistical difference between on-site, perimeter, and off-site samples, or if there were increasing or decreasing trends that indicated that further investigation might be warranted. This work provided the SNL Environmental Programs and Assurance Department with a sound baseline data reference against which to compare future operational impacts. In addition, it demonstrates the commitment that the Laboratories have to go beyond mere compliance to achieve excellence in its operations. This data is presented in graphical format with narrative commentaries on particular items of interest.

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# Introduction

In order to establish a baseline for trace metals that exist in the soils of Sandia National Laboratories, KTF, HI, for the purpose of determining potential impacts to the environs from operations at the Laboratories, in 1996, 2002, and 2007, the SNL Environmental Programs and Assurance Department collected soil samples at numerous locations on-site, on the perimeter, and off-site. The locations are shown in Figures 1 and 2 and tabulated in Table 1. Samples were submitted to an analytical laboratory for metal-in-soil analyses (target analyte list [TAL] metals).

These soil results were compared to determine if there was any statistical difference between on-site, perimeter, and off-site samples, or if there were increasing or decreasing trends that indicated that further investigation might be warranted to ascertain the cause of the observed anomaly (Shyr, Herrera, and Haaker 1998). This work provided the SNL Environmental Programs and Assurance Department with a sound baseline data reference against which to compare future operational impacts. In addition, it demonstrates the commitment that the Laboratories have to go beyond mere compliance, but to also achieve excellence in its operations. This data is presented in graphical format, with narrative commentaries on particular items of interest.

## Table 1. Terrestrial Surveillance Locations at KTF

| Location Number | Sample Location |
|---|---|
| C-01 | Rec Area I Beach Access sign – N. Nohili Road |
| C-02 | No Trespassing sign – West of Location C-01 |
| C-03 | N. Nohili Road and Hoku Road |
| C-04 | Hoku Road W of Building 515 |
| C-05 | Polihale State Park – Monkey Pod Tree |
| C-06 | Polihale State Park – Camping sign |
| C-07 | Polihale State Park – "Caution Road narrows" sign |
| C-08 | N. Nohili Road and Palai Olani Road |
| C-09 | Kokole Point Launch Area – Bldg H10 |
| C-10 | Kokole Point Launch Area – West |
| C-11 | Kokole Point Launch Area – South |
| S-12 | Near Wind Radar Road |
| S-13 | Sandia/KTF sign – DOE Trail Road |
| S-14 | Building 638 |
| S-15 | Between Building 638 and 639 |
| S-16 | Building 639 East |
| S-17 | Building 640 East |
| S-18 | Building 640 West |
| S-19 | Building 685 West |
| S-20 | MAB Building Parking Lot |
| S-21 | Building 645 and 645A South |
| S-22 | Missile Service Tower Hill |
| S-23 | Pad 1 West Corner |
| | **Main Compound** |
| S-24 | Main Compound – NE Corner Fence |
| S-25 | Main Compound – SE Corner Fence |
| S-26 | Main Compound – N Fence |
| S-27 | Main Compound – NW of Launch Ops Bldg |
| S-28 | SE Corner of Diesel Fuel Tank, DOE Trail |

C = Community, S = On-site, P = Perimeter

These are usually sampled only every 5 years. Since KTF activities have never and have no plans to use radionuclides, samples are not analyzed for radionuclides. Only soil samples are collected and analyzed for Target Analyte List (TAL) metals.

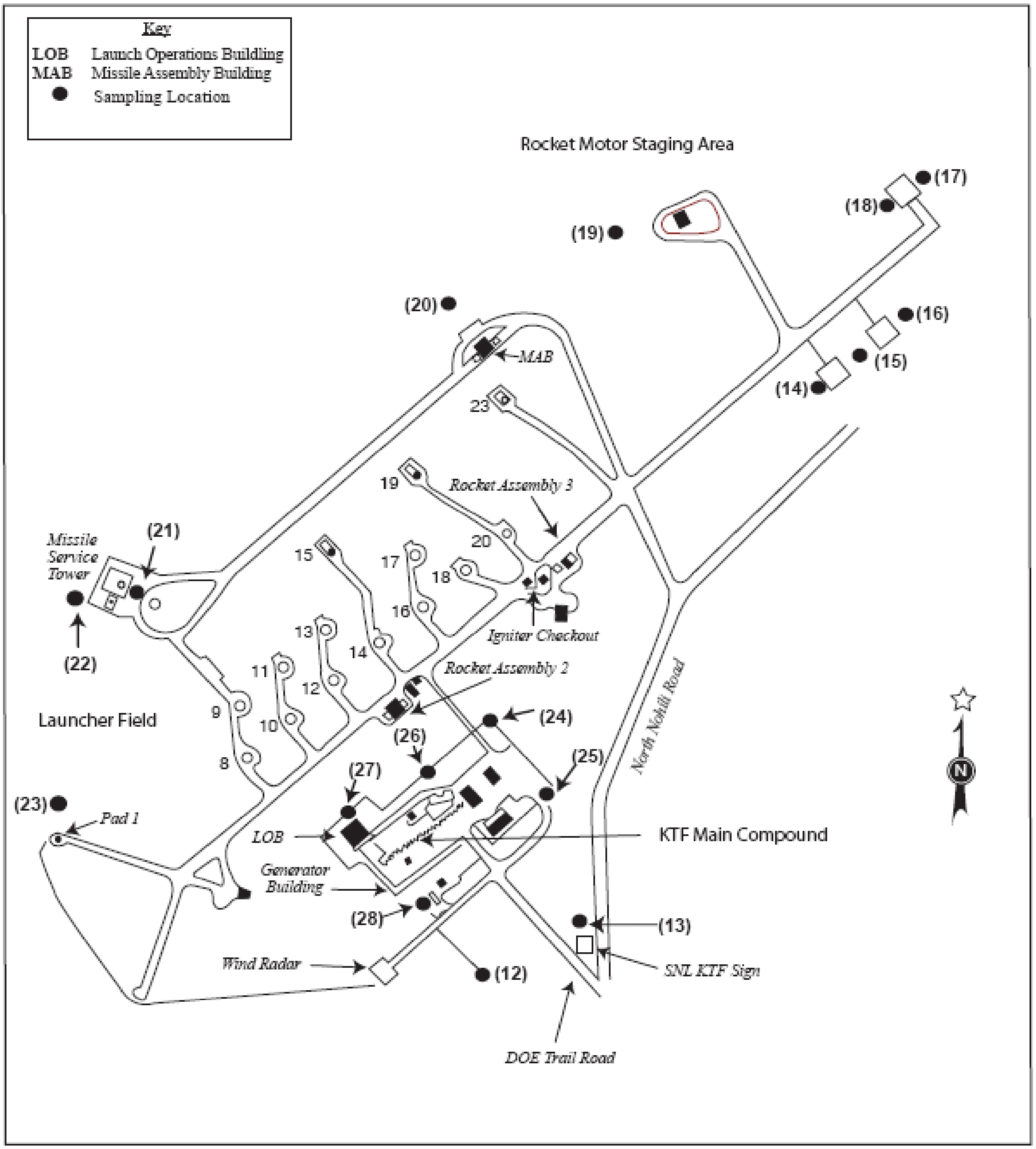



**Figure 1. On-Site Sample Locations at the Kauai Test Facility**

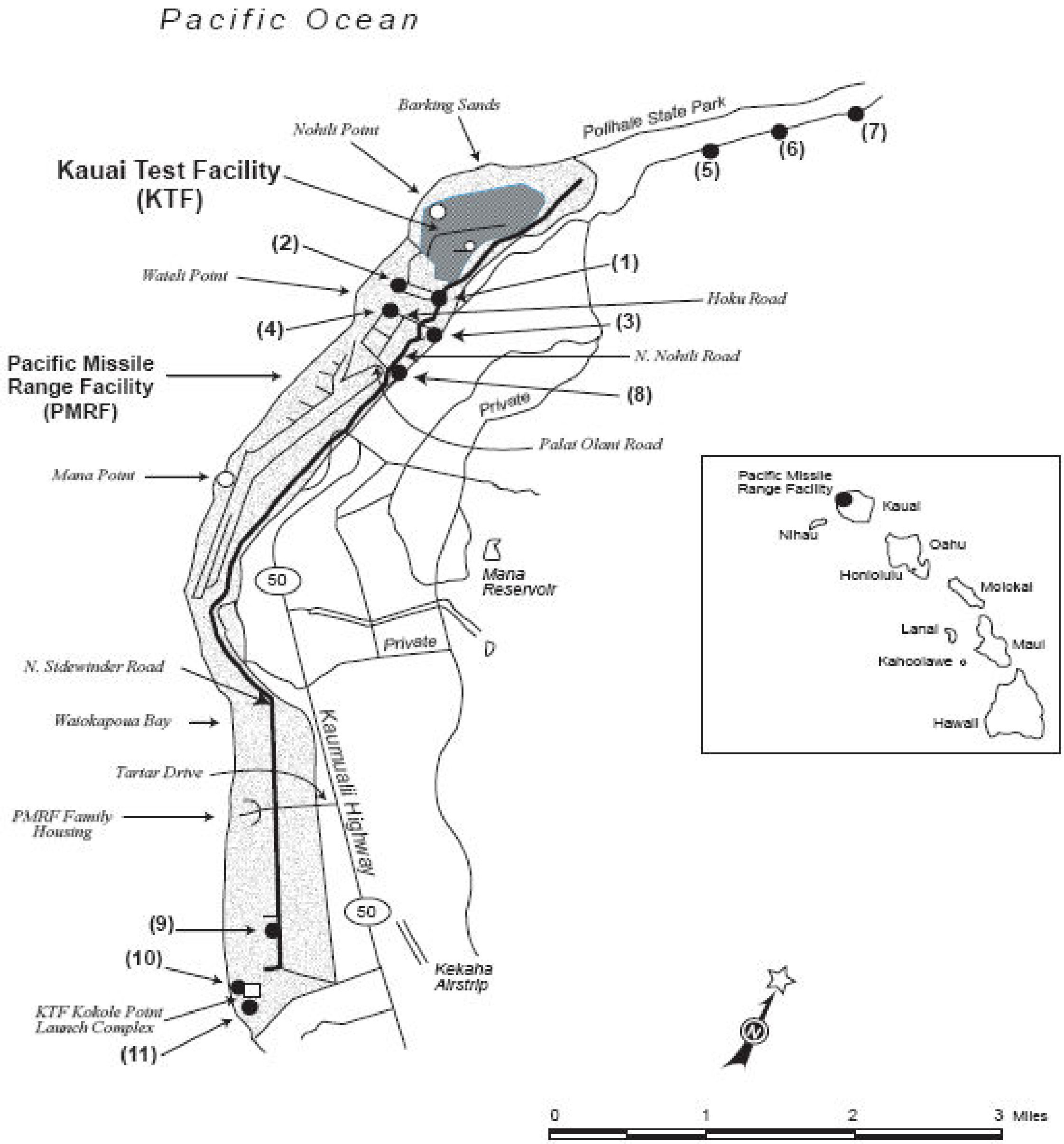



**Figure 2. Off-Site Sample Locations at the Kauai Test Facility**

Results of the soil samples were evaluated using probability plotting, which provided a visual representation of the entire data set for all locations and for all times sampled. If the results were similar, or fit a linear distribution when plotted on logarithmic or log-probability scales, then the results were attributable to natural origin. Summary statistics and EPA Industrial/Residential soil concentration guidelines for each element were imbedded in each plot. If any samples indicated concentrations greater than expected from the rest of the sample distribution, further evaluation was conducted to determine if SNL KTF facility operations were possibly responsible for the observed result. Table 2 provides the summary statistics for the metals in soil observed at KTF. Table 3 provides various reference values for metals-in-soil.

Appendix A contains a detailed description of the mechanics of lognormal plotting. Appendix B contains the plots of the soil data. Associated with each plot presented are the summary statistics for each analyte. Applicable EPA Region 9 Screening Levels (if available) for Industrial and Residential use are indicated on the graphs.

Table 2. Summary Statistics of KTF Metals in Soil

| ANALYTE | Mean | Std Dev | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| Aluminum | 6857 | 4576 | 1410 | 6600 | 31400 |
| Antimony | 2.22 | 2.58 | 0.10 | 0.50 | 8.00 |
| Arsenic | 12.88 | 11.99 | 3.84 | 9.05 | 55.70 |
| Barium | 14.86 | 16.56 | 4.34 | 11.00 | 161.00 |
| Beryllium | 0.24 | 0.19 | 0.04 | 0.12 | 0.50 |
| Cadmium | 0.41 | 0.24 | 0.05 | 0.42 | 1.40 |
| Calcium | 279618 | 58818 | 154000 | 282500 | 394000 |
| Chromium | 57.6 | 32.4 | 11.6 | 51.2 | 180.0 |
| Cobalt | 15.67 | 9.91 | 1.45 | 14.95 | 41.70 |
| Copper | 21.9 | 41.1 | 1.6 | 14.0 | 350.0 |
| Iron | 15738 | 8684 | 2580 | 14000 | 42000 |
| Lead | 6.85 | 9.92 | 0.28 | 4.59 | 64.20 |
| Magnesium | 35472 | 15462 | 14000 | 32400 | 101000 |
| Manganese | 305 | 155 | 77 | 280 | 808 |
| Mercury | 0.04 | 0.04 | 0.001 | 0.01 | 0.10 |
| Nickel | 183 | 137 | 11 | 160 | 670 |
| Potassium | 283.4 | 246.7 | 62.0 | 247.0 | 2000.0 |
| Selenium | 2.72 | 2.64 | 0.15 | 2.46 | 12.00 |
| Silver | 0.29 | 0.29 | 0.04 | 0.20 | 2.13 |
| Sodium | 2234 | 949 | 1060 | 2105 | 9500 |
| Thallium | 6.95 | 9.54 | 0.04 | 3.93 | 65.00 |
| Vanadium | 22.55 | 12.09 | 5.45 | 22.05 | 76.00 |
| Zinc | 123.4 | 315.1 | 2.7 | 38.2 | 2880.0 |

# Table 3. Various Reference Values for Metals-in-Soil

| | EPA Region 9 PRGs (Soil Screening Levels)[2] | | US Soil Concentrations[3] | |
|---|---|---|---|---|
| **Analyte** | **Residential** | **Industrial** | **Lower Limit** | **Upper Limit** |
| **Aluminum** | **76,000** | **100,000** | **4,500** | **100,000** |
| **Antimony** | **31** | **410** | **0.25** | **0.6** |
| **Arsenic** | **0.39** | **1.6** | **1** | **93** |
| **Barium** | **5,400** | **67,000** | **20** | **1,500** |
| **Beryllium** | **150** | **1,900** | **0.04** | **2.54** |
| **Cadmium** | **37** | **450** | **0.41** | **0.57** |
| **Calcium** | **n/a** | **n/a** | **n/a** | **n/a** |
| **Chromium** | **210** | **450** | **7** | **1,500** |
| **Cobalt** | **900** | **1,900** | **3** | **50** |
| **Copper** | **3,100** | **41,000** | **3** | **300** |
| **Iron** | **23,000** | **100,000** | **5,000** | **50,000** |
| **Lead** | **400** | **800** | **10** | **70** |
| **Magnesium** | **n/a** | **n/a** | **n/a** | **n/a** |
| **Manganese** | **1,800** | **19,000** | **20** | **3,000** |
| **Mercury** | **23** | **310** | **0.02** | **1.5** |
| **Nickel** | **1,600** | **20,000** | **5** | **150** |
| **Potassium** | **n/a** | **n/a** | **n/a** | **n/a** |
| **Selenium** | **390** | **5,100** | **0.1** | **4** |
| **Silica (Silicon)** | **n/a** | **n/a** | **24,000** | **368,000** |
| **Silver** | **390** | **5,100** | **0.2** | **3.2** |
| **Sodium** | **n/a** | **n/a** | **n/a** | **n/a** |
| **Strontium** | **47,000** | **100,000** | **7** | **1,000** |
| **Thallium** | **5.2** | **67** | **0.02** | **2.8** |
| **Vanadium** | **78** | **1,000** | **0.7** | **98** |
| **Zinc** | **23,000** | **100,000** | **13** | **300** |

ND = not detectable
n/a = not available

(1) Dragun, James, A. Chiasson, *Elements in North American Soils*, 1991, Hazardous Materials Control Resources Institute, (Used Nevada Soils to determine values).
(2) EPA Region 9 Preliminary Remediation Goals (PRGs), U.S.E.P.A., October 2004.
(3) US Soil Surface Concentrations, Kabata-Pendias, A., Pendias, H., CRC, *Trace Elements in Soils and Plants*, 2nd Edition, 1992

# Summary

Soil and sediment samples have been collected from 1996, 2002, and 2007 at KTF as one means of monitoring for the potential effects on the environment of facility operations at the Laboratories. The results of this sampling effort are reported in the Annual Site Environmental Report (at KTF, samples are collected and reported every fifth year) (ASER, SNL 2003). The data indicate that KTF operations have made no significant impact to existing concentration of TAL metal in surface soil.

## Appendix A - Data Analysis

The data in this report is presented in the form of lognormal probability plots. Such plots are useful tools for conveniently cataloguing and evaluating large amounts of data, as well as providing a first approximation of the similarity (or differences) of the data. The basis for using lognormal plotting is experience which has shown that large quantities of environmental data (many similar analyte/media combinations) yield a straight line when plotted on a log-probability or logarithmic scale (Miller 1977). The presumption of lognormal distribution is never a bad presumption and is never worse than the presumption of arithmetic-normal (Michels 1971). Because the data is represented graphically, the mean, standard deviation, expected upper limits, and any abnormalities can be readily determined visually (Waite 1975).

Characteristics of special importance in the use of lognormal plots are linearity (denoting data from a common population), standard geometric deviation ($\sigma_g$, an indicator of variability or range), and geometric mean ($X_g$). The unit of slope in a lognormal plot involves a logarithmic increment. Thus, the standard deviation is a multiplier of the geometric mean (Michels 1971). The values for $\sigma_g$ and $X_g$ can be obtained from the graphs by the ratio of the 84%/50% intercepts and the 50% intercepts, respectively (Miller 1977). Linearity of the graph implies that any potential KTF contribution to the observed concentration is indistinguishable from regional levels of the element. Anomalous results (potentially attributable to KTF operations) must necessarily occur at a higher concentration than would be expected from regional distributions. For convenience, summary statistics for each element was imbedded in each plot. Not included in this list, but which can be calculated, is the Upper Tolerance Limit (UTL), which is defined as:

$$95^{th}\ UTL = \bar{X} + K*S$$

Where UTL = Upper Tolerance Limit
$\bar{X}$ = Sample Arithmetic Mean
S = Sample Standard Deviation
K = One-sided normal tolerance factor

Values for K are commonly determined from tables such as those provided by Lieberman (Leiberman 1958). A typical value of K equal to 1.927 should be assigned, which is for sample size of n = 100. The sample size for each element was about 100. This UTL can be used to estimate a level above which a sample result may not be attributable to naturally occurring “background” levels of the element.

Whenever a particular result appears elevated (on the lognormal plot) compared to the expected concentration based on the population comprised of all the other locations, further investigation to determine if KTF operations are potentially responsible may include (but should not be limited to) the following:

- What is the geographical location of the sample? Is there a detectable pattern to the anomalous observation or is the sample from an area in close proximity to a facility which has the potential for release of the analyte or contaminant?
- Does the location of the sample(s) show elevated levels for other analytes or for the results obtained from the same location in previous years?
- If several locations appear to be elevated, is there a particular year that had the elevated results? How did these compare to perimeter or off-site sample results?

As can be observed in many of the graphs, data at the lower end of the range frequently “falls off” in a manner that suggests that these results do not belong in the distribution being plotted, or are otherwise anomalous. However, in almost all instances, these results represent reported values that were at the extreme lower limit of the analytical method employed at the time of analysis. This is not atypical, since the plotted values do not include the analytical uncertainty or method detection level (MDL) for a given result. Also, the MDL changes (frequently becomes better) over time as the state-of-the-art for analytical science improves, and the aggregated data may include data that actually has a range of MDLs, which only becomes an artifact if the given analyte’s concentration is near the MDL. In several of the plots, many of the same reported values appear as a “flat line”. These values are typically the “less than” values reported by the laboratory when the analyte was not otherwise detected.

Appendix B contains the plots of the soil data. Any noteworthy anomalies in the plots are noted within the given plot. Associated with each plot presented in Appendix B are the summary statistics and EPA Region 9 Screening Levels for each analyte.

## References


Dragun and Dragun, J. and K. Chekiri, *Elements in North American Soils.* The Association for Environmental Chekiri Health and Sciences, Amherst, MA (2005).

Kabata - Pendias and Pendias 2002, *Trace Elements in Soils and Plants*, 3rd. Ed. CRC Press, Inc., Boca Raton, FL (2002).

Hawaii 2005. *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater,* Hawaii Hazard and Emergency Evaluation and Response (HEER) Office, *May 2005.*

Lieberman, G.J., 1958, "Tables for One-Sided Statistical Tolerance Limits," *Industrial Quality Control*, Vol. 14, No. 10.

McLish, T.J., L.C. Hall, L.L. Berg (1994), *"Evaluation of Metals and Radiologic Parameters in Surface Soil at Site 300" Appendix P - Data to support Baseline Risk Assessment in "Final Site-Wide Remedial Investigation Report Lawrence Livermore National Laboratory Site 300,* UCRL-AT-108131.

*Michels, D.E. (1971) "Lognormal Analysis of Data for Plutonium in the Outdoors", LA-4756, Los Alamos National Labs, 1971.*

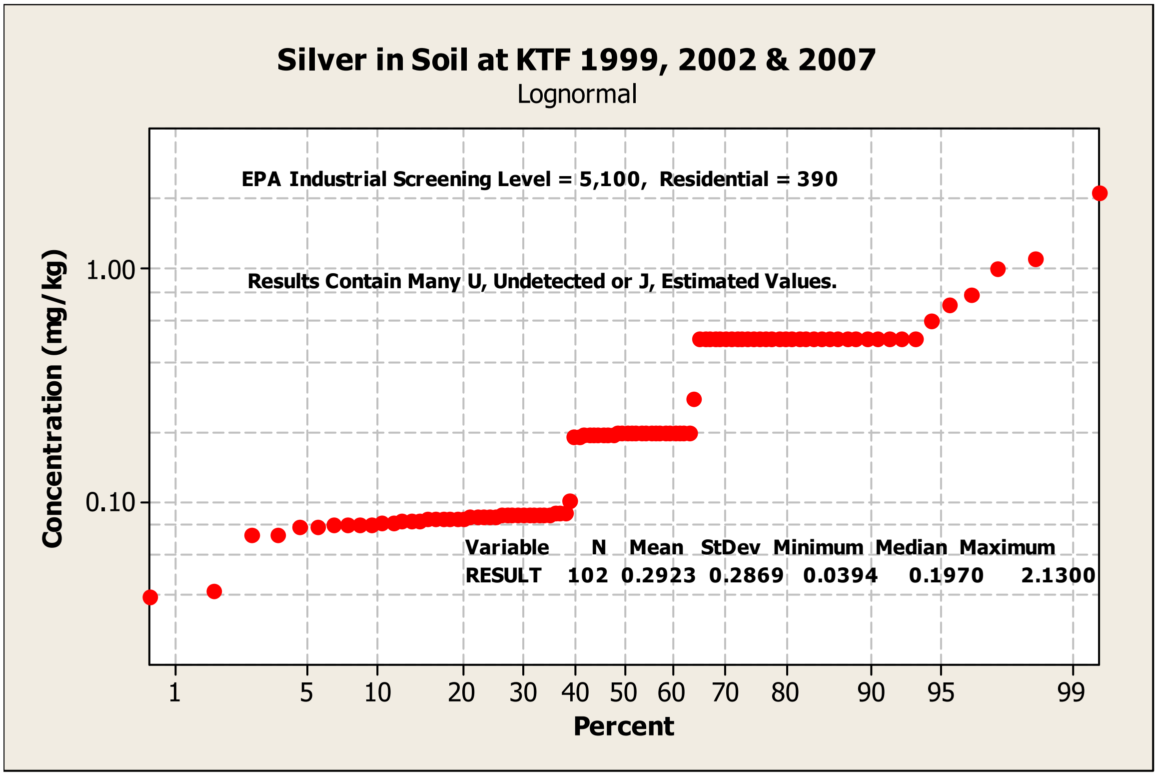
Miller, M.L., Fix, J.L. and Bramson, P.E 1977. *Radiochemical Analyses of Soil and Vegetation Samples Taken for the Hanford Environs, 1971-1976*. BNWL-2249.

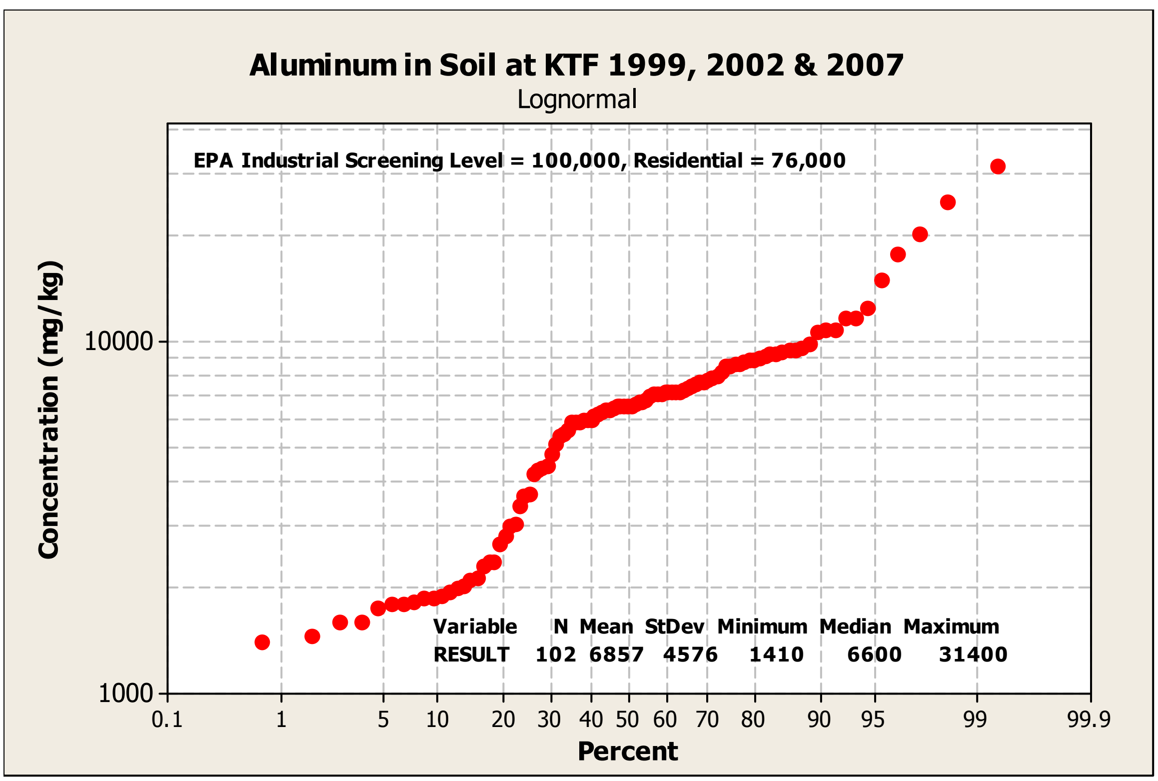
Shyr, Herrera, and Haaker 1998. *The Role of Data Analysis in Sampling Design of Environmental Monitoring*, SAND98-0612. Sandia National Laboratories, Albuquerque, NM (March 1998).

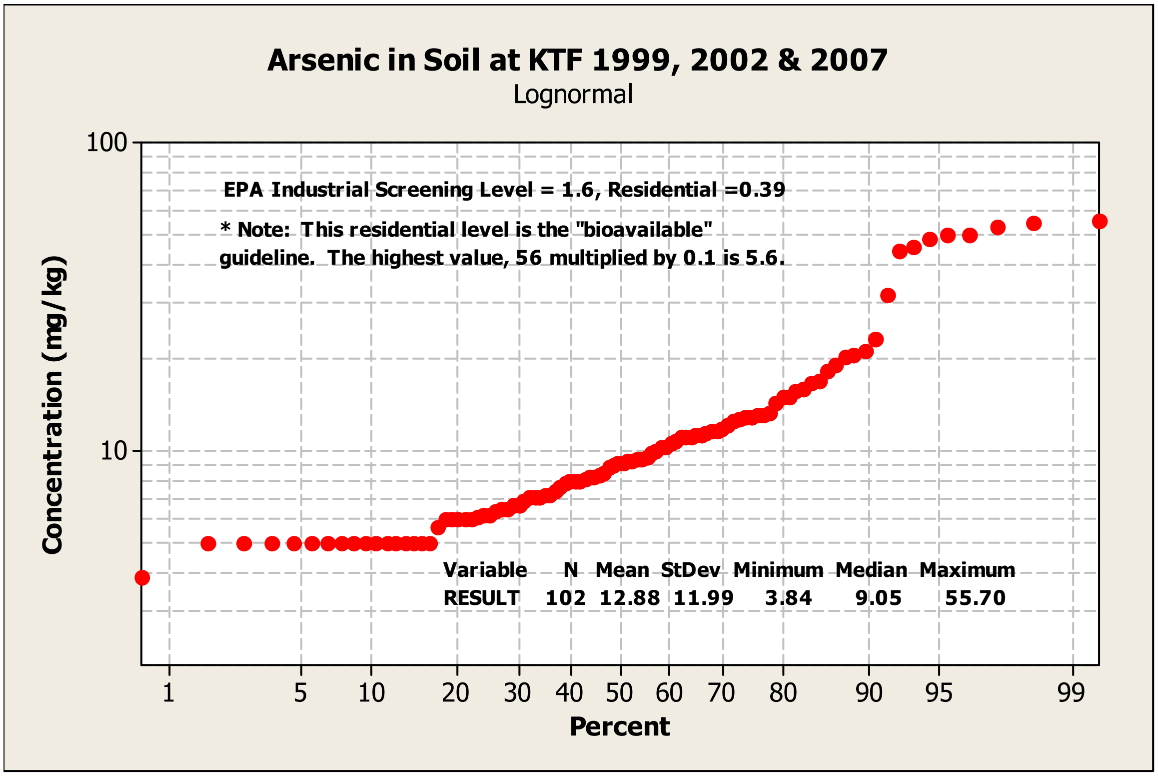
SNL 2003. *Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii*, SAND2003-2550, September 2003.

Waite, D.A., and Bramson, P.E. 1975. *Interpretation of Near Background Environmental Surveillance Data by Distribution Analysis,* IAEA-SM-202/706, Battelle, Pacific Northwest Laboratories, Richland, WA.

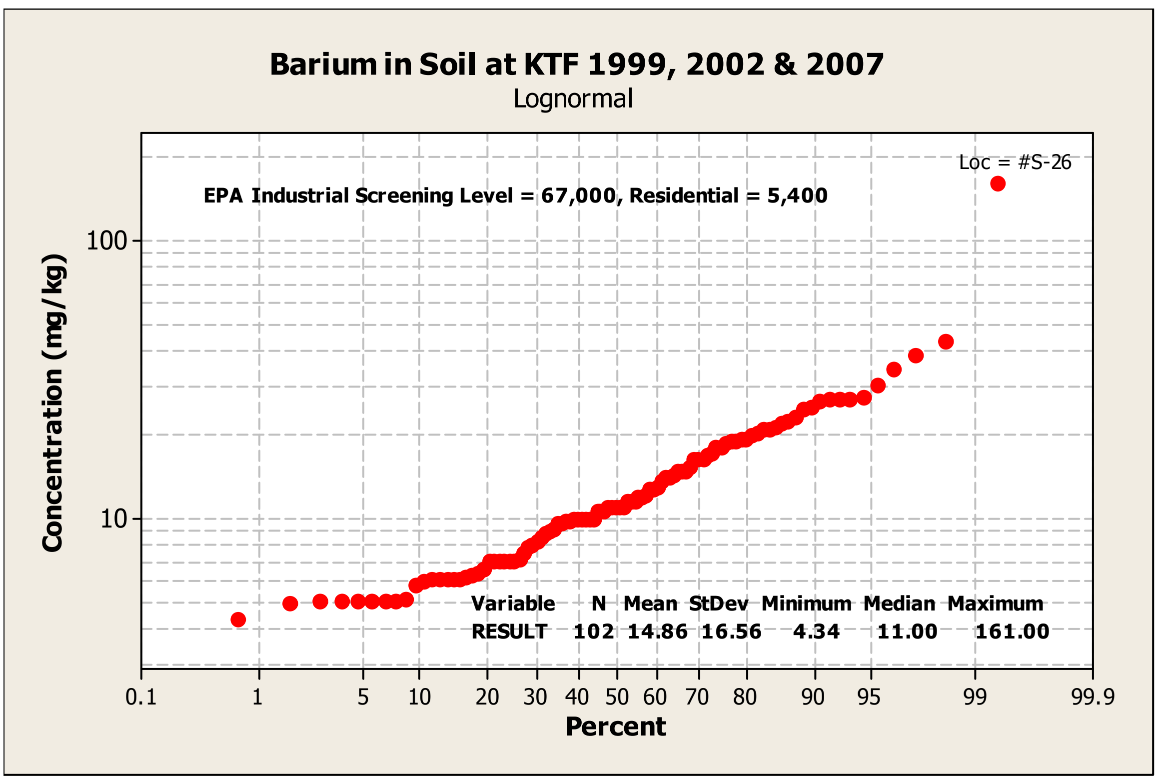
# Appendix B – TAL Metals in soil in the KTF Environs



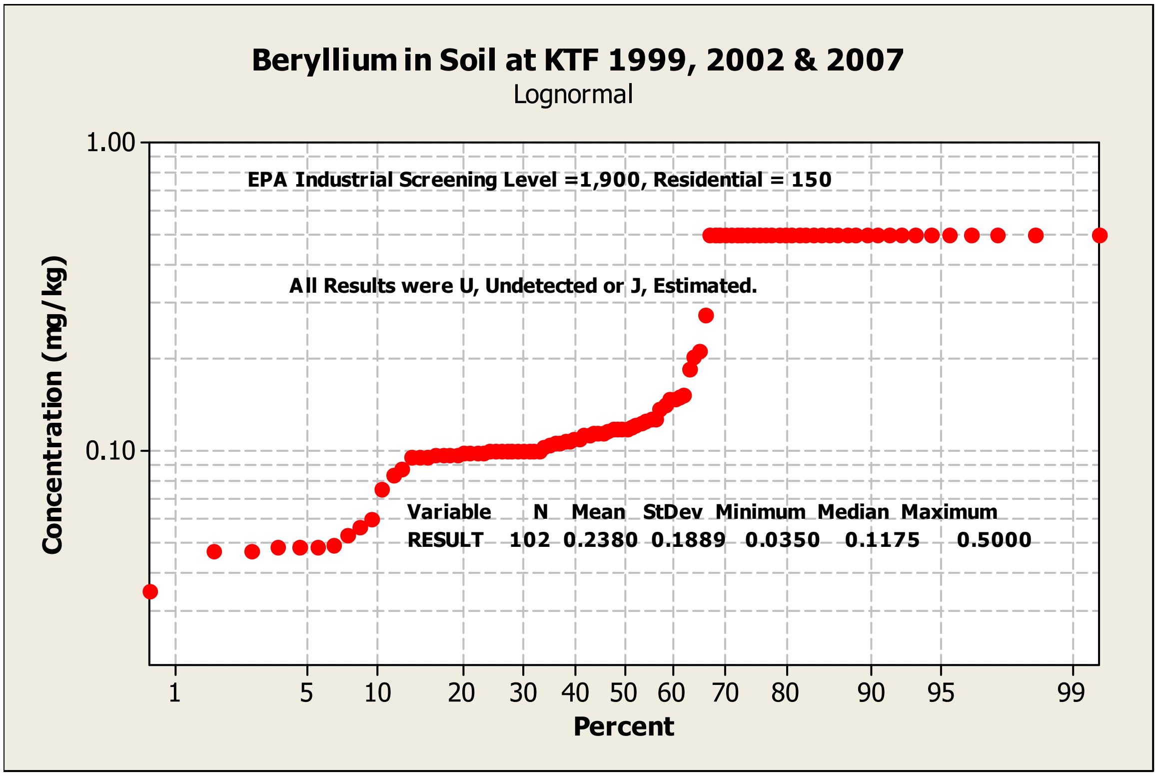



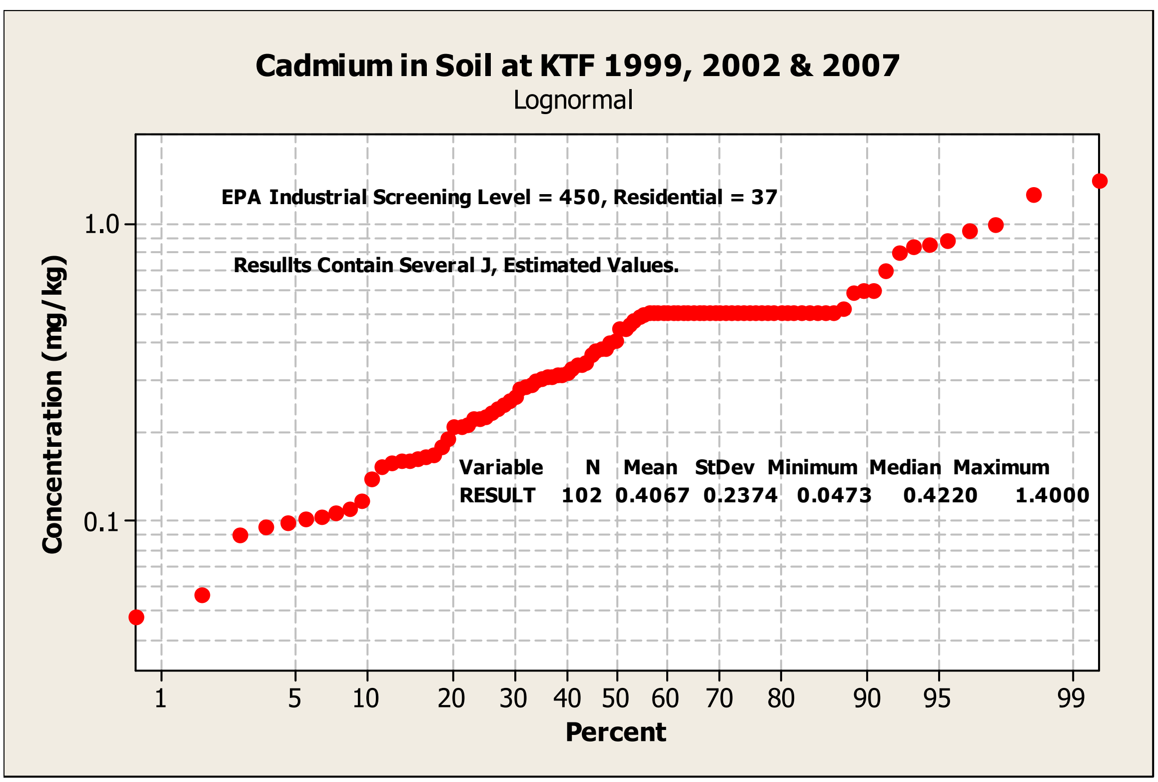


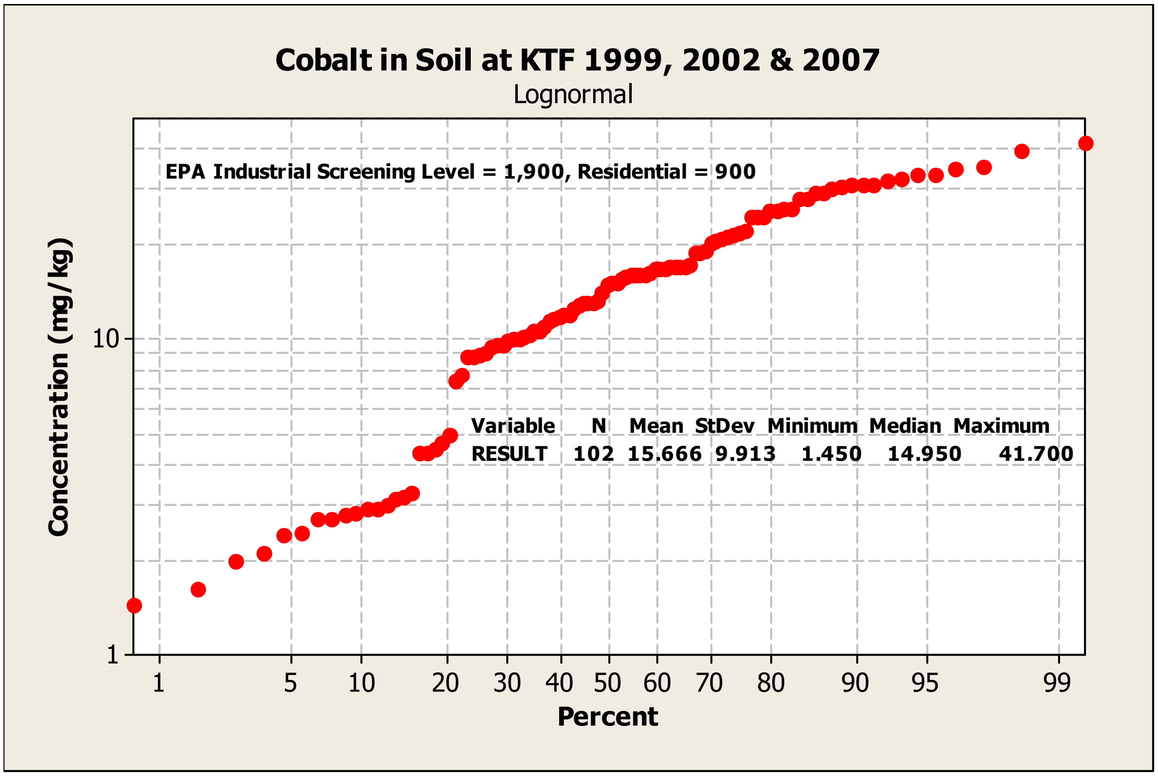
Arsenic in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
Percent
EPA Industrial Screening Level = 1.6, Residential =0.39
* Note: This residential level is the "bioavailable"
guideline. The highest value, 56 multiplied by 0.1 is 5.6.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 12.88 11.99 3.84 9.05 55.70

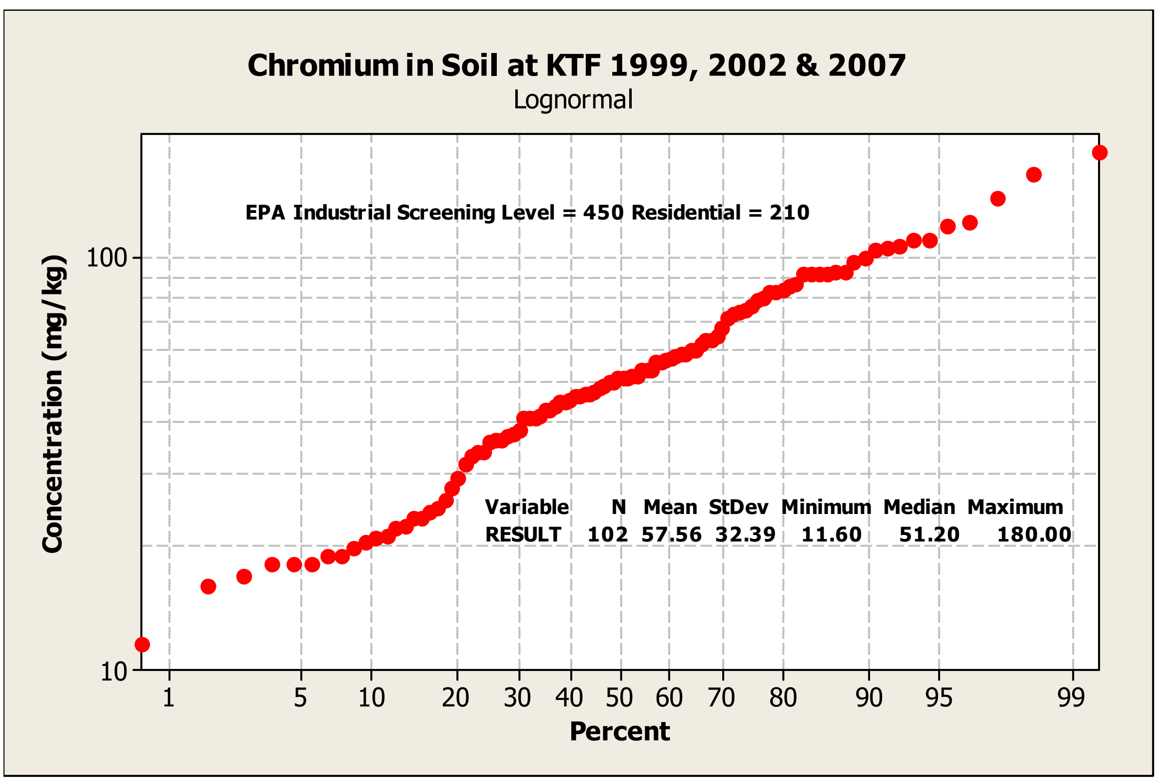



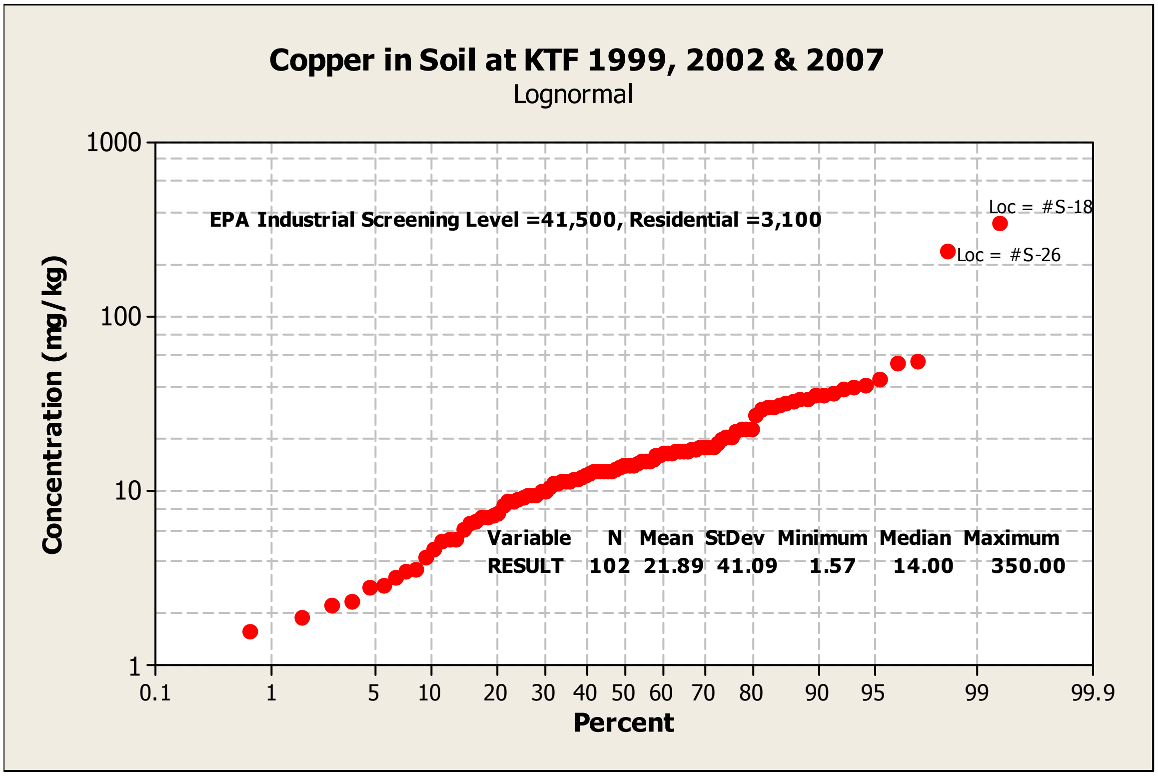
Barium in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
Percent
Loc = #S-26
EPA Industrial Screening Level = 67,000, Residential = 5,400
Variable N Mean StDev Minimum Median Maximum
RESULT 102 14.86 16.56 4.34 11.00 161.00

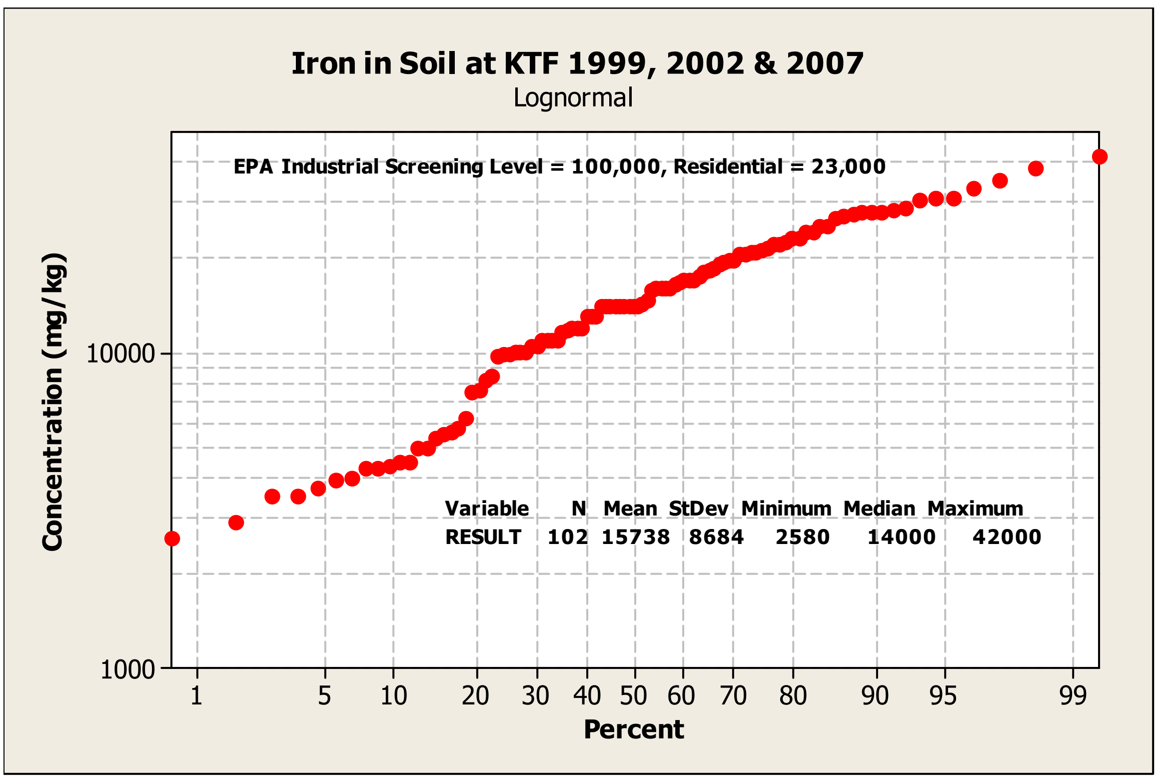

Beryllium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level =1,900, Residential = 150
All Results were U, Undetected or J, Estimated.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 0.2380 0.1889 0.0350 0.1175 0.5000
Concentration (mg/kg)
1.00
0.10
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

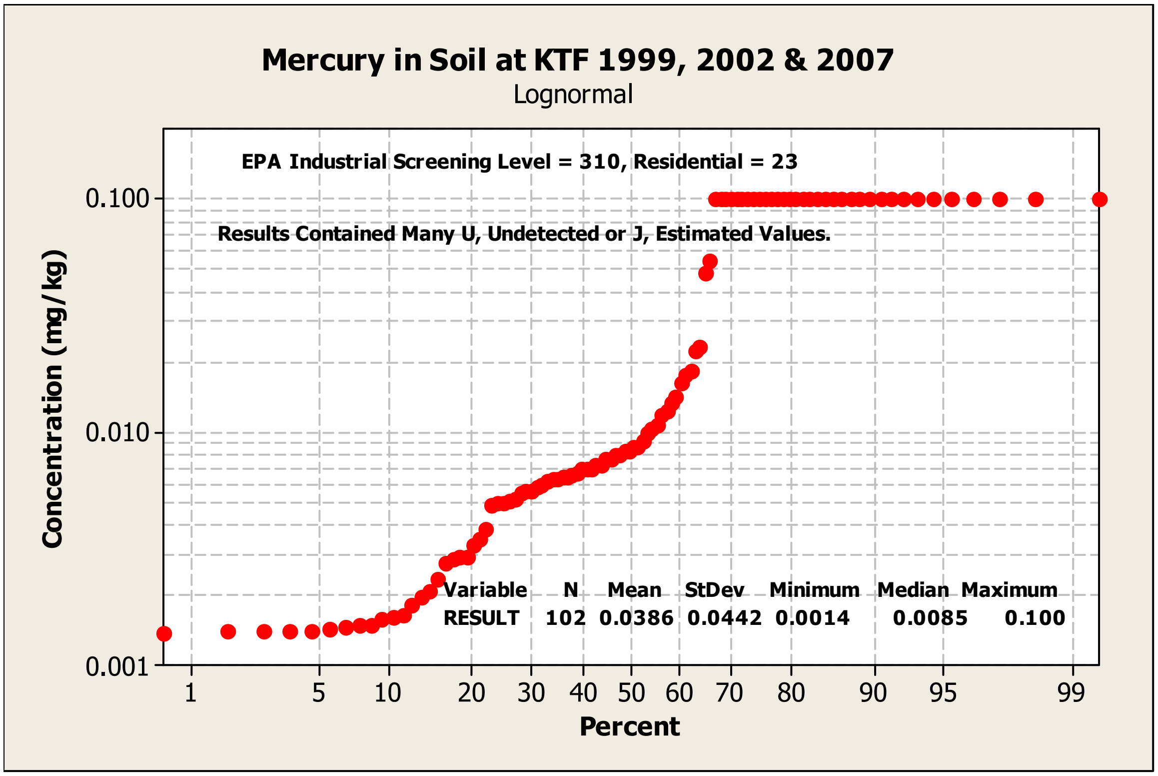

Cadmium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 450, Residential = 37
Resullts Contain Several J, Estimated Values.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 0.4067 0.2374 0.0473 0.4220 1.4000
Concentration (mg/kg)
1.0
0.1
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

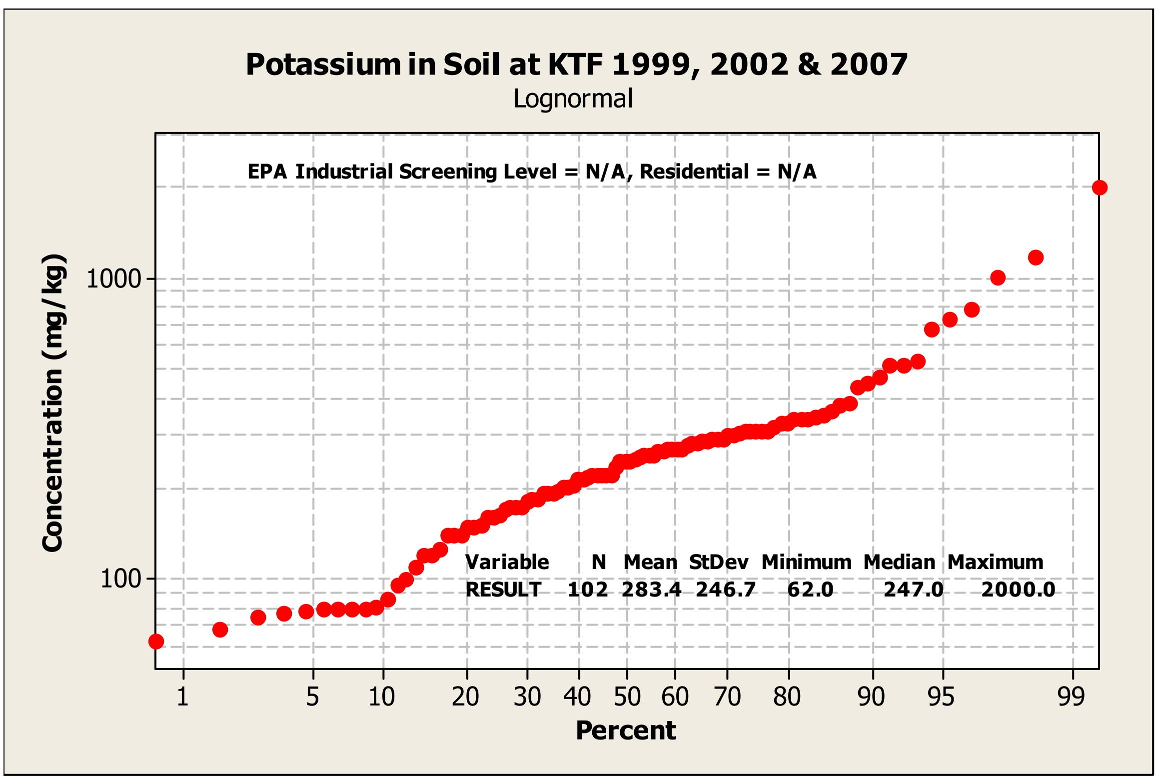

Cobalt in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 1,900, Residential = 900
Variable N Mean StDev Minimum Median Maximum
RESULT 102 15.666 9.913 1.450 14.950 41.700
Concentration (mg/kg)
10
1
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

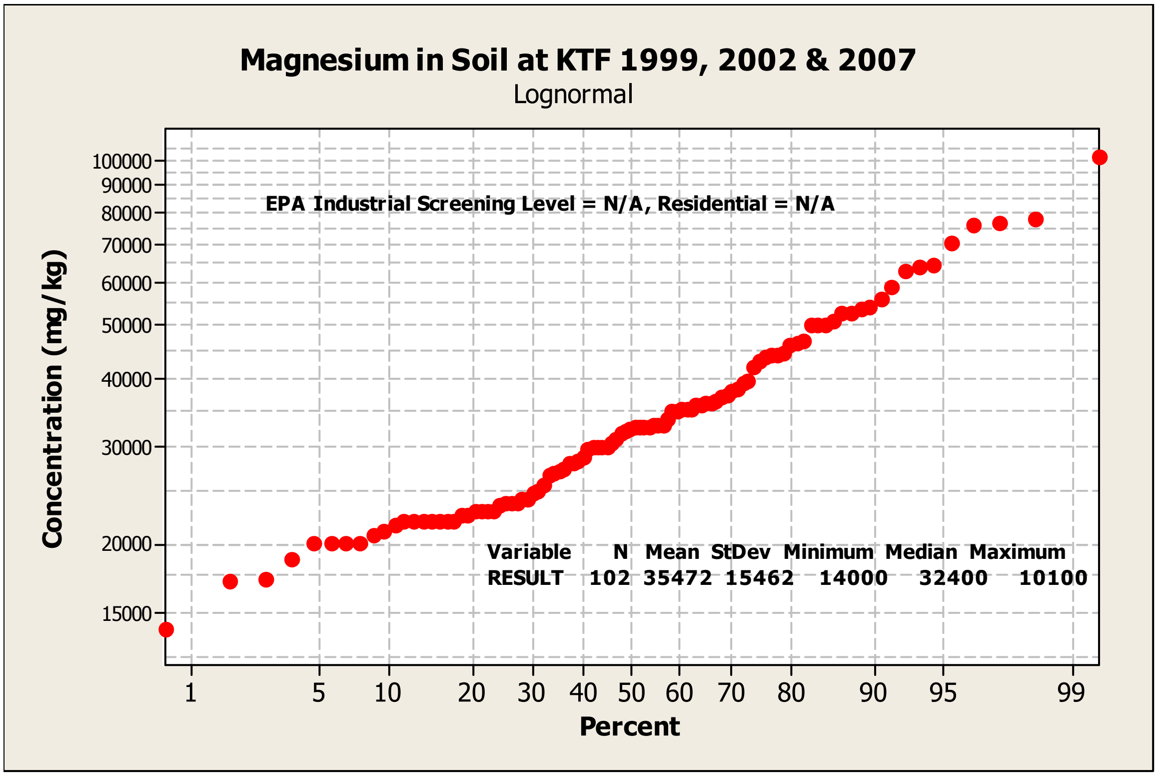

Chromium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 450 Residential = 210
Variable N Mean StDev Minimum Median Maximum
RESULT 102 57.56 32.39 11.60 51.20 180.00
Concentration (mg/kg)
100
10
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

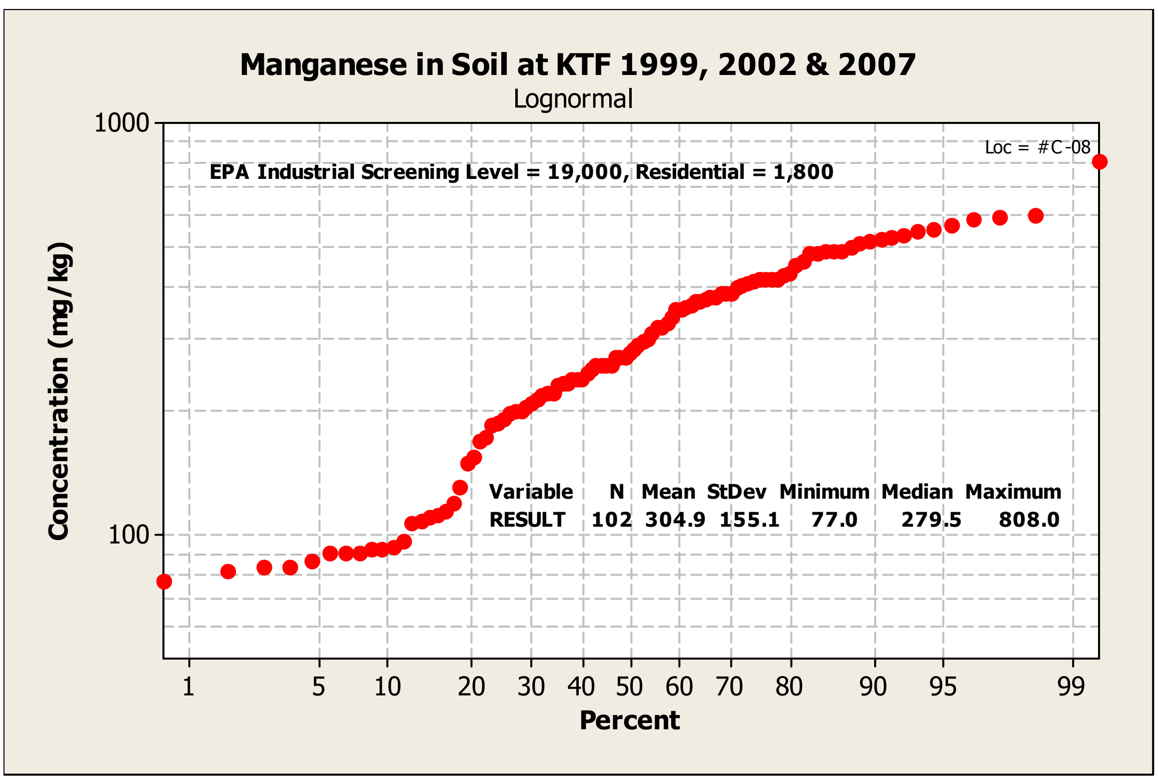

Copper in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
1000
100
10
1
EPA Industrial Screening Level =41,500, Residential =3,100
Loc = #S-18
Loc = #S-26
Variable N Mean StDev Minimum Median Maximum
RESULT 102 21.89 41.09 1.57 14.00 350.00
0.1 1 5 10 20 30 40 50 60 70 80 90 95 99 99.9
Percent

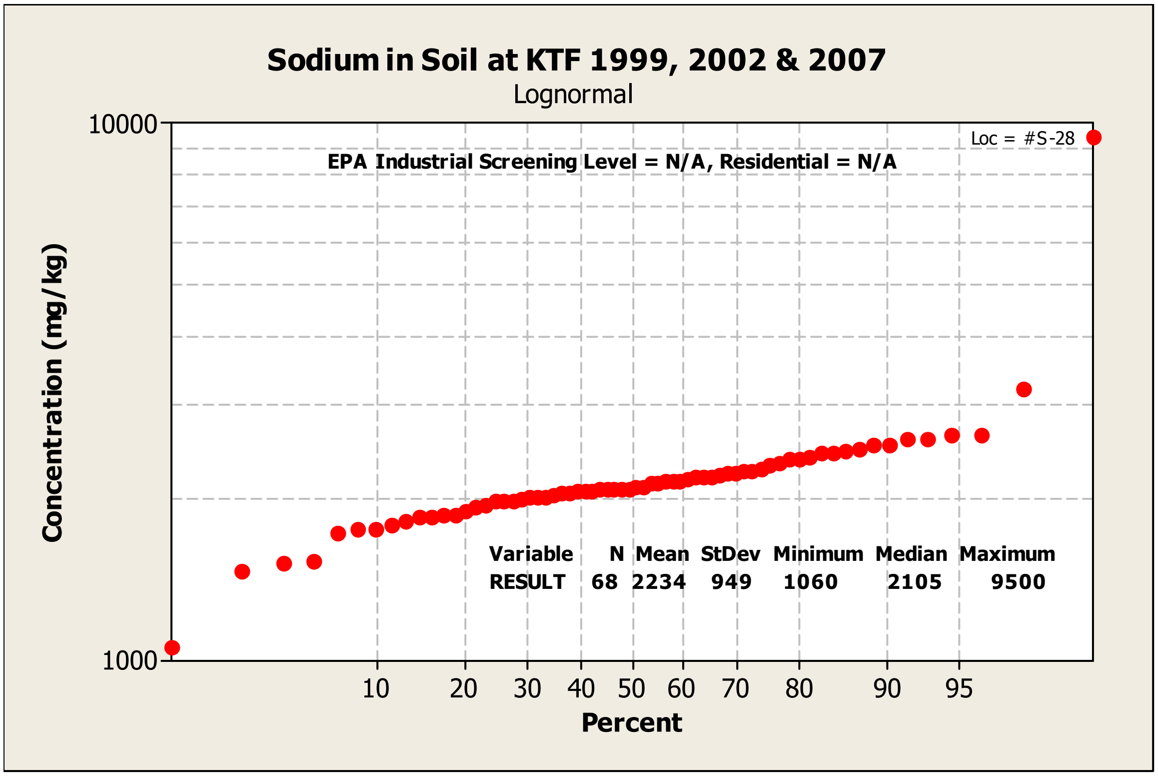

Iron in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
10000
1000
EPA Industrial Screening Level = 100,000, Residential = 23,000
Variable N Mean StDev Minimum Median Maximum
RESULT 102 15738 8684 2580 14000 42000
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

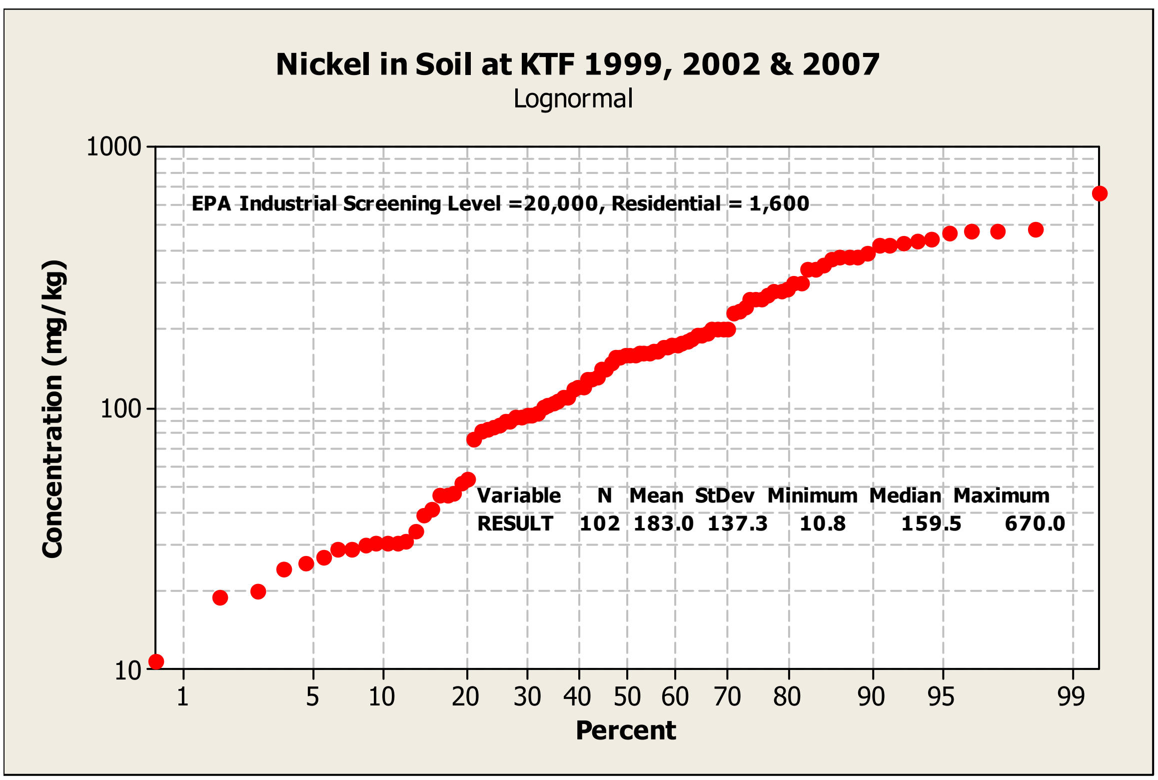

Mercury in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 310, Residential = 23
Results Contained Many U, Undetected or J, Estimated Values.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 0.0386 0.0442 0.0014 0.0085 0.100
Concentration (mg/kg)
0.100
0.010
0.001
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

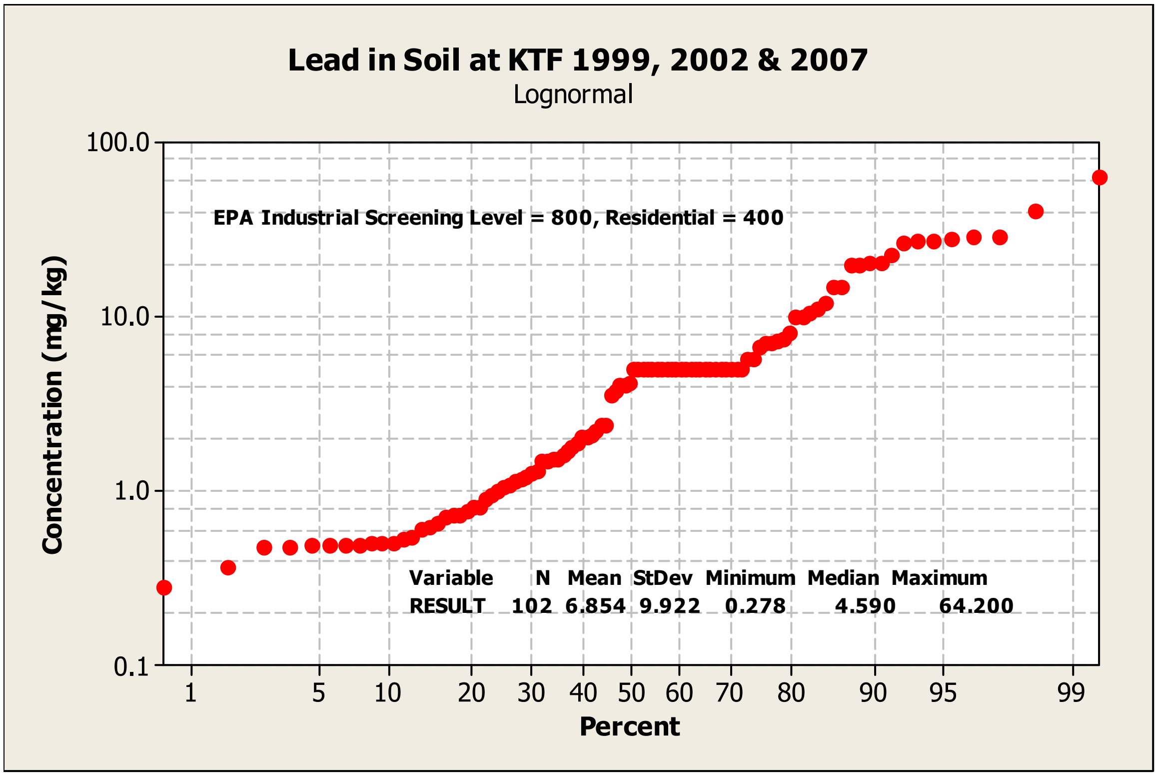

Potassium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = N/A, Residential = N/A
Variable N Mean StDev Minimum Median Maximum
RESULT 102 283.4 246.7 62.0 247.0 2000.0
Concentration (mg/kg)
1000
100
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

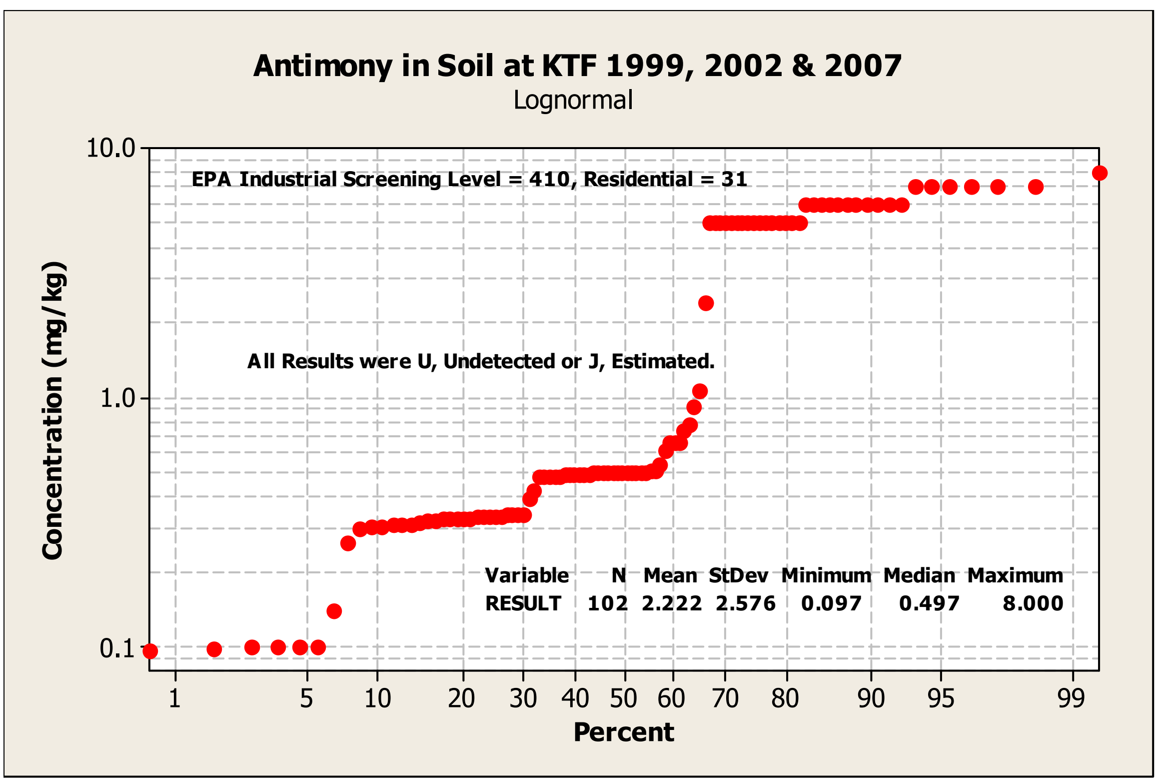

Magnesium in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
100000
90000
80000
70000
60000
50000
40000
30000
20000
15000
EPA Industrial Screening Level = N/A, Residential = N/A
Variable N Mean StDev Minimum Median Maximum
RESULT 102 35472 15462 14000 32400 10100
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

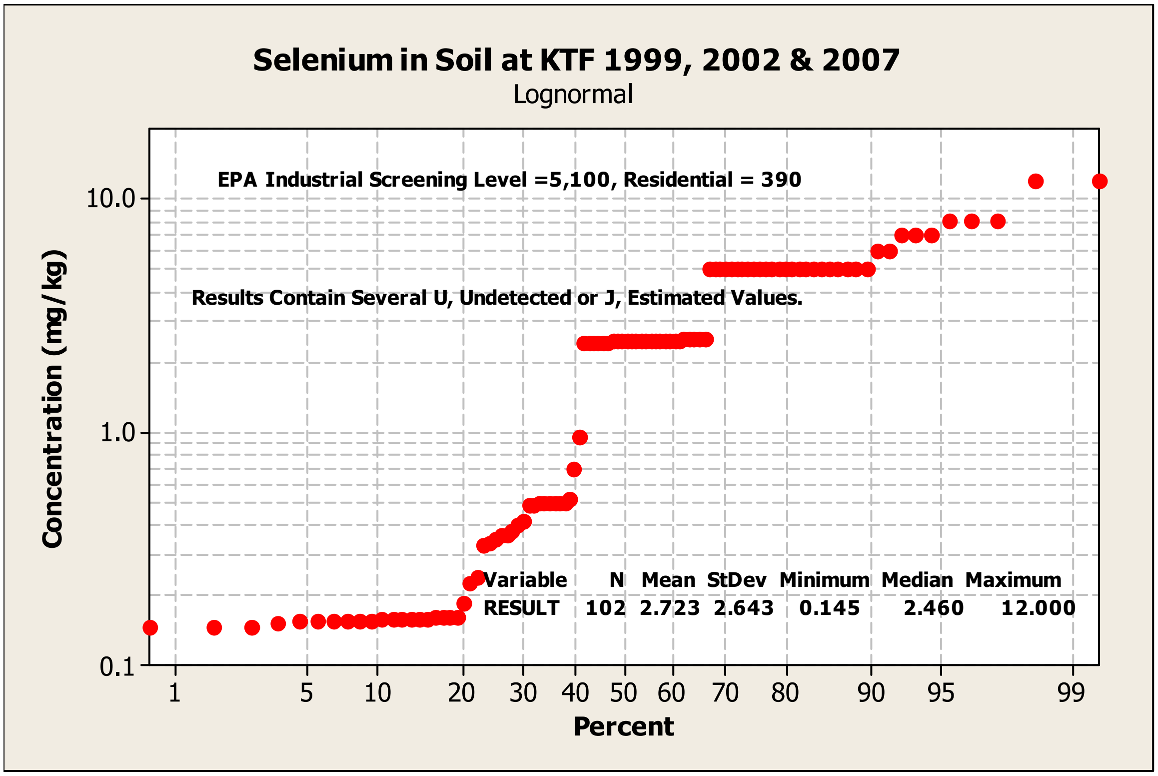

Manganese in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
1000
100
Loc = #C-08
EPA Industrial Screening Level = 19,000, Residential = 1,800
Variable N Mean StDev Minimum Median Maximum
RESULT 102 304.9 155.1 77.0 279.5 808.0
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent


Sodium in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
10000
1000
Loc = #S-28
EPA Industrial Screening Level = N/A, Residential = N/A
Variable N Mean StDev Minimum Median Maximum
RESULT 68 2234 949 1060 2105 9500
10
20
30
40
50
60
70
80
90
95
Percent

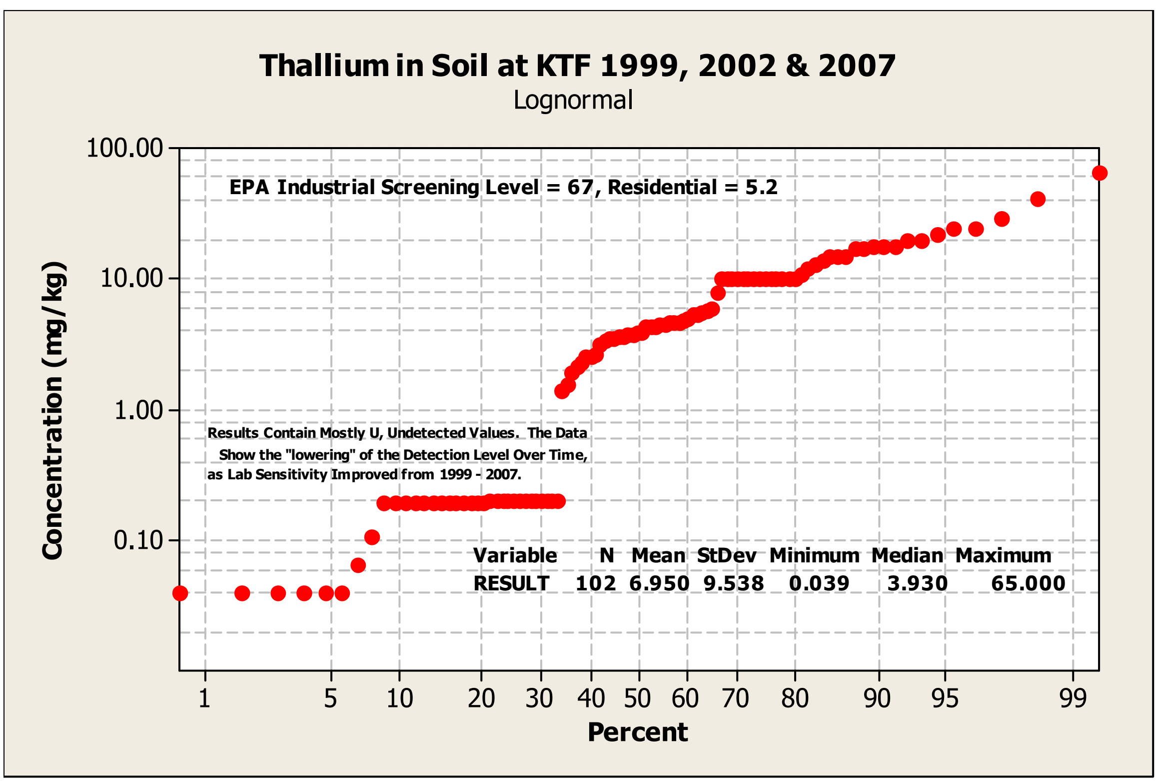

Nickel in Soil at KTF 1999, 2002 & 2007
Lognormal
Concentration (mg/kg)
1000
100
10
EPA Industrial Screening Level =20,000, Residential = 1,600
Variable N Mean StDev Minimum Median Maximum
RESULT 102 183.0 137.3 10.8 159.5 670.0
1
5
10
20
30
40
50
60
70
80
90
95
99
Percent


Lead in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 800, Residential = 400
Variable N Mean StDev Minimum Median Maximum
RESULT 102 6.854 9.922 0.278 4.590 64.200
Concentration (mg/kg)
100.0
10.0
1.0
0.1
1
5
10
20
30
40
50
60
70
80
90
95
99
Percent

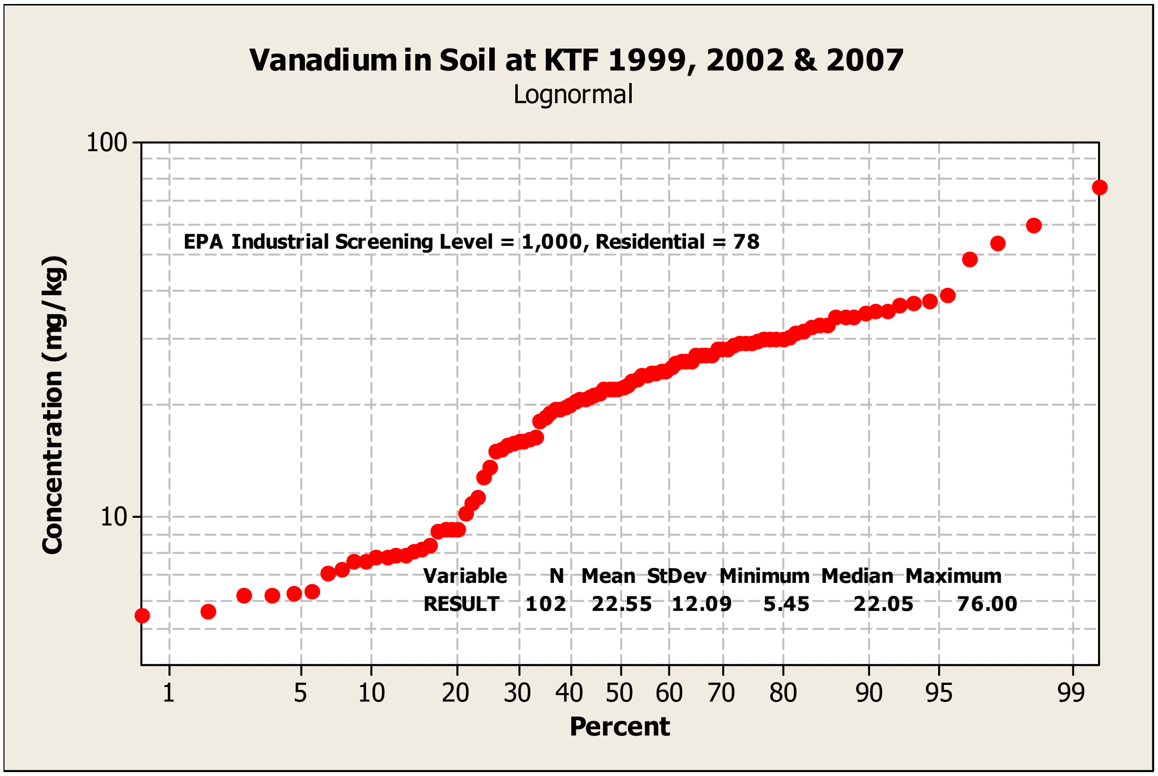

Antimony in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 410, Residential = 31
All Results were U, Undetected or J, Estimated.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 2.222 2.576 0.097 0.497 8.000
Concentration (mg/kg)
10.0
1.0
0.1
1
5
10
20
30
40
50
60
70
80
90
95
99
Percent

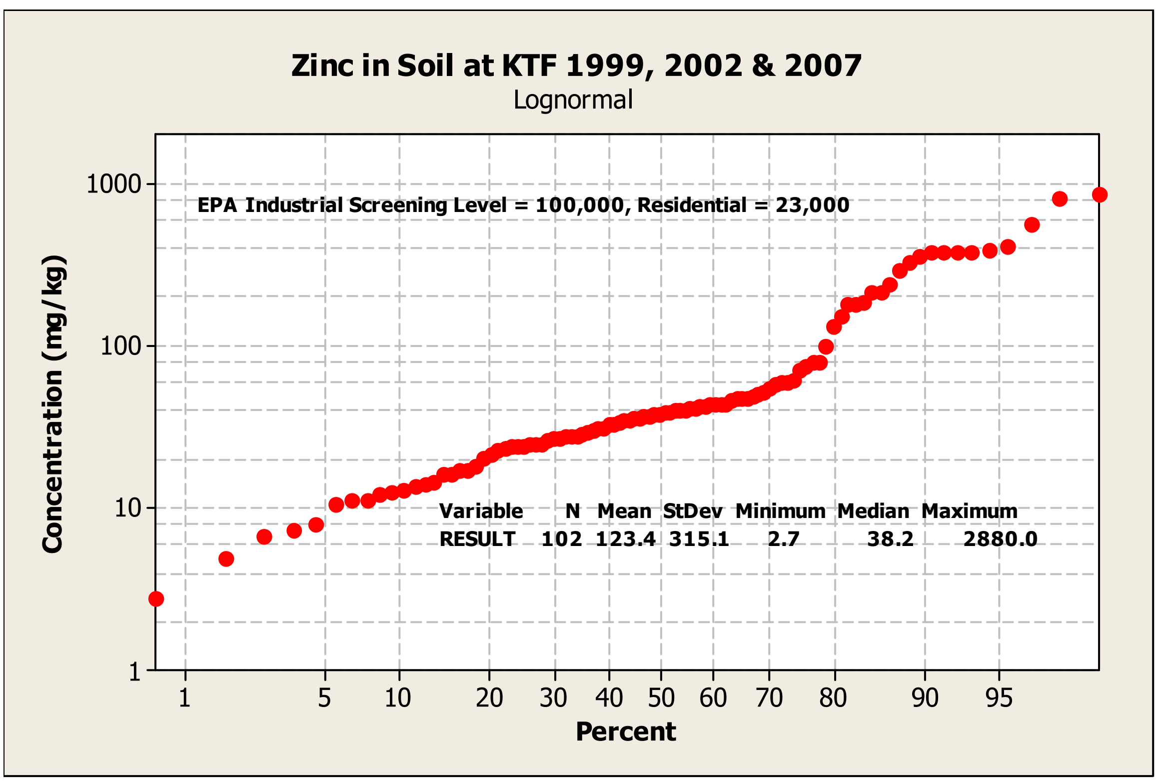


Selenium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level =5,100, Residential = 390
Results Contain Several U, Undetected or J, Estimated Values.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 2.723 2.643 0.145 2.460 12.000
Concentration (mg/kg)
10.0
1.0
0.1
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent

Thallium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 67, Residential = 5.2
Results Contain Mostly U, Undetected Values. The Data
Show the "lowering" of the Detection Level Over Time,
as Lab Sensitivity Improved from 1999 - 2007.
Variable N Mean StDev Minimum Median Maximum
RESULT 102 6.950 9.538 0.039 3.930 65.000
Concentration (mg/kg)
100.00
10.00
1.00
0.10
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent


Vanadium in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 1,000, Residential = 78
Variable N Mean StDev Minimum Median Maximum
RESULT 102 22.55 12.09 5.45 22.05 76.00
Concentration (mg/kg)
100
10
1 5 10 20 30 40 50 60 70 80 90 95 99
Percent


Zinc in Soil at KTF 1999, 2002 & 2007
Lognormal
EPA Industrial Screening Level = 100,000, Residential = 23,000
Variable N Mean StDev Minimum Median Maximum
RESULT 102 123.4 315.1 2.7 38.2 2880.0
Concentration (mg/kg)
1000
100
10
1
1 5 10 20 30 40 50 60 70 80 90 95
Percent

# Distribution

| | | | |
|---|---|---|---|
| 2 | MS9018 | Central Technical Files | 8945-1 |
| 2 | MS0899 | Technical Library | 4536 |

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