# Identifying and Controlling Sources of Ultra-Trace Metals in Control Blanks and Ensuring High-Quality Data for Sensitive Environmental Risk-Based Decisions

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# Prudhoe Bay Site Location

- North Slope of Alaska, 250 miles north of the Arctic Circle, 175 miles west of the Alaska-Canada border, and 1,300 miles south of the true North Pole.
- Approx. 250 sq. mile project boundary
- Project Sites segregated into 10 categories.


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# Background Water Study

# Magnitude of Water Study

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# Background

- Control of blank contamination necessary for purposes of site delineation, toxicological evaluations, and site screening/remediation.
- Differentiate actual site concentrations from potential sources of introduced field or analytical contamination.
- Critical during development of background site metals conditions and screening/cleanup criteria.

# Background

- Trace-level concentrations of total/dissolved metals were observed in the field sample collection season of 2014 through 2016.
- Seven metals detected in equipment rinsate blanks above the Tier I or Tier II human health or ecological risk screening levels.
- Detection of T/D metals in field quality control (QC) samples resulted in qualification of both T/D metals sample results.
- Presence or absence of low-level site contamination?
- Single-use tubing and filters used for collection.

# Purpose of Equipment Blank Investigation

- No specific contamination acceptance criteria for field collection process.

- Goal of equipment rinsate blanks was to verify that contamination was not introduced during the sample collection process or equipment.

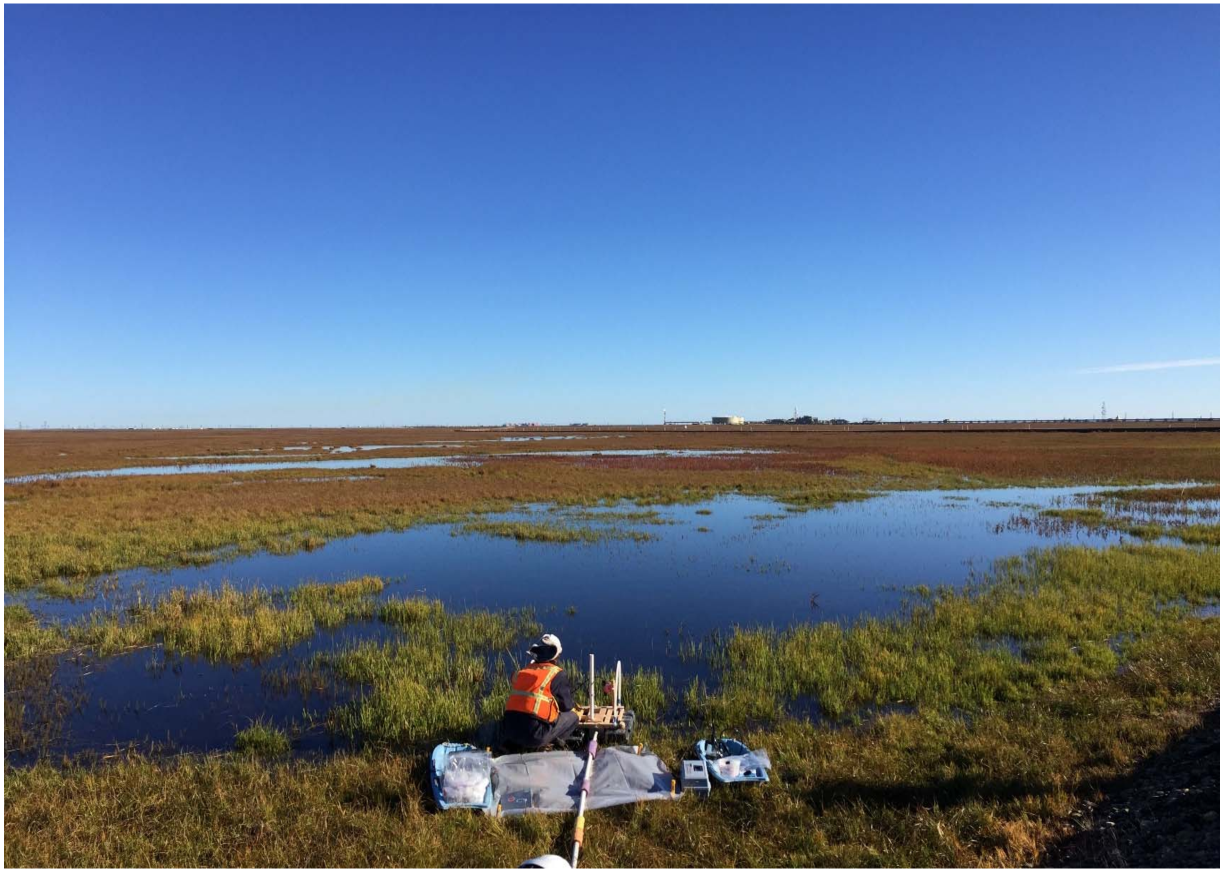
- Identify potential sources of metals contamination in equipment rinsate blanks that could be reduced or eliminated.

# Areas of Investigation

- Multiple avenues of potential contamination were investigated including:
  - A study of sample tubing, peristaltic pumps and in-line filters;
  - Field observation of equipment blank collection processes;
  - Initial and post water-quality monitoring;
  - Sample bottle cleanliness and storage of deionized water for use in collection of the equipment rinsate blanks.

# Four-Year Study – Why it took so long!

# Sampling Surface Water Lakes



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# Tubing and In-line Filter Study

- Is residual contamination present in new, unused tubing and filters?
- Is insufficient volume purged through the equipment prior to field collection of the aqueous samples? Differences were noted during a field audit.
- Duplicate samples of each disposable (single-use) tubing and 0.45-µm in-line filters were collected in a laboratory setting using deionized water.
- Three different manufacturers of tubing and filters were included in study.
- Study was designed and then conducted in laboratory setting.

# Study Details

- A first-draw sample of the equipment was collected using 250 mL of deionized water.
- A second sample was collected after purging the equipment with approximately 1.25 L of deionized water.
- Samples were both undigested and digested by SW-846 Method 3020A.
- Both undigested and digested samples were analyzed by SW-846 Method 6010C and 6020A.

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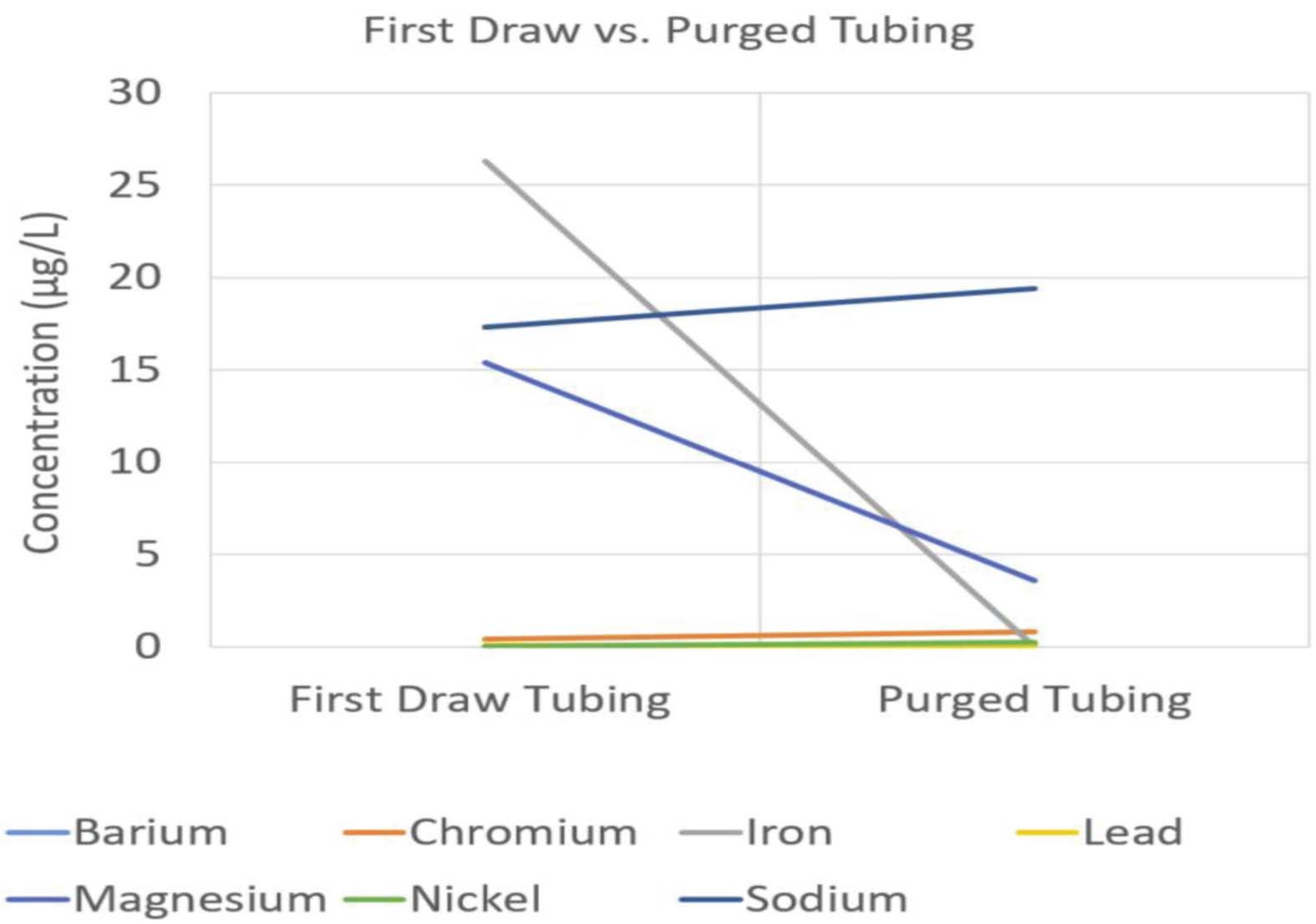
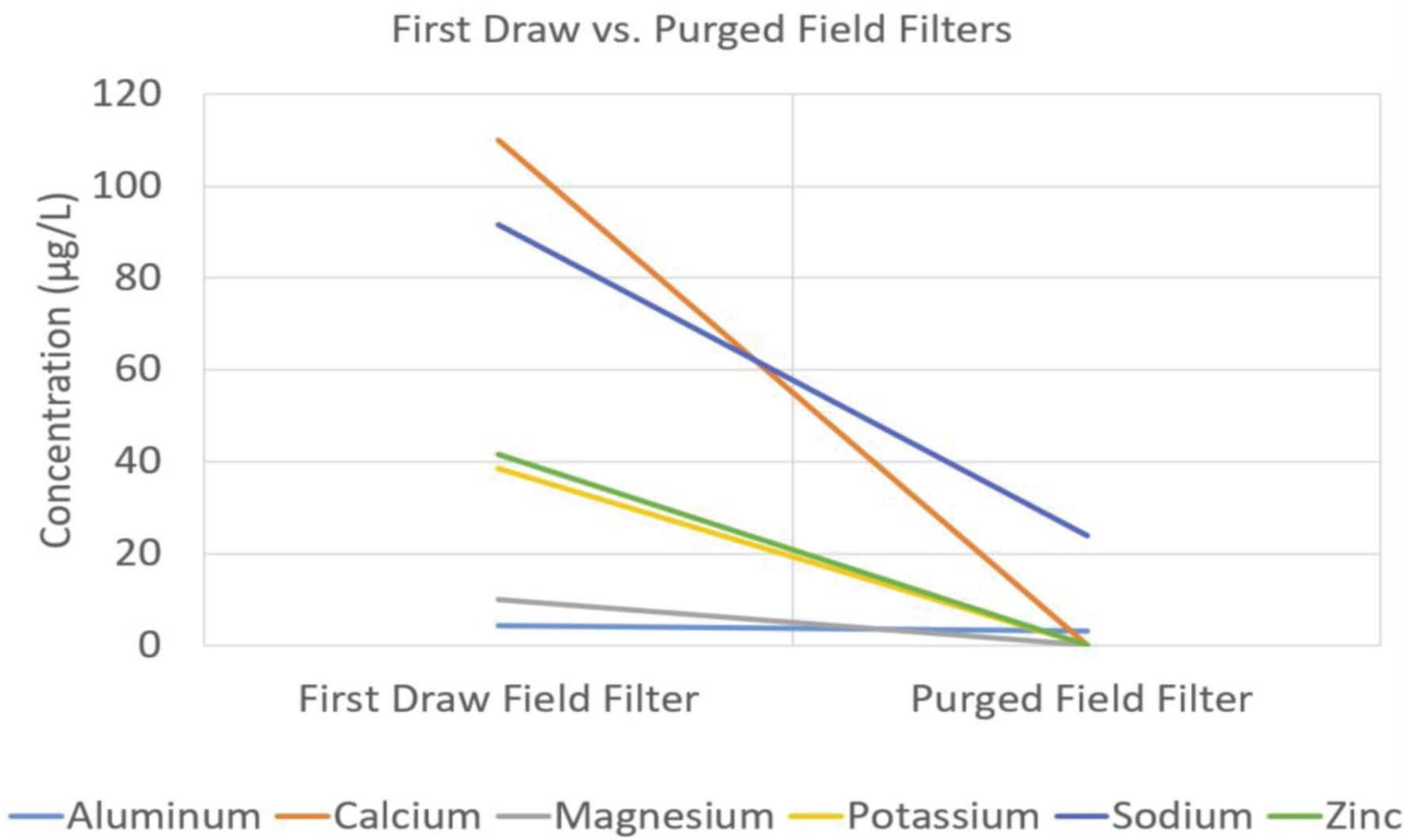
# Study Results

| Analyte | First Draw Concentration (µg/L) | Purge Concentration (µg/L) | Analyte | First Draw Concentration (µg/L) | Purge Concentration (µg/L) |
|---|---|---|---|---|---|
| Teflon, Silicone, and Polyethylene Tubing Analysis | | | | | |
| Barium | ND | 0.16 J | Magnesium | 15.4 | 3.6 J |
| Chromium | 0.43 J | 0.80 | Nickel | ND | 0.27 J |
| Iron | 26.3 J | ND | Sodium | 17.3 J | 19.4 J |
| Lead | 0.061 J | ND | | | |
| 0.45 µm, High-Capacity, In-Line Filter Analysis | | | | | |
| Aluminum | 4.3 J | 3.2 J | Magnesium | 10.0 | ND |
| Antimony | 0.32 J | ND | Manganese | ND | 0.24 J |
| Barium | 0.14 J | ND | Nickel | 0.62 | ND |
| Calcium | 110 | ND | Potassium | 38.4 J | ND |
| Chromium | 0.85 | 0.17 J | Sodium | 91.6 | 23.8 J |
| Copper | 1.6 | ND | Zinc | 41.5 | ND |

# Tubing Results



# Filter Results



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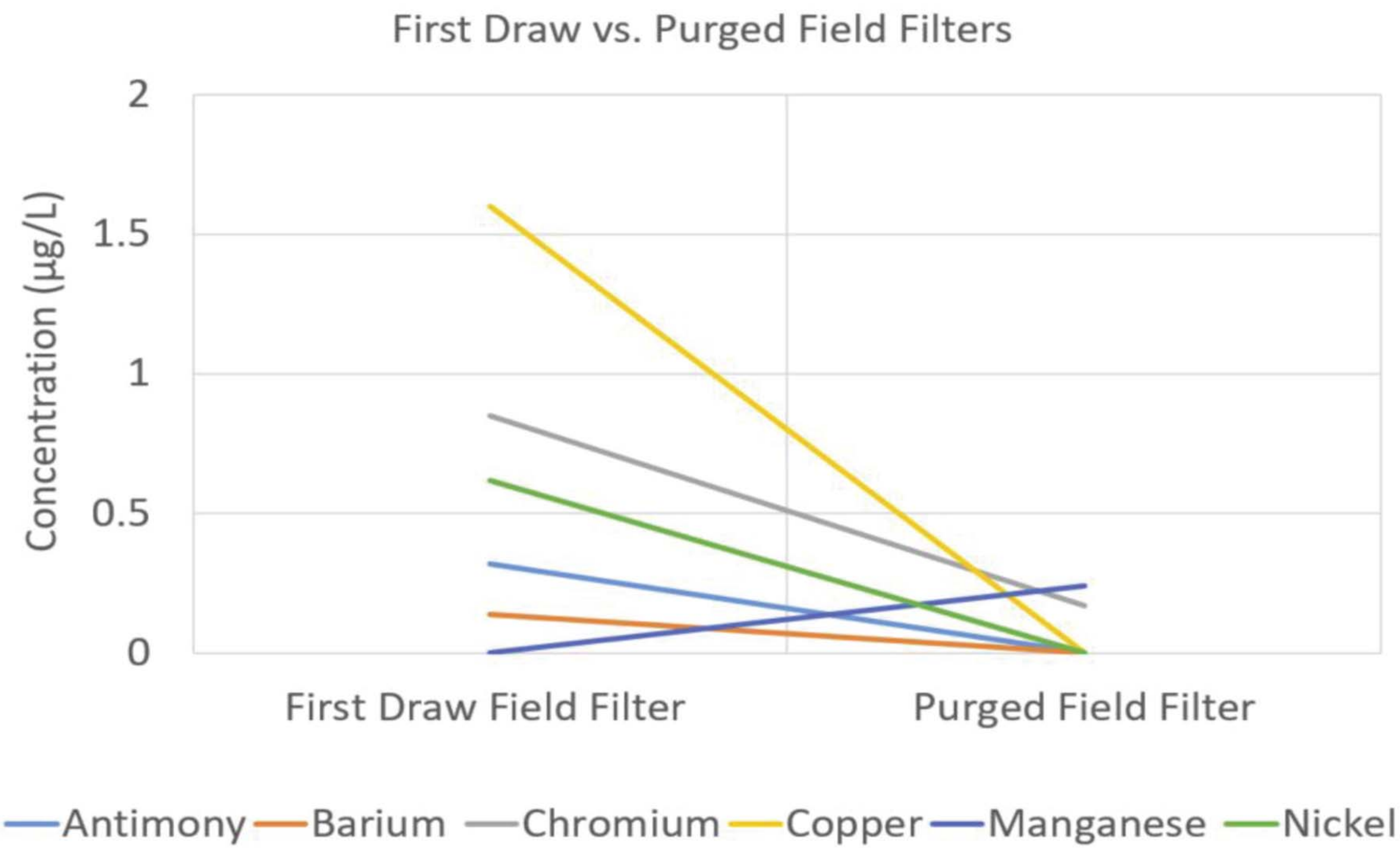

# Tubing and Filter Study Conclusions

- Little contamination could be contributed to the sample tubing used during collection of samples.
- Low levels of contamination could be removed by purging with 1.25 L prior to collection.
- Significant contamination could be contributed to the in-line filters. The majority of the contamination could be removed by purging with 1.25 L prior to collection.

# 2015 Field Season:

- Implemented sample pre-purging of disposable tubing and in-line filters based on the study results.
- It **did not** result in the anticipated elimination of equipment rinsate blank contamination.
- Additional causes of contamination were suspected.

# Average equipment blank contamination observed

| Analyte | Fraction | 2014 EB Average (µg/L) | 2015 EB Average (µg/L) | 2016 EB Average (µg/L) | Analyte | Fraction | 2014 EB Average (µg/L) | 2015 EB Average (µg/L) | 2016 EB Average (µg/L) |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | D | ND | 34.4 J | 33.2 J | Copper | D | 0.37 J | 0.33 J | 1.5 |
| | T | ND | 57.9 | 30.7 J | | T | ND | ND | 1.3 |
| Magnesium | D | ND | 7.8 J | 8.6 J | Iron | D | ND | 21.7 | ND |
| | T | ND | 11.8 | 8.6 J | | T | ND | 26.4 | 172 |
| Potassium | D | ND | ND | 51.3 J | Lead | D | 0.095 J | 0.20 | 0.030 J |
| | T | ND | ND | 33.9 J | | T | ND | 0.19 | 0.052 J |
| Sodium | D | ND | 151 | 114 J | Manganese | D | 0.15 J | 0.64 | 0.31 J |
| | T | ND | 147 | 115 J | | T | 0.14 J | 0.71 | 0.42 J |
| Aluminum | D | 2.1 J | 3.3 J | 5.5 J | Nickel | D | ND | 0.53 | 0.16 J |
| | T | 1.6 J | 4.0 J | 6.0 J | | T | 0.35 J | ND | 0.18 J |
| Antimony | D | ND | ND | 0.057 J | Selenium | D | ND | ND | ND |
| | T | ND | ND | 0.29 J | | T | ND | ND | 0.48 J |
| Arsenic | D | ND | ND | ND | Silver | D | ND | ND | 0.036 J |
| | T | ND | ND | 0.21 J | | T | 0.089 J | ND | 0.055 J |
| Barium | D | ND | 0.21 J | 0.34 | Vanadium | D | ND | ND | 0.13 J |
| | T | 0.18 J | 0.24 J | 0.37 | | T | ND | ND | 0.13 J |
| Cadmium | D | ND | ND | 0.039 J | Zinc | D | ND | ND | 2.1 J |
| | T | ND | ND | 0.034 J | | T | ND | ND | 1.9 J |
| Chromium | D | 0.32 J | 0.81 | 0.25 J | | | | | |
| | T | 0.56 | 0.24 J | 0.24 J | | | | | |

# 2016 Field Season

- Field audit did not note any processes contributing to field blank contamination.
- Observed that the laboratory-provided deionized water was contained in amber liter bottles.
- Determined that the amber bottles were not certified clean for metals.
- Analysis of an unused bottle of deionized water revealed very similar results in both the analytes detected and the analyte concentrations when compared to the equipment blank contamination.

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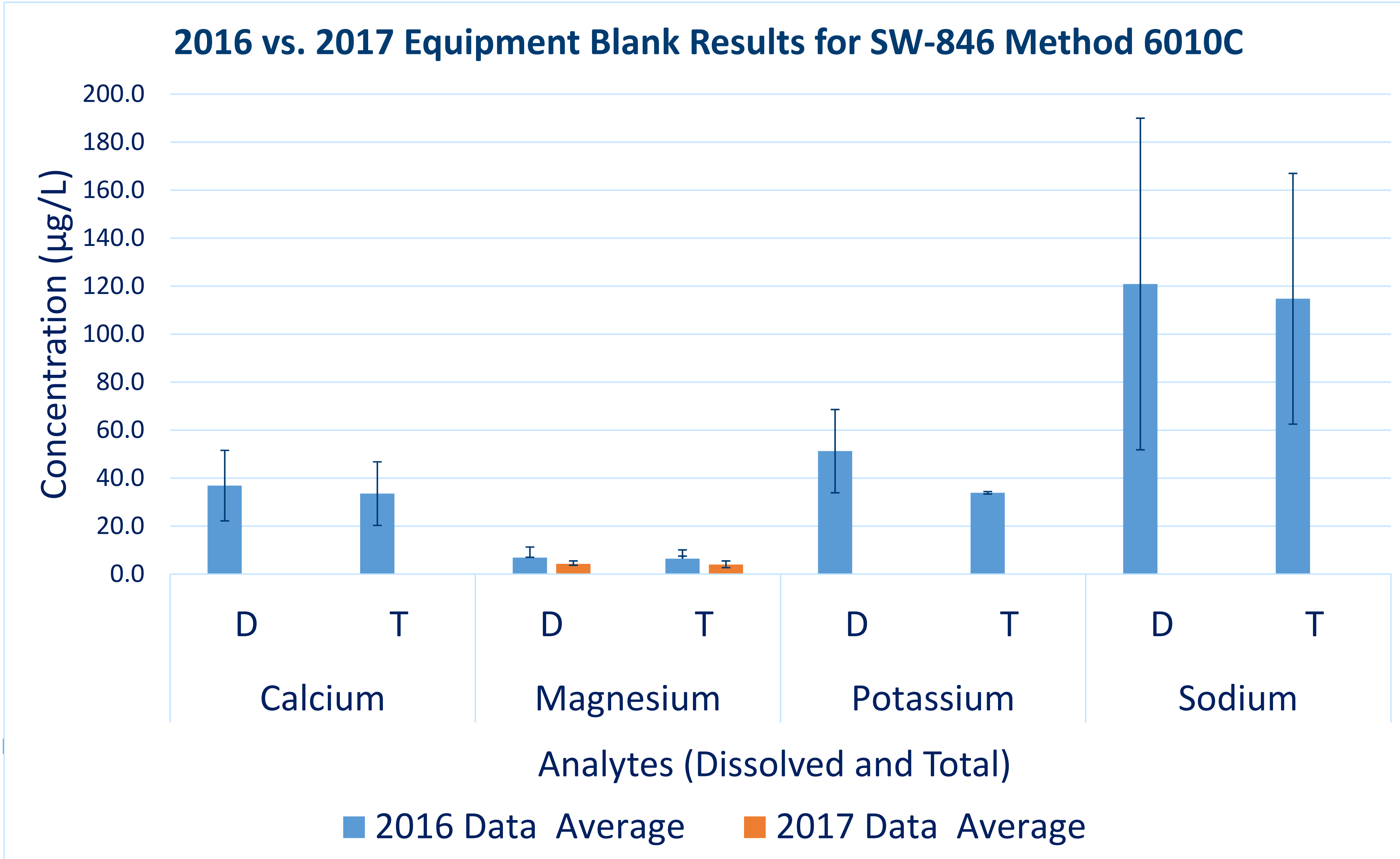
# 2016 Comparison of Retesting Results

| Analyte | Average 2016 EB Concentration (µg/L) | Average Retesting Concentration (µg/L) | Analyte | Average 2016 EB Concentration (µg/L) | Average Retesting Concentration (µg/L) | Analyte | Average 2016 EB Concentration (µg/L) | Average Retesting Concentration (µg/L) |
|---|---|---|---|---|---|---|---|---|
| Calcium | 30.7 J | 53.9 J | Barium | 0.37 | 0.50 | Manganese | 0.42 J | 0.47 J |
| Magnesium | 8.6 J | 14.0 J | Cadmium | 0.034 J | 0.015 J | Nickel | 0.18 J | 0.16 J |
| Potassium | 33.9 J | 11.9 J | Chromium | 0.24 J | 0.19 J | Selenium | 0.48 J | ND |
| Sodium | 114.5 J | 183 J | Copper | 1.3 | 1.7 | Silver | 0.055 J | ND |
| Aluminum | 6.0 J | 7.0 J | Iron | 172 | ND | Vanadium | 0.13 J | ND |
| Antimony | 0.29 J | ND | Lead | 0.052 J | 0.027 J | Zinc | 1.9 J | 1.6 J |
| Arsenic | 0.21 J | 0.093 J | | | | | | |

# 2017 Field Season

- 2017 equipment blank bottleware was properly sourced and certified clean to the method detection limit (MDL) for analytes of interest prior to shipment to the Field Team.
- Field audit and review of bottle check data confirmed acceptability of results.
- Several types of bottles are used to contain equipment blank water.
- A significant reduction in contamination was observed for most analytes.

# 2016 vs. 2017 Equipment Blank Results



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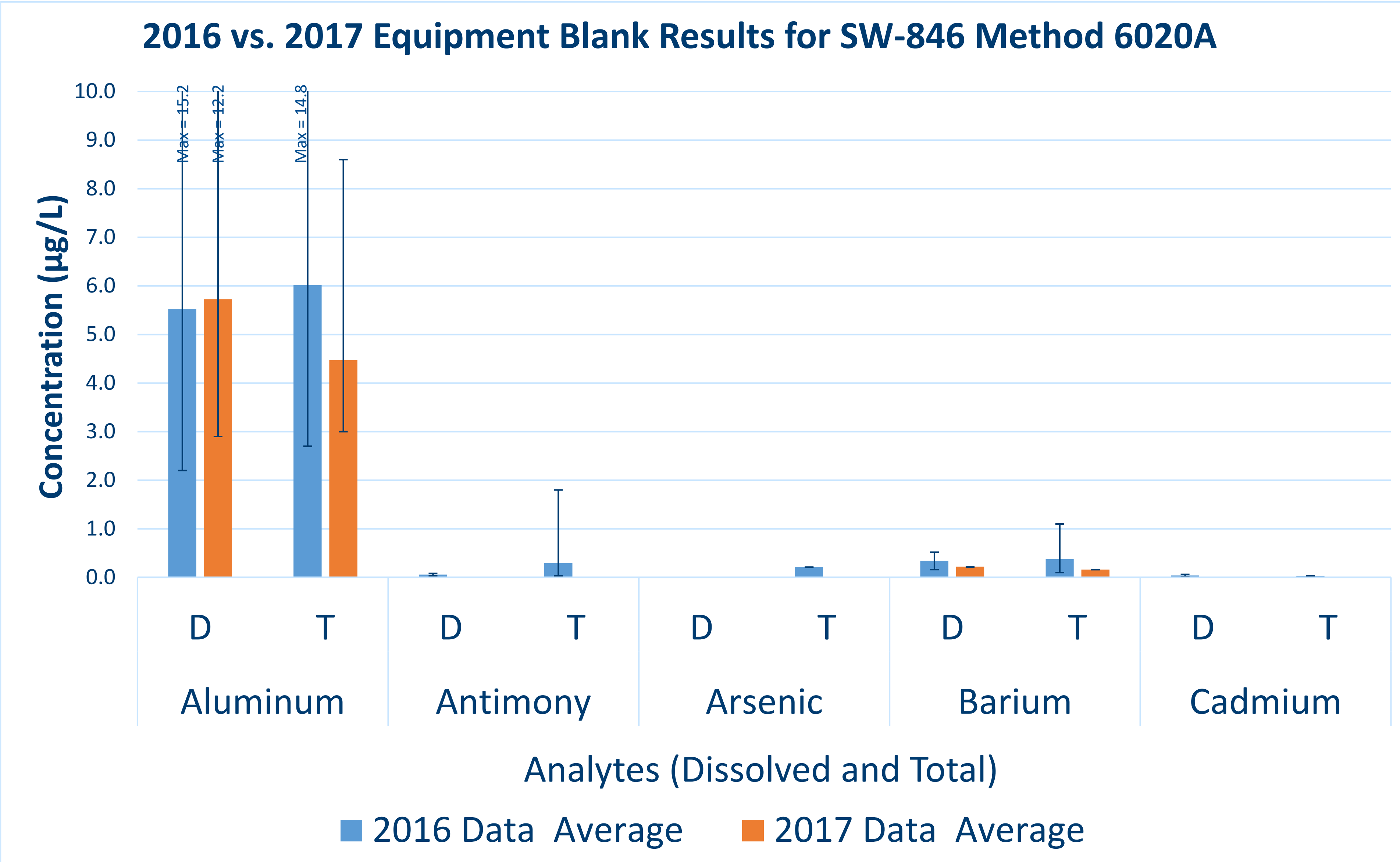

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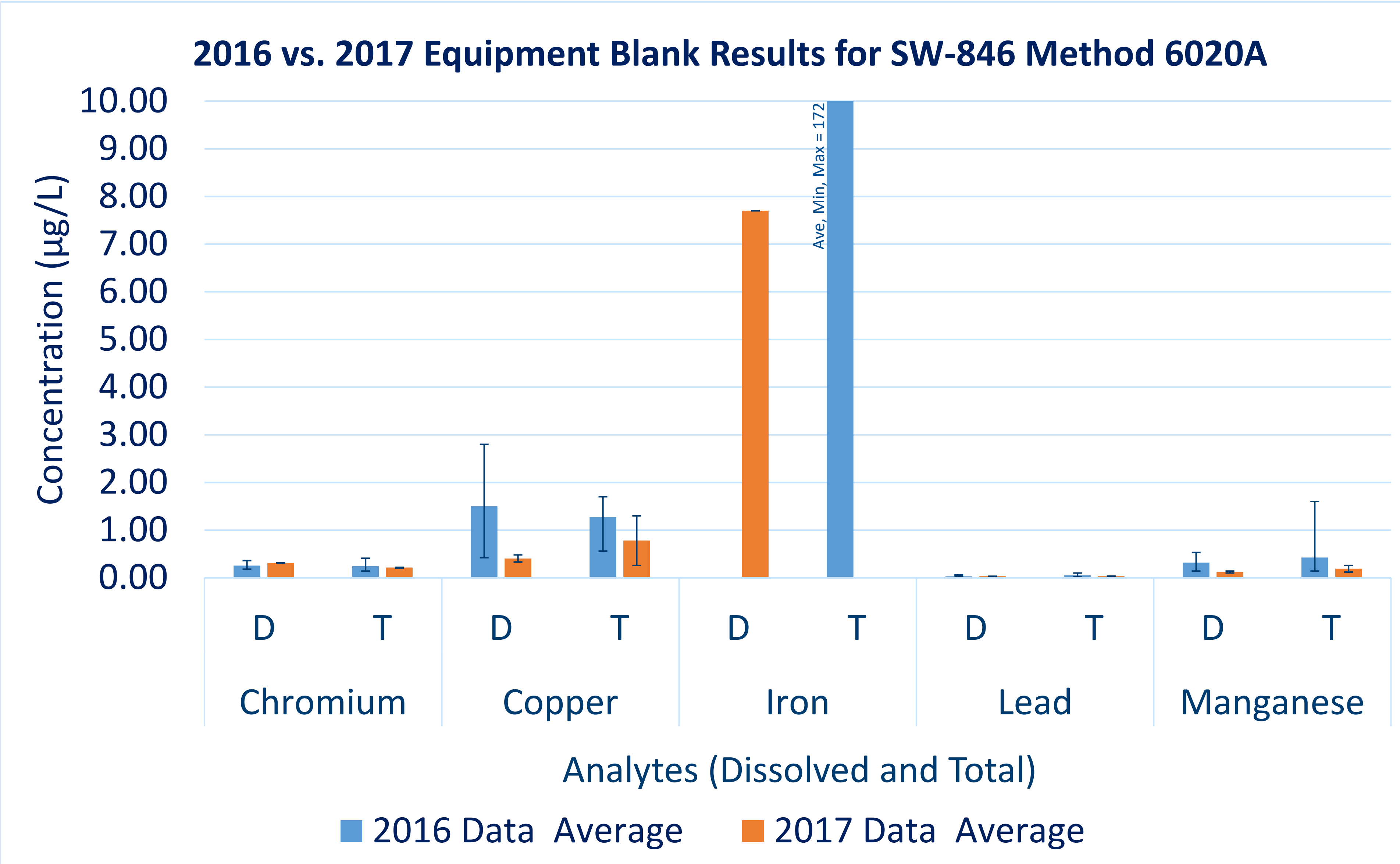
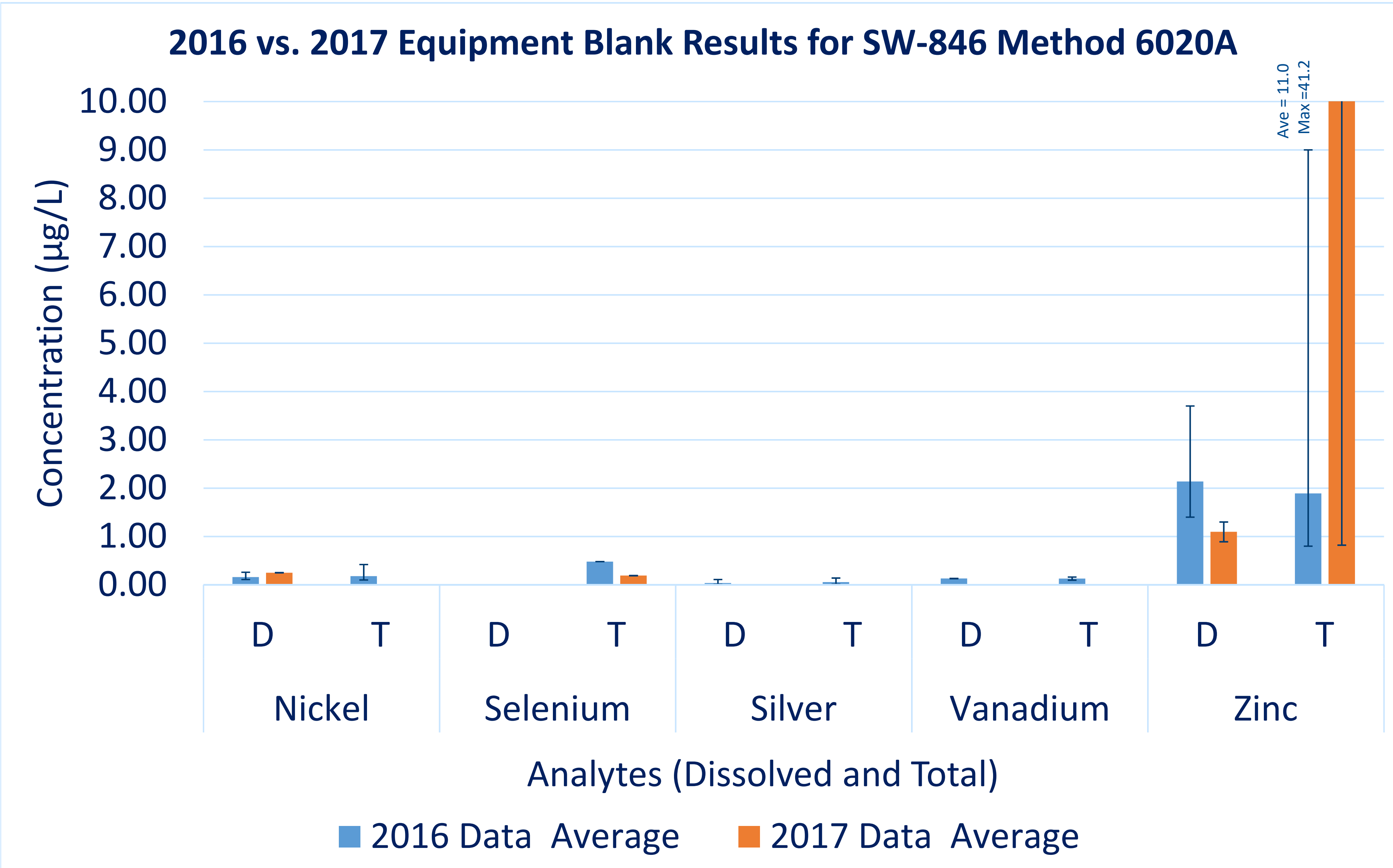


# 2016 vs. 2017 Equipment Blank Results



# Conclusions

- An overall reduction in the number of positive results in the equipment blanks and a reduction in the concentration of those positive results, was observed in 2017.
- The amount of sample data qualified due to equipment blank contamination was reduced from 5.2% of all analytes reported in 2016 to 1.8% of all analytes reported during the 2017 sampling season.
- Data provided evidence of improved qualitative and quantitative measurements to the Project Team.

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# Acknowledgements

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# Thank You

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