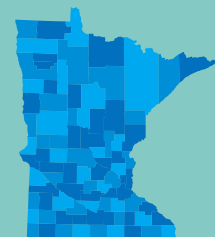


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# Soil Background Threshold Value Evaluation

Environmental Analysis and Outcomes Division



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# Introduction

This version replaces the draft releases of this document in June 2015 and September 2016.

The Minnesota Pollution Control Agency (MPCA) revised the soil reference values (SRVs) and released draft SRVs in October 2014, June 2015, and September 2016. SRVs are derived based on U.S. Environmental Protection Agency's (EPA) methodology, toxicity values, exposure parameters and chemical specific information. They do not take natural or ambient background into consideration. MPCA estimated that there were SRVs for eight inorganics and two organics that might be below background soil concentrations. As a result, MPCA's Environmental Analysis and Outcome (EAO) Division conducted an evaluation to determine if the health based SRVs were below background concentrations and if necessary, establish appropriate soil background values (Background Threshold Values or BTVs).

All references in this document to the concentration of a chemical in soil are based on dry weight.

**For the purposes of this document, background is defined as indicated below.**

## Natural background

Natural background is defined as the amount of chemical present in soil or sediment due to geological characteristics or releases from non-anthropogenic sources (examples: forest fires, volcanic activity). This does **not** include releases from local anthropogenic sources or from distant anthropogenic sources of persistent chemicals due to their ability to be transported long distances. If a chemical's risk-based value (protective of human or ecological risk) is less than a natural background value, it is appropriate to use the natural background value instead of the risk-based value.

There are some cases where either obtaining concentrations representing natural background is unrealistic or anthropogenic concentrations of some chemicals are ubiquitous in the environment. In these cases, it may be appropriate to replace a risk-based value with an ambient background value.

## Ambient background

Ambient background of chemicals in soil and sediment is defined differently depending on the goals of a project and the area being addressed. MPCA's Water Quality Standards Unit most often uses ambient background to describe either:

- A value that is appropriate to replace a risk-based value or
- The amount of a chemical that is ubiquitously present in the environment

This can be accomplished for different sized areas such as the entire state, a city, rural area or a defined specific site.

In cases where the goal is to replace a risk-based value, ambient background levels are defined as the amount of a persistent chemical that may be present in soil or sediment from distant anthropogenic sources. In this context, it is not appropriate to include local anthropogenic sources. Some examples of chemicals where ambient concentrations may be appropriate to use rather than natural are benzo[a]pyrene (B[a]P) and 2,3,7,8-tetrachlordibenzo-p-dioxin (TCDD).

In cases where the goal is to report the amount of a chemical present in the environment, all natural and anthropogenic sources may be included. There may be some instances where certain sources are or are not included depending on the goal of the project which will be clearly stated in the purpose of the project.

# Inorganics

The eight SRVs for inorganics that could be below background include aluminum, arsenic, barium, chromium, cobalt, iron, thallium and vanadium.

## USGS soil survey

MPCA used the United States Geological Survey's (USGS) geochemical and mineralogical survey of soils to evaluate whether the SRVs for the eight inorganics were below background values and if so, establish BTVs. The USGS collected soil samples from 2007 to 2010 in the conterminous United States. Soil from a total of 137 sites was collected in Minnesota. Laboratory analysis of the soil samples was completed in 2013. Measures were taken to collect samples from soils that were not impacted by local anthropogenic sources. Samples at each site were obtained from three different intervals below the ground surface: 0 to 5 cm, A horizon and C horizon (USGS 2013). Splits of all samples collected by the USGS are stored in a sample archive in the USGS Denver facility.

## Analytical methods

Soil preparation and analytical methods used by the USGS for their study differ from the EPA's methods typically used for cleanup sites. Inorganic concentrations obtained using these two methods are not consistent. Differences in concentrations resulting from the two methods are also not consistent across the state as these differences vary depending on the geological characteristics of the area where the sample was taken and also by the specific nature of the individual inorganic. Previous studies have shown that for most elements, USGS's analytical method results in higher concentrations than EPA's analytical methods. The differences are most likely due to the preparation methods.

## Preparation methods

Sample preparation using USGS's method includes air drying at ambient temperature, sieving to less than 2 mm and grinding to less than 150  $\mu\text{m}$ . EPA's method includes suggestions for sample homogenization but leaves the final decision on how to prepare an individual sample up to the laboratory. A consequence is that the USGS methods result in finer grain sized samples compared to samples prepared using EPA's method, thus increasing the soil particle surface area that can be digested.

A near-total four acid digestion is used in the USGS method. Ground samples are digested with a mixture of hot nitric, hydrochloric, hydrofluoric and perchloric acid. Samples for arsenic analyses are first fused in a mixture of sodium peroxide and sodium hydroxide and then dissolved in hydrochloric acid. This type of aggressive digestion yields higher concentrations for some inorganics than a less aggressive type of digestion.

The EPA methods (SW846 3050B or 3051A) use a less aggressive aqua regia digestion. For arsenic and thallium analyses, digestion is accomplished using hydrogen peroxide and nitric and hydrochloric acid. Digestion for the other inorganics is accomplished using hydrogen peroxide and nitric acid. These digestions are not intended to be total digestion techniques but will dissolve analytes that could become environmentally available.

Generally, the amount of silicate minerals present in an area seems to influence differences between the results of the two analytical methods. The most common silicate minerals in Minnesota soils are quartz, feldspar, and clay.

## Laboratory analytical techniques

Inorganics in the soil samples analyzed as part of USGS's soil survey using USGS's method were detected using the following analytical techniques:

- Inductively coupled plasma – atomic emission spectrometry (ICP-AES) for aluminum, chromium, iron and vanadium
- Inductively coupled plasma – mass spectrometry (ICP-MS) for cobalt and thallium
- Hydride-generation atomic absorption spectrometry for arsenic

Laboratory analytical techniques used in EPA's method of analysis are provided in the EPA method reanalysis section below.

## Analytical results

There is some uncertainty in the reported results from laboratory analytical testing. This is a result of sampling technique, the chosen aliquot of sample to be analyzed by the laboratory and laboratory analysis methods. Because of this uncertainty, a 20% variance as a decrease or increase from the reported results of analytical testing of inorganics is generally acknowledged. For example, if the actual soil concentration is 100 mg/kg, the analytical results could be reported somewhere between 80 to 120 mg/kg.

Background concentrations of chemicals found in soil vary depending on the local geology and physical and chemical properties of the soil. They are heterogeneous both laterally and vertically and over small and large areas. Although MPCA calculates one background value for purposes of screening, chemical background concentrations are more accurately described as a range, rather than one value, due to this variation. It is important to consider these factors when evaluating whether observed concentrations are a result of a release or background.

## EPA method reanalysis

MPCA's EAO and Remediation Divisions reanalyzed a subset of USGS's soil samples to determine what the differences were between USGS's and EPA's methods for the eight inorganics in Minnesota soils. The reanalyzed USGS soil samples were outside of their holding time when they were reanalyzed. Samples had been stored at room temperature in a sample archive in the USGS Denver facility since they were collected. Although the longer than normal storage time under room temperature conditions is not expected to significantly impact the results of the analysis, this has not been confirmed by laboratory testing.

Samples from the 0 to 5 cm depth below the ground surface were chosen to be reanalyzed for the following reasons:

- When people are expected to be exposed to deeper soils or ecological species are of concern, the concentrations of inorganics are similar between the 0 to 5 cm and A horizon
- People are more likely to be exposed to surface soils in most cases
- Surface soil is typically evaluated at cleanup sites

If there is an exposure concern regarding soil at deeper depths, appropriate background values should be established on a site-specific basis.

A subset of 48 USGS 0 to 5 cm depth soil samples (out of 137 total available samples) was chosen to be reanalyzed using EPA's soil analytical method. Samples were selected based on the following factors (Figure 1A, Table 1):

- 24 samples (listed below) were chosen in a stratified random fashion to represent differences in geology across the state, representing varying abundances of quartz and clay in soil. Varying proportions of these two silicate minerals are a good proxy for varying soil parent materials (Figures 1B, 1C).
  - Samples 168, 665, 985, 1589, 2216, 2713, 3125, 3545, 3993, 4120, 4953, 5017, 7112, 7129, 7577, 7797, 8053, 8089, 8665, 8757, 9160, 9845, 10649 and 11573
- 14 samples (listed below) were chosen in a stratified random fashion to represent the different major land resource areas and land cover across the state which incorporated variations in vegetation and climate (Figure 1D, Table 1).
  - Samples 1753, 2009, 4040, 5337, 6553, 7065, 9881, 10137, 11317, 11893, 12341, 12505, 12761 and 12904
- An additional group of 10 samples (listed below) was chosen based on their proximity to major cities and the Minnesota River to capture those areas with potentially higher populations (Figure 1D).
  - Samples 12853, 10293, 12917, 10869, 3944, 5288, 12136, 11161, 2265 and 12232

Three of these samples (7797, 8757 and 12853) were not reanalyzed since they could not be located in the USGS archive. Therefore a total of 45 USGS samples were reanalyzed using EPA's soil analytical method (36 samples were chosen in a stratified random fashion and nine samples were chosen based on their proximity to major cities and the Minnesota River).

Samples were analyzed by Pace Analytical Services, Inc. using EPA Method 6010C for aluminum, barium, chromium, cobalt, iron and vanadium via ICP-AES and EPA Method 6020A for arsenic and thallium via ICP-MS (Pace Analytical 2015).

## SRVs and BTVs

SRVs and BTVs are both used to evaluate cleanup sites. The difference between these values and their appropriate use is listed below.

- **SRVs**
  - Derived based on EPA's methodology, toxicity data, exposure parameters and chemical-specific information
  - SRVs are compared to the **95% upper confidence limit (95% UCL) of the mean site concentration or the maximum site concentration if a 95% UCL cannot be calculated**
- **BTVs**
  - Established based on an upper percentile estimate of a background dataset representative of natural background for inorganics or in this case ambient background for organics such as B[a]P
  - BTVs are compared to the **maximum site concentration**
  - When a maximum concentration exceeds a BTV, the Proportions test may be used to determine if an allowable proportion of the site dataset would likely exceed a BTV

## Rounding exposure concentrations

When it is necessary to round an exposure concentration to compare to a BTV the concentration should be rounded up or down following the accepted mathematical procedure. The last digit in the concentration past the last digit in the BTV is rounded down if it is less than 5 and rounded up if it is equal to or greater than 5. For example:

- If a concentration of 10.2 mg/kg is being compared to a BTV of 10 mg/kg, the 10.2 would be rounded to 10 mg/kg and would not be considered an exceedance.
- If a concentration of 10.5 mg/kg is being compared to a BTV of 10 mg/kg, the 10.5 would be rounded up to 11 mg/kg and be considered an exceedance.

## Minnesota specific USGS maps

The USGS created maps that show the spatial distribution of each inorganic across the conterminous United States as an interpolated and smoothed average color surface maps (USGS 2014). MPCA used a subset of the USGS points to create similar interpolated surfaces, requiring the points fall inside of Minnesota. The interpolated surfaces were made with ESRI's ArcMap geographical information system software using an inverse distance weighted method to create a continuous grid across Minnesota. The values produced by the grid match the range of values of the input points. Values do not go outside the actual observed values for any of the points. The grid is made up of cells that are just under 3 km<sup>2</sup>. There are several 'bull's-eye' patterns around points. USGS's color scheme ranging from blues (lowest concentrations) to reds (highest concentrations) was used. There are ten classes for all maps except thallium which has seven. The color breaks match to about 10% of the data.

These Minnesota specific inorganic maps represent data from USGS's complete dataset. They are shown in Figures 2 through 9.

## ProUCL

ProUCL is free statistical software developed by EPA to be used at cleanup sites. It provides outlier tests, estimates the distribution of a dataset and provides potential BTVs (ProUCL 2013).

Each dataset was evaluated for potential outliers by using the Rosner outlier test, Q-Q plots, histograms and box plots generated using ProUCL, version 5.0. Potential outliers should only be removed if there is evidence to suggest there was an error during sampling or laboratory analysis. If no error can be found, but the values are still thought to be potential outliers based on results of the Rosner test and evaluation of the plots, the dataset is evaluated both with and without outliers. Any differences in the results of the two datasets is evaluated to ensure a reasonable decision is made to establish a BTV.

Dataset distribution and BTVs were determined using the "Upper Limit-BTVs" calculation in ProUCL. This calculation can be used for datasets that include non-detect data as well as datasets that do not contain non-detect data. ProUCL determines whether the dataset is parametric (fits a normal, gamma or lognormal distribution) or nonparametric and whether there is non-detect data present and provides the following types of BTVs:

- Upper Percentiles
- Upper Prediction Limits (UPL)
- Upper Simultaneous Limit (USL)
- **Upper Tolerance Limit (UTL)**

Upper percentiles and UPLs are not appropriate to use in this type of application where there will be a large number of comparisons to the BTV due to high false positive error rates. This means a larger number of soil concentrations from sites that actually reflect background levels will exceed the BTV and appear as if they are contaminated.

USLs are not appropriate to use in this type of application since they represent an upper limit on the largest value of the dataset and would result in high false negative rates. This means a large number of soil concentrations from sites that actually are contaminated will not exceed the BTV and appear like they represent background levels.



**UTLs were chosen as the appropriate statistic to determine BTVs** since they are appropriate to use in this type of application where there will be a large number of comparisons to the BTV. The use of UTLs as BTVs are not likely to result in large false positive or negative error rates. In some cases, the coverage of the UTL may be adjusted to account for the differences between the USGS and EPA analytical methods for a specific inorganic but the confidence coefficient of 0.95 is always used. For example, a UTL95-95 represents the 95% upper confidence limit on the 95<sup>th</sup> percentile; a UTL95-85 represents the 95% upper confidence limit on the 85<sup>th</sup> percentile. ProUCL refers to the percentile as coverage. For example, a 95% UTL with 90% coverage represents the 95% upper confidence limit on the 90<sup>th</sup> percentile.

ProUCL calculates BTVs for datasets that have non-detect data and datasets that do not contain non-detect data. Several methods are included to handle the non-detect data: Kaplan Meier (KM), regression on order (ROS) statistics and substitution methods. Although substitution methods are no longer recommended to be used, they are included since they have been used historically and can be useful for comparison purposes. Substitution method UTLs have been provided in this evaluation as supplemental information only.

Since lognormal BTVs tend to be unrealistically high, they are not recommended to be used. Lognormal UTLs have been provided in this evaluation as supplemental information only.

EPA does not recommend using nonparametric bias-corrected accelerated (BCA) Bootstrap BTVs since they are still being investigated by EPA. Nonparametric BCA Bootstrap UTLs have been provided in this evaluation as supplemental information only.

## Inorganics – evaluation

After the 45 soil samples from USGS were reanalyzed using EPA’s laboratory analytical methods, there were three soil background datasets:

- Entire Minnesota USGS dataset (137 samples)
  - Analysis performed using USGS method
- Subset of USGS dataset (45 samples)
  - Analysis performed using USGS method
- Subset of USGS dataset (45 samples)
  - Reanalysis using EPA method

MPCA determined that it was appropriate to derive BTVs based on the EPA reanalyzed samples even though they were not all chosen randomly (36 of the 45 samples were chosen randomly and nine were not; see EPA method reanalysis section above) because sample analysis for remediation sites is usually conducted using EPA methods.

The datasets were evaluated to determine the following.

- Differences in concentrations across the state of Minnesota using Minnesota specific USGS maps
- Potential outliers using USGS’s complete dataset (137 samples) and EPA’s ProUCL software
- BTVs using the EPA reanalyzed 45 sample dataset and EPA’s ProUCL software

## Inorganics – results

### Aluminum

#### **USGS complete dataset (137 samples)**

Based on the USGS complete dataset, it appears that aluminum background concentrations vary across the state. Higher concentrations are present in the southwest to mid-south, northwest, and northeast portions of the state (Figure 2).

The USGS complete aluminum dataset did not include any non-detect data (Table 2A). Two potential outliers were found at the 5% and 1% significance levels: 2,900 mg/kg (Lab ID C-338083, Site ID 473) and 10,000 mg/kg (Lab ID C-338144, Site ID 2777). One potential outlier was found at the 5% significance level but not at the 1% significance level: 73,900 mg/kg (Lab ID C-338193, Site ID 4953). Both datasets, with and without potential outliers, were evaluated for BTVs using EPA's ProUCL software. Only outliers identified at both the 5% and 1% significance levels were removed during evaluation of the dataset without potential outliers.

#### **USGS and EPA data subsets (45 samples each)**

Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -95% to -67% (Table 2B). An approximate -70% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 2C).

#### **Conclusion**

Table 2D summarizes ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for aluminum is 19,000 mg/kg.***

### Arsenic

#### **USGS complete dataset (137 samples)**

Based on the USGS complete dataset, it appears that arsenic background concentrations vary across the state. Higher concentrations are present predominantly in the southwest portion of the state. Some higher concentrations are also present in the southern third of the state, in the northwest and some areas near the northeast (Figure 3).

The USGS complete arsenic dataset (137 samples) included non-detect data (Table 3A). No potential outliers were found at the 5% or 1% significance levels.

#### **USGS and EPA data subsets (45 samples each)**

Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -75% to 39% (Table 3B). An approximate -1% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 3C).

#### **Conclusion**

Table 3D summarizes ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for arsenic is 9 mg/kg.***

## Barium

### USGS complete dataset (137 samples)

Based on the USGS complete dataset, it appears that barium background concentrations vary across the state. Higher concentrations are present in the southern third of the state and some areas throughout the central and eastern areas of the state (Figure 4).

The USGS complete barium dataset (137 samples) did not include any non-detect data (Table 4A). Two potential outliers were found at the 5% and 1% significance level: 25 mg/kg (Lab ID C-338083, Site ID 473) and 153 m/kg (Lab ID C-338144, Site ID 2777). Both datasets, with and without potential outliers, were evaluated for BTVs using EPA's ProUCL software.

### USGS and EPA data subsets (45 samples each)

Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -95% to -65% (Table 4B). An approximate -71% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 4C).

### Conclusion

Table 4D summarizes ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for barium is 210 mg/kg.***

## Chromium

### USGS complete dataset (137 samples)

Based on the USGS complete dataset, it appears that total chromium background concentrations vary across the state. Higher concentrations are present in the northeast and northwest (Figure 5).

The USGS complete total chromium dataset (137 samples) did not include any non-detect data (Table 5A). One potential outlier was found at the 5% and 1% significance level: 98 mg/kg (Lab ID C-338205, Site ID 9845). Both datasets, with and without potential outliers, were evaluated for BTVs using EPA's ProUCL software.

### USGS and EPA data subsets (45 samples each)

Comparison of the 45 sample data subset reanalyzed using EPA methods to USGS data indicates differences in individual samples ranging from -84% to -48% (Table 5B). An approximate -63% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 5C).

### Conclusion

Table 5D summarizes ProUCL calculated UTLs for total chromium using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for chromium is 27 mg/kg.***

## Cobalt

### USGS complete dataset (137 samples)

Based on the USGS complete dataset, it appears that cobalt background concentrations vary across the state. Higher concentrations are present predominantly in the upper most northeast but some are present in the northwest (Figure 6).

The USGS complete cobalt dataset (137 samples) did not include any non-detect data (Table 6A). Two potential outliers were found at the 5% and 1% significance level: 19.3 mg/kg (Lab ID C-338160, Site ID

5749) and 19.4 mg/kg (Lab ID C-338214, Site ID 10869). Both datasets, with and without potential outliers, were evaluated for BTVs using EPA's ProUCL software.

#### **USGS and EPA data subsets (45 samples each)**

Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -56% to 21% (Table 6B). An approximate -19% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 6C).

#### **Conclusion**

Table 6D summarizes ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for cobalt is 12 mg/kg.***

## **Iron**

#### **USGS complete dataset (137 samples)**

Based on the USGS complete dataset, it appears that iron background concentrations vary across the state. Higher concentrations are present in a small region located northwest of Duluth (Figure 7).

The USGS complete iron dataset (137 samples) did not include any non-detect data (Table 7A). One potential outlier was found at the 5% and 1% significance level: 117,000 mg/kg (Lab ID C-338083, Site ID 473). Both datasets, with and without potential outliers, were evaluated for BTVs using EPA's ProUCL software.

#### **USGS and EPA data subsets (45 samples each)**

Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -65% to -2% (Table 7B). An approximate -32% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 7C).

#### **Conclusion**

Table 7D summarizes ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for iron is 29,000 mg/kg.***

## **Thallium**

#### **USGS complete dataset (137 samples)**

Based on the USGS complete dataset, it appears that thallium background concentrations vary across the state. Higher concentrations are present primarily in the northwest and southern areas of the state (Figure 8).

The USGS complete thallium dataset (137 samples) included non-detect data (Table 8A). Detections are close to the reporting limit of 0.1 mg/kg and range from approximately 0.2 to 0.6 mg/kg. No potential outliers were found at the 5% or 1% significance levels. The dataset does not follow a discernible distribution.

#### **USGS and EPA data subsets (45 samples each)**

Data from reanalysis using EPA methods appear to follow a distribution and are reported to 2 significant figures (Table 8B). Detections are close to the reporting limits of 0.099 mg/kg. Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -79% to -35%. An approximate -55% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 8C). Since both the USGS analyzed and EPA reanalyzed

datasets were close to their respective method reporting limits, there is a higher amount of uncertainty associated with these datasets.

### **Conclusion**

Table 8D shows ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for thallium is 0.29 mg/kg.***

## **Vanadium**

### **USGS complete dataset (137 samples)**

Based on the USGS complete dataset, it appears that vanadium background concentrations vary across the state. Higher concentrations are present in the northwest, northeast and some southern portions of the state (Figure 9).

The USGS complete vanadium dataset (137 samples) did not include any non-detect data (Table 9A). One potential outlier was found at the 5% significance level, but not at the 1% significance level: 161 mg/kg, (Lab ID C-338193, Site ID 4953). One additional potential outlier was found upon examination of the Q-Q plot: 144 mg/kg (Lab ID C-338122, Site ID 9049). No outliers were removed.

### **USGS and EPA data subsets (45 samples each)**

Comparison of the 45 sample data subset reanalyzed using EPA methods to the USGS data subset indicates differences in individual samples ranging from -76% to -11% (Table 9B). An approximate -52% difference between USGS and EPA methods is observed in the 95<sup>th</sup> percentile (Table 9C).

### **Conclusion**

Table 9D shows ProUCL calculated UTLs using the USGS complete dataset (137 samples), USGS 45 sample subset, and EPA method results for the reanalyzed data subset (45 samples).

***A reasonable statewide default BTV for vanadium is 62 mg/kg.***

## **Organics**

Two organics SRVs were estimated to be potentially below background: benzo[a]pyrene (B[a]P) equivalents and 2,3,7,8-tetrachlordibenzo-p-dioxin (TCDD) equivalents.

### **Organics – evaluation**

It was **not** possible to use statistical calculations to establish BTVs for B[a]P and TCDD. BTVs were established using the range of concentrations from background data available from other states, information regarding how other states evaluated B[a]P equivalents, data from a cleanup site in Minnesota and professional judgement.

### **Organics – results**

#### **Benzo[a]pyrene equivalents – background sources**

B[a]P equivalents background data are available from the following sources (Table 10A and 10B):

- Washington Department of Ecology (WA DOE 2011a, WA DOE 2011b, WA DOE 2011c)
- California Department of Toxic Substances Control (CA DTSC 2009)
- New York Department of Environmental Conservation (NYSDEC 2006)

- Minnesota Pollution Control Agency - St. Regis Paper Company Superfund Site (MPCA 2011)

B[a]P background data are available from the following sources (Table 10A and 10B):

- Illinois Environmental Protection Agency (IEPA 2007, EPRI 2004, USGS 2003, Chicago)
- New Jersey Department of Environmental Protection (NJDEP 1993)

MPCA and all of the states included in Table 10 calculate B[a]P equivalents based on EPA's short list of seven cPAHs listed below (refer to the [SRV TSD](#) and [SRV spreadsheet](#), "BaP Equivalents" tab for additional information). The potency equivalency factor (PEF) used by MPCA is listed in parentheses next to each cPAH.

- Benzo[a]anthracene (0.1)
- Benzo[b]fluoranthene (0.1)
- Benzo[k]fluoranthene (0.1)
- Benzo[a]pyrene (1)
- Chrysene (0.01)
- Dibenzo(a,h)anthracene (0.56)
- Indeno[1,2,3,-c,d]pyrene (0.1)

These states did not calculate B[a]P equivalent concentrations using the same PEFs as those used by MPCA. Differences in PEFs used by other states are listed below:

- **Washington**
  - Dibenzo(a,h)anthracene PEF of 0.1
- **California**
  - Dibenzo(a,h)anthracene PEF of 0.34
- **New York**
  - Benzo(k)fluoranthene PEF of 0.01
  - Dibenzo(a,h)anthracene PEF of 1

Although the use of varying PEFs may result in a slight difference in the calculated B[a]P equivalent concentration, it is not expected to make a significant impact on the determination of an appropriate BTV for B[a]P equivalents since the BTV was not determined based on statistical evaluation of the data. The determination was made based on the range of concentrations from background data available from other states, information regarding how other states evaluated B[a]P equivalents, data from a cleanup site in Minnesota and professional judgement.

Background data available from other states should **not** be viewed as being consistent in the manner in which it was obtained or thought of as being completely comparable. Many items differed between studies, most importantly the definition of ambient background, criteria used to choose appropriate samples and methods used in sampling and laboratory analysis.

Below is an overview of each dataset MPCA considered:

- **Washington** Department of Ecology
  - Natural background sampling conducted in state parks with population density less than 500 people per square mile
  - Ambient urban sampling conducted in city owned roadway planting strips
- **California** Department of Toxic Substances Control
  - Applies specifically to manufactured gas plants

- Sampling conducted in areas near manufactured gas plants and a naval hospital
- **New York** Department of Environmental Conservation
  - Source distant sampling conducted 5 meters away from any human activity
  - Near source sampling conducted within 2 meters of a road or driveway
  - Remote sampling conducted 15 meters away from any human activity
- **Minnesota** Pollution Control Agency - St. Regis Paper Company Superfund Site
  - Site-specific background using two background reference areas located in rural areas
- **Illinois** Environmental Protection Agency
  - This data represents B[a]P data only, **not** B[a]P equivalents
  - Chicago sampling conducted in areas where there was no evidence of prior PAH releases via a background investigation and site inspection
  - Metropolitan statistical area (MSA) sampling conducted in areas with a population of at least 50,000 in parks, roadway medians, utility right of ways, commercial, residential, parking lot buffers, and vacant lots
  - Outside metropolitan area sampling conducted in non-MSA areas in parks, roadway medians, utility right of ways, commercial, residential, parking lot buffers, and vacant lots
- **New Jersey** Department of Environmental Protection
  - This data represents B[a]P data only, **not** B[a]P equivalents
  - Natural background sampling conducted in 9 rural areas with different physiographic provinces with population density less than 1,000 people per square mile

***Based on the available data, a reasonable statewide applicable BTV for B[a]P equivalents is 2 mg/kg.***

If the site being evaluated is located in a rural area where background concentrations are expected to be lower, site-specific background might be more appropriate to use instead of the BTV. If the site being evaluated is located in an urban area where background concentrations are expected to be higher, site-specific background might be more appropriate to use instead of the BTV.

## **2,3,7,8-Tetrachlorodibenzo-p-dioxin equivalents – background sources**

TCDD equivalents background data are available from the following sources (Table 11A and 11B):

- **Washington** Department of Ecology (WA DOE 2011a, WA DOE 2011b, WA DOE 2011c)
- **Montana** Department of Environmental Quality (MT DEQ 2011)
- **Minnesota** Pollution Control Agency – St. Regis Paper Company Superfund Site (MPCA 2011)

To calculate TCDD equivalents, MPCA includes polychlorinated biphenyls (PCBs). Washington and Montana did not include PCBs in their TCDD equivalents calculations. Exclusion of PCBs is not expected to make a significant difference in calculated background levels.

Background data available from other states should not be viewed as being consistent in the manner in which it was obtained or thought of as being completely comparable. Many items differed between studies, most importantly the definition of ambient background, criteria used to choose appropriate samples and methods used in sampling and laboratory analysis.

Below is an overview of each dataset MPCA considered:

- **Washington** Department of Ecology
  - Natural background sampling conducted in state parks with population density less than 500 people per square mile
  - Ambient urban sampling conducted in city owned roadway planting strips

- **Montana** Department of Environmental Quality
  - Background from sites with no know dioxin point sources in urban and rural areas
- **Minnesota** Pollution Control Agency – St. Regis Paper Company Superfund Site
  - Site-specific background for cleanup site using two background reference areas located in rural areas

***Based on the available data, a reasonable statewide applicable BTV for TCDD equivalents is 7.0E-06 mg/kg.*** If the site being evaluated is located in a rural area where background concentrations are expected to be lower, site-specific background might be more appropriate to use instead of the BTV. If the site being evaluated is located in an urban area where background concentrations are expected to be higher, site-specific background might be more appropriate to use instead of the BTV.



# References

CA DTSC 2009. California Department of Toxics Substance Control. Use of the Northern and Southern California Polynuclear Aromatic Hydrocarbon (PAH) Studies in the Manufactured Gas Plant Site Cleanup Process. July 1, 2009. [https://dtsc.ca.gov/wp-content/uploads/sites/31/2018/01/MGP\\_PAH\\_Advisory\\_070109.pdf](https://dtsc.ca.gov/wp-content/uploads/sites/31/2018/01/MGP_PAH_Advisory_070109.pdf), <https://www.dtsc.ca.gov/assessingrisk/humanrisk2.cfm>

Chicago. City of Chicago. Urban Area Polycyclic Aromatic Hydrocarbon Study Tiered Approach to Corrective Action Objectives. [http://www.cityofchicago.org/dam/city/depts/doe/general/UrbanManagementAndBrownfields\\_PDFs/USGSBackgroundPNASStudySummary.pdf](http://www.cityofchicago.org/dam/city/depts/doe/general/UrbanManagementAndBrownfields_PDFs/USGSBackgroundPNASStudySummary.pdf)

EPRI 2004. Electrical Power Research Institute. Polycyclic Aromatic Hydrocarbons (PAHS) in Surface Soil in Illinois : Background PASH, EPRI, Palo Alto, CA, We Energies, Milwaukee, and IEPA, Springfield, IL: 2004. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=00000000001011376>

IEPA 2007. Illinois Environmental Protection Agency. Title 35: Environmental Protection, Subtitle G: Waste Disposal, Chapter 1: Pollution Control Board, Subchapter f: Risk Based Cleanup Objectives, Part 742, Tiered Approach to Corrective Action Objectives, Subpart A: Introduction. Section 742.appendix A: General. Section 742.Table H Concentrations of Polynuclear Aromatic Hydrocarbon Chemicals in Background Soils. February 23, 2007. <https://www.ilga.gov/commission/jcar/admincode/035/03500742ZZ9996ahR.html>

MA DEP. Massachusetts Department of Environmental Protection. Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil. Updates: Section 2.3 Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan (1992). <http://www.mass.gov/eea/docs/dep/cleanup/laws/backtu.pdf>

MPCA 2011. Minnesota Pollution Control Agency. Integral Consulting. St. Regis Paper Company Site, Preliminary Remediation Goals (PRGs) for Soils. April 11, 2011.

MT DEQ 2011. Montana Department of Environmental Quality, Remediation Division. Montana Dioxin Background Investigation Report. April 2011. <https://deq.mt.gov/Portals/112/Land/StateSuperfund/Documents/DioxinGuide/DioxinBackgroundStudy.pdf>

NJDEP 2002. New Jersey Department of Environmental Protection. Characterization of Ambient Levels of Selected Metals and cPAHs In New Jersey Soils: Year III – Rural Areas of New Jersey, Highlands, Valley and Ridge, and Coastal Plain Physiographic Provinces. March 2002. [https://www.nj.gov/dep/dsr/publications/Characterization%20of%20Ambient%20Levels%20of%20Selected%20Metals%20and%20cPAHs%20in%20NJ%20Soils\\_Year%20Three\\_Highlands,%20Valley%20and%20Ridge,%20and%20Coastal%20Plain%20\\_Full%20Report.pdf](https://www.nj.gov/dep/dsr/publications/Characterization%20of%20Ambient%20Levels%20of%20Selected%20Metals%20and%20cPAHs%20in%20NJ%20Soils_Year%20Three_Highlands,%20Valley%20and%20Ridge,%20and%20Coastal%20Plain%20_Full%20Report.pdf)

NYSDEC 2006. New York State Department of Environmental Conservation. New York State Brownfield Cleanup Program Development of Soil Cleanup Objectives Technical Support Document. Appendix D. September 2006. <https://www.dec.ny.gov/chemical/34189.html>

Pace Analytical 2015. Diane Anderson. Pace Analytical Services, Inc. Report of Laboratory Analysis for Minnesota Pollution Control Agency. January 21, 2015.

ProUCL 2013. Felicia Barnett, Anita Singh, Ashok K. Singh. Environmental Protection Agency. ProUCL Version 5.0.00 Technical Guide, Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. September 2013. [https://www.epa.gov/sites/production/files/2015-03/documents/proucl\\_v5.0\\_tech.pdf](https://www.epa.gov/sites/production/files/2015-03/documents/proucl_v5.0_tech.pdf)

USGS 2003. U.S. Geological Survey. Robert T. Kay, Terri L. Arnold, William F. Cannon, David Graham, Eric Morton, and Raymond Bienert. Concentrations of Polynuclear Aromatic Hydrocarbons and Inorganic Constituents in Ambient Surface Soils, Chicago, Illinois: 2001-02. Water- Resources Investigations Report 03-4105. 2003. <https://pubs.usgs.gov/wri/2003/4105/report.pdf>

USGS 2013. Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L., 2013, Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19 p., <http://pubs.usgs.gov/ds/801/>

USGS 2014. Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, and Ellefsen, K.J., 2014, Geochemical and mineralogical maps for soils of the conterminous United States: U.S. Geological Survey Open-File Report 2014–1082, 386 p., <https://pubs.usgs.gov/of/2014/1082/>

WA DOE 2011a. Washington Department of Ecology, Toxics Cleanup Program. Frequently Asked Questions, Washington Soil Dioxin Study Results. September 2011. <https://fortress.wa.gov/ecy/publications/documents/1109219zh.pdf>

WA DOE 2011b. Washington Department of Ecology. Draft Washington State Background Soil Concentration Study, Rural State Parks, Washington State. June 7, 2011. 17330-29. [http://www.ecy.wa.gov/programs/tcp/sites\\_brochure/lower\\_duwamish/SoilDioxinStudy/Draft%20Rural%20Ecology%20Background%20Report.pdf](http://www.ecy.wa.gov/programs/tcp/sites_brochure/lower_duwamish/SoilDioxinStudy/Draft%20Rural%20Ecology%20Background%20Report.pdf)

WA DOE 2011c. Washington Department of Ecology, Toxics Cleanup Program. Urban Seattle Area Soil Dioxin and PAH Concentrations, Initial Summary Report. September 2011. 11-09-049. <https://fortress.wa.gov/ecy/publications/publications/1109049.pdf>

# Figures

Figure 1A. USGS samples reanalyzed using EPA's analytical method.

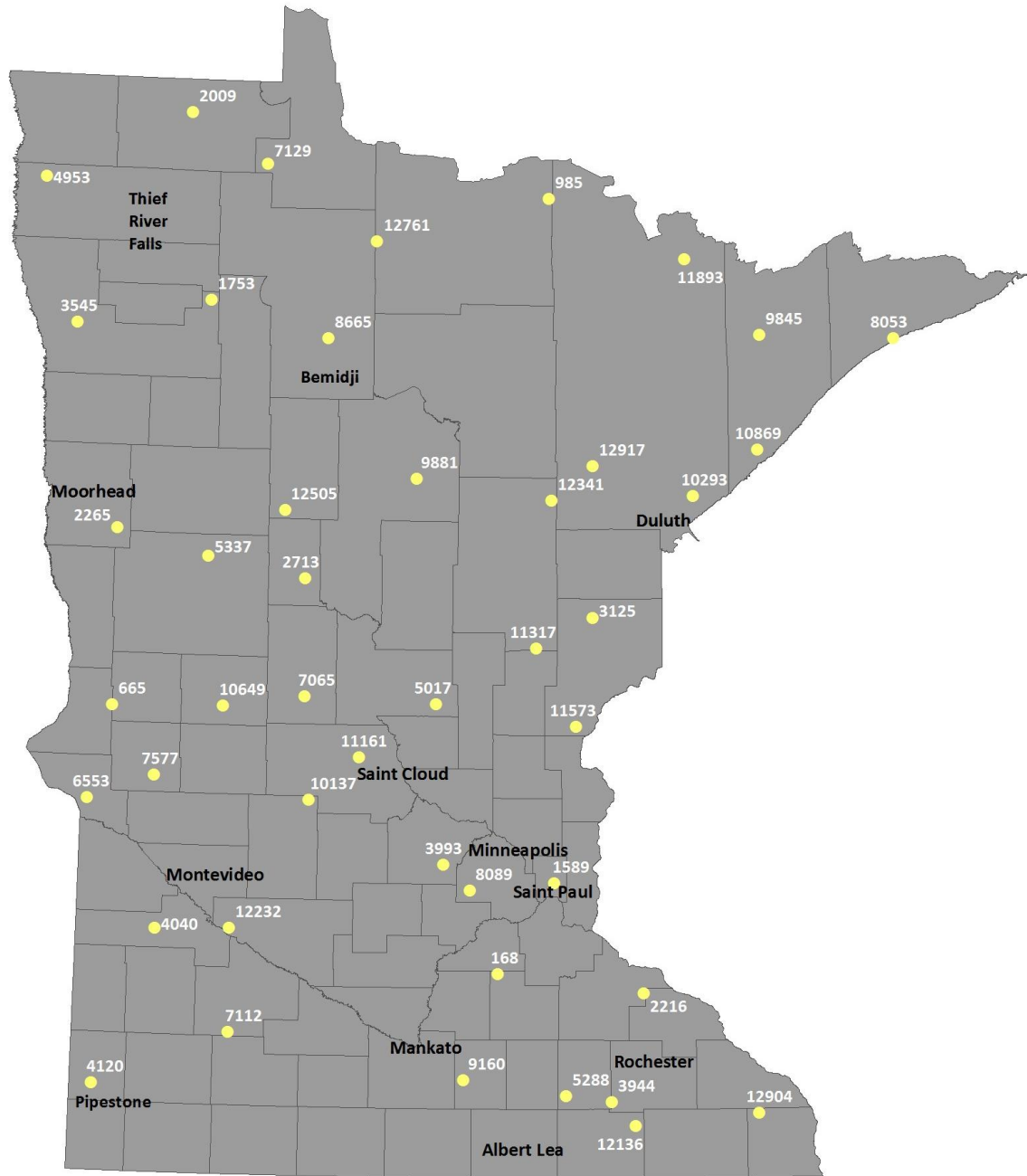


Figure 1B. USGS samples reanalyzed using EPA's analytical method – quartz.

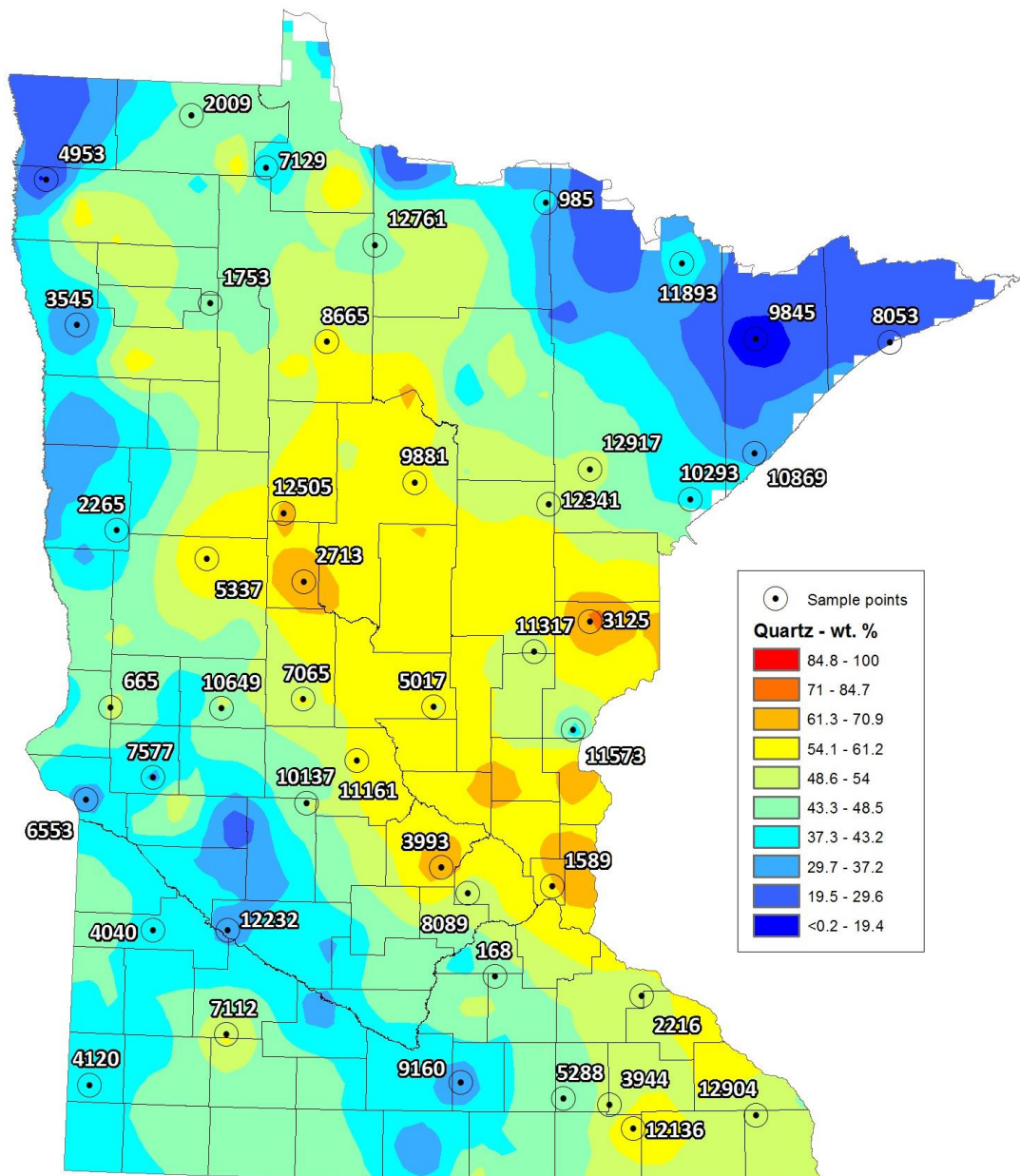


Figure 1C. USGS samples reanalyzed using EPA's analytical method – clay.

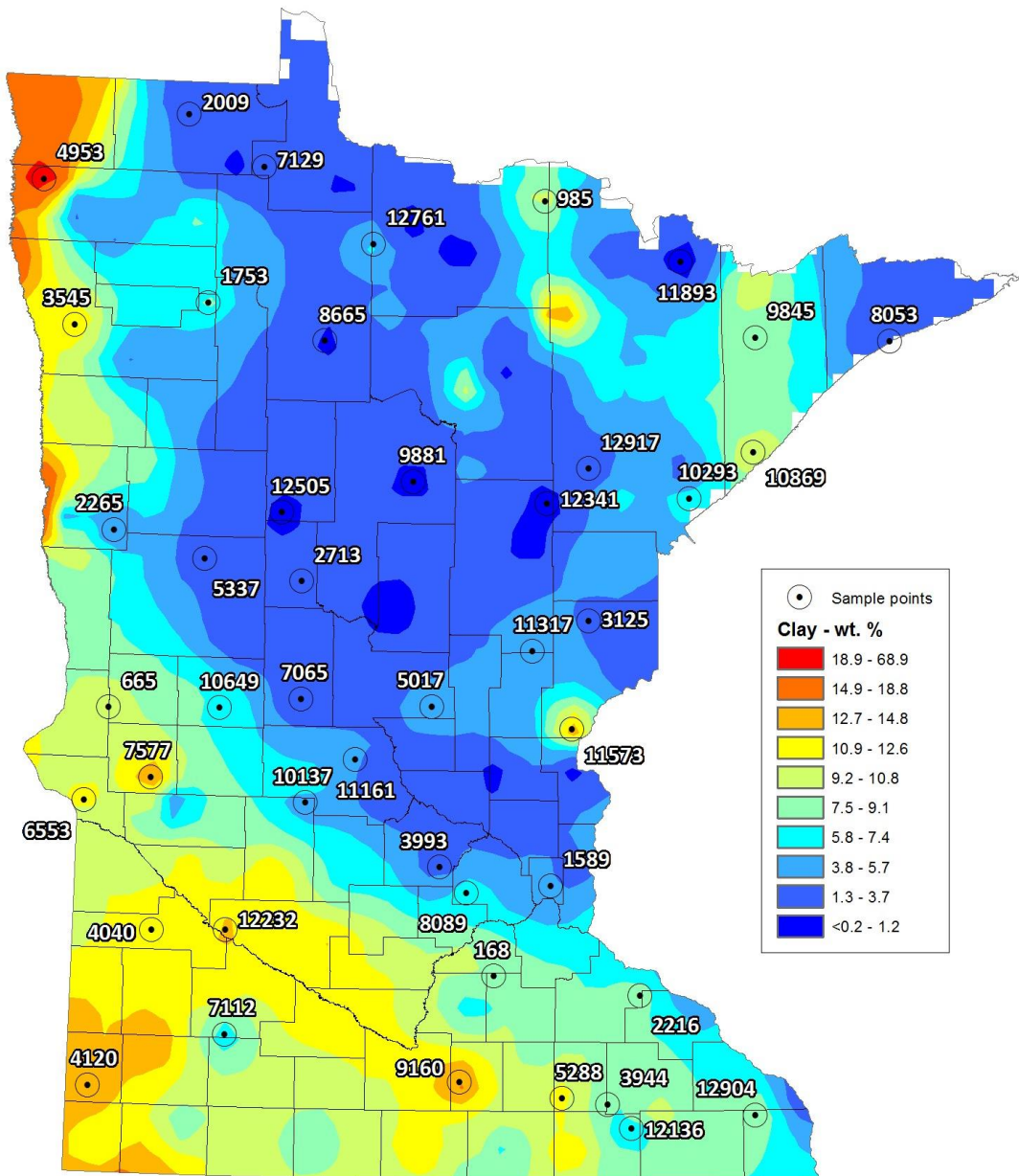




Figure 1D. USGS samples reanalyzed using EPA’s analytical method – major land resource areas.

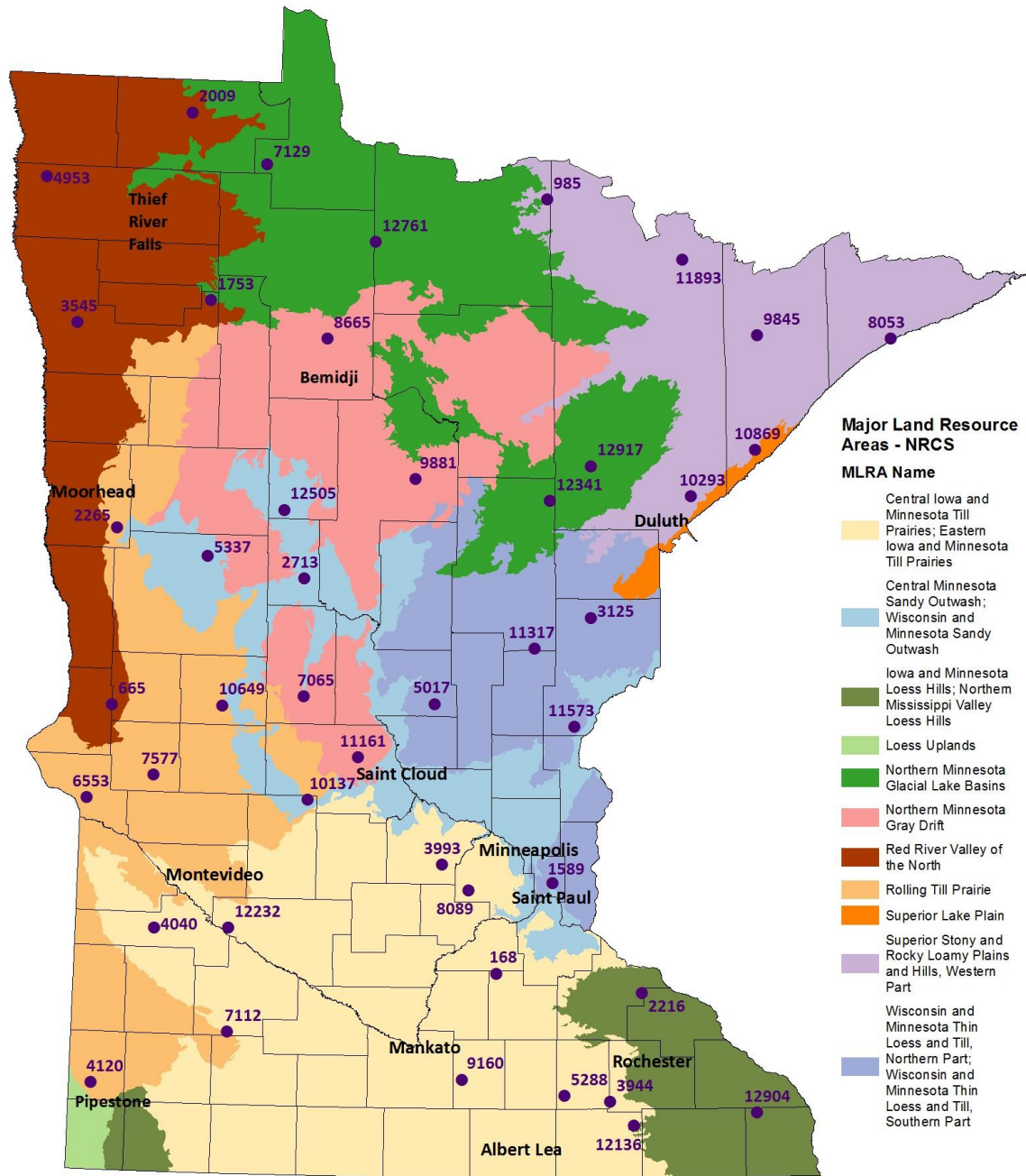


Figure 2. Aluminum concentrations from USGS's complete dataset.

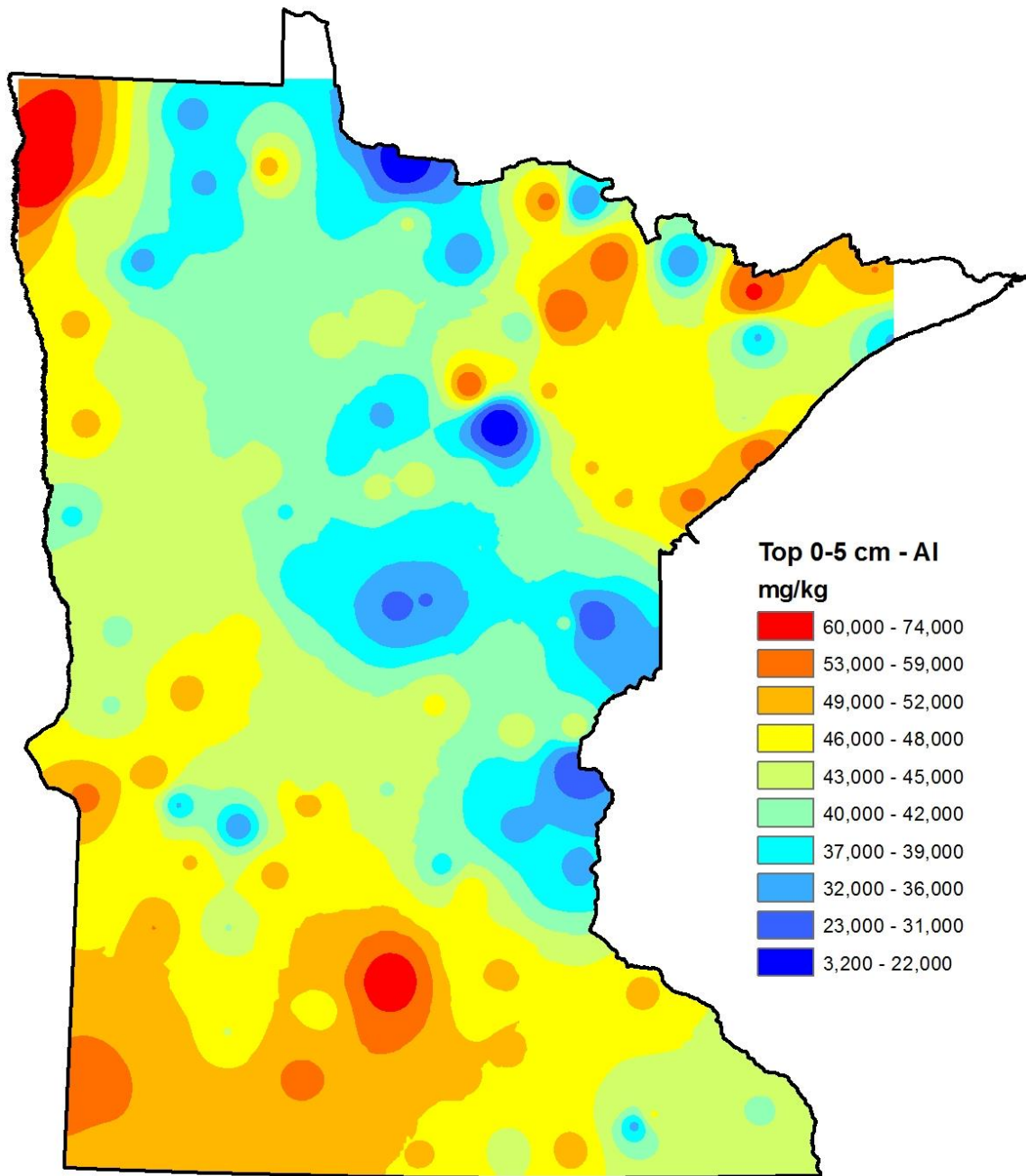


Figure 3. Arsenic concentrations from USGS's complete dataset.

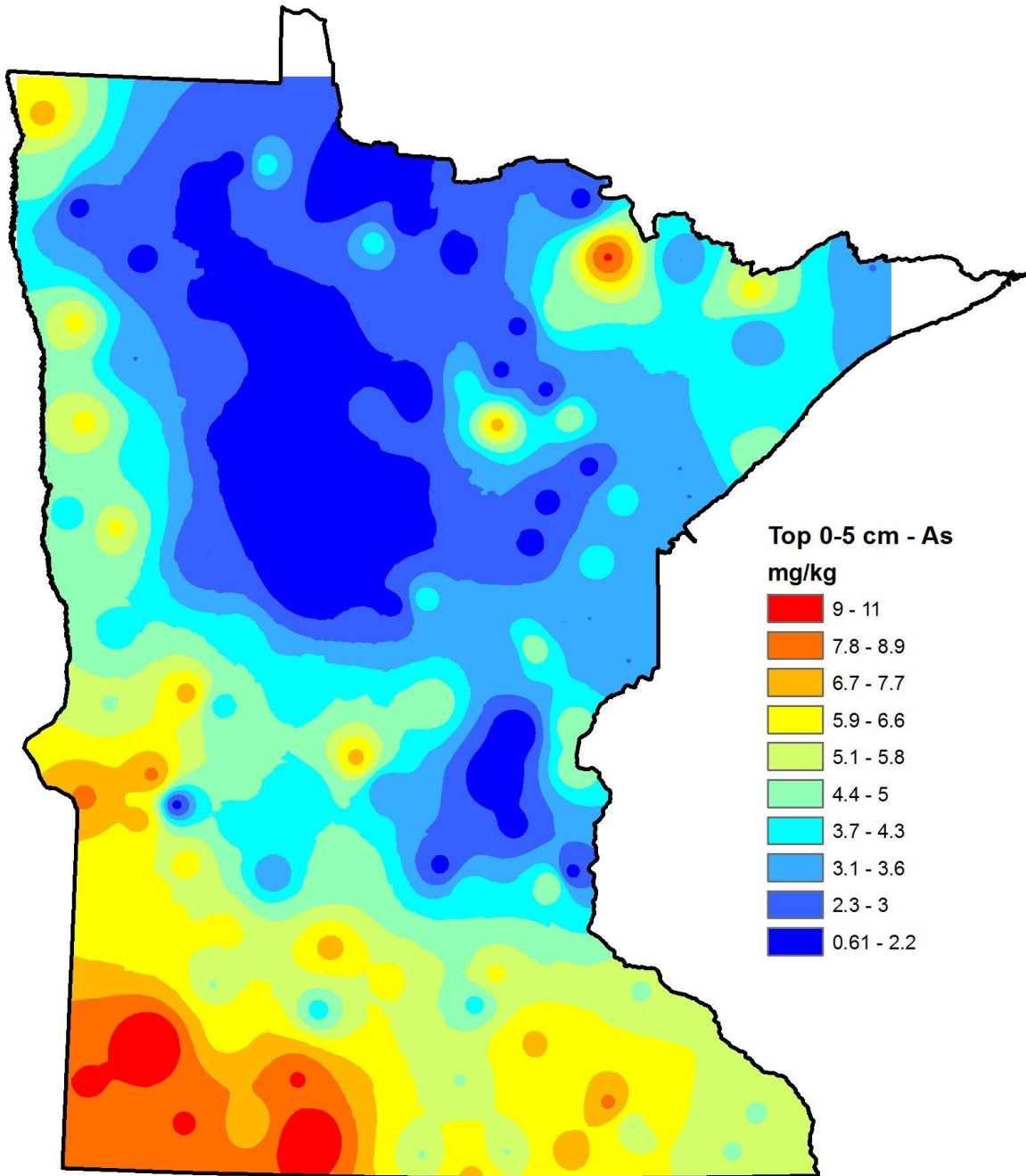




Figure 4. Barium concentrations from USGS's complete dataset.

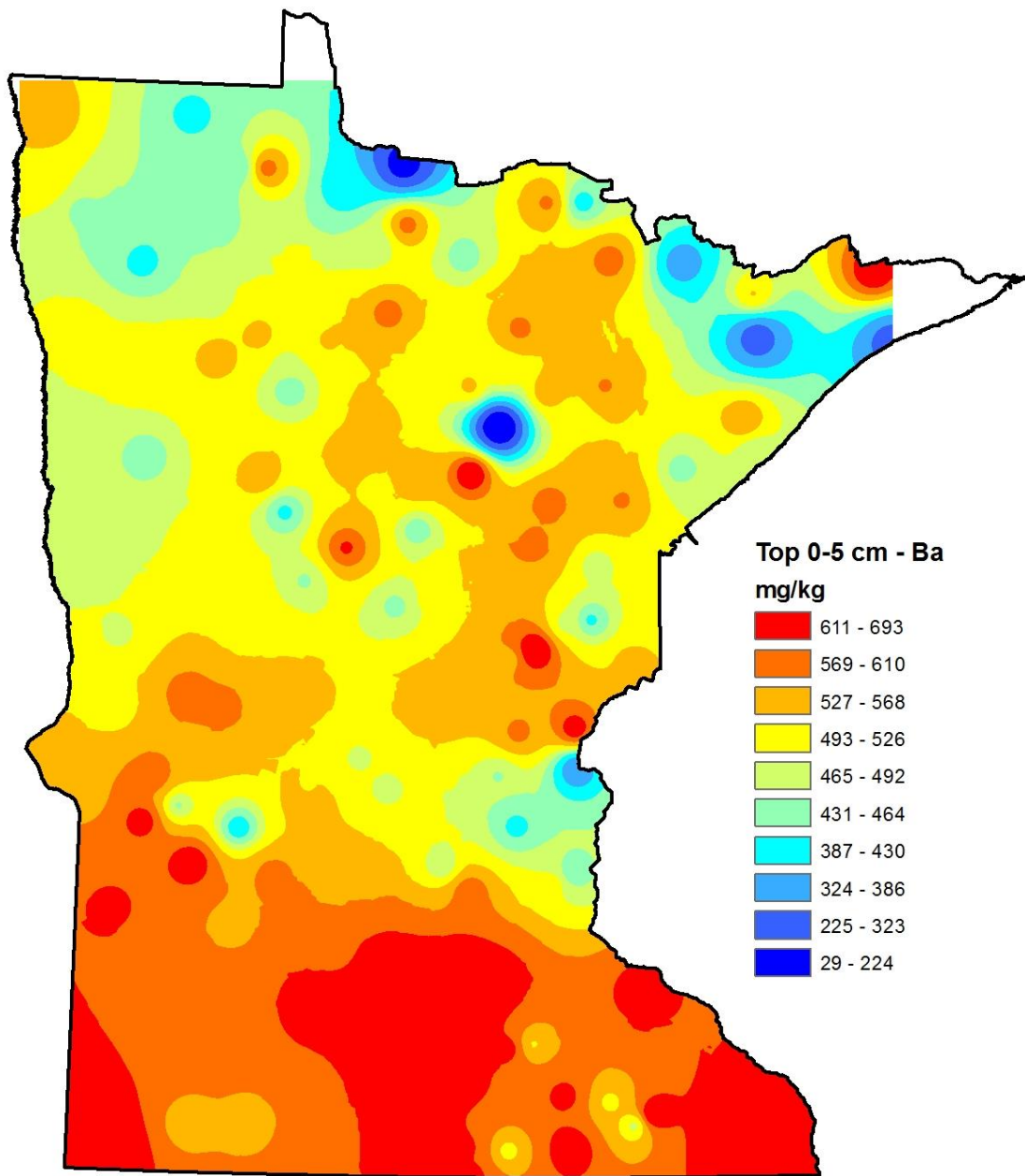


Figure 5. Chromium concentrations from USGS's complete dataset.

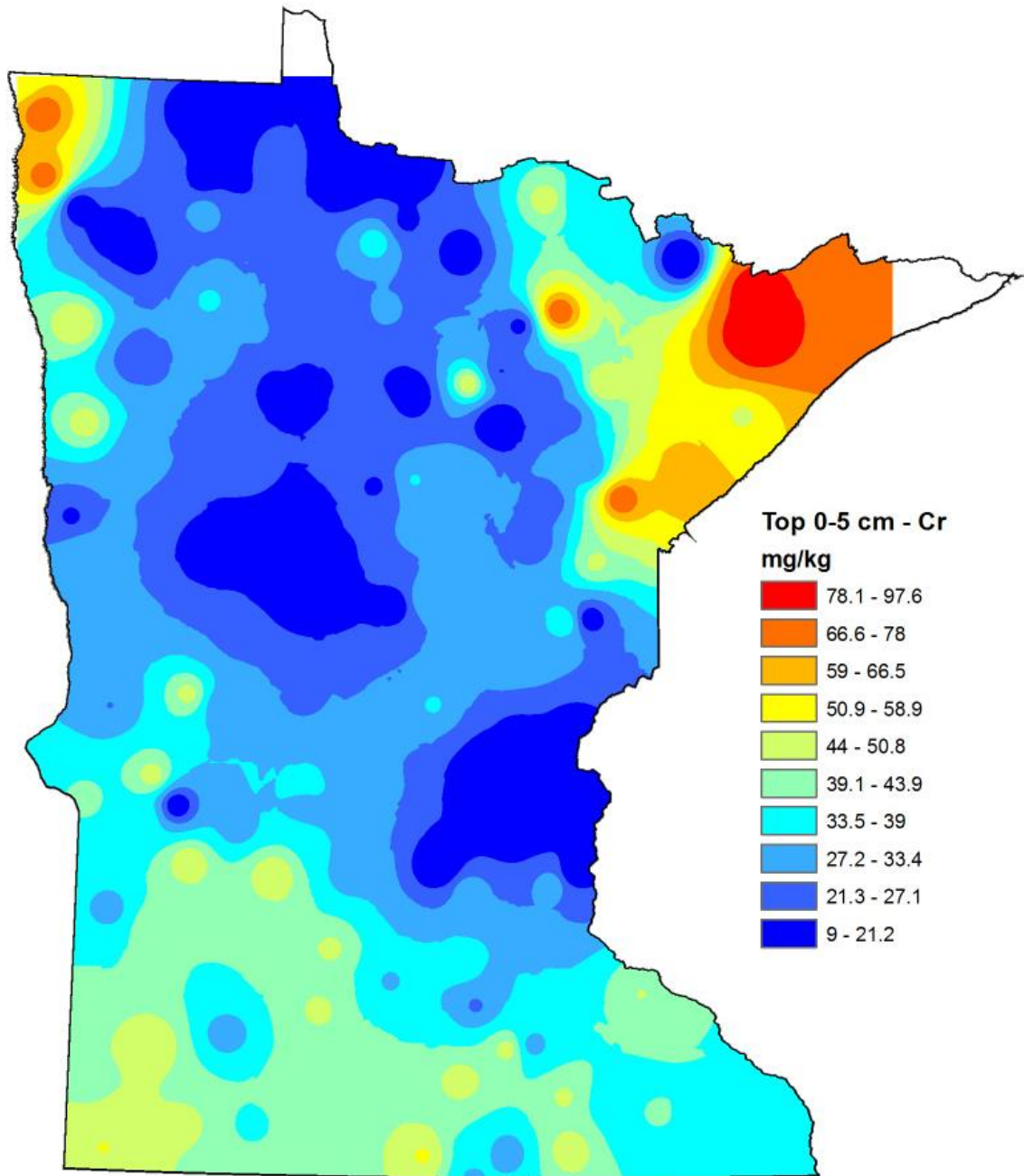


Figure 6. Cobalt concentrations from USGS's complete dataset.

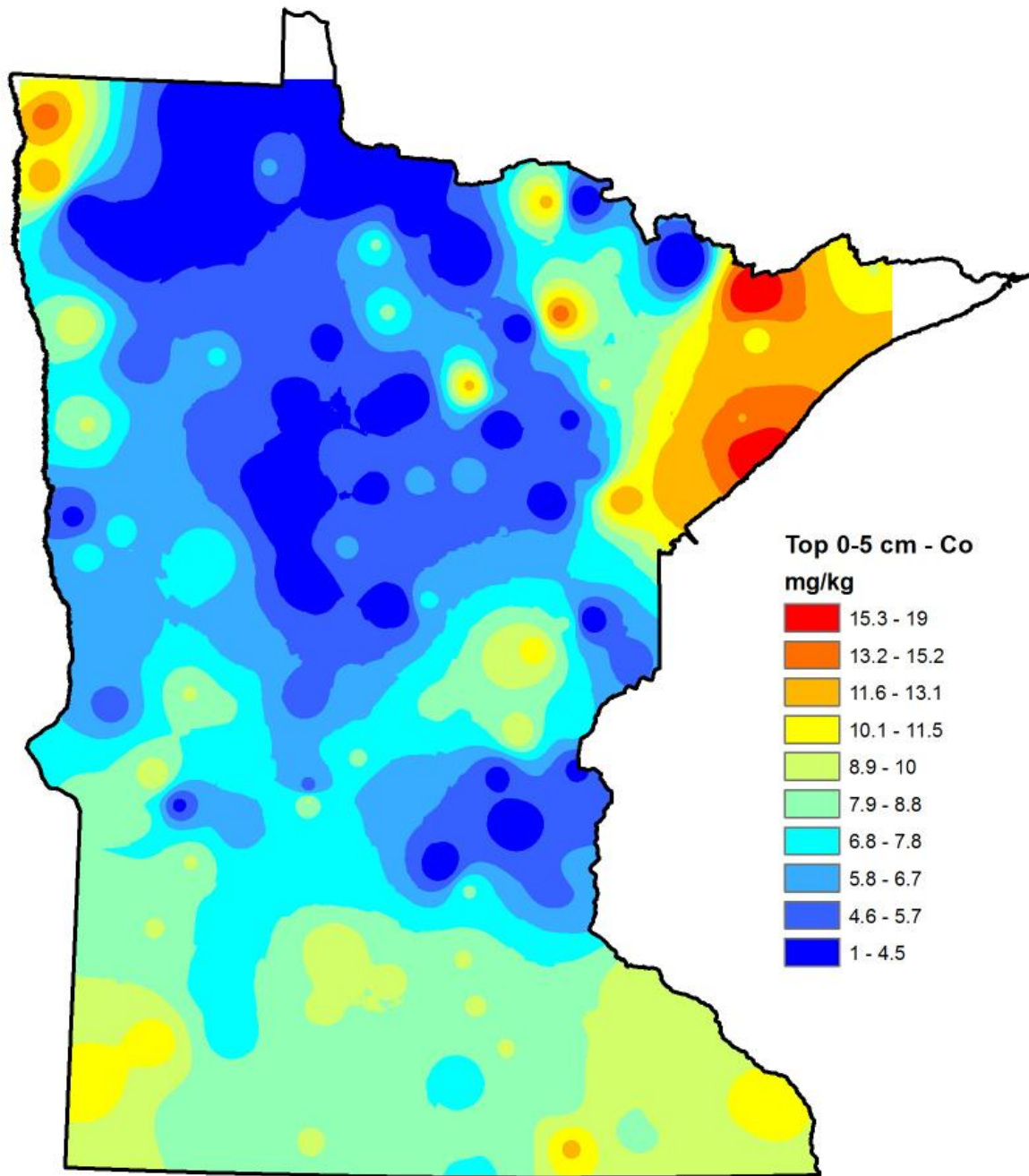


Figure 7. Iron concentrations from USGS's complete dataset.

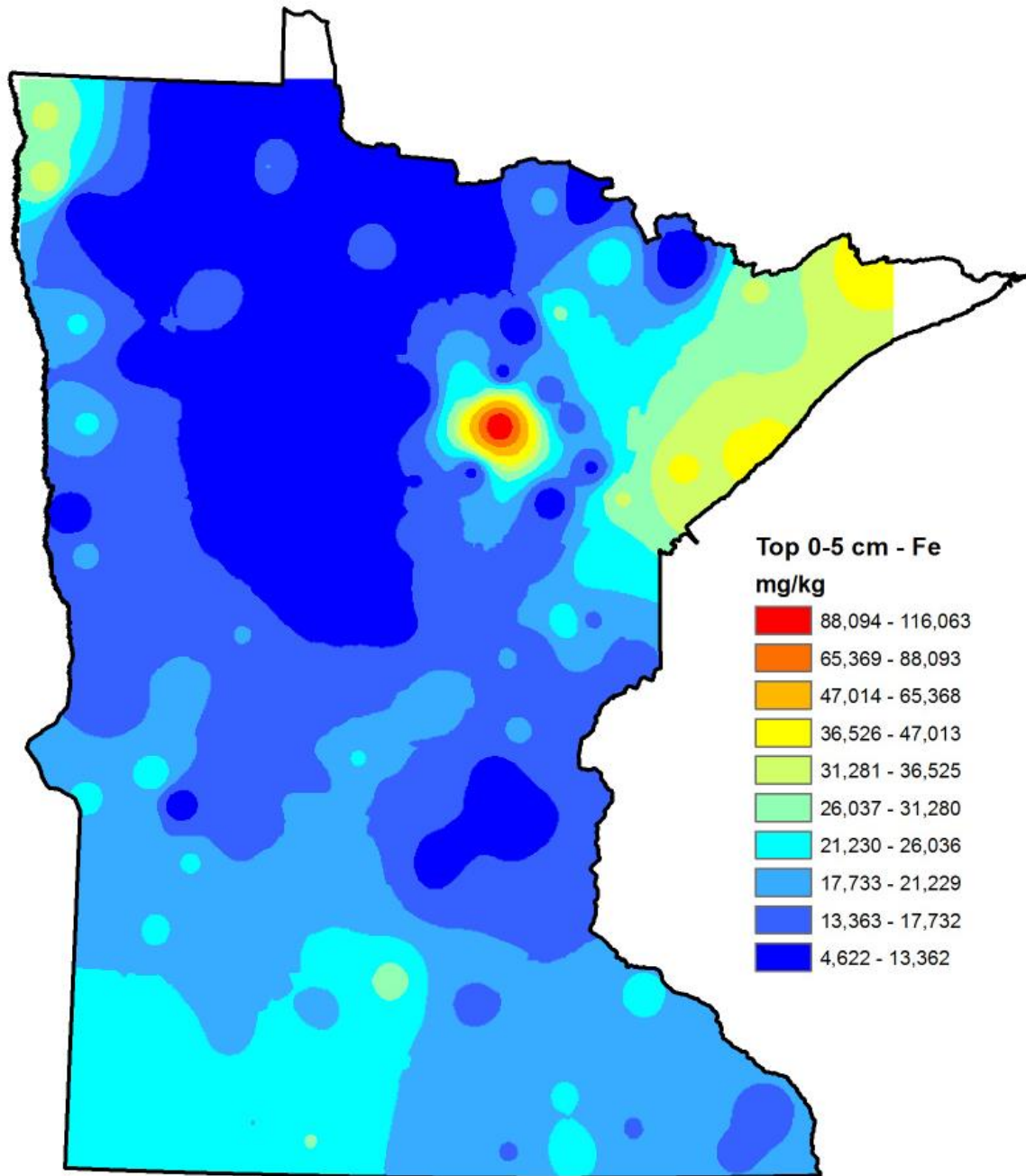


Figure 8. Thallium concentrations from USGS's complete dataset.

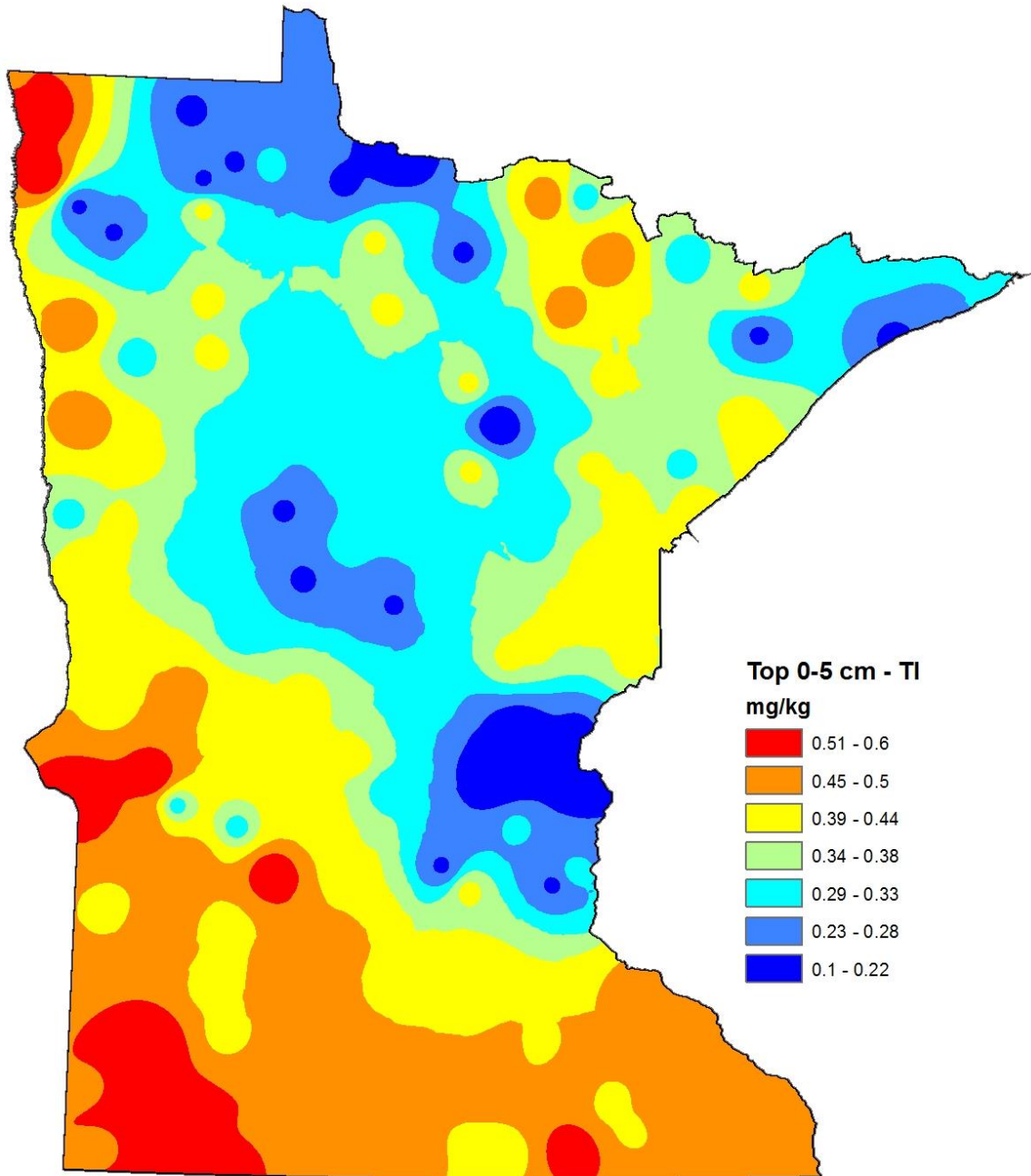
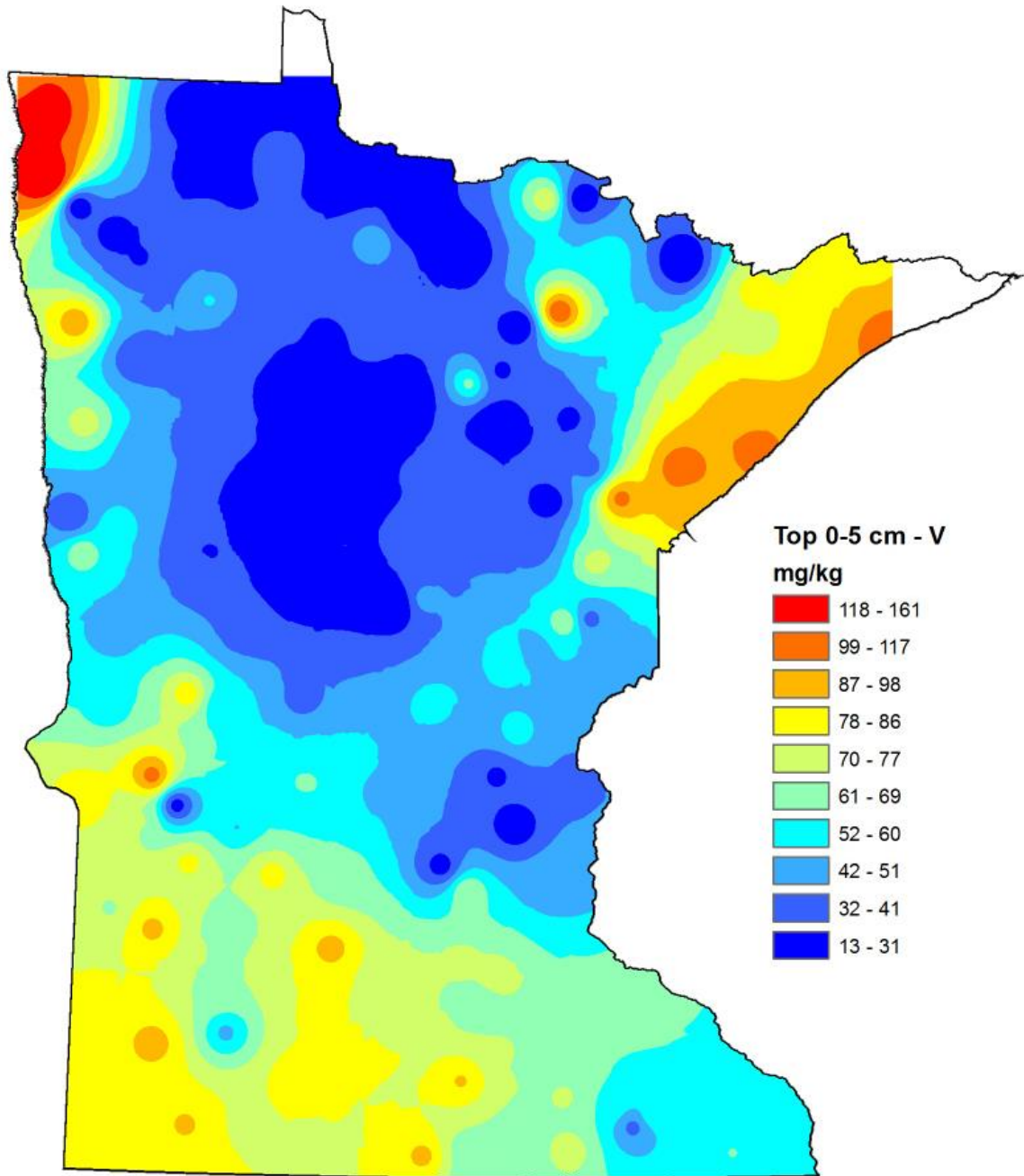




Figure 9. Vanadium concentrations from USGS's complete dataset.



# Tables

**Table 1. USGS samples – land cover.**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               |
|----------|---------|--------------------|----------------------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  |
| C-338090 | 985     | Forested Upland    | Mixed Forest               |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses |
| C-338099 | 1753    | Shrubland          | Shrubland                  |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  |
| C-338182 | 3944    | Planted/Cultivated | Row Crops                  |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous      |
| C-338184 | 4040    | Planted/Cultivated | Fallow                     |
| C-338185 | 4120    | Planted/Cultivated | Row Crops                  |
| C-338193 | 4953    | Planted/Cultivated | Fallow                     |
| C-338194 | 5017    | Planted/Cultivated | Fallow                     |
| C-338155 | 5288    | Planted/Cultivated | Row Crops                  |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous      |
| C-338165 | 6553    | Planted/Cultivated | Fallow                     |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous      |
| C-338173 | 7112    | Planted/Cultivated | Row Crops                  |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest           |
| C-338106 | 7577    | Planted/Cultivated | Row Crops                  |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest           |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest           |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous      |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest           |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest           |
| C-338200 | 9160    | Planted/Cultivated | Row Crops                  |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest           |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest           |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous      |
| C-338210 | 10293   | Forested Upland    | Mixed Forest               |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest           |
| C-338214 | 10869   | Forested Upland    | Mixed Forest               |
| C-338351 | 11161   | Planted/Cultivated | Row Crops                  |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest           |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     |
|----------|---------|--------------------|------------------|
| C-321817 | 11573   | Planted/Cultivated | Row Crops        |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest |
| C-338370 | 12761   | Shrubland          | Shrubland        |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      |

**Table 2A. Aluminum – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Aluminum mg/kg |
|----------|---------|--------------------|----------------------------|----------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 49700          |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 43100          |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 2900           |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 41300          |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 33700          |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 52400          |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 41700          |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 45600          |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 53500          |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 41200          |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 50400          |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 44100          |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 43900          |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 37900          |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 49400          |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 41100          |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 41300          |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 45600          |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 45700          |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 34100          |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 48800          |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 33400          |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 49100          |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 43000          |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 47900          |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 39400          |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 45500          |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 36200          |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 53200          |



| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Aluminum<br>mg/kg |
|----------|---------|--------------------|-----------------------|-------------------|
| C-338144 | 2777    | Forested Upland    | Mixed Forest          | 10000             |
| C-338145 | 2969    | Planted/Cultivated | Row Crops             | 42800             |
| C-338147 | 3016    | Planted/Cultivated | Row Crops             | 51100             |
| C-338149 | 3125    | Forested Upland    | Mixed Forest          | 23000             |
| C-338150 | 3289    | Forested Upland    | Mixed Forest          | 39000             |
| C-321807 | 3381    | Planted/Cultivated | Row Crops             | 44100             |
| C-338176 | 3481    | Planted/Cultivated | Row Crops             | 50400             |
| C-338177 | 3545    | Planted/Cultivated | Row Crops             | 49200             |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest      | 55600             |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest      | 38400             |
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 50200             |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 44400             |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 37600             |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 52000             |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 55300             |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 48300             |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 41400             |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 57300             |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 45700             |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 32700             |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 43000             |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 73900             |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 45700             |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 45500             |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 39600             |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 48200             |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 45000             |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 37200             |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 60300             |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 37000             |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 31500             |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 49700             |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 37800             |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 51500             |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 53300             |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 41400             |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 41600             |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 29100             |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 50700             |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 42300             |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 43000             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Aluminum<br>mg/kg |
|----------|---------|--------------------|-----------------------|-------------------|
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 44900             |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 50500             |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 39600             |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 32900             |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 22200             |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 51100             |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 43200             |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 57400             |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 36600             |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 46600             |
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 45300             |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 35300             |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 47000             |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 46500             |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 48800             |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 42700             |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 42900             |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 43000             |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 34300             |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 44200             |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 47800             |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 48800             |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 36600             |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 66200             |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 41500             |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 49000             |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 34200             |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 46300             |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 34200             |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 35300             |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 44700             |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 51700             |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 46700             |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 53700             |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 41900             |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 45300             |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 40800             |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 54900             |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 43100             |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 49900             |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 37900             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Aluminum<br>mg/kg |
|--|---------|--------------------|------------------|-------------------|
| C-338351   | 11161   | Planted/Cultivated | Row Crops        | 44300             |
| C-338352   | 11208   | Planted/Cultivated | Row Crops        | 51600             |
| C-338353   | 11225   | Forested Upland    | Mixed Forest     | 37000             |
| C-338354   | 11317   | Forested Upland    | Deciduous Forest | 38800             |
| C-338355   | 11481   | Forested Upland    | Deciduous Forest | 46300             |
| C-321817   | 11573   | Planted/Cultivated | Row Crops        | 44000             |
| C-338357   | 11737   | Planted/Cultivated | Row Crops        | 49500             |
| C-338358   | 11893   | Forested Upland    | Evergreen Forest | 32800             |
| C-338359   | 11929   | Forested Upland    | Mixed Forest     | 30600             |
| C-338360   | 11976   | Planted/Cultivated | Row Crops        | 70100             |
| C-338361   | 12121   | Planted/Cultivated | Row Crops        | 42100             |
| C-338362   | 12136   | Planted/Cultivated | Row Crops        | 34700             |
| C-338363   | 12149   | Forested Upland    | Mixed Forest     | 52000             |
| C-338364   | 12185   | Planted/Cultivated | Row Crops        | 41100             |
| C-338366   | 12232   | Planted/Cultivated | Row Crops        | 41600             |
| C-338367   | 12341   | Forested Upland    | Mixed Forest     | 40000             |
| C-338368   | 12456   | Planted/Cultivated | Row Crops        | 49000             |
| C-338369   | 12505   | Forested Upland    | Deciduous Forest | 38400             |
| C-338370   | 12761   | Shrubland          | Shrubland        | 39400             |
| C-321803   | 12853   | Planted/Cultivated | Pasture/Hay      | 34100             |
| C-338125   | 12904   | Planted/Cultivated | Pasture/Hay      | 41200             |
| C-338126   | 12917   | Planted/Cultivated | Pasture/Hay      | 48800             |
| C-338128   | 12953   | Planted/Cultivated | Fallow           | 35300             |
| C-338129   | 13017   | Forested Upland    | Deciduous Forest | 39500             |
| C-338130   | 13160   | Planted/Cultivated | Row Crops        | 45400             |
| C-321809   | 13209   | Planted/Cultivated | Pasture/Hay      | 37200             |
| Samples highlighted in gray were considered outliers |         |                    |                  |                   |

**Table 2B. Aluminum – 45 sample data subset.**

| Lab ID   | Site ID | Aluminum<br>USGS<br>Method<br>mg/kg | Aluminum<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338081 | 168     | 49700                               | 8320                               | 41380                    | -83.26%                             | -1  |
| C-338084 | 665     | 41300                               | 9040                               | 32260                    | -78.11%                             | -1  |
| C-338090 | 985     | 53500                               | 10900                              | 42600                    | -79.63%                             | 0   |
| C-338096 | 1589    | 37900                               | 7800                               | 30100                    | -79.42%                             | -1  |
| C-338099 | 1753    | 41300                               | 10200                              | 31100                    | -75.30%                             | 0   |
| C-338133 | 2009    | 34100                               | 5330                               | 28770                    | -84.37%                             | -1  |
| C-338136 | 2216    | 49100                               | 12400                              | 36700                    | -74.75%                             | 0   |
| C-338137 | 2265    | 43000                               | 7860                               | 35140                    | -81.72%                             | -1  |
| C-338142 | 2713    | 36200                               | 3110                               | 33090                    | -91.41%                             | -1  |
| C-338149 | 3125    | 23000                               | 2190                               | 20810                    | -90.48%                             | -1  |
| C-338177 | 3545    | 49200                               | 16300                              | 32900                    | -66.87%                             | 0   |
| C-338182 | 3944    | 44400                               | 12600                              | 31800                    | -71.62%                             | 0   |
| C-338183 | 3993    | 37600                               | 4330                               | 33270                    | -88.48%                             | -1  |
| C-338184 | 4040    | 52000                               | 13700                              | 38300                    | -73.65%                             | 0   |
| C-338185 | 4120    | 55300                               | 18500                              | 36800                    | -66.55%                             | 0   |
| C-338193 | 4953    | 73900                               | 19300                              | 54600                    | -73.88%                             | 0   |
| C-338194 | 5017    | 45700                               | 7450                               | 38250                    | -83.70%                             | -1  |
| C-338155 | 5288    | 48200                               | 15100                              | 33100                    | -68.67%                             | 0   |
| C-338156 | 5337    | 45000                               | 9640                               | 35360                    | -78.58%                             | -1  |
| C-338165 | 6553    | 53300                               | 15700                              | 37600                    | -70.54%                             | 0   |
| C-338172 | 7065    | 43000                               | 5410                               | 37590                    | -87.42%                             | -1  |
| C-338173 | 7112    | 44900                               | 5390                               | 39510                    | -88.00%                             | -1  |
| C-338103 | 7129    | 50500                               | 5380                               | 45120                    | -89.35%                             | -1  |
| C-338106 | 7577    | 51100                               | 8450                               | 42650                    | -83.46%                             | -1  |
| C-338112 | 8053    | 35300                               | 9680                               | 25620                    | -72.58%                             | -1  |
| C-338113 | 8089    | 47000                               | 5160                               | 41840                    | -89.02%                             | -1  |
| C-338120 | 8665    | 43000                               | 2460                               | 40540                    | -94.28%                             | -1  |
| C-338200 | 9160    | 49000                               | 7760                               | 41240                    | -84.16%                             | -1  |
| C-338205 | 9845    | 35300                               | 6680                               | 28620                    | -81.08%                             | -1  |
| C-338206 | 9881    | 44700                               | 3020                               | 41680                    | -93.24%                             | -1  |
| C-338207 | 10137   | 51700                               | 4980                               | 46720                    | -90.37%                             | -1  |

| Lab ID   | Site ID | Aluminum<br>USGS<br>Method<br>mg/kg | Aluminum<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338210 | 10293   | 53700                               | 12400                              | 41300                    | -76.91%                             | 0   |
| C-338212 | 10649   | 45300                               | 3760                               | 41540                    | -91.70%                             | -1  |
| C-338214 | 10869   | 54900                               | 13100                              | 41800                    | -76.14%                             | 0   |
| C-338351 | 11161   | 44300                               | 4590                               | 39710                    | -89.64%                             | -1  |
| C-338354 | 11317   | 38800                               | 4650                               | 34150                    | -88.02%                             | -1  |
| C-321817 | 11573   | 44000                               | 5030                               | 38970                    | -88.57%                             | -1  |
| C-338358 | 11893   | 32800                               | 2530                               | 30270                    | -92.29%                             | -1  |
| C-338362 | 12136   | 34700                               | 5270                               | 29430                    | -84.81%                             | -1  |
| C-338366 | 12232   | 41600                               | 6370                               | 35230                    | -84.69%                             | -1  |
| C-338367 | 12341   | 40000                               | 2810                               | 37190                    | -92.98%                             | -1  |
| C-338369 | 12505   | 38400                               | 1950                               | 36450                    | -94.92%                             | -1  |
| C-338370 | 12761   | 39400                               | 7200                               | 32200                    | -81.73%                             | -1  |
| C-338125 | 12904   | 41200                               | 5680                               | 35520                    | -86.21%                             | -1  |
| C-338126 | 12917   | 48800                               | 4150                               | 44650                    | -91.50%                             | -1  |

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 2C. Aluminum – 45 sample data subset statistics.**

| Sample<br>Statistics        | Aluminum<br>All Data<br>USGS<br>Method<br>mg/kg | Aluminum<br>USGS<br>Method<br>mg/kg | Aluminum<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|-----------------------------|---|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| Minimum                     | 22200   | 23000                               | 1950                               | 21050                    | -91.52%                             | -1  |
| 50 <sup>th</sup> Percentile | 44000   | 44400                               | 6680                               | 37720                    | -84.95%                             | -1  |
| 75 <sup>th</sup> Percentile | 49000   | 49200                               | 10200                              | 39000                    | -79.27%                             | 0   |
| 90 <sup>th</sup> Percentile | 52240   | 53420                               | 14540                              | 38880                    | -72.78%                             | 0   |
| 95 <sup>th</sup> Percentile | 55390   | 54660                               | 16180                              | 38480                    | -70.40%                             | 0   |
| Maximum                     | 73900   | 73900                               | 19300                              | 54600                    | -73.88%                             | 0   |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 2D. Aluminum ProUCL calculated UTLs.**

| <b>Sample Statistics<br/>95<sup>th</sup> Percentile<br/>95% Confidence Coefficient</b> | <b>Aluminum<br/>All USGS<br/>Data with<br/>Outliers<br/>mg/kg</b> | <b>Aluminum<br/>All USGS<br/>Data<br/>without<br/>Outliers<br/>mg/kg</b> | <b>Aluminum<br/>USGS<br/>Method<br/>Data<br/>mg/kg</b> | <b>Aluminum<br/>EPA<br/>Method<br/>Data<br/>mg/kg</b> |
|--|---|--|--|---|
| <i>Normal Distribution</i>   |   |  |  |   |
| 95% UTL with 95% Coverage  | 60514   | 58883  | 61665  | 17297   |
| <i>Gamma Distribution</i>  |   |  |  |   |
| 95% WH UTL with 95% Coverage   | 66707   | 60091  | 63378  | 19733   |
| 95% HW UTL with 95% Coverage   | 68377   | 60305  | 63688  | 20339   |
| <i>Lognormal Distribution</i>  |   |  |  |   |
| 95% UTL with 95% Coverage  | 76495   | 61063  | 64799  | 23095   |
| <i>Nonparametric - No Distribution</i>   |   |  |  |   |
| 95% Percentile Bootstrap UTL with 95% Coverage   | 59160   | 60300  | 70180  | 19140   |
| 95% UTL with 95% Coverage  | 60300   | 60300  | 55300  | 18500   |
| 95% BCA Bootstrap UTL with 95% Coverage  | 59080   | 60040  | 70180  | 18700   |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 3A. Arsenic – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Arsenic mg/kg |
|----------|---------|--------------------|----------------------------|---------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 6             |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 5.1           |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 6.9           |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 4.5           |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 1.7           |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 5.9           |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 2.7           |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 4.9           |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 3.1           |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 2             |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 7.2           |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 1.5           |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 2.6           |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 4.6           |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 1.5           |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 2.5           |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 2.2           |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 5.3           |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 6.1           |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 2.9           |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 5             |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 2.5           |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 4.9           |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 5.8           |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 7             |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 2.1           |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 3.2           |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 1.3           |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 8.7           |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 2.4           |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 3.6           |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 8.6           |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 2.6           |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 1.6           |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 0.6           |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 6.6           |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  | 6.1           |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest           | 8.5           |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest           | 1.3           |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Arsenic mg/kg |
|----------|---------|--------------------|-----------------------|---------------|
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 6.8           |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 7.8           |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 1.7           |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 6             |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 9.2           |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 6.9           |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 1.7           |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 4             |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 5.1           |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 3.7           |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 2.8           |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 4.6           |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 5.2           |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 4.2           |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 4             |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 6             |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 3             |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 1.2           |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 5.7           |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 2             |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 2.3           |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 2.9           |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 3.9           |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 8.2           |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 7.8           |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 2.9           |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 4             |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 1.9           |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 10.8          |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 2.2           |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 4.2           |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 6.1           |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 4.4           |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 3.4           |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 1.7           |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 5.4           |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 8.1           |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 2.7           |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 5.3           |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 1.7           |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 4.3           |



| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Arsenic mg/kg |
|----------|---------|--------------------|-----------------------|---------------|
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 6.2           |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 2.6           |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 4.4           |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 5.4           |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 3.7           |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 5.4           |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 1.8           |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 1.4           |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 2.4           |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 4.9           |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 2.9           |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 6             |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 1.7           |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 7.4           |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 3             |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 5.2           |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 2.2           |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 3.6           |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 2.5           |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 3.3           |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 2.2           |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 4.3           |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 5.5           |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 3.2           |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 3.5           |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 3.6           |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 1.9           |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 4.8           |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 1.5           |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 6.9           |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 1.3           |
| C-338351 | 11161   | Planted/Cultivated | Row Crops             | 6.6           |
| C-338352 | 11208   | Planted/Cultivated | Row Crops             | 10.8          |
| C-338353 | 11225   | Forested Upland    | Mixed Forest          | 1.7           |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest      | 5             |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest      | 1.9           |
| C-321817 | 11573   | Planted/Cultivated | Row Crops             | 5.4           |
| C-338357 | 11737   | Planted/Cultivated | Row Crops             | 6.4           |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest      | 3.1           |
| C-338359 | 11929   | Forested Upland    | Mixed Forest          | 3.7           |
| C-338360 | 11976   | Planted/Cultivated | Row Crops             | 6.3           |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Arsenic mg/kg |
|----------|---------|--------------------|------------------|---------------|
| C-338361 | 12121   | Planted/Cultivated | Row Crops        | 1.6           |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 4.5           |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 3.4           |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 3.8           |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 5.5           |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 2             |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 6.4           |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 1.3           |
| C-338370 | 12761   | Shrubland          | Shrubland        | 3.5           |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 2.2           |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 5.2           |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 2.1           |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 2.3           |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 1.8           |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 6.5           |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 1.4           |

Samples highlighted in brown are non-detects

**Table 3B. Arsenic – 45 sample data subset.**

| Lab ID   | Site ID | Arsenic USGS Method mg/kg | Arsenic EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|----------|---------|---------------------------|--------------------------|-----------------------|-------------------------------|--------------------------------------|
| C-338081 | 168     | 6                         | 5.6                      | 0.4                   | -6.67%                        | 0                                    |
| C-338084 | 665     | 4.5                       | 3.3                      | 1.2                   | -26.67%                       | 0                                    |
| C-338090 | 985     | 3.1                       | 3.1                      | 0                     | 0.00%                         | 0                                    |
| C-338096 | 1589    | 4.6                       | 5.8                      | -1.2                  | 26.09%                        | 0                                    |
| C-338099 | 1753    | 2.2                       | 2.2                      | 0                     | 0.00%                         | 0                                    |
| C-338133 | 2009    | 2.9                       | 3.3                      | -0.4                  | 13.79%                        | 0                                    |
| C-338136 | 2216    | 4.9                       | 6.8                      | -1.9                  | 38.78%                        | 0                                    |
| C-338137 | 2265    | 5.8                       | 5.3                      | 0.5                   | -8.62%                        | 0                                    |
| C-338142 | 2713    | 1.3                       | 0.75                     | 0.55                  | -42.31%                       | -1                                   |
| C-338149 | 3125    | 2.6                       | 1.9                      | 0.7                   | -26.92%                       | 0                                    |
| C-338177 | 3545    | 6.1                       | 6.1                      | 0                     | 0.00%                         | 0                                    |
| C-338182 | 3944    | 7.8                       | 8.0                      | -0.2                  | 2.56%                         | 0                                    |
| C-338183 | 3993    | 1.7                       | 2.2                      | -0.5                  | 29.41%                        | 0                                    |
| C-338184 | 4040    | 6                         | 6.7                      | -0.7                  | 11.67%                        | 0                                    |
| C-338185 | 4120    | 9.2                       | 9.7                      | -0.5                  | 5.43%                         | 0                                    |

| Lab ID   | Site ID | Arsenic<br>USGS<br>Method<br>mg/kg | Arsenic<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|------------------------------------|-----------------------------------|--------------------------|-------------------------------------|---|
| C-338193 | 4953    | 4.6                                | 3.8                               | 0.8                      | -17.39%                             | 0   |
| C-338194 | 5017    | 5.2                                | 5.0                               | 0.2                      | -3.85%                              | 0   |
| C-338155 | 5288    | 6                                  | 5.4                               | 0.6                      | -10.00%                             | 0   |
| C-338156 | 5337    | 3                                  | 2.5                               | 0.5                      | -16.67%                             | 0   |
| C-338165 | 6553    | 7.8                                | 7.9                               | -0.1                     | 1.28%                               | 0   |
| C-338172 | 7065    | 4.2                                | 3.1                               | 1.1                      | -26.19%                             | 0   |
| C-338173 | 7112    | 6.1                                | 5.9                               | 0.2                      | -3.28%                              | 0   |
| C-338103 | 7129    | 4.4                                | 1.1                               | 3.3                      | -75.00%                             | 0   |
| C-338106 | 7577    | 8.1                                | 5.3                               | 2.8                      | -34.57%                             | 0   |
| C-338112 | 8053    | 2.6                                | 1.9                               | 0.7                      | -26.92%                             | 0   |
| C-338113 | 8089    | 4.4                                | 2.8                               | 1.6                      | -36.36%                             | 0   |
| C-338120 | 8665    | 1.4                                | 0.66                              | 0.74                     | -52.86%                             | -1  |
| C-338200 | 9160    | 5.2                                | 2.4                               | 2.8                      | -53.85%                             | 0   |
| C-338205 | 9845    | 3.3                                | 1.9                               | 1.4                      | -42.42%                             | 0   |
| C-338206 | 9881    | 2.2                                | 0.87                              | 1.33                     | -60.45%                             | 0   |
| C-338207 | 10137   | 4.3                                | 3.6                               | 0.7                      | -16.28%                             | -1  |
| C-338210 | 10293   | 3.2                                | 2.2                               | 1                        | -31.25%                             | 0   |
| C-338212 | 10649   | 3.6                                | 3.3                               | 0.3                      | -8.33%                              | 0   |
| C-338214 | 10869   | 4.8                                | 3.7                               | 1.1                      | -22.92%                             | 0   |
| C-338351 | 11161   | 6.6                                | 3.2                               | 3.4                      | -51.52%                             | 0   |
| C-338354 | 11317   | 5                                  | 1.9                               | 3.1                      | -62.00%                             | 0   |
| C-321817 | 11573   | 5.4                                | 4.4                               | 1                        | -18.52%                             | 0   |
| C-338358 | 11893   | 3.1                                | 1.5                               | 1.6                      | -51.61%                             | 0   |
| C-338362 | 12136   | 4.5                                | 4.8                               | -0.3                     | 6.67%                               | 0   |
| C-338366 | 12232   | 5.5                                | 5.2                               | 0.3                      | -5.45%                              | 0   |
| C-338367 | 12341   | 2                                  | 1.8                               | 0.2                      | -10.00%                             | 0   |
| C-338369 | 12505   | 1.3                                | 0.42                              | ND                       | ND                                  | NA  |
| C-338370 | 12761   | 3.5                                | 3.5                               | 0                        | 0.00%                               | 0   |
| C-338125 | 12904   | 5.2                                | 6.1                               | -0.9                     | 17.31%                              | 0   |
| C-338126 | 12917   | 2.1                                | 2.1                               | 0                        | 0.00%                               | 0   |

Samples highlighted in brown are non-detects

ND – non-detect data, EPA method reporting limit is 0.42 mg/kg

NA – not applicable

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 3C. Arsenic – 45 samples data subset statistics.**

| Sample Statistics           | Arsenic All Data USGS Method mg/kg | Arsenic USGS Method mg/kg | Arsenic EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|-----------------------------|------------------------------------|---------------------------|--------------------------|-----------------------|-------------------------------|--------------------------------------|
| Minimum                     | 0.6                                | 1.3                       | 0.7                      | 0.64                  | -49.23%                       | -1                                   |
| 50 <sup>th</sup> Percentile | 4.1                                | 4.4                       | 3.8                      | 0.55                  | -12.61%                       | 0                                    |
| 75 <sup>th</sup> Percentile | 5.5                                | 5.5                       | 5.3                      | 0.18                  | -3.18%                        | 0                                    |
| 90 <sup>th</sup> Percentile | 6.9                                | 6.4                       | 6.5                      | -0.12                 | 1.88%                         | 0                                    |
| 95 <sup>th</sup> Percentile | 8.1                                | 7.8                       | 7.7                      | 0.06                  | -0.83%                        | 0                                    |
| Maximum                     | 10.8                               | 9.2                       | 9.7                      | -0.50                 | 5.43%                         | 0                                    |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 3D. Arsenic ProUCL calculated UTLs.**

| Sample Statistics With Non-detects<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Arsenic All USGS Data mg/kg | Arsenic USGS Method Data mg/kg | Arsenic EPA Method Data mg/kg |
|---|-----------------------------|--------------------------------|-------------------------------|
| <i>Normal Distribution</i>  |                             |                                |                               |
| 95% UTL with 95% Coverage - Kaplan Meier  | NA                          |                                | 8.241                         |
| 95% UTL with 95% Coverage - DL/2  | NA                          |                                | 8.303                         |
| 95% UTL with 95% Coverage   |                             | 8.355                          |                               |
| <i>Gamma Distribution</i>   |                             |                                |                               |
| 95% WH UTL with 95% Coverage - ROS  | 9.197                       |                                | 10.13                         |
| 95% HW UTL with 95% Coverage - ROS  | 9.435                       |                                | 10.66                         |
| 95% WH UTL with 95% Coverage - Kaplan Meier   | 9.139                       |                                | 9.979                         |
| 95% HW UTL with 95% Coverage - Kaplan Meier   | 9.362                       |                                | 10.47                         |
| 95% WH UTL with 95% Coverage  |                             | 9.558                          |                               |
| 95% HW UTL with 95% Coverage  |                             | 9.834                          |                               |
| <i>Lognormal Distribution</i>   |                             |                                |                               |
| 95% UTL with 95% Coverage - ROS   | 10.29                       |                                | 12.73                         |
| 95% Bootstrap (%) UTL 95% Coverage - ROS  | 8.7                         |                                | 9.34                          |
| 95% BCA UTL 95% Coverage - ROS  | 8.7                         |                                | 13.05                         |
| 95% UTL 95% Coverage - DL/2   | 10.7                        |                                | 14.52                         |
| 95% UTL with 95% Coverage   |                             | 11.02                          |                               |
| <i>Nonparametric - No Distribution</i>  |                             |                                |                               |
| 95% UTL with 95% Coverage   | 8.7                         |                                | 8                             |
| 95% Percentile Bootstrap UTL with 95% Coverage  |                             | 8.98                           |                               |
| 95% UTL with 95% Coverage   |                             | 8.1                            |                               |
| 95% BCA Bootstrap UTL with 95% Coverage   |                             | 8.1                            |                               |

Black font – 137 samples from complete USGS Minnesota dataset (includes non-detect data)

Brown font – 45 samples analyzed using USGS method (does not include non-detect data)

Blue font – 45 samples reanalyzed using EPA method (includes non-detect data)

Substitution method UTLs are not recommended (DL/2)

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 4A. Barium – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Barium mg/kg |
|----------|---------|--------------------|----------------------------|--------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 640          |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 477          |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 25           |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 500          |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 412          |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 543          |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 554          |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 640          |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 576          |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 583          |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 648          |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 563          |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 583          |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 504          |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 558          |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 665          |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 483          |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 555          |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 616          |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 417          |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 656          |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 535          |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 636          |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 479          |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 635          |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 436          |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 445          |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 460          |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 589          |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 153          |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 522          |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 544          |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 422          |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 582          |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 580          |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 592          |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  | 511          |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest           | 590          |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest           | 618          |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Barium mg/kg |
|----------|---------|--------------------|-----------------------|--------------|
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 590          |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 515          |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 470          |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 600          |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 657          |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 523          |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 513          |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 536          |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 503          |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 404          |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 452          |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 519          |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 564          |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 641          |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 479          |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 624          |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 530          |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 499          |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 528          |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 442          |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 415          |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 586          |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 475          |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 693          |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 557          |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 548          |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 567          |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 453          |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 600          |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 586          |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 539          |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 575          |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 587          |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 483          |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 449          |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 325          |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 593          |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 522          |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 541          |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 550          |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 667          |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Barium mg/kg |
|----------|---------|--------------------|-----------------------|--------------|
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 656          |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 284          |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 594          |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 608          |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 574          |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 512          |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 488          |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 529          |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 418          |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 662          |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 572          |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 652          |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 448          |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 565          |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 485          |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 627          |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 436          |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 516          |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 551          |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 269          |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 565          |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 552          |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 623          |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 487          |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 440          |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 585          |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 483          |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 468          |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 515          |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 541          |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 401          |
| C-338351 | 11161   | Planted/Cultivated | Row Crops             | 487          |
| C-338352 | 11208   | Planted/Cultivated | Row Crops             | 574          |
| C-338353 | 11225   | Forested Upland    | Mixed Forest          | 434          |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest      | 680          |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest      | 512          |
| C-321817 | 11573   | Planted/Cultivated | Row Crops             | 641          |
| C-338357 | 11737   | Planted/Cultivated | Row Crops             | 491          |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest      | 351          |
| C-338359 | 11929   | Forested Upland    | Mixed Forest          | 495          |
| C-338360 | 11976   | Planted/Cultivated | Row Crops             | 693          |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Barium mg/kg |
|----------|---------|--------------------|------------------|--------------|
| C-338361 | 12121   | Planted/Cultivated | Row Crops        | 458          |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 483          |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 653          |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 487          |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 550          |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 593          |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 624          |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 421          |
| C-338370 | 12761   | Shrubland          | Shrubland        | 473          |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 441          |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 661          |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 560          |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 460          |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 538          |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 618          |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 462          |

Samples highlighted in gray were considered outliers

**Table 4B. Barium – 45 sample data subset.**

| Lab ID   | Site ID | Barium USGS Method mg/kg | Barium EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|----------|---------|--------------------------|-------------------------|-----------------------|-------------------------------|--------------------------------------|
| C-338081 | 168     | 640                      | 114                     | 526                   | -82.19%                       | 0                                    |
| C-338084 | 665     | 500                      | 88.0                    | 412                   | -82.40%                       | -1                                   |
| C-338090 | 985     | 576                      | 103                     | 473                   | -82.12%                       | 0                                    |
| C-338096 | 1589    | 504                      | 97.4                    | 406.6                 | -80.67%                       | -1                                   |
| C-338099 | 1753    | 483                      | 106                     | 377                   | -78.05%                       | 0                                    |
| C-338133 | 2009    | 417                      | 71.5                    | 345.5                 | -82.85%                       | -1                                   |
| C-338136 | 2216    | 636                      | 134                     | 502                   | -78.93%                       | 0                                    |
| C-338137 | 2265    | 479                      | 91.4                    | 387.6                 | -80.92%                       | -1                                   |
| C-338142 | 2713    | 460                      | 39.2                    | 420.8                 | -91.48%                       | -1                                   |
| C-338149 | 3125    | 422                      | 22.7                    | 399.3                 | -94.62%                       | -1                                   |
| C-338177 | 3545    | 511                      | 157                     | 354                   | -69.28%                       | 0                                    |
| C-338182 | 3944    | 515                      | 144                     | 371                   | -72.04%                       | 0                                    |
| C-338183 | 3993    | 470                      | 48.8                    | 421.2                 | -89.62%                       | -1                                   |
| C-338184 | 4040    | 600                      | 213                     | 387                   | -64.50%                       | 0                                    |
| C-338185 | 4120    | 657                      | 198                     | 459                   | -69.86%                       | 0                                    |
| C-338193 | 4953    | 519                      | 135                     | 384                   | -73.99%                       | 0                                    |
| C-338194 | 5017    | 564                      | 86.0                    | 478                   | -84.75%                       | -1                                   |



| Lab ID   | Site ID | Barium<br>USGS<br>Method<br>mg/kg | Barium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-----------------------------------|----------------------------------|--------------------------|-------------------------------------|---|
| C-338155 | 5288    | 624                               | 200                              | 424                      | -67.95%                             | 0   |
| C-338156 | 5337    | 530                               | 98.9                             | 431.1                    | -81.34%                             | -1  |
| C-338165 | 6553    | 557                               | 113                              | 444                      | -79.71%                             | 0   |
| C-338172 | 7065    | 539                               | 83.8                             | 455.2                    | -84.45%                             | -1  |
| C-338173 | 7112    | 575                               | 103                              | 472                      | -82.09%                             | 0   |
| C-338103 | 7129    | 587                               | 94.7                             | 492.3                    | -83.87%                             | -1  |
| C-338106 | 7577    | 593                               | 98.3                             | 494.7                    | -83.42%                             | -1  |
| C-338112 | 8053    | 284                               | 52.9                             | 231.1                    | -81.37%                             | -1  |
| C-338113 | 8089    | 594                               | 68.6                             | 525.4                    | -88.45%                             | -1  |
| C-338120 | 8665    | 529                               | 57.6                             | 471.4                    | -89.11%                             | -1  |
| C-338200 | 9160    | 627                               | 123                              | 504                      | -80.38%                             | 0   |
| C-338205 | 9845    | 269                               | 82.6                             | 186.4                    | -69.29%                             | -1  |
| C-338206 | 9881    | 565                               | 85.8                             | 479.2                    | -84.81%                             | -1  |
| C-338207 | 10137   | 552                               | 47.4                             | 504.6                    | -91.41%                             | -1  |
| C-338210 | 10293   | 487                               | 77.8                             | 409.2                    | -84.02%                             | -1  |
| C-338212 | 10649   | 585                               | 71.3                             | 513.7                    | -87.81%                             | -1  |
| C-338214 | 10869   | 468                               | 84.2                             | 383.8                    | -82.01%                             | -1  |
| C-338351 | 11161   | 487                               | 38.8                             | 448.2                    | -92.03%                             | -1  |
| C-338354 | 11317   | 680                               | 161                              | 519                      | -76.32%                             | 0   |
| C-321817 | 11573   | 641                               | 73.7                             | 567.3                    | -88.50%                             | -1  |
| C-338358 | 11893   | 351                               | 59.4                             | 291.6                    | -83.08%                             | -1  |
| C-338362 | 12136   | 483                               | 115                              | 368                      | -76.19%                             | 0   |
| C-338366 | 12232   | 550                               | 118                              | 432                      | -78.55%                             | 0   |
| C-338367 | 12341   | 593                               | 157                              | 436                      | -73.52%                             | 0   |
| C-338369 | 12505   | 421                               | 28.3                             | 392.7                    | -93.28%                             | -1  |
| C-338370 | 12761   | 473                               | 90.8                             | 382.2                    | -80.80%                             | -1  |
| C-338125 | 12904   | 661                               | 116                              | 545                      | -82.45%                             | 0   |
| C-338126 | 12917   | 560                               | 43.1                             | 516.9                    | -92.30%                             | -1  |

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 4C. Barium – 45 sample data subset statistics.**

| Sample Statistics           | Barium All Data USGS Method mg/kg | Barium USGS Method mg/kg | Barium EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|-----------------------------|-----------------------------------|--------------------------|-------------------------|-----------------------|-------------------------------|--------------------------------------|
| Minimum                     | 269                               | 269                      | 23                      | 246                   | -91.56%                       | -1                                   |
| 50 <sup>th</sup> Percentile | 541                               | 529                      | 98                      | 432                   | -81.56%                       | -1                                   |
| 75 <sup>th</sup> Percentile | 590                               | 593                      | 116                     | 477                   | -80.44%                       | 0                                    |
| 90 <sup>th</sup> Percentile | 641                               | 638                      | 157                     | 481                   | -75.41%                       | 0                                    |
| 95 <sup>th</sup> Percentile | 658                               | 654                      | 191                     | 463                   | -70.85%                       | 0                                    |
| Maximum                     | 693                               | 680                      | 213                     | 467                   | -68.68%                       | 0                                    |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 4D. Barium ProUCL calculated UTLs.**

| Sample Statistics<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Barium All USGS Data with Outliers mg/kg | Barium All USGS Data no Outliers mg/kg | Barium USGS Method Data mg/kg | Barium EPA Method Data mg/kg |
|--|--|--|-------------------------------|------------------------------|
| <i>Normal Distribution</i>   |  |  |                               |                              |
| 95% UTL with 95% Coverage  | 713.1                                    | 690.3                                  | 719.9                         | 190.1                        |
| <i>Gamma Distribution</i>  |  |  |                               |                              |
| 95% WH UTL with 95% Coverage   | 798.6                                    | 708.7                                  | 755.9                         | 214.4                        |
| 95% HW UTL with 95% Coverage   | 822.3                                    | 711.7                                  | 762.1                         | 220.3                        |
| <i>Lognormal Distribution</i>  |  |  |                               |                              |
| 95% UTL with 95% Coverage  | 943.3                                    | 722                                    | 783.9                         | 246.2                        |
| <i>Nonparametric - No Distribution</i>   |  |  |                               |                              |
| 95% Percentile Bootstrap UTL with 95% Coverage                                 | 667                                      | 667                                    | 676.2                         | 210.4                        |
| 95% UTL with 95% Coverage  | 667                                      | 667                                    | 661                           | 200                          |
| 95% BCA Bootstrap UTL with 95% Coverage  | 667                                      | 667                                    | 675.4                         | 210                          |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 5A. Chromium – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Chromium mg/kg |
|----------|---------|--------------------|----------------------------|----------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 33             |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 32             |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 9              |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 27             |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 19             |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 51             |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 33             |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 38             |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 47             |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 22             |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 48             |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 26             |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 28             |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 31             |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 23             |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 33             |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 35             |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 31             |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 38             |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 16             |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 52             |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 27             |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 44             |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 28             |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 39             |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 12             |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 64             |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 9              |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 41             |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 11             |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 37             |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 45             |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 16             |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 19             |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 20             |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 46             |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  | 50             |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest           | 36             |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest           | 21             |
| C-338181 | 3784    | Planted/Cultivated | Row Crops                  | 45             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Chromium mg/kg |
|----------|---------|--------------------|-----------------------|----------------|
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 35             |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 12             |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 43             |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 43             |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 31             |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 24             |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 48             |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 24             |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 30             |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 14             |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 73             |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 34             |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 26             |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 45             |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 45             |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 23             |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 13             |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 88             |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 30             |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 35             |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 49             |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 20             |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 51             |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 40             |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 29             |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 49             |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 17             |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 40             |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 20             |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 26             |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 29             |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 26             |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 38             |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 16             |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 9              |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 47             |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 22             |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 76             |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 27             |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 45             |
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 40             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Chromium mg/kg |
|----------|---------|--------------------|-----------------------|----------------|
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 70             |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 31             |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 37             |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 76             |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 29             |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 15             |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 22             |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 14             |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 38             |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 49             |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 49             |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 31             |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 74             |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 28             |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 47             |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 19             |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 24             |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 25             |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 98             |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 34             |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 31             |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 31             |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 64             |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 29             |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 29             |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 23             |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 58             |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 20             |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 38             |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 16             |
| C-338351 | 11161   | Planted/Cultivated | Row Crops             | 28             |
| C-338352 | 11208   | Planted/Cultivated | Row Crops             | 48             |
| C-338353 | 11225   | Forested Upland    | Mixed Forest          | 14             |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest      | 33             |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest      | 21             |
| C-321817 | 11573   | Planted/Cultivated | Row Crops             | 18             |
| C-338357 | 11737   | Planted/Cultivated | Row Crops             | 47             |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest      | 10             |
| C-338359 | 11929   | Forested Upland    | Mixed Forest          | 32             |
| C-338360 | 11976   | Planted/Cultivated | Row Crops             | 33             |
| C-338361 | 12121   | Planted/Cultivated | Row Crops             | 15             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Chromium mg/kg |
|----------|---------|--------------------|------------------|----------------|
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 35             |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 75             |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 33             |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 42             |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 23             |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 46             |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 11             |
| C-338370 | 12761   | Shrubland          | Shrubland        | 38             |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 17             |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 38             |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 27             |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 15             |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 28             |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 32             |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 9              |

Samples highlighted in gray were considered outliers

**Table 5B. Chromium – 45 sample data subset.**

| Lab ID   | Site ID | Chromium<br>USGS<br>Method<br>mg/kg | Chromium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338081 | 168     | 33                                  | 12.4                               | 20.6                     | -62.42%                             | 0   |
| C-338084 | 665     | 27                                  | 13.1                               | 13.9                     | -51.48%                             | 0   |
| C-338090 | 985     | 47                                  | 19.2                               | 27.8                     | -59.15%                             | 0   |
| C-338096 | 1589    | 31                                  | 14.4                               | 16.6                     | -53.55%                             | 0   |
| C-338099 | 1753    | 35                                  | 12.9                               | 22.1                     | -63.14%                             | 0   |
| C-338133 | 2009    | 16                                  | 7.4                                | 8.6                      | -53.75%                             | -1  |
| C-338136 | 2216    | 44                                  | 15.9                               | 28.1                     | -63.86%                             | 0   |
| C-338137 | 2265    | 28                                  | 11.5                               | 16.5                     | -58.93%                             | 0   |
| C-338142 | 2713    | 9                                   | 3.9                                | 5.1                      | -56.67%                             | 0   |
| C-338149 | 3125    | 16                                  | 3.9                                | 12.1                     | -75.63%                             | -1  |
| C-338177 | 3545    | 50                                  | 24.9                               | 25.1                     | -50.20%                             | 0   |
| C-338182 | 3944    | 35                                  | 13.7                               | 21.3                     | -60.86%                             | 0   |
| C-338183 | 3993    | 12                                  | 6.2                                | 5.8                      | -48.33%                             | -1  |
| C-338184 | 4040    | 43                                  | 17.7                               | 25.3                     | -58.84%                             | 0   |
| C-338185 | 4120    | 43                                  | 19.4                               | 23.6                     | -54.88%                             | 0   |
| C-338193 | 4953    | 73                                  | 31.4                               | 41.6                     | -56.99%                             | 0   |
| C-338194 | 5017    | 34                                  | 13.0                               | 21                       | -61.76%                             | 0   |
| C-338155 | 5288    | 45                                  | 17.1                               | 27.9                     | -62.00%                             | 0   |

| Lab ID   | Site ID | Chromium<br>USGS<br>Method<br>mg/kg | Chromium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338156 | 5337    | 23                                  | 10.5                               | 12.5                     | -54.35%                             | 0   |
| C-338165 | 6553    | 40                                  | 18.0                               | 22                       | -55.00%                             | 0   |
| C-338172 | 7065    | 26                                  | 7.3                                | 18.7                     | -71.92%                             | -1  |
| C-338173 | 7112    | 29                                  | 7.6                                | 21.4                     | -73.79%                             | -1  |
| C-338103 | 7129    | 26                                  | 7.1                                | 18.9                     | -72.69%                             | -1  |
| C-338106 | 7577    | 47                                  | 12.7                               | 34.3                     | -72.98%                             | 0   |
| C-338112 | 8053    | 70                                  | 16.8                               | 53.2                     | -76.00%                             | 0   |
| C-338113 | 8089    | 31                                  | 9.0                                | 22                       | -70.97%                             | -1  |
| C-338120 | 8665    | 22                                  | 4.3                                | 17.7                     | -80.45%                             | -1  |
| C-338200 | 9160    | 47                                  | 11.3                               | 35.7                     | -75.96%                             | 0   |
| C-338206 | 9881    | 34                                  | 5.5                                | 28.5                     | -83.82%                             | -1  |
| C-338207 | 10137   | 31                                  | 9.7                                | 21.3                     | -68.71%                             | -1  |
| C-338210 | 10293   | 64                                  | 21.6                               | 42.4                     | -66.25%                             | 0   |
| C-338212 | 10649   | 29                                  | 6.9                                | 22.1                     | -76.21%                             | -1  |
| C-338214 | 10869   | 58                                  | 23.3                               | 34.7                     | -59.83%                             | 0   |
| C-338351 | 11161   | 28                                  | 12.3                               | 15.7                     | -56.07%                             | 0   |
| C-338354 | 11317   | 33                                  | 6.7                                | 26.3                     | -79.70%                             | -1  |
| C-321817 | 11573   | 18                                  | 9.2                                | 8.8                      | -48.89%                             | -1  |
| C-338358 | 11893   | 10                                  | 3.4                                | 6.6                      | -66.00%                             | -1  |
| C-338362 | 12136   | 35                                  | 8.3                                | 26.7                     | -76.29%                             | -1  |
| C-338366 | 12232   | 42                                  | 9.5                                | 32.5                     | -77.38%                             | -1  |
| C-338367 | 12341   | 23                                  | 4.2                                | 18.8                     | -81.74%                             | -1  |
| C-338369 | 12505   | 11                                  | 4.1                                | 6.9                      | -62.73%                             | -1  |
| C-338370 | 12761   | 38                                  | 12.0                               | 26                       | -68.42%                             | 0   |
| C-338125 | 12904   | 38                                  | 9.4                                | 28.6                     | -75.26%                             | -1  |
| C-338126 | 12917   | 27                                  | 7.7                                | 19.3                     | -71.48%                             | -1  |

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 5C. Chromium – 45 sample data subset statistics.**

| Sample Statistics           | Chromium All Data USGS Method mg/kg | Chromium USGS Method mg/kg | Chromium EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|-----------------------------|-------------------------------------|----------------------------|---------------------------|-----------------------|-------------------------------|--------------------------------------|
| Minimum                     | 9                                   | 9                          | 3                         | 6                     | -62.22%                       | 0                                    |
| 50 <sup>th</sup> Percentile | 31                                  | 33                         | 11                        | 22                    | -66.97%                       | 0                                    |
| 75 <sup>th</sup> Percentile | 43                                  | 43                         | 15                        | 28                    | -65.64%                       | 0                                    |
| 90 <sup>th</sup> Percentile | 50                                  | 49                         | 19                        | 30                    | -60.61%                       | 0                                    |
| 95 <sup>th</sup> Percentile | 66                                  | 63                         | 23                        | 40                    | -63.48%                       | 0                                    |
| Maximum                     | 88                                  | 73                         | 31                        | 42                    | -56.99%                       | 0                                    |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 5D. Chromium ProUCL calculated UTLs.**

| Sample Statistics<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Chromium All USGS Data with Outliers mg/kg | Chromium All USGS Data no Outliers mg/kg | Chromium USGS Method Data with Outliers mg/kg | Chromium USGS Method Data no Outliers mg/kg | Chromium EPA Method Data mg/kg |
|--|--|--|---|---|--------------------------------|
| <i>Normal Distribution</i>   |  |  |   |   |                                |
| 95% UTL with 95% Coverage  | 65.13                                      | 63.01                                    | 71.98   | 65.12                                       | 24.62                          |
| <i>Gamma Distribution</i>  |  |  |   |   |                                |
| 95% WH UTL with 95% Coverage   | 70.33                                      | 68.52                                    | 79.94   | 73.86                                       | 27.63                          |
| 95% HW UTL with 95% Coverage   | 71.69                                      | 69.89                                    | 82.06   | 75.97                                       | 28.38                          |
| <i>Lognormal Distribution</i>  |  |  |   |   |                                |
| 95% UTL with 95% Coverage  | 77.67                                      | 75.81                                    | 91.77   | 85.24                                       | 31.69                          |
| <i>Nonparametric - No Distribution</i>   |  |  |   |   |                                |
| 95% Percentile Bootstrap UTL with 95% Coverage                                 | 75.2                                       | 75                                       | 93  | 72.55                                       | 30.1                           |
| 95% UTL with 95% Coverage  | 76   | 75                                       | 73  | 73  | 24.9                           |
| 95% BCA Bootstrap UTL with 95% Coverage  | 76   | 74.25                                    | 92.4  | 70.75                                       | 28.96                          |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA



**Table 6A. Cobalt – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Cobalt mg/kg |
|----------|---------|--------------------|----------------------------|--------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 8.3          |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 7.3          |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 2.6          |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 5.2          |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 3.6          |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 10.4         |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 9.8          |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 9.2          |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 12           |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 5.6          |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 11.8         |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 4            |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 7.7          |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 4.7          |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 5.1          |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 5.5          |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 5.4          |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 6.9          |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 8            |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 3.4          |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 7.8          |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 5.3          |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 9.8          |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 7            |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 8            |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 3.8          |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 13.3         |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 3.2          |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 8.1          |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 2.2          |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 5            |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 7.9          |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 2.8          |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 3.2          |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 10.2         |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 9.3          |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  | 10.2         |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest           | 8.4          |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest           | 5.8          |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Cobalt mg/kg |
|----------|---------|--------------------|-----------------------|--------------|
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 9.9          |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 9.7          |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 3.2          |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 9.1          |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 10.5         |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 8.3          |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 4.9          |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 12           |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 3.7          |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 5.6          |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 3.3          |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 12.7         |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 8.4          |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 9.1          |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 7.2          |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 7.5          |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 7.6          |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 3.3          |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 19.3         |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 4.5          |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 3.4          |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 6.6          |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 4.2          |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 9.9          |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 8.4          |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 6.9          |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 13.1         |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 2.6          |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 8.5          |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 3.5          |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 5            |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 7.3          |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 6.1          |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 8.1          |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 1.5          |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 4.3          |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 10.3         |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 5            |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 14.2         |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 4.6          |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 8.5          |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Cobalt mg/kg |
|----------|---------|--------------------|-----------------------|--------------|
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 9.4          |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 11.8         |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 7.8          |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 7.2          |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 12.7         |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 7.5          |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 6.8          |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 4.2          |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 3.2          |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 9.3          |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 9.3          |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 9.4          |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 3.3          |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 13.5         |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 6.3          |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 7.2          |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 3.7          |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 5.9          |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 4.1          |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 11           |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 5.7          |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 8.6          |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 7.5          |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 13           |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 6.1          |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 7.6          |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 4.9          |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 19.4         |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 3.8          |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 8.1          |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 2.6          |
| C-338351 | 11161   | Planted/Cultivated | Row Crops             | 8            |
| C-338352 | 11208   | Planted/Cultivated | Row Crops             | 10.5         |
| C-338353 | 11225   | Forested Upland    | Mixed Forest          | 2.6          |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest      | 10.6         |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest      | 4.6          |
| C-321817 | 11573   | Planted/Cultivated | Row Crops             | 6.9          |
| C-338357 | 11737   | Planted/Cultivated | Row Crops             | 8.9          |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest      | 1.3          |
| C-338359 | 11929   | Forested Upland    | Mixed Forest          | 7.1          |
| C-338360 | 11976   | Planted/Cultivated | Row Crops             | 9.1          |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Cobalt mg/kg |
|----------|---------|--------------------|------------------|--------------|
| C-338361 | 12121   | Planted/Cultivated | Row Crops        | 3.2          |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 7.7          |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 10           |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 5.7          |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 7            |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 3.1          |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 8.7          |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 3            |
| C-338370 | 12761   | Shrubland          | Shrubland        | 7.5          |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 5.9          |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 10.9         |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 4.9          |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 3.6          |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 4.7          |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 7.4          |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 3.7          |

Samples highlighted in gray were considered outliers

**Table 6B. Cobalt – 45 sample data subset.**

| Lab ID   | Site ID | Cobalt USGS Method mg/kg | Cobalt EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|----------|---------|--------------------------|-------------------------|-----------------------|-------------------------------|--------------------------------------|
| C-338081 | 168     | 8.3                      | 7.5                     | 0.8                   | -9.64%                        | 0                                    |
| C-338084 | 665     | 5.2                      | 4.9                     | 0.3                   | -5.77%                        | 0                                    |
| C-338090 | 985     | 12                       | 9.8                     | 2.2                   | -18.33%                       | -1                                   |
| C-338096 | 1589    | 4.7                      | 5.7                     | -1                    | 21.28%                        | 0                                    |
| C-338099 | 1753    | 5.4                      | 4.6                     | 0.8                   | -14.81%                       | 0                                    |
| C-338133 | 2009    | 3.4                      | 3.1                     | 0.3                   | -8.82%                        | 0                                    |
| C-338136 | 2216    | 9.8                      | 9.1                     | 0.7                   | -7.14%                        | 0                                    |
| C-338137 | 2265    | 7                        | 5.5                     | 1.5                   | -21.43%                       | 0                                    |
| C-338142 | 2713    | 3.2                      | 2.5                     | 0.7                   | -21.88%                       | 0                                    |
| C-338149 | 3125    | 2.8                      | 1.4                     | 1.4                   | -50.00%                       | 0                                    |
| C-338177 | 3545    | 10.2                     | 8.8                     | 1.4                   | -13.73%                       | -1                                   |
| C-338182 | 3944    | 9.7                      | 5.9                     | 3.8                   | -39.18%                       | 0                                    |
| C-338183 | 3993    | 3.2                      | 3.2                     | 0                     | 0.00%                         | 0                                    |
| C-338184 | 4040    | 9.1                      | 9.2                     | -0.1                  | 1.10%                         | 0                                    |

| Lab ID   | Site ID | Cobalt USGS Method mg/kg | Cobalt EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|----------|---------|--------------------------|-------------------------|-----------------------|-------------------------------|--------------------------------------|
| C-338185 | 4120    | 10.5                     | 10.2                    | 0.3                   | -2.86%                        | 0                                    |
| C-338193 | 4953    | 12.7                     | 9.9                     | 2.8                   | -22.05%                       | -1                                   |
| C-338194 | 5017    | 8.4                      | 5.9                     | 2.5                   | -29.76%                       | 0                                    |
| C-338155 | 5288    | 7.5                      | 5.0                     | 2.5                   | -33.33%                       | 0                                    |
| C-338156 | 5337    | 7.6                      | 8.7                     | -1.1                  | 14.47%                        | 0                                    |
| C-338165 | 6553    | 8.4                      | 7.8                     | 0.6                   | -7.14%                        | 0                                    |
| C-338172 | 7065    | 5                        | 3.6                     | 1.4                   | -28.00%                       | 0                                    |
| C-338173 | 7112    | 7.3                      | 4.5                     | 2.8                   | -38.36%                       | 0                                    |
| C-338103 | 7129    | 6.1                      | 3.6                     | 2.5                   | -40.98%                       | 0                                    |
| C-338106 | 7577    | 10.3                     | 6.2                     | 4.1                   | -39.81%                       | -1                                   |
| C-338112 | 8053    | 11.8                     | 7.2                     | 4.6                   | -38.98%                       | -1                                   |
| C-338113 | 8089    | 7.8                      | 5.3                     | 2.5                   | -32.05%                       | 0                                    |
| C-338120 | 8665    | 4.2                      | 2.3                     | 1.9                   | -45.24%                       | 0                                    |
| C-338200 | 9160    | 7.2                      | 3.7                     | 3.5                   | -48.61%                       | 0                                    |
| C-338205 | 9845    | 11                       | 5.5                     | 5.5                   | -50.00%                       | -1                                   |
| C-338206 | 9881    | 5.7                      | 2.5                     | 3.2                   | -56.14%                       | 0                                    |
| C-338207 | 10137   | 8.6                      | 3.9                     | 4.7                   | -54.65%                       | 0                                    |
| C-338210 | 10293   | 13                       | 9.0                     | 4                     | -30.77%                       | -1                                   |
| C-338212 | 10649   | 7.6                      | 4.5                     | 3.1                   | -40.79%                       | 0                                    |
| C-338214 | 10869   | 19.4                     | 12.7                    | 6.7                   | -34.54%                       | 0                                    |
| C-338351 | 11161   | 8                        | 4.4                     | 3.6                   | -45.00%                       | 0                                    |
| C-338354 | 11317   | 10.6                     | 6.6                     | 4                     | -37.74%                       | -1                                   |
| C-321817 | 11573   | 6.9                      | 4.6                     | 2.3                   | -33.33%                       | 0                                    |
| C-338358 | 11893   | 1.3                      | 0.74                    | 0.56                  | -43.08%                       | -1                                   |
| C-338362 | 12136   | 7.7                      | 6.7                     | 1                     | -12.99%                       | 0                                    |
| C-338366 | 12232   | 7                        | 4.5                     | 2.5                   | -35.71%                       | 0                                    |
| C-338367 | 12341   | 3.1                      | 2.1                     | 1                     | -32.26%                       | 0                                    |
| C-338369 | 12505   | 3                        | 1.7                     | 1.3                   | -43.33%                       | 0                                    |
| C-338370 | 12761   | 7.5                      | 5.0                     | 2.5                   | -33.33%                       | 0                                    |
| C-338125 | 12904   | 10.9                     | 6.6                     | 4.3                   | -39.45%                       | -1                                   |
| C-338126 | 12917   | 4.9                      | 2.5                     | 2.4                   | -48.98%                       | 0                                    |

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 6C. Cobalt – 45 sample data subset statistics.**

| Sample Statistics<br>NO Outliers | Cobalt All Data<br>USGS Method<br>mg/kg | Cobalt USGS<br>Method<br>mg/kg | Cobalt EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------------------------------|---|--------------------------------|-------------------------------|--------------------------|-------------------------------------|---|
| Minimum                          | 1.3                                     | 1.3                            | 0.7                           | 0.6                      | -43.08%                             | -1  |
| 50 <sup>th</sup> Percentile      | 7.2                                     | 7.6                            | 5.0                           | 2.6                      | -33.77%                             | 0   |
| 75 <sup>th</sup> Percentile      | 9.1                                     | 9.7                            | 6.8                           | 2.9                      | -29.82%                             | 0   |
| 90 <sup>th</sup> Percentile      | 10.6                                    | 11.0                           | 9.1                           | 1.9                      | -17.32%                             | -1  |
| 95 <sup>th</sup> Percentile      | 12.2                                    | 12.0                           | 9.7                           | 2.3                      | -18.88%                             | -1  |
| Maximum                          | 14.2                                    | 13.0                           | 10.2                          | 2.8                      | -21.54%                             | 0   |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 6D. Cobalt ProUCL calculated UTLs.**

| Sample Statistics<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Cobalt All USGS<br>Data with<br>Outliers<br>mg/kg | Cobalt All USGS<br>Data no<br>Outliers<br>mg/kg | Cobalt USGS<br>Method<br>Data with<br>Outliers<br>mg/kg | Cobalt USGS<br>Method<br>Data no<br>Outliers<br>mg/kg | Cobalt EPA<br>Method<br>Data<br>mg/kg |
|--|---|---|---|---|---------------------------------------|
| <i>Normal Distribution</i>   |   |   |   |   |                                       |
| 95% UTL with 95% Coverage  | 13.23   | 12.51   | 14.78   | 13.54   | 11.17                                 |
| <i>Gamma Distribution</i>  |   |   |   |   |                                       |
| 95% WH UTL with 95% Coverage   | 14.59   | 13.91   | 16.91   | 15.83   | 13.14                                 |
| 95% HW UTL with 95% Coverage   | 14.9  | 14.23   | 17.45   | 16.36   | 13.65                                 |
| <i>Lognormal Distribution</i>  |   |   |   |   |                                       |
| 95% UTL with 95% Coverage  | 16.25   | 15.54   | 19.93   | 18.74   | 16.14                                 |
| <i>Nonparametric - No Distribution</i>   |   |   |   |   |                                       |
| 95% Percentile Bootstrap UTL with 95% Coverage                                 | 13.5  | 13.1  | 18.12   | 12.96   | 12.2                                  |
| 95% UTL with 95% Coverage  | 13.5  | 13.1  | 13  | 13  | 10.2                                  |
| 95% BCA Bootstrap UTL with 95% Coverage  | 13.34   | 13.03   | 17.92   | 12.82   | 12.14                                 |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 7A. Iron – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Iron mg/kg |
|----------|---------|--------------------|----------------------------|------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 18500      |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 18700      |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 117000     |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 15200      |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 9700       |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 26200      |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 18000      |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 19000      |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 19500      |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 13500      |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 23500      |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 11200      |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 11300      |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 16300      |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 13600      |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 12300      |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 16400      |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 19000      |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 18400      |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 8400       |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 21100      |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 16300      |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 21900      |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 17400      |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 20900      |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 10200      |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 38800      |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 7000       |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 24800      |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 4600       |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 15400      |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 24100      |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 17000      |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 7000       |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 18600      |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 21100      |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  | 21900      |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest           | 24900      |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest           | 12400      |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Iron mg/kg |
|----------|---------|--------------------|-----------------------|------------|
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 22000      |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 20000      |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 8400       |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 21900      |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 25100      |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 20500      |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 10900      |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 22100      |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 14200      |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 14300      |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 10200      |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 35200      |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 20300      |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 14800      |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 24800      |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 21700      |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 14000      |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 6400       |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 32300      |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 15600      |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 7700       |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 18800      |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 10400      |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 23500      |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 21900      |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 11800      |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 36200      |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 7300       |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 26200      |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 9300       |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 14500      |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 20200      |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 17900      |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 24700      |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 4800       |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 14100      |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 24200      |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 11600      |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 26900      |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 9600       |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 20400      |



| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Iron mg/kg |
|----------|---------|--------------------|-----------------------|------------|
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 20600      |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 34900      |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 17700      |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 19700      |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 32300      |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 17300      |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 12800      |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 9700       |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 9100       |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 17400      |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 25500      |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 21900      |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 12600      |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 33100      |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 17500      |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 21000      |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 8600       |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 18100      |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 8800       |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 26300      |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 13100      |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 20200      |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 18000      |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 35900      |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 14500      |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 14800      |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 12400      |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 41600      |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 8800       |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 21200      |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 7800       |
| C-338351 | 11161   | Planted/Cultivated | Row Crops             | 21700      |
| C-338352 | 11208   | Planted/Cultivated | Row Crops             | 25000      |
| C-338353 | 11225   | Forested Upland    | Mixed Forest          | 7900       |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest      | 15200      |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest      | 11400      |
| C-321817 | 11573   | Planted/Cultivated | Row Crops             | 15200      |
| C-338357 | 11737   | Planted/Cultivated | Row Crops             | 22100      |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest      | 6400       |
| C-338359 | 11929   | Forested Upland    | Mixed Forest          | 17300      |
| C-338360 | 11976   | Planted/Cultivated | Row Crops             | 28800      |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Iron mg/kg |
|----------|---------|--------------------|------------------|------------|
| C-338361 | 12121   | Planted/Cultivated | Row Crops        | 9100       |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 16700      |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 42600      |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 16300      |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 18900      |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 8700       |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 20900      |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 7400       |
| C-338370 | 12761   | Shrubland          | Shrubland        | 17400      |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 14800      |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 17100      |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 12200      |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 9000       |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 11900      |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 18700      |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 10800      |

Samples highlighted in gray were considered outliers

**Table 7B. Iron – 45 sample data subset.**

| Lab ID   | Site ID | Iron USGS Method mg/kg | Iron EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|----------|---------|------------------------|-----------------------|-----------------------|-------------------------------|--------------------------------------|
| C-338081 | 168     | 18500                  | 12200                 | 6300                  | -34.05%                       | 0                                    |
| C-338084 | 665     | 15200                  | 12600                 | 2600                  | -17.11%                       | 0                                    |
| C-338090 | 985     | 19500                  | 15200                 | 4300                  | -22.05%                       | 0                                    |
| C-338096 | 1589    | 16300                  | 12600                 | 3700                  | -22.70%                       | 0                                    |
| C-338099 | 1753    | 16400                  | 12600                 | 3800                  | -23.17%                       | 0                                    |
| C-338133 | 2009    | 8400                   | 7890                  | 510                   | -6.07%                        | 0                                    |
| C-338136 | 2216    | 21900                  | 18500                 | 3400                  | -15.53%                       | 0                                    |
| C-338137 | 2265    | 17400                  | 12900                 | 4500                  | -25.86%                       | 0                                    |
| C-338142 | 2713    | 7000                   | 4380                  | 2620                  | -37.43%                       | 0                                    |
| C-338149 | 3125    | 17000                  | 6020                  | 10980                 | -64.59%                       | -1                                   |
| C-338177 | 3545    | 21900                  | 21400                 | 500                   | -2.28%                        | 0                                    |
| C-338182 | 3944    | 20000                  | 16900                 | 3100                  | -15.50%                       | 0                                    |
| C-338183 | 3993    | 8400                   | 6940                  | 1460                  | -17.38%                       | 0                                    |
| C-338184 | 4040    | 21900                  | 21400                 | 500                   | -2.28%                        | 0                                    |

| Lab ID   | Site ID | Iron<br>USGS<br>Method<br>mg/kg | Iron<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|---------------------------------|--------------------------------|--------------------------|-------------------------------------|---|
| C-338185 | 4120    | 25100                           | 24300                          | 800                      | -3.19%                              | 0   |
| C-338193 | 4953    | 35200                           | 25100                          | 10100                    | -28.69%                             | 0   |
| C-338194 | 5017    | 20300                           | 17100                          | 3200                     | -15.76%                             | 0   |
| C-338155 | 5288    | 21700                           | 18900                          | 2800                     | -12.90%                             | 0   |
| C-338156 | 5337    | 14000                           | 12600                          | 1400                     | -10.00%                             | 0   |
| C-338165 | 6553    | 21900                           | 20400                          | 1500                     | -6.85%                              | 0   |
| C-338172 | 7065    | 14500                           | 10800                          | 3700                     | -25.52%                             | 0   |
| C-338173 | 7112    | 20200                           | 13600                          | 6600                     | -32.67%                             | 0   |
| C-338103 | 7129    | 17900                           | 8850                           | 9050                     | -50.56%                             | -1  |
| C-338106 | 7577    | 24200                           | 15500                          | 8700                     | -35.95%                             | 0   |
| C-338112 | 8053    | 34900                           | 20800                          | 14100                    | -40.40%                             | 0   |
| C-338113 | 8089    | 17700                           | 9680                           | 8020                     | -45.31%                             | -1  |
| C-338120 | 8665    | 9700                            | 3990                           | 5710                     | -58.87%                             | 0   |
| C-338200 | 9160    | 21000                           | 14100                          | 6900                     | -32.86%                             | 0   |
| C-338205 | 9845    | 26300                           | 13400                          | 12900                    | -49.05%                             | 0   |
| C-338206 | 9881    | 13100                           | 5170                           | 7930                     | -60.53%                             | -1  |
| C-338207 | 10137   | 20200                           | 10400                          | 9800                     | -48.51%                             | 0   |
| C-338210 | 10293   | 35900                           | 22500                          | 13400                    | -37.33%                             | 0   |
| C-338212 | 10649   | 14800                           | 8230                           | 6570                     | -44.39%                             | -1  |
| C-338214 | 10869   | 41600                           | 28900                          | 12700                    | -30.53%                             | 0   |
| C-338351 | 11161   | 21700                           | 12100                          | 9600                     | -44.24%                             | 0   |
| C-338354 | 11317   | 15200                           | 7710                           | 7490                     | -49.28%                             | -1  |
| C-321817 | 11573   | 15200                           | 8130                           | 7070                     | -46.51%                             | -1  |
| C-338358 | 11893   | 6400                            | 3690                           | 2710                     | -42.34%                             | 0   |
| C-338362 | 12136   | 16700                           | 12000                          | 4700                     | -28.14%                             | 0   |
| C-338366 | 12232   | 18900                           | 12800                          | 6100                     | -32.28%                             | 0   |
| C-338367 | 12341   | 8700                            | 3650                           | 5050                     | -58.05%                             | 0   |
| C-338369 | 12505   | 7400                            | 3120                           | 4280                     | -57.84%                             | 0   |
| C-338370 | 12761   | 17400                           | 13700                          | 3700                     | -21.26%                             | 0   |
| C-338125 | 12904   | 17100                           | 11100                          | 6000                     | -35.09%                             | 0   |
| C-338126 | 12917   | 12200                           | 5280                           | 6920                     | -56.72%                             | -1  |

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 7C. Iron – 45 sample data subset statistics.**

| Sample Statistics           | Iron All Data USGS Method mg/kg | Iron USGS Method mg/kg | Iron EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|-----------------------------|---------------------------------|------------------------|-----------------------|-----------------------|-------------------------------|--------------------------------------|
| Minimum                     | 4600                            | 6400                   | 3120                  | 3280                  | -51.25%                       | 0                                    |
| 50 <sup>th</sup> Percentile | 17400                           | 17700                  | 12600                 | 5100                  | -28.81%                       | 0                                    |
| 75 <sup>th</sup> Percentile | 21750                           | 21700                  | 16900                 | 4800                  | -22.12%                       | 0                                    |
| 90 <sup>th</sup> Percentile | 26200                           | 25820                  | 21400                 | 4420                  | -17.12%                       | 0                                    |
| 95 <sup>th</sup> Percentile | 33550                           | 35140                  | 23940                 | 11200                 | -31.87%                       | 0                                    |
| Maximum                     | 42600                           | 41600                  | 28900                 | 12700                 | -30.53%                       | 0                                    |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 7D. Iron ProUCL calculated UTLs.**

| Sample Statistics<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Iron All USGS Data with Outliers mg/kg | Iron All USGS Data no Outliers mg/kg | Iron USGS Method Data mg/kg | Iron EPA Method Data mg/kg |
|--|--|--------------------------------------|-----------------------------|----------------------------|
| <i>Normal Distribution</i>   |  |                                      |                             |                            |
| 95% UTL with 95% Coverage  | 39912                                  | 32166                                | 34493                       | 26072                      |
| <i>Gamma Distribution</i>  |  |                                      |                             |                            |
| 95% WH UTL with 95% Coverage   | 38197                                  | 34642                                | 37655                       | 30412                      |
| 95% HW UTL with 95% Coverage   | 38494                                  | 35220                                | 38394                       | 31473                      |
| <i>Lognormal Distribution</i>  |  |                                      |                             |                            |
| 95% UTL with 95% Coverage  | 40312                                  | 37628                                | 41494                       | 36286                      |
| <i>Nonparametric - No Distribution</i>   |  |                                      |                             |                            |
| 95% Percentile Bootstrap UTL with 95% Coverage                                 | 36720                                  | 36200                                | 40460                       | 28140                      |
| 95% UTL with 95% Coverage  | 38800                                  | 36200                                | 35900                       | 25100                      |
| 95% BCA Bootstrap UTL with 95% Coverage  | 38800                                  | 36200                                | 40460                       | 27980                      |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 8A. Thallium – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Thallium mg/kg |
|----------|---------|--------------------|----------------------------|----------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 0.1            |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 0.3            |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 0.5            |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 0.4            |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 0.5            |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 0.3            |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 0.6            |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 0.3            |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 0.4            |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 0.2            |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 0.3            |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 0.4            |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 0.4            |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 0.2            |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 0.5            |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 0.4            |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 0.5            |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 0.4            |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 0.5            |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 0.3            |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 0.3            |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 0.2            |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 0.5            |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 0.1            |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 0.4            |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 0.6            |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 0.4            |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 0.3            |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 0.1            |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 0.5            |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Thallium mg/kg |
|----------|---------|--------------------|-----------------------|----------------|
| C-338177 | 3545    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest      | 0.5            |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 0.4            |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 0.2            |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 0.5            |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 0.4            |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 0.4            |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 0.3            |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 0.2            |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 0.6            |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 0.3            |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 0.4            |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 0.4            |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 0.3            |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 0.3            |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 0.4            |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 0.3            |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 0.3            |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 0.6            |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 0.3            |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 0.6            |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 0.4            |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 0.4            |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 0.2            |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 0.3            |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 0.4            |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 0.4            |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 0.3            |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Thallium mg/kg |
|----------|---------|--------------------|-----------------------|----------------|
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 0.4            |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 0.2            |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 0.1            |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 0.6            |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 0.3            |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 0.5            |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 0.3            |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 0.5            |
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 0.2            |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 0.4            |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 0.4            |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 0.4            |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 0.4            |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 0.3            |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 0.4            |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 0.4            |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 0.6            |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 0.3            |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 0.5            |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 0.2            |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 0.2            |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 0.3            |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 0.4            |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 0.4            |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 0.4            |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 0.4            |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 0.4            |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 0.3            |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 0.4            |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Thallium mg/kg |
|----------|---------|--------------------|------------------|----------------|
| C-338215 | 10905   | Forested Upland    | Mixed Forest     | 0.3            |
| C-338216 | 10952   | Planted/Cultivated | Row Crops        | 0.5            |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay      | 0.2            |
| C-338351 | 11161   | Planted/Cultivated | Row Crops        | 0.4            |
| C-338352 | 11208   | Planted/Cultivated | Row Crops        | 0.6            |
| C-338353 | 11225   | Forested Upland    | Mixed Forest     | 0.2            |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest | 0.4            |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest | 0.3            |
| C-321817 | 11573   | Planted/Cultivated | Row Crops        | 0.2            |
| C-338357 | 11737   | Planted/Cultivated | Row Crops        | 0.5            |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest | 0.3            |
| C-338359 | 11929   | Forested Upland    | Mixed Forest     | 0.3            |
| C-338360 | 11976   | Planted/Cultivated | Row Crops        | 0.4            |
| C-338361 | 12121   | Planted/Cultivated | Row Crops        | 0.2            |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 0.4            |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 0.3            |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 0.4            |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 0.4            |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 0.3            |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 0.5            |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 0.2            |
| C-338370 | 12761   | Shrubland          | Shrubland        | 0.4            |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 0.3            |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 0.5            |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 0.4            |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 0.3            |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 0.3            |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 0.4            |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 0.1            |

Samples highlighted in brown are non-detects



**Table 8B. Thallium – 45 sample data subset.**

| Lab ID   | Site ID | Thallium<br>USGS<br>Method<br>mg/kg | Thallium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338081 | 168     | 0.4                                 | 0.26                               | 0.14                     | -35.00%                             | 0   |
| C-338084 | 665     | 0.4                                 | 0.16                               | 0.24                     | -60.00%                             | 0   |
| C-338090 | 985     | 0.5                                 | 0.18                               | 0.32                     | -64.00%                             | 0   |
| C-338096 | 1589    | 0.2                                 | 0.10                               | 0.1                      | -50.00%                             | 0   |
| C-338099 | 1753    | 0.4                                 | 0.10                               | 0.3                      | -75.00%                             | 0   |
| C-338133 | 2009    | 0.2                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338136 | 2216    | 0.5                                 | 0.19                               | 0.31                     | -62.00%                             | 0   |
| C-338137 | 2265    | 0.4                                 | 0.18                               | 0.22                     | -55.00%                             | 0   |
| C-338142 | 2713    | 0.2                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338149 | 3125    | 0.4                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338177 | 3545    | 0.5                                 | 0.28                               | 0.22                     | -44.00%                             | 0   |
| C-338182 | 3944    | 0.4                                 | 0.16                               | 0.24                     | -60.00%                             | 0   |
| C-338183 | 3993    | 0.2                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338184 | 4040    | 0.5                                 | 0.19                               | 0.31                     | -62.00%                             | 0   |
| C-338185 | 4120    | 0.5                                 | 0.21                               | 0.29                     | -58.00%                             | 0   |
| C-338193 | 4953    | 0.6                                 | 0.27                               | 0.33                     | -55.00%                             | 0   |
| C-338194 | 5017    | 0.3                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338155 | 5288    | 0.5                                 | 0.13                               | 0.37                     | -74.00%                             | 0   |
| C-338156 | 5337    | 0.3                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338165 | 6553    | 0.6                                 | 0.27                               | 0.33                     | -55.00%                             | 0   |
| C-338172 | 7065    | 0.4                                 | 0.092                              | 0.308                    | -77.00%                             | -1  |
| C-338173 | 7112    | 0.4                                 | 0.14                               | 0.26                     | -65.00%                             | 0   |
| C-338103 | 7129    | 0.3                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338106 | 7577    | 0.6                                 | 0.24                               | 0.36                     | -60.00%                             | 0   |
| C-338112 | 8053    | 0.2                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338113 | 8089    | 0.4                                 | 0.097                              | 0.303                    | -75.75%                             | -1  |
| C-338120 | 8665    | 0.3                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338200 | 9160    | 0.5                                 | 0.13                               | 0.37                     | -74.00%                             | 0   |
| C-338205 | 9845    | 0.2                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338206 | 9881    | 0.3                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338207 | 10137   | 0.4                                 | 0.086                              | 0.314                    | -78.50%                             | -1  |

| Lab ID   | Site ID | Thallium<br>USGS<br>Method<br>mg/kg | Thallium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338210 | 10293   | 0.4                                 | 0.11                               | 0.29                     | -72.50%                             | 0   |
| C-338212 | 10649   | 0.4                                 | 0.19                               | 0.21                     | -52.50%                             | 0   |
| C-338214 | 10869   | 0.4                                 | 0.14                               | 0.26                     | -65.00%                             | 0   |
| C-338351 | 11161   | 0.4                                 | 0.089                              | 0.311                    | -77.75%                             | -1  |
| C-338354 | 11317   | 0.4                                 | 0.12                               | 0.28                     | -70.00%                             | 0   |
| C-321817 | 11573   | 0.2                                 | 0.11                               | 0.09                     | -45.00%                             | 0   |
| C-338358 | 11893   | 0.3                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338362 | 12136   | 0.4                                 | 0.23                               | 0.17                     | -42.50%                             | 0   |
| C-338366 | 12232   | 0.4                                 | 0.19                               | 0.21                     | -52.50%                             | 0   |
| C-338367 | 12341   | 0.3                                 | 0.17                               | 0.13                     | -43.33%                             | 0   |
| C-338369 | 12505   | 0.2                                 | 0.099                              | ND                       | ND                                  | NA  |
| C-338370 | 12761   | 0.4                                 | 0.15                               | 0.25                     | -62.50%                             | 0   |
| C-338125 | 12904   | 0.5                                 | 0.20                               | 0.3                      | -60.00%                             | 0   |
| C-338126 | 12917   | 0.4                                 | 0.099                              | ND                       | ND                                  | NA  |

Samples highlighted in brown are non-detects

ND – non-detect data, EPA method reporting limit is 0.099 mg/kg

NA – not applicable

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 8C. Thallium – 45 sample data subset statistics.**

| Sample<br>Statistics        | Thallium<br>All Data<br>USGS<br>Method<br>mg/kg | Thallium<br>USGS<br>Method<br>mg/kg | Thallium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|-----------------------------|---|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| Minimum                     | 0.1   | 0.2                                 | 0.09                               | 0.11                     | -57.00%                             | -1  |
| 50 <sup>th</sup> Percentile | 0.4   | 0.4                                 | 0.12                               | 0.29                     | -71.25%                             | 0   |
| 75 <sup>th</sup> Percentile | 0.4   | 0.4                                 | 0.18                               | 0.24                     | -57.06%                             | 0   |
| 90 <sup>th</sup> Percentile | 0.5   | 0.5                                 | 0.22                               | 0.28                     | -55.20%                             | 0   |
| 95 <sup>th</sup> Percentile | 0.6   | 0.6                                 | 0.27                               | 0.32                     | -54.62%                             | 0   |
| Maximum                     | 0.6   | 0.6                                 | 0.28                               | 0.32                     | -53.33%                             | 0   |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 8D. Thallium ProUCL calculated UTLs.**

| Sample Statistics<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Thallium<br>All USGS<br>Data<br>mg/kg | Thallium<br>USGS<br>Method<br>Data<br>mg/kg | Thallium<br>EPA<br>Method<br>Data<br>mg/kg |
|--|---------------------------------------|---|--|
| <i>Normal Distribution</i>   |                                       |   |  |
| 95% UTL with 95% Coverage - Kaplan Meier                                       | NA                                    |   | 0.267                                      |
| 95% UTL with 95% Coverage - DL/2   | NA                                    |   | 0.283                                      |
| 95% UTL with 95% Coverage  |                                       | NA  |  |
| <i>Gamma Distribution</i>  |                                       |   |  |
| 95% WH UTL with 95% Coverage - ROS   | NA                                    |   | 0.311                                      |
| 95% HW UTL with 95% Coverage - ROS   | NA                                    |   | 0.32                                       |
| 95% WH UTL with 95% Coverage - Kaplan Meier                                    | NA                                    |   | 0.283                                      |
| 95% HW UTL with 95% Coverage - Kaplan Meier                                    | NA                                    |   | 0.286                                      |
| 95% WH UTL with 95% Coverage   |                                       | NA  |  |
| 95% HW UTL with 95% Coverage   |                                       | NA  |  |
| <i>Lognormal Distribution</i>  |                                       |   |  |
| 95% UTL with 95% Coverage - ROS  | NA                                    |   | 0.317                                      |
| 95% Bootstrap (%) UTL 95% Coverage - ROS                                       | NA                                    |   | 0.278                                      |
| 95% BCA UTL 95% Coverage - ROS   | NA                                    |   | 0.278                                      |
| 95% KM UTL 95% Coverage  |                                       |   | 0.297                                      |
| 95% UTL 95% Coverage - DL/2  | NA                                    |   | 0.395                                      |
| 95% UTL with 95% Coverage  |                                       | NA  |  |
| <i>Nonparametric - No Distribution</i>   |                                       |   |  |
| 95% UTL with 95% Coverage  | 0.6                                   |   | NA   |
| 95% Percentile Bootstrap UTL with 95% Coverage                                 |                                       | 0.6   |  |
| 95% UTL with 95% Coverage  |                                       | 0.6   |  |
| 95% BCA Bootstrap UTL with 95% Coverage  |                                       | 0.6   |  |

Black font – 137 samples from complete USGS Minnesota dataset (includes non-detect data)

Brown font – 45 samples analyzed using USGS method (does not include non-detect data)

Blue font – 45 samples reanalyzed using EPA method (includes non-detect data)

Substitution method UTLs are not recommended (DL/2)

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 9A. Vanadium – Complete USGS dataset (137 samples).**

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2               | Vanadium mg/kg |
|----------|---------|--------------------|----------------------------|----------------|
| C-338081 | 168     | Planted/Cultivated | Row Crops                  | 73             |
| C-338082 | 217     | Planted/Cultivated | Row Crops                  | 66             |
| C-338083 | 473     | Forested Upland    | Mixed Forest               | 13             |
| C-338084 | 665     | Planted/Cultivated | Row Crops                  | 54             |
| C-338086 | 729     | Herbaceous Upland  | Grasslands/Herbaceous      | 30             |
| C-338087 | 857     | Planted/Cultivated | Row Crops                  | 109            |
| C-338088 | 921     | Forested Upland    | Deciduous Forest           | 56             |
| C-338089 | 968     | Planted/Cultivated | Row Crops                  | 71             |
| C-338090 | 985     | Forested Upland    | Mixed Forest               | 75             |
| C-338092 | 1077    | Forested Upland    | Mixed Forest               | 31             |
| C-338093 | 1192    | Planted/Cultivated | Row Crops                  | 73             |
| C-338094 | 1241    | Forested Upland    | Mixed Forest               | 29             |
| C-338095 | 1497    | Forested Upland    | Deciduous Forest           | 40             |
| C-338096 | 1589    | Planted/Cultivated | Urban/Recreational Grasses | 47             |
| C-338097 | 1653    | Forested Upland    | Mixed Forest               | 37             |
| C-338098 | 1689    | Forested Upland    | Deciduous Forest           | 40             |
| C-338099 | 1753    | Shrubland          | Shrubland                  | 52             |
| C-338100 | 1945    | Planted/Cultivated | Row Crops                  | 61             |
| C-338132 | 1992    | Planted/Cultivated | Row Crops                  | 65             |
| C-338133 | 2009    | Planted/Cultivated | Urban/Recreational Grasses | 21             |
| C-338134 | 2072    | Planted/Cultivated | Row Crops                  | 89             |
| C-338135 | 2101    | Forested Upland    | Deciduous Forest           | 45             |
| C-338136 | 2216    | Planted/Cultivated | Row Crops                  | 66             |
| C-338137 | 2265    | Planted/Cultivated | Small Grains               | 57             |
| C-338139 | 2457    | Planted/Cultivated | Fallow                     | 69             |
| C-338140 | 2521    | Planted/Cultivated | Pasture/Hay                | 23             |
| C-338141 | 2677    | Forested Upland    | Evergreen Forest           | 109            |
| C-338142 | 2713    | Planted/Cultivated | Pasture/Hay                | 16             |
| C-338143 | 2760    | Planted/Cultivated | Row Crops                  | 83             |
| C-338144 | 2777    | Forested Upland    | Mixed Forest               | 13             |
| C-338145 | 2969    | Planted/Cultivated | Row Crops                  | 63             |
| C-338147 | 3016    | Planted/Cultivated | Row Crops                  | 87             |
| C-338149 | 3125    | Forested Upland    | Mixed Forest               | 38             |
| C-338150 | 3289    | Forested Upland    | Mixed Forest               | 19             |
| C-321807 | 3381    | Planted/Cultivated | Row Crops                  | 55             |
| C-338176 | 3481    | Planted/Cultivated | Row Crops                  | 82             |
| C-338177 | 3545    | Planted/Cultivated | Row Crops                  | 93             |
| C-338179 | 3701    | Forested Upland    | Deciduous Forest           | 56             |
| C-338180 | 3737    | Forested Upland    | Deciduous Forest           | 31             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Vanadium mg/kg |
|----------|---------|--------------------|-----------------------|----------------|
| C-338181 | 3784    | Planted/Cultivated | Row Crops             | 90             |
| C-338182 | 3944    | Planted/Cultivated | Row Crops             | 59             |
| C-338183 | 3993    | Herbaceous Upland  | Grasslands/Herbaceous | 26             |
| C-338184 | 4040    | Planted/Cultivated | Fallow                | 89             |
| C-338185 | 4120    | Planted/Cultivated | Row Crops             | 84             |
| C-338186 | 4264    | Planted/Cultivated | Row Crops             | 60             |
| C-338188 | 4313    | Forested Upland    | Deciduous Forest      | 35             |
| C-338189 | 4569    | Planted/Cultivated | Pasture/Hay           | 62             |
| C-338190 | 4725    | Forested Upland    | Deciduous Forest      | 27             |
| C-338191 | 4761    | Planted/Cultivated | Row Crops             | 51             |
| C-338192 | 4825    | Planted/Cultivated | Pasture/Hay           | 23             |
| C-338193 | 4953    | Planted/Cultivated | Fallow                | 161            |
| C-338194 | 5017    | Planted/Cultivated | Fallow                | 54             |
| C-338195 | 5064    | Planted/Cultivated | Row Crops             | 62             |
| C-338154 | 5173    | Forested Upland    | Deciduous Forest      | 72             |
| C-338155 | 5288    | Planted/Cultivated | Row Crops             | 70             |
| C-338156 | 5337    | Herbaceous Upland  | Grasslands/Herbaceous | 33             |
| C-338158 | 5593    | Forested Upland    | Mixed Forest          | 19             |
| C-338160 | 5749    | Forested Upland    | Mixed Forest          | 79             |
| C-338161 | 5785    | Forested Upland    | Mixed Forest          | 39             |
| C-338162 | 6005    | Forested Upland    | Mixed Forest          | 23             |
| C-338163 | 6041    | Planted/Cultivated | Row Crops             | 80             |
| C-338157 | 6361    | Planted/Cultivated | Fallow                | 31             |
| C-338164 | 6424    | Planted/Cultivated | Row Crops             | 81             |
| C-338165 | 6553    | Planted/Cultivated | Fallow                | 84             |
| C-338166 | 6617    | Forested Upland    | Deciduous Forest      | 38             |
| C-338168 | 6773    | Forested Upland    | Evergreen Forest      | 97             |
| C-338169 | 6809    | Forested Upland    | Deciduous Forest      | 19             |
| C-338170 | 6856    | Planted/Cultivated | Row Crops             | 75             |
| C-338171 | 6873    | Forested Upland    | Evergreen Forest      | 23             |
| C-338172 | 7065    | Herbaceous Upland  | Grasslands/Herbaceous | 38             |
| C-338173 | 7112    | Planted/Cultivated | Row Crops             | 49             |
| C-338103 | 7129    | Forested Upland    | Evergreen Forest      | 40             |
| C-338104 | 7221    | Planted/Cultivated | Pasture/Hay           | 67             |
| C-338105 | 7385    | Forested Upland    | Mixed Forest          | 15             |
| C-321815 | 7477    | Planted/Cultivated | Row Crops             | 37             |
| C-338106 | 7577    | Planted/Cultivated | Row Crops             | 103            |
| C-338107 | 7641    | Planted/Cultivated | Row Crops             | 33             |
| C-338108 | 7797    | Forested Upland    | Deciduous Forest      | 110            |
| C-338109 | 7833    | Forested Upland    | Mixed Forest          | 29             |
| C-338111 | 7880    | Planted/Cultivated | Pasture/Hay           | 79             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2          | Vanadium mg/kg |
|----------|---------|--------------------|-----------------------|----------------|
| C-338148 | 8040    | Planted/Cultivated | Row Crops             | 56             |
| C-338112 | 8053    | Forested Upland    | Evergreen Forest      | 107            |
| C-338113 | 8089    | Herbaceous Upland  | Grasslands/Herbaceous | 68             |
| C-338199 | 8136    | Planted/Cultivated | Row Crops             | 66             |
| C-338114 | 8245    | Forested Upland    | Evergreen Forest      | 102            |
| C-338151 | 8360    | Planted/Cultivated | Row Crops             | 60             |
| C-338116 | 8409    | Planted/Cultivated | Row Crops             | 29             |
| C-338120 | 8665    | Forested Upland    | Deciduous Forest      | 29             |
| C-321805 | 8757    | Forested Upland    | Deciduous Forest      | 22             |
| C-338117 | 8808    | Planted/Cultivated | Row Crops             | 60             |
| C-338118 | 8821    | Forested Upland    | Mixed Forest          | 52             |
| C-338119 | 8857    | Planted/Cultivated | Row Crops             | 79             |
| C-338121 | 8921    | Forested Upland    | Deciduous Forest      | 38             |
| C-338122 | 9049    | Planted/Cultivated | Row Crops             | 144            |
| C-338198 | 9113    | Planted/Cultivated | Row Crops             | 48             |
| C-338200 | 9160    | Planted/Cultivated | Row Crops             | 87             |
| C-338202 | 9177    | Forested Upland    | Mixed Forest          | 19             |
| C-338203 | 9433    | Forested Upland    | Deciduous Forest      | 37             |
| C-338204 | 9689    | Forested Upland    | Deciduous Forest      | 28             |
| C-338205 | 9845    | Forested Upland    | Evergreen Forest      | 74             |
| C-338206 | 9881    | Forested Upland    | Deciduous Forest      | 33             |
| C-338207 | 10137   | Herbaceous Upland  | Grasslands/Herbaceous | 53             |
| C-338209 | 10184   | Planted/Cultivated | Row Crops             | 68             |
| C-338210 | 10293   | Forested Upland    | Mixed Forest          | 95             |
| C-338211 | 10457   | Planted/Cultivated | Row Crops             | 45             |
| C-338212 | 10649   | Forested Upland    | Deciduous Forest      | 53             |
| C-338213 | 10713   | Forested Upland    | Mixed Forest          | 30             |
| C-338214 | 10869   | Forested Upland    | Mixed Forest          | 102            |
| C-338215 | 10905   | Forested Upland    | Mixed Forest          | 24             |
| C-338216 | 10952   | Planted/Cultivated | Row Crops             | 74             |
| C-338217 | 10969   | Planted/Cultivated | Pasture/Hay           | 25             |
| C-338351 | 11161   | Planted/Cultivated | Row Crops             | 54             |
| C-338352 | 11208   | Planted/Cultivated | Row Crops             | 90             |
| C-338353 | 11225   | Forested Upland    | Mixed Forest          | 20             |
| C-338354 | 11317   | Forested Upland    | Deciduous Forest      | 47             |
| C-338355 | 11481   | Forested Upland    | Deciduous Forest      | 29             |
| C-321817 | 11573   | Planted/Cultivated | Row Crops             | 50             |
| C-338357 | 11737   | Planted/Cultivated | Row Crops             | 73             |
| C-338358 | 11893   | Forested Upland    | Evergreen Forest      | 16             |
| C-338359 | 11929   | Forested Upland    | Mixed Forest          | 45             |
| C-338360 | 11976   | Planted/Cultivated | Row Crops             | 71             |

| Lab ID   | Site ID | Land Cover 1       | Land Cover 2     | Vanadium mg/kg |
|----------|---------|--------------------|------------------|----------------|
| C-338361 | 12121   | Planted/Cultivated | Row Crops        | 23             |
| C-338362 | 12136   | Planted/Cultivated | Row Crops        | 38             |
| C-338363 | 12149   | Forested Upland    | Mixed Forest     | 85             |
| C-338364 | 12185   | Planted/Cultivated | Row Crops        | 46             |
| C-338366 | 12232   | Planted/Cultivated | Row Crops        | 63             |
| C-338367 | 12341   | Forested Upland    | Mixed Forest     | 24             |
| C-338368 | 12456   | Planted/Cultivated | Row Crops        | 70             |
| C-338369 | 12505   | Forested Upland    | Deciduous Forest | 18             |
| C-338370 | 12761   | Shrubland          | Shrubland        | 51             |
| C-321803 | 12853   | Planted/Cultivated | Pasture/Hay      | 49             |
| C-338125 | 12904   | Planted/Cultivated | Pasture/Hay      | 54             |
| C-338126 | 12917   | Planted/Cultivated | Pasture/Hay      | 37             |
| C-338128 | 12953   | Planted/Cultivated | Fallow           | 26             |
| C-338129 | 13017   | Forested Upland    | Deciduous Forest | 36             |
| C-338130 | 13160   | Planted/Cultivated | Row Crops        | 61             |
| C-321809 | 13209   | Planted/Cultivated | Pasture/Hay      | 29             |

**Table 9B. Vanadium – 45 sample data subset.**

| Lab ID   | Site ID | Vanadium USGS Method mg/kg | Vanadium EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|----------|---------|----------------------------|---------------------------|-----------------------|-------------------------------|--------------------------------------|
| C-338081 | 168     | 73                         | 28.6                      | 44.4                  | -60.82%                       | 0                                    |
| C-338084 | 665     | 54                         | 26.8                      | 27.2                  | -50.37%                       | 0                                    |
| C-338090 | 985     | 75                         | 34.4                      | 40.6                  | -54.13%                       | 0                                    |
| C-338096 | 1589    | 47                         | 25.4                      | 21.6                  | -45.96%                       | 0                                    |
| C-338099 | 1753    | 52                         | 23.2                      | 28.8                  | -55.38%                       | 0                                    |
| C-338133 | 2009    | 21                         | 18.7                      | 2.3                   | -10.95%                       | 0                                    |
| C-338136 | 2216    | 66                         | 32.5                      | 33.5                  | -50.76%                       | 0                                    |
| C-338137 | 2265    | 57                         | 27.8                      | 29.2                  | -51.23%                       | 0                                    |
| C-338142 | 2713    | 16                         | 6.6                       | 9.4                   | -58.75%                       | -1                                   |
| C-338149 | 3125    | 38                         | 15.9                      | 22.1                  | -58.16%                       | 0                                    |
| C-338177 | 3545    | 93                         | 47.7                      | 45.3                  | -48.71%                       | 0                                    |
| C-338182 | 3944    | 59                         | 28.1                      | 30.9                  | -52.37%                       | 0                                    |
| C-338183 | 3993    | 26                         | 13.2                      | 12.8                  | -49.23%                       | 0                                    |
| C-338184 | 4040    | 89                         | 50.2                      | 38.8                  | -43.60%                       | 0                                    |
| C-338185 | 4120    | 84                         | 40.9                      | 43.1                  | -51.31%                       | 0                                    |

| Lab ID   | Site ID | Vanadium<br>USGS<br>Method<br>mg/kg | Vanadium<br>EPA<br>Method<br>mg/kg | Difference<br>USGS - EPA | Percent<br>Difference<br>USGS - EPA | Order of<br>Magnitude<br>Change<br>USGS - EPA |
|----------|---------|-------------------------------------|------------------------------------|--------------------------|-------------------------------------|---|
| C-338193 | 4953    | 161                                 | 58.8                               | 102.2                    | -63.48%                             | -1  |
| C-338194 | 5017    | 54                                  | 29.1                               | 24.9                     | -46.11%                             | 0   |
| C-338155 | 5288    | 70                                  | 35.7                               | 34.3                     | -49.00%                             | 0   |
| C-338156 | 5337    | 33                                  | 20.1                               | 12.9                     | -39.09%                             | 0   |
| C-338165 | 6553    | 84                                  | 46.7                               | 37.3                     | -44.40%                             | 0   |
| C-338172 | 7065    | 38                                  | 14.7                               | 23.3                     | -61.32%                             | 0   |
| C-338173 | 7112    | 49                                  | 15.2                               | 33.8                     | -68.98%                             | 0   |
| C-338103 | 7129    | 40                                  | 12.1                               | 27.9                     | -69.75%                             | 0   |
| C-338106 | 7577    | 103                                 | 30.2                               | 72.8                     | -70.68%                             | -1  |
| C-338112 | 8053    | 107                                 | 46.7                               | 60.3                     | -56.36%                             | -1  |
| C-338113 | 8089    | 68                                  | 19.9                               | 48.1                     | -70.74%                             | 0   |
| C-338120 | 8665    | 29                                  | 6.9                                | 22.1                     | -76.21%                             | -1  |
| C-338200 | 9160    | 87                                  | 21.6                               | 65.4                     | -75.17%                             | 0   |
| C-338205 | 9845    | 74                                  | 21.9                               | 52.1                     | -70.41%                             | 0   |
| C-338206 | 9881    | 33                                  | 8.5                                | 24.5                     | -74.24%                             | -1  |
| C-338207 | 10137   | 53                                  | 14.4                               | 38.6                     | -72.83%                             | 0   |
| C-338210 | 10293   | 95                                  | 46.7                               | 48.3                     | -50.84%                             | 0   |
| C-338212 | 10649   | 53                                  | 13.4                               | 39.6                     | -74.72%                             | 0   |
| C-338214 | 10869   | 102                                 | 55.7                               | 46.3                     | -45.39%                             | -1  |
| C-338351 | 11161   | 54                                  | 19.4                               | 34.6                     | -64.07%                             | 0   |
| C-338354 | 11317   | 47                                  | 14.8                               | 32.2                     | -68.51%                             | 0   |
| C-321817 | 11573   | 50                                  | 18.8                               | 31.2                     | -62.40%                             | 0   |
| C-338358 | 11893   | 16                                  | 6.9                                | 9.1                      | -56.88%                             | -1  |
| C-338362 | 12136   | 38                                  | 15.8                               | 22.2                     | -58.42%                             | 0   |
| C-338366 | 12232   | 63                                  | 20.6                               | 42.4                     | -67.30%                             | 0   |
| C-338367 | 12341   | 24                                  | 8.5                                | 15.5                     | -64.58%                             | -1  |
| C-338369 | 12505   | 18                                  | 5.9                                | 12.1                     | -67.22%                             | -1  |
| C-338370 | 12761   | 51                                  | 19.6                               | 31.4                     | -61.57%                             | 0   |
| C-338125 | 12904   | 54                                  | 17.1                               | 36.9                     | -68.33%                             | 0   |
| C-338126 | 12917   | 37                                  | 12.8                               | 24.2                     | -65.41%                             | 0   |

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method



**Table 9C. Vanadium – 45 sample data subset statistics.**

| Sample Statistics           | Vanadium All Data USGS Method mg/kg | Vanadium USGS Method mg/kg | Vanadium EPA Method mg/kg | Difference USGS - EPA | Percent Difference USGS - EPA | Order of Magnitude Change USGS - EPA |
|-----------------------------|-------------------------------------|----------------------------|---------------------------|-----------------------|-------------------------------|--------------------------------------|
| Minimum                     | 13                                  | 16                         | 6                         | 10                    | -63.13%                       | -1                                   |
| 50 <sup>th</sup> Percentile | 53                                  | 54                         | 20                        | 34                    | -62.78%                       | 0                                    |
| 75 <sup>th</sup> Percentile | 73                                  | 74                         | 30                        | 44                    | -59.19%                       | 0                                    |
| 90 <sup>th</sup> Percentile | 89                                  | 94                         | 47                        | 48                    | -50.42%                       | 0                                    |
| 95 <sup>th</sup> Percentile | 102                                 | 103                        | 50                        | 53                    | -51.65%                       | -1                                   |
| Maximum                     | 161                                 | 161                        | 59                        | 102                   | -63.48%                       | -1                                   |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

**Table 9D. Vanadium ProUCL calculated UTLs.**

| Sample Statistics<br>95 <sup>th</sup> Percentile<br>95% Confidence Coefficient | Vanadium All USGS Data mg/kg | Vanadium USGS Method Data mg/kg | Vanadium EPA Method Data mg/kg |
|--|------------------------------|---------------------------------|--------------------------------|
| <i>Normal Distribution</i>   |                              |                                 |                                |
| 95% UTL with 95% Coverage  | 106.8                        | 119.1                           | 53.55                          |
| <i>Gamma Distribution</i>  |                              |                                 |                                |
| 95% WH UTL with 95% Coverage   | 118.1                        | 134                             | 61.31                          |
| 95% HW UTL with 95% Coverage   | 120.8                        | 137.7                           | 63.28                          |
| <i>Lognormal Distribution</i>  |                              |                                 |                                |
| 95% UTL with 95% Coverage  | 132.7                        | 154.6                           | 72.38                          |
| <i>Nonparametric - No Distribution</i>   |                              |                                 |                                |
| 95% Percentile Bootstrap UTL with 95% Coverage                                 | 109                          | 150.2                           | 58.18                          |
| 95% UTL with 95% Coverage  | 109                          | 107                             | 55.7                           |
| 95% BCA Bootstrap UTL with 95% Coverage  | 109                          | 150.2                           | 57.08                          |

Black font – 137 samples from complete USGS Minnesota dataset

Brown font – 45 samples analyzed using USGS method

Blue font – 45 samples reanalyzed using EPA method

Lognormal UTLs are not recommended since they tend to be unrealistically high

BCA Bootstrap UTL is not recommended since it is still being investigated by EPA

**Table 10A. B[a]P Equivalent and B[a]P Background Data Compared to Residential/Recreational SRV.**

| Dataset  | Minimum mg/kg | Maximum mg/kg | Average mg/kg | 90 <sup>th</sup> Percentile mg/kg | 95 <sup>th</sup> Percentile mg/kg | UTL95-95 mg/kg | Purpose of Study            | Number of Samples |
|--|---------------|---------------|---------------|-----------------------------------|-----------------------------------|----------------|-----------------------------|-------------------|
| Washington DOE - Urban <sup>1</sup>                      | <b>0.0019</b> | <i>8.9</i>    | <b>0.26</b>   | <b>0.39</b>                       |                                   |                | Ambient, urban              | 120               |
| Washington DOE - Rural, Forested <sup>1</sup>            |               | <b>0.024</b>  | <b>0.003</b>  |                                   | <b>0.007</b>                      |                | Ambient, rural              | 24                |
| Washington DOE - Rural, Open <sup>1</sup>                |               | <b>0.004</b>  | <b>0.001</b>  |                                   | <b>0.002</b>                      |                | Ambient, rural              | 17                |
| California DTSC - Northern, CA PEFs <sup>1</sup>         |               | <i>2.80</i>   | <b>0.21</b>   |                                   | <i>0.9</i>                        | <i>1.5</i>     | Ambient, MGP                | 86                |
| California DTSC - Southern, CA PEFs <sup>1</sup>         |               | <i>4.00</i>   | <b>0.16</b>   |                                   | <b>0.61</b>                       | <i>0.90</i>    | Ambient, MGP                | 185               |
| New York SDOC - Source Distant <sup>1</sup>              |               |               |               |                                   | <i>0.96</i>                       |                | Ambient, rural              | 118               |
| New York SDOC - Near Source <sup>1</sup>                 |               |               |               |                                   | <i>6.18</i>                       |                | Ambient, rural              | 28                |
| New York SDOC – Remote <sup>1</sup>                      |               |               |               |                                   | <b>0.27</b>                       |                | Ambient, rural              | 119               |
| Minnesota PCA - St. Regis Site - All Data <sup>2</sup>   | <b>0.00</b>   | <i>1.90</i>   | <b>0.20</b>   |                                   | <b>0.72</b>                       |                | Site-specific               | 18                |
| Minnesota PCA - St. Regis Site - Remove 1.9 <sup>2</sup> | <b>0.00</b>   | <b>0.51</b>   | <b>0.10</b>   |                                   | <b>0.37</b>                       |                | Site-specific               | 18                |
| <b>Illinois EPA – Chicago</b>                            |               |               |               |                                   | <i>1.3</i>                        |                | <b>Ambient, Chicago</b>     | <b>57</b>         |
| <b>Illinois EPA - In MSA <sup>3,4</sup></b>              |               |               |               |                                   | <i>2.1</i>                        |                | <b>Ambient, MSA</b>         | <b>160 total</b>  |
| <b>Illinois EPA - Outside MSA <sup>3,4</sup></b>         |               |               |               |                                   | <i>0.98</i>                       |                | <b>Ambient, outside MSA</b> | <b>160 total</b>  |
| <b>New Jersey DEP - Valley &amp; Ridge</b>               |               |               |               |                                   | <b>ND</b>                         |                | <b>Natural, rural</b>       | <b>23</b>         |
| <b>New Jersey DEP - Highlands</b>                        |               |               |               |                                   | <b>0.10</b>                       |                | <b>Natural, rural</b>       | <b>23</b>         |
| <b>New Jersey DEP - Coastal Plain</b>                    |               |               |               |                                   | <b>0.069</b>                      |                | <b>Natural, rural</b>       | <b>44</b>         |

MGP – Manufactured Gas Plant

UTL95-95 – Upper tolerance limit with 95% coverage and 95% confidence

**Data in blue, bolded font for Illinois EPA and New Jersey DEP is B[a]P only data and does NOT represent B[a]P equivalents; ND = non-detect.**

1 - Dibenzo(a,h)anthracene PEF: MPCA = 0.56, CA DTSC = 0.34, WA DOE = 0.1, NYSDOC = 1.

2 - Maximum of 1.9 is a potential outlier. If removed maximum is 0.51 and average is 0.10 mg/kg.

3 - MSA – Metropolitan Statistical Area - Core areas associated with at least one urbanized area with a population of at least 50,000.

4 - 160 total samples for inside and outside MSAs.

Residential/Recreational SRV = 0.88 mg/kg

**Columns highlighted in green and bolded - concentration is less than Residential/Recreational SRV**

*Columns highlighted in red and italicized – concentration is greater than Residential/Recreational SRV*

**Table 10B. B[a]P) Equivalent and B[a]P Background Data Compared to Commercial/Industrial SRV.**

| Dataset  | Minimum mg/kg | Maximum mg/kg | Average mg/kg | 90 <sup>th</sup> Percentile mg/kg | 95 <sup>th</sup> Percentile mg/kg | UTL95-95 mg/kg | Purpose of Study            | Number of Samples |
|--|---------------|---------------|---------------|-----------------------------------|-----------------------------------|----------------|-----------------------------|-------------------|
| Washington DOE - Urban <sup>1</sup>                      | <b>0.0019</b> | <b>8.9</b>    | <b>0.26</b>   | <b>0.39</b>                       |                                   |                | Ambient, urban              | 120               |
| Washington DOE - Rural, Forested <sup>1</sup>            |               | <b>0.024</b>  | <b>0.003</b>  |                                   | <b>0.007</b>                      |                | Ambient, rural              | 24                |
| Washington DOE - Rural, Open <sup>1</sup>                |               | <b>0.004</b>  | <b>0.001</b>  |                                   | <b>0.002</b>                      |                | Ambient, rural              | 17                |
| California DTSC - Northern, CA PEFs <sup>1</sup>         |               | <b>2.80</b>   | <b>0.21</b>   |                                   | <b>0.9</b>                        | <b>1.5</b>     | Ambient, MGP                | 86                |
| California DTSC - Southern, CA PEFs <sup>1</sup>         |               | <b>4.00</b>   | <b>0.16</b>   |                                   | <b>0.61</b>                       | <b>0.90</b>    | Ambient, MGP                | 185               |
| New York SDOC - Source Distant <sup>1</sup>              |               |               |               |                                   | <b>0.96</b>                       |                | Ambient, rural              | 118               |
| New York SDOC - Near Source <sup>1</sup>                 |               |               |               |                                   | <b>6.18</b>                       |                | Ambient, rural              | 28                |
| New York SDOC – Remote <sup>1</sup>                      |               |               |               |                                   | <b>0.27</b>                       |                | Ambient, rural              | 119               |
| Minnesota PCA - St. Regis Site - All Data <sup>2</sup>   | <b>0.00</b>   | <b>1.90</b>   | <b>0.20</b>   |                                   | <b>0.72</b>                       |                | Site-specific               | 18                |
| Minnesota PCA - St. Regis Site - Remove 1.9 <sup>2</sup> | <b>0.00</b>   | <b>0.51</b>   | <b>0.10</b>   |                                   | <b>0.37</b>                       |                | Site-specific               | 18                |
| <b>Illinois EPA – Chicago</b>                            |               |               |               |                                   | <b>1.3</b>                        |                | <b>Ambient, Chicago</b>     | <b>57</b>         |
| <b>Illinois EPA - In MSA <sup>3,4</sup></b>              |               |               |               |                                   | <b>2.1</b>                        |                | <b>Ambient, MSA</b>         | <b>160 total</b>  |
| <b>Illinois EPA - Outside MSA <sup>3,4</sup></b>         |               |               |               |                                   | <b>0.98</b>                       |                | <b>Ambient, outside MSA</b> | <b>160 total</b>  |
| <b>New Jersey DEP - Valley &amp; Ridge</b>               |               |               |               |                                   | <b>ND</b>                         |                | <b>Natural, rural</b>       | <b>23</b>         |
| <b>New Jersey DEP - Highlands</b>                        |               |               |               |                                   | <b>0.10</b>                       |                | <b>Natural, rural</b>       | <b>23</b>         |
| <b>New Jersey DEP - Coastal Plain</b>                    |               |               |               |                                   | <b>0.069</b>                      |                | <b>Natural, rural</b>       | <b>44</b>         |

MGP – Manufactured Gas Plant

UTL95-95 – Upper tolerance limit with 95% coverage and 95% confidence

Data in blue, bolded font for Illinois EPA and New Jersey DEP is B[a]P only data and does NOT represent B[a]P equivalents; ND = non-detect.

1 - Dibenzo(a,h)anthracene PEF: MPCA = 0.56, CA DTSC = 0.34, WA DOE = 0.1, NYSDOC = 1.

2 - Maximum of 1.9 is a potential outlier. If removed maximum is 0.51 and average is 0.10 mg/kg.

3 - MSA – Metropolitan Statistical Area - Core areas associated with at least one urbanized area with a population of at least 50,000.

4 - 160 total samples for inside and outside MSAs.

Commercial/Industrial SRV = 23 mg/kg

Columns highlighted in green and bolded - concentration is less than Commercial/Industrial SRV

Columns highlighted in red and italicized – concentration is greater than Commercial/Industrial SRV

**Table 11A. TCDD Equivalent Background Data Compared to Residential/Recreational SRV.**

| Dataset   | Minimum mg/kg   | Maximum mg/kg   | Average mg/kg   | 95% UCL of Mean mg/kg | 90 <sup>th</sup> Percentile mg/kg | 95 <sup>th</sup> Percentile mg/kg | UTL90-95 mg/kg  | Purpose of Study | Number of Samples |
|---|-----------------|-----------------|-----------------|-----------------------|-----------------------------------|-----------------------------------|-----------------|------------------|-------------------|
| Washington DOE - Urban, ND = 0                  | <b>1.30E-06</b> | <i>1.10E-04</i> | <i>1.90E-05</i> |                       | <i>4.60E-05</i>                   |                                   |                 | Ambient          | 120               |
| Washington DOE - Urban, ND = ½ DL               | <b>1.70E-06</b> | <i>1.10E-04</i> | <i>1.90E-05</i> |                       | <i>4.60E-05</i>                   |                                   |                 | Ambient          | 120               |
| Washington DOE - Rural, Forested, ND = 0        |                 | <i>8.68E-06</i> | <b>2.17E-06</b> |                       |                                   | <i>7.95E-06</i>                   |                 | Ambient          | 24                |
| Washington DOE - Rural, Forested, KM, ND = ½ DL |                 | <i>9.08E-06</i> | <b>2.44E-06</b> |                       |                                   | <i>8.18E-06</i>                   |                 | Ambient          | 24                |
| Washington DOE - Rural, Forested, KM, ND = DL   |                 | <i>9.08E-06</i> | <b>2.57E-06</b> |                       |                                   | <i>8.53E-06</i>                   |                 | Ambient          | 24                |
| Washington DOE - Rural, Open, ND = 0            |                 | <i>2.16E-06</i> | <b>2.16E-07</b> |                       |                                   | <b>1.15E-06</b>                   |                 | Ambient          | 17                |
| Washington DOE - Rural, Open, KM, ND = ½ DL     |                 | <i>2.30E-06</i> | <b>5.62E-07</b> |                       |                                   | <b>1.31E-06</b>                   |                 | Ambient          | 17                |
| Washington DOE - Rural, Open, KM, ND = DL       |                 | <i>2.30E-06</i> |                 |                       |                                   |                                   |                 | Ambient          | 17                |
| Montana DEQ - All Urban                         | <b>1.24E-07</b> | <i>1.27E-05</i> | <b>1.97E-06</b> | <b>3.31E-06</b>       |                                   |                                   | <i>7.46E-06</i> | Ambient          | 62                |
| Montana DEQ - Urban, Residential                | <b>1.24E-07</b> | <b>2.71E-06</b> | <b>9.82E-07</b> | <b>1.38E-06</b>       |                                   |                                   | <b>2.56E-06</b> | Ambient          | 21                |
| Montana DEQ - Urban, Commercial                 | <b>1.40E-07</b> | <b>3.82E-06</b> | <b>1.63E-06</b> | <b>2.06E-06</b>       |                                   |                                   | <b>3.82E-06</b> | Ambient          | 18                |
| Montana DEQ - Urban, Industrial                 | <b>1.30E-07</b> | <i>9.34E-06</i> | <b>2.18E-06</b> | <b>4.55E-06</b>       |                                   |                                   | <i>5.84E-06</i> | Ambient          | 20                |
| Montana DEQ - All Rural                         | <b>1.12E-07</b> | <b>2.86E-06</b> | <b>7.90E-07</b> | <b>1.13E-06</b>       |                                   |                                   | <b>1.82E-06</b> | Ambient          | 61                |
| Montana DEQ - Rural, Open                       | <b>1.20E-07</b> | <b>1.41E-06</b> | <b>6.78E-07</b> | <b>8.44E-07</b>       |                                   |                                   | <b>1.27E-06</b> | Ambient          | 20                |
| Montana DEQ - Rural, Agricultural               | <b>1.49E-07</b> | <b>1.85E-06</b> | <b>8.11E-07</b> | <b>1.37E-06</b>       |                                   |                                   | <b>1.50E-06</b> | Ambient          | 20                |
| Montana DEQ - Rural, Forested                   | <b>1.12E-07</b> | <b>1.20E-06</b> | <b>6.26E-07</b> | <b>8.91E-07</b>       |                                   |                                   | <b>1.20E-06</b> | Ambient          | 18                |
| Minnesota PCA - St. Regis Site                  | <b>1.00E-07</b> | <i>8.04E-06</i> | <b>2.59E-06</b> |                       |                                   | <i>6.03E-06</i>                   |                 | Site-specific    | 18                |

ND – non-detected data

DL – detection limit

KM – Kaplan Meier statistics

95% UCL – 95% upper confidence limit of the mean

UTL90-95 – Upper tolerance limit with 95% coverage and 90% confidence

Residential/Recreational SRV = 5.0E-06 mg/kg

**Columns highlighted in green and bolded - concentration is less than Residential/Recreational SRV**

*Columns highlighted in red and italicized – concentration is greater than Residential/Recreational SRV*

**Table 11B. 2,3,7,8-tetrachlordibenzo-p-dioxin (TCDD) Equivalent Background Data Compared to Commercial/Industrial SRV.**

| Dataset   | Minimum mg/kg   | Maximum mg/kg   | Average mg/kg   | 95% UCL of Mean mg/kg | 90 <sup>th</sup> Percentile mg/kg | 95 <sup>th</sup> Percentile mg/kg | UTL90-95 mg/kg  | Purpose of Study | Number of Samples |
|---|-----------------|-----------------|-----------------|-----------------------|-----------------------------------|-----------------------------------|-----------------|------------------|-------------------|
| Washington DOE - Urban, ND = 0                  | <b>1.30E-06</b> | <i>1.10E-04</i> | <b>1.90E-05</b> |                       | <i>4.60E-05</i>                   |                                   |                 | Ambient          | 120               |
| Washington DOE - Urban, ND = ½ DL               | <b>1.70E-06</b> | <i>1.10E-04</i> | <b>1.90E-05</b> |                       | <i>4.60E-05</i>                   |                                   |                 | Ambient          | 120               |
| Washington DOE - Rural, Forested, ND = 0        |                 | <b>8.68E-06</b> | <b>2.17E-06</b> |                       |                                   | <b>7.95E-06</b>                   |                 | Ambient          | 24                |
| Washington DOE - Rural, Forested, KM, ND = ½ DL |                 | <b>9.08E-06</b> | <b>2.44E-06</b> |                       |                                   | <b>8.18E-06</b>                   |                 | Ambient          | 24                |
| Washington DOE - Rural, Forested, KM, ND = DL   |                 | <b>9.08E-06</b> | <b>2.57E-06</b> |                       |                                   | <b>8.53E-06</b>                   |                 | Ambient          | 24                |
| Washington DOE - Rural, Open, ND = 0            |                 | <b>2.16E-06</b> | <b>2.16E-07</b> |                       |                                   | <b>1.15E-06</b>                   |                 | Ambient          | 17                |
| Washington DOE - Rural, Open, KM, ND = ½ DL     |                 | <b>2.30E-06</b> | <b>5.62E-07</b> |                       |                                   | <b>1.31E-06</b>                   |                 | Ambient          | 17                |
| Washington DOE - Rural, Open, KM, ND = DL       |                 | <b>2.30E-06</b> |                 |                       |                                   |                                   |                 | Ambient          | 17                |
| Montana DEQ - All Urban                         | <b>1.24E-07</b> | <b>1.27E-05</b> | <b>1.97E-06</b> | <b>3.31E-06</b>       |                                   |                                   | <b>7.46E-06</b> | Ambient          | 62                |
| Montana DEQ - Urban, Residential                | <b>1.24E-07</b> | <b>2.71E-06</b> | <b>9.82E-07</b> | <b>1.38E-06</b>       |                                   |                                   | <b>2.56E-06</b> | Ambient          | 21                |
| Montana DEQ - Urban, Commercial                 | <b>1.40E-07</b> | <b>3.82E-06</b> | <b>1.63E-06</b> | <b>2.06E-06</b>       |                                   |                                   | <b>3.82E-06</b> | Ambient          | 18                |
| Montana DEQ - Urban, Industrial                 | <b>1.30E-07</b> | <b>9.34E-06</b> | <b>2.18E-06</b> | <b>4.55E-06</b>       |                                   |                                   | <b>5.84E-06</b> | Ambient          | 20                |
| Montana DEQ - All Rural                         | <b>1.12E-07</b> | <b>2.86E-06</b> | <b>7.90E-07</b> | <b>1.13E-06</b>       |                                   |                                   | <b>1.82E-06</b> | Ambient          | 61                |
| Montana DEQ - Rural, Open                       | <b>1.20E-07</b> | <b>1.41E-06</b> | <b>6.78E-07</b> | <b>8.44E-07</b>       |                                   |                                   | <b>1.27E-06</b> | Ambient          | 20                |
| Montana DEQ - Rural, Agricultural               | <b>1.49E-07</b> | <b>1.85E-06</b> | <b>8.11E-07</b> | <b>1.37E-06</b>       |                                   |                                   | <b>1.50E-06</b> | Ambient          | 20                |
| Montana DEQ - Rural, Forested                   | <b>1.12E-07</b> | <b>1.20E-06</b> | <b>6.26E-07</b> | <b>8.91E-07</b>       |                                   |                                   | <b>1.20E-06</b> | Ambient          | 18                |
| Minnesota PCA - St. Regis Site                  | <b>1.00E-07</b> | <b>8.04E-06</b> | <b>2.59E-06</b> |                       |                                   | <b>6.03E-06</b>                   |                 | Site-specific    | 18                |

ND – non-detected data

DL – detection limit

KM – Kaplan Meier statistics

95% UCL – 95% upper confidence limit of the mean

UTL90-95 – Upper tolerance limit with 95% coverage and 90% confidence

Commercial/Industrial SRV = 2.7E-05 mg/kg

**Columns highlighted in green and bolded - concentration is less than Commercial/Industrial SRV**

*Columns highlighted in red and italicized – concentration is greater than Commercial/Industrial SRV*