Willard Spur Nutrient Cycling

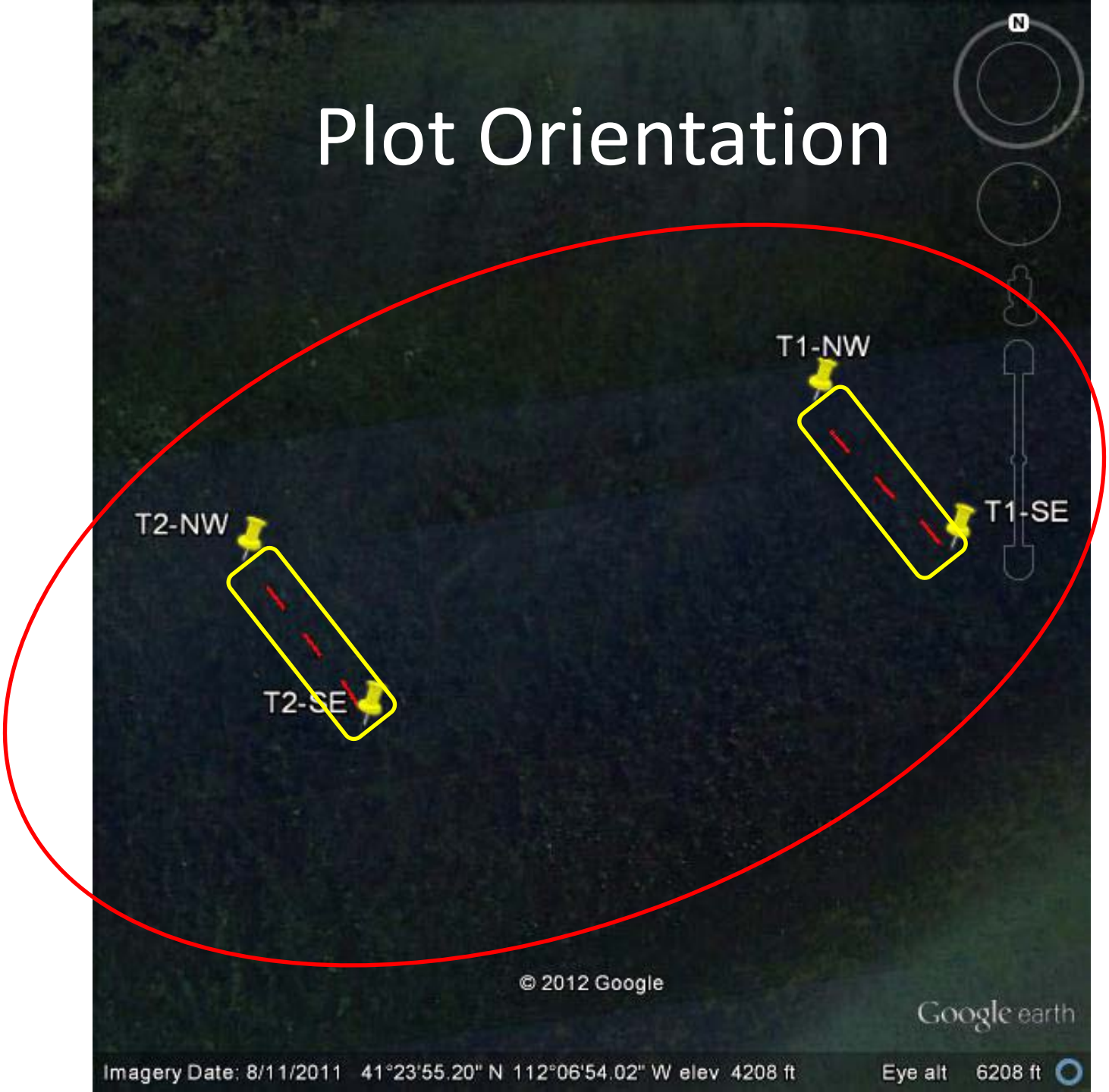
Dr. Heidi Hoven
Dr. William Johnson
Dr. Ramesh Goel

Joel Pierson
Mitch Hogsett
Ramin Nasrabadi

- Site Plan
- Site set up
  - Supplies
  - How installed
- Challenges
  - Debris
  - Cost
  - Wildlife
- Sampling
  - Sample Tracking Tool
  - Sample Analysis Plan
- Preliminary results
- Changes to Sampling Plan

Plot Location

Plot Orientation



Target Concentrations

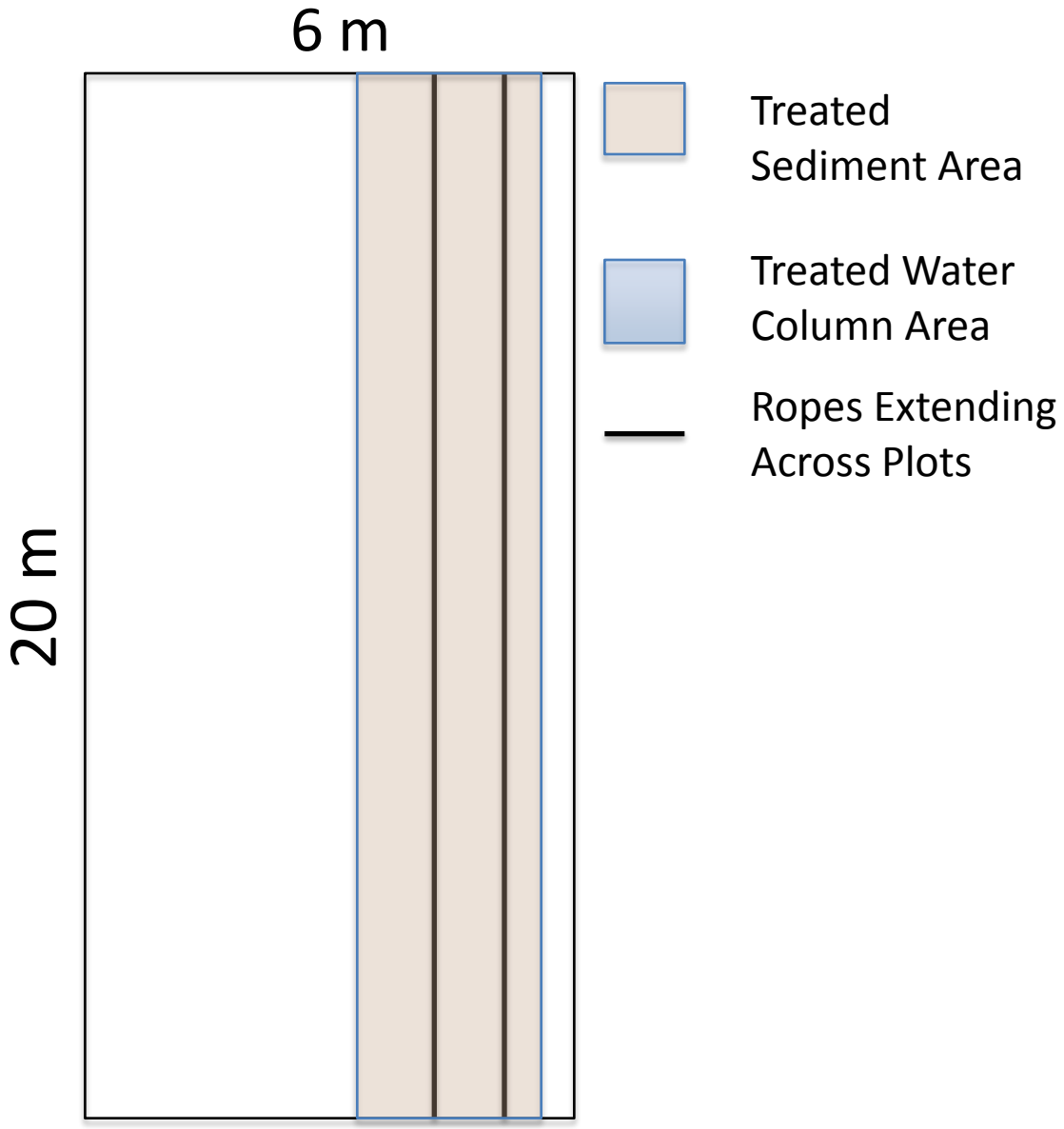
Treatment Area	Total Phosphate	Nitrogen (Ammonia)	Nitrogen (Nitrate)
Water Column: High	0.4 mg/L	2.5 mg/L	ND
Water Column: Low	0.1 mg/L	1.1 mg/L	ND
Sediment: High	200 mg/kg		
Sediment: Low	100 mg/kg		

Setting Up the Site: April

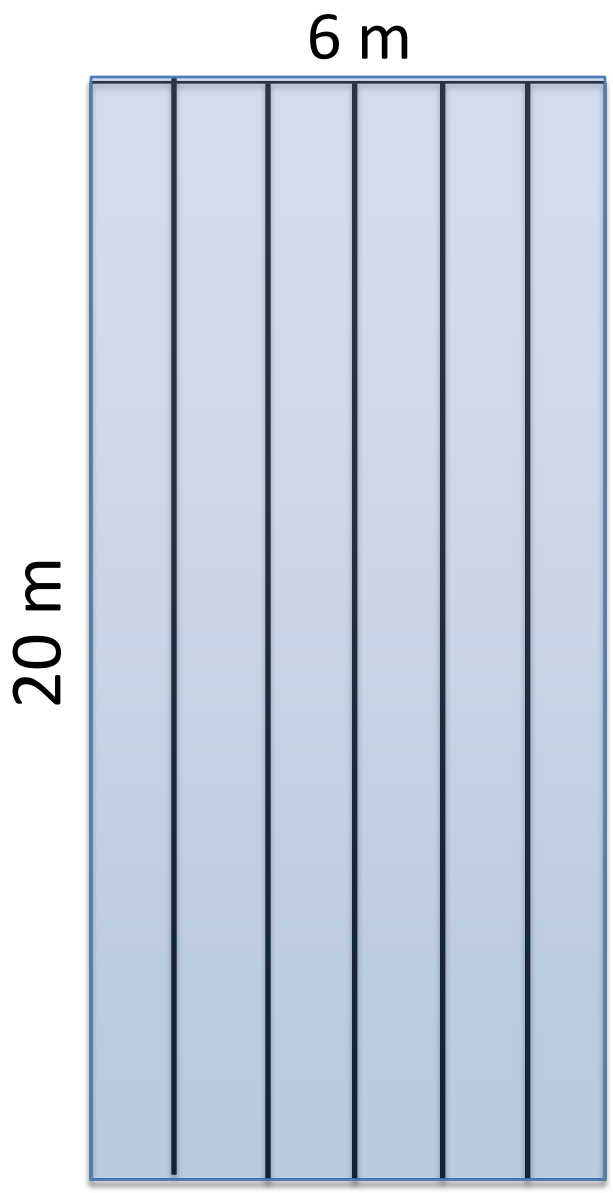
Setting Up the Site: April

Setting Up the Site

Sediment Plots



Water Column Plots



Setting Up the Site: May

Setting Up the Site: June

N

Control

Low

High

Fence

Treatment/Control Plots

Challenges: Floating Debris

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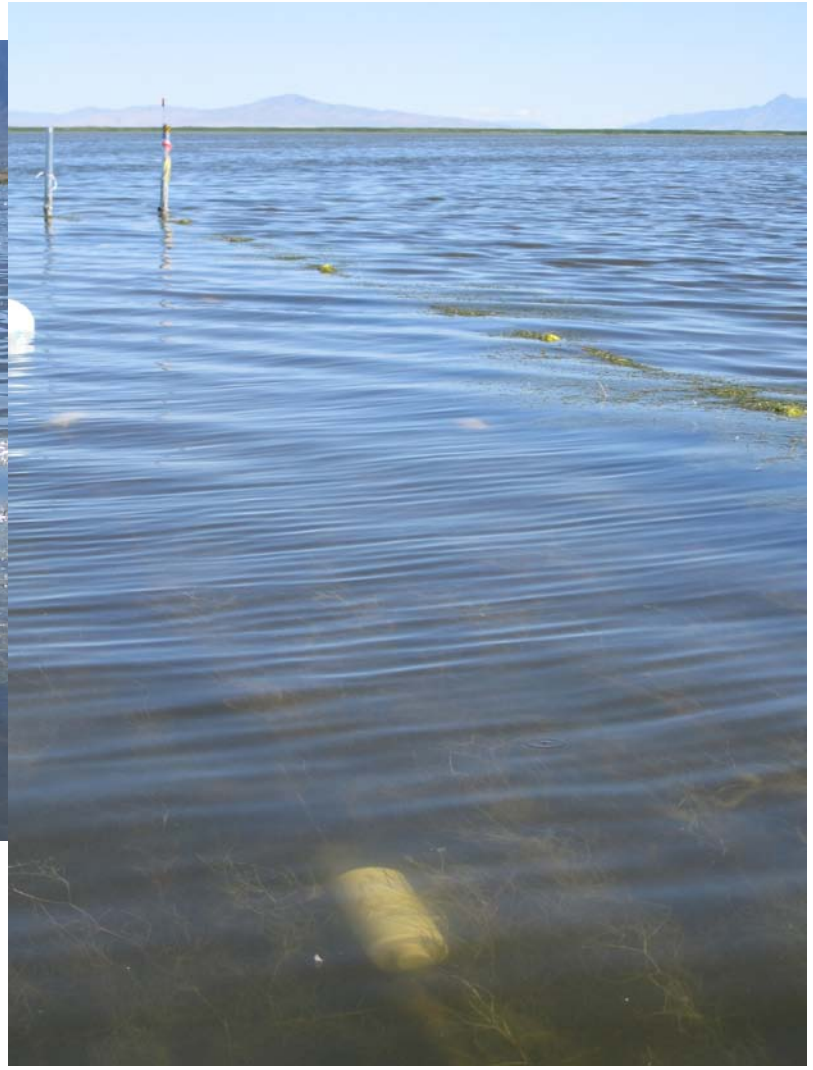
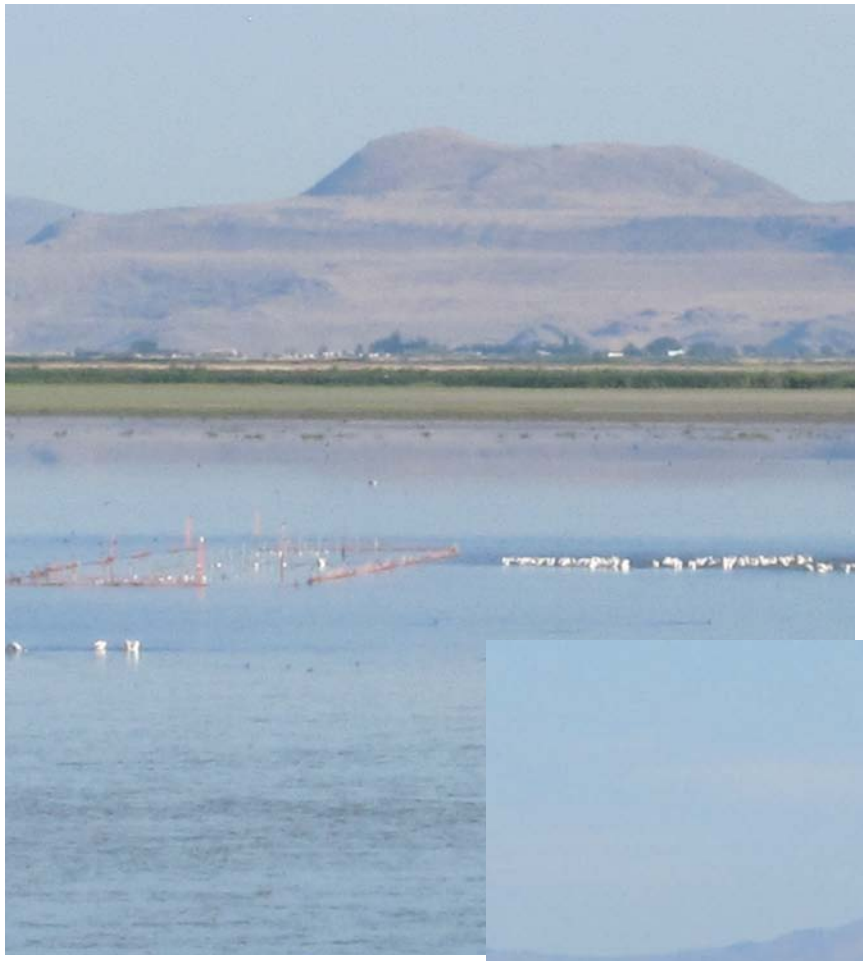


Challenges: Floating Debris

THE UNIVERSITY OF UTAH

Challenges: Wildlife



Challenges: Cost of Site Materials

	Approximate Cost
Osmocote Fertilizer	$3100
Posts/Markers/Fence	$2200
Bags and Ropes	$1200
Total	$6500

Chemical Analysis: Water Column

- **Field Parameters** (YSI Probe): One measurement per treatment/control plot
  - pH
  - Conductance
  - Temp
  - Dissolved Oxygen
  - Alkalinity
    - Volume: 25 ml,
    - Container: provided in Hach kit,
    - Preservation: analyzed in field,
    - Holding time: minutes)
  - Time Budget: ¼ Day – calibrate probe to prepare for field work

Chemical Analysis: Water Column

- **Utah State Health Lab:** Four samples per treatment/control plot
  - Carbonaceous BODs (container: 1.9 L Plastic BOD bottle; preservative: none; holding time: 2 days)
  - Non-filtered Nutrients (500 ml bottle preserved with sulfuric acid, hold time 28 days)
    - Ammonia
    - Nitrate/Nitrite
    - Total Phosphorous
    - TKN
  - Filtered Trace Elements (one 250 ml bottle preserved with nitric acid, hold time 28 days)
    - EPA Method 200.8-DISS: Al, As, Ba, Bo, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K
  - Filtered Nutrients (250 mL bottle preserved with sulfuric acid, hold time 28 days)
    - Nitrate/Nitrite
    - Total Nitrogen
    - Dissolved Phosphorous
  - General Chemistry Parameters (1 liter bottle with no preservative, hold time 7 days)
    - Sulfate
    - Alkalinity
    - Turbidity
    - Carbonate solids
    - TVS
    - TSS
    - TDS
    - Time Budget: ¼ Day - Transfer samples to UTSL

Chemical Analysis: Water Column

- **University of Utah: Johnson Lab**
  - Total and Methyl Mercury: One sample per treatment/control plot
    - Volume: 250 ml,
    - Container: FLPE
    - Preservation: 2.5 ml concentrated HCl + 2.5 ml water
    - Holding time: THg 3 months; MeHg 6 months
    - THg: Double bag FLPE bottle and use “clean hands dirty hands” technique in field.
    - Remove 100 ml for MeHg analysis, then add 1% (1.5 ml) BrCl to THg sample volume when ready to analyze.
    - Unfiltered to match 2012 wetland study.
      - Time Budget: ¼ Day - Separate into MeHg and THg; 1% BrCl for THg. 3 days - Analyze for MeHg and THg

Chemical Analysis: Water Column

- **University of Utah: Johnson Lab**
  - Trace Elements: Four samples per treatment/control plot
    - Volume: 30 ml, container: LDPE (acid leach 10% HCl overnight),
    - Preservation: filter 45 um, 2.4% HNO3 (0.75 ml concentrated HNO3 + 0.75 ml Milli-Q water to dilute),
    - Holding time: 6 months
    - Submit to Diego in 30 ml LDPE
    - Method corresponds to EPA 200.8-Metals:
    - Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, S e, Sr, Ti, Tl, U, V, Zn
    - Time Budget: ¼ Day - Transfer to Diego Fernandez

Chemical Analysis: Water Column

- **University of Utah: Johnson Lab**
  - Major Anions (IC): Four samples per treatment/control plot
    - Volume: 30 ml,
    - Container: LDPE,
    - Preservation: none, filter using 45 um, refrigerate samples,
    - Holding time: Low DO, run immediately; Oxic, run within 1-2 weeks)
      - EPA Method 300.0-DISS: PO42-, NO3-, Cl-, SO42-, Br-, F-
    - Time Budget: 1 Day - Transfer to IC tubes and run on IC

Chemical Analysis: Sediment

- Three sample sites per treatment/control plot for a total of 18 samples. At each sample site three to four 1.5-inch diameter 10-cm long cores will be collected and homogenized in a single Ziploc Bag, split, and sent to the following labs for analyses:
  - Utah State University Analytical Lab
  - University of Utah: Johnson Lab
  - University of Utah: Ehleringer Lab

Chemical Analysis: Sediment

- **Utah State University Analytical Laboratories**
  - Nutrients (pH, salinity, texture, P, K, Nitrate-N**, micronutrients, sulfate, organic matter)
    - Amount: about 2 cups sediment from homogenized sample described above
    - Preservation: Freeze
    - Holding time: 28 days at 4-6 deg C
    - Time Budget: ¼ Day - Transfer samples to USU

Chemical Analysis: Sediment

- **University of Utah: Johnson Lab**
- Total and Methyl Mercury
  - Mass: 2 g (1 g for THg and 1 g for MeHg)
  - Container: 50 ml centrifuge tube transferred to PPCO tube (To clean PPCO tubes, acid leach 10% HCl overnight)
  - Total: Extraction using nitric acid and BrCl
  - Methyl: Extraction using dimethyl chloride
  - Holding Time: Sediment 14 days at 4-6 deg C; Extract 2 days.
  - Time Budget: 2 Days - Extractions, 3 Days – Analysis

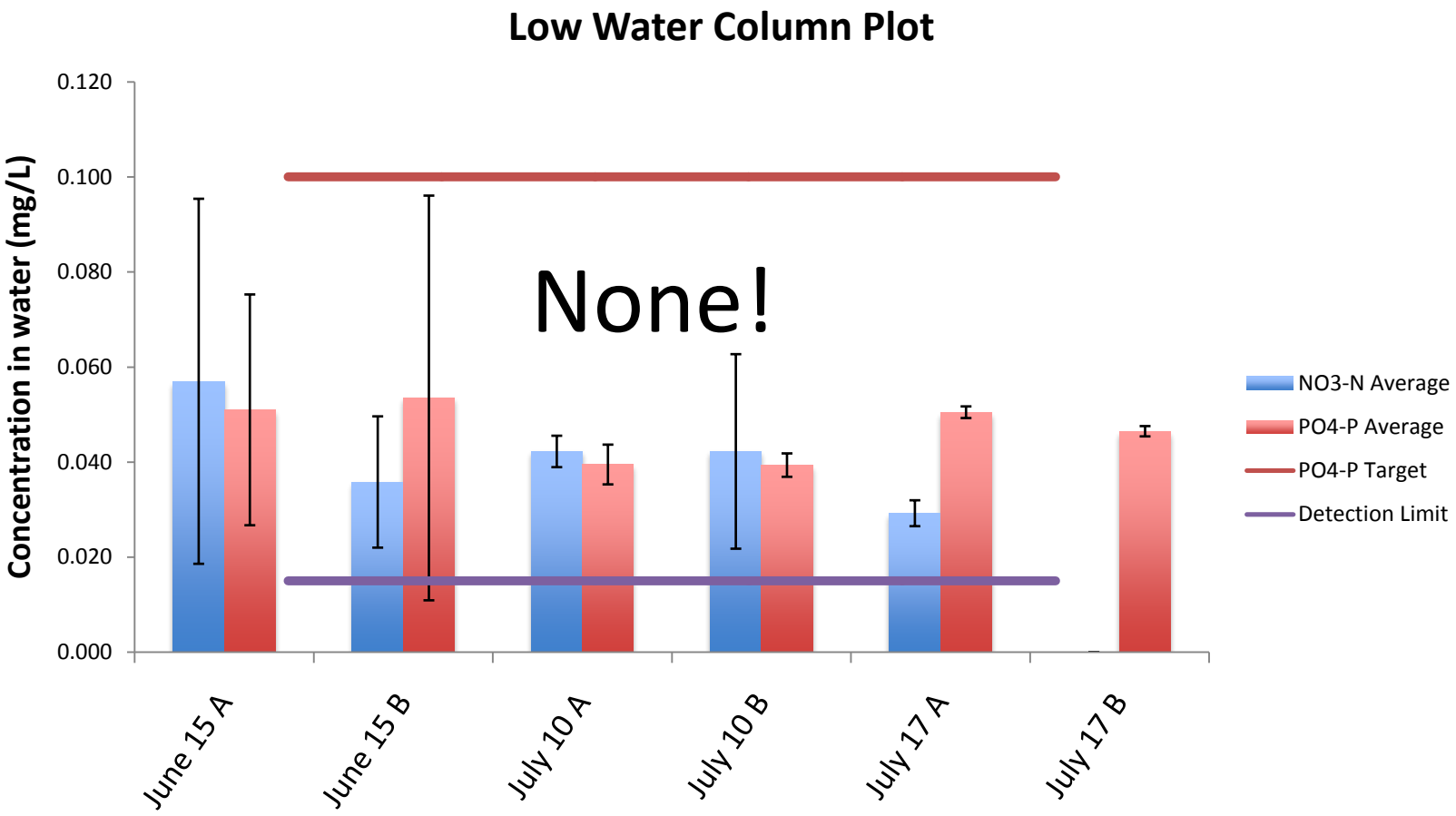
Chemical Analysis: Sediment

- **University of Utah: Johnson Lab**
  - Trace Elements
    (Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Sr, Ti, Tl, U, V, Zn)
  - Acid leach 1 g sample for ICPMS
  - Mass: 1 g
    - Container: 50 ml centrifuge tube transferred to PPCO tube (To clean PPCO tubes, acid leach 10% HCl overnight)
    - Extraction Procedure: 5% HCl leach for 3 days; be consistent between sample events. Centrifuge and remove leachate. Generally only 2 ml is necessary; transfer to acid leached 10 ml conical blue top tube.
  - Holding time: 6 months
  - Time Budget: ¼ Day – Measure 1 g wet sample into PPCO tubes. ¼ Day – Centrifuge and transfer 2 ml leachate to blue top tubes

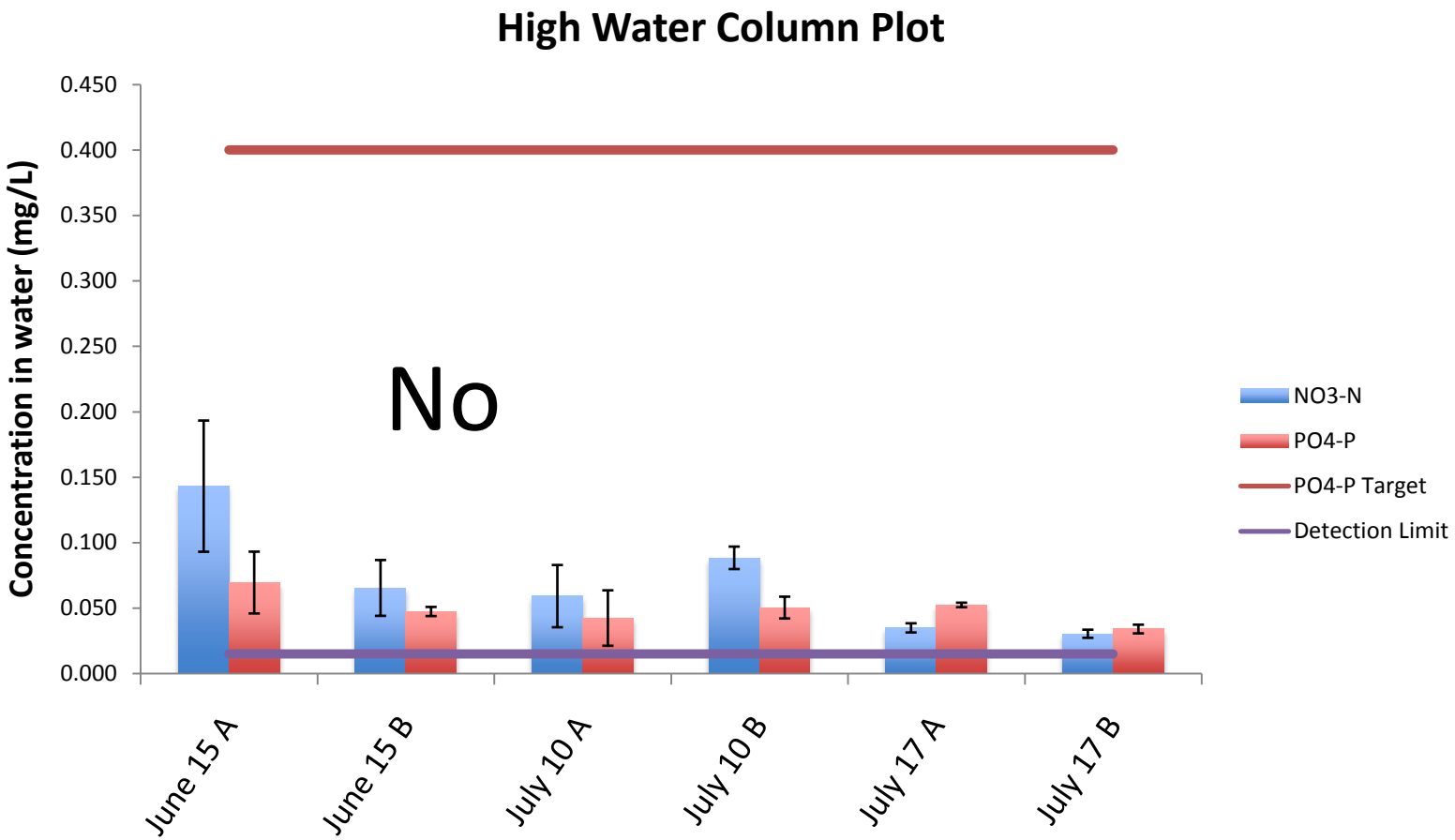
Chemical Analysis: Sediment

- **University of Utah: Ehleringer lab**
  - Sediment Nutrients (%C and %N)
    - Procedure: Dry sample in glass bottle in oven, bring to Ehleringer lab to crush and transfer to tin capsule for acidification, crushing, weighing. Crush and acidify samples the day before weighing.
    - Preservation: store weighed samples in vacuum desiccator,
    - Holding time: run samples immediately
    - Time Budget: ½ Day - Dry sediment (~10 g) and measure wet and dry weights. 1 Day - Crush and acidify dried samples. ½ Day – Weigh samples

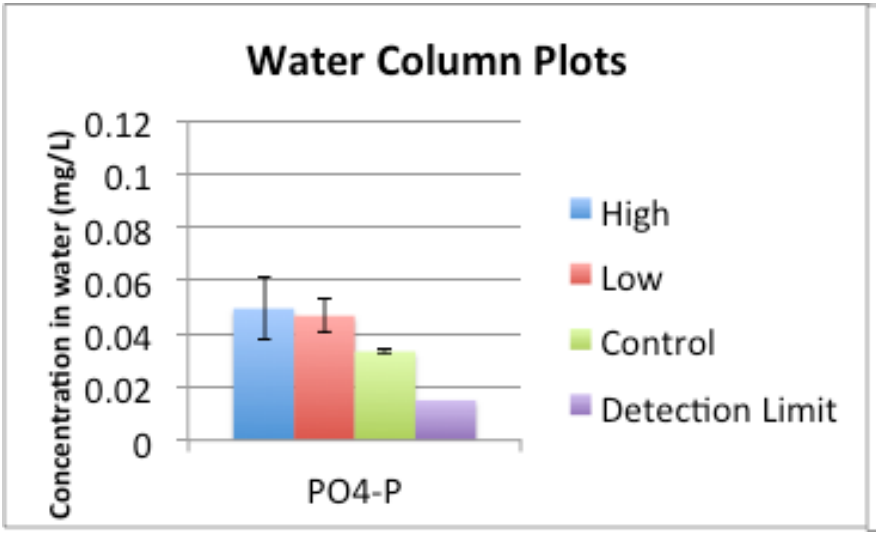
Potential Spatial & Temporal Trends

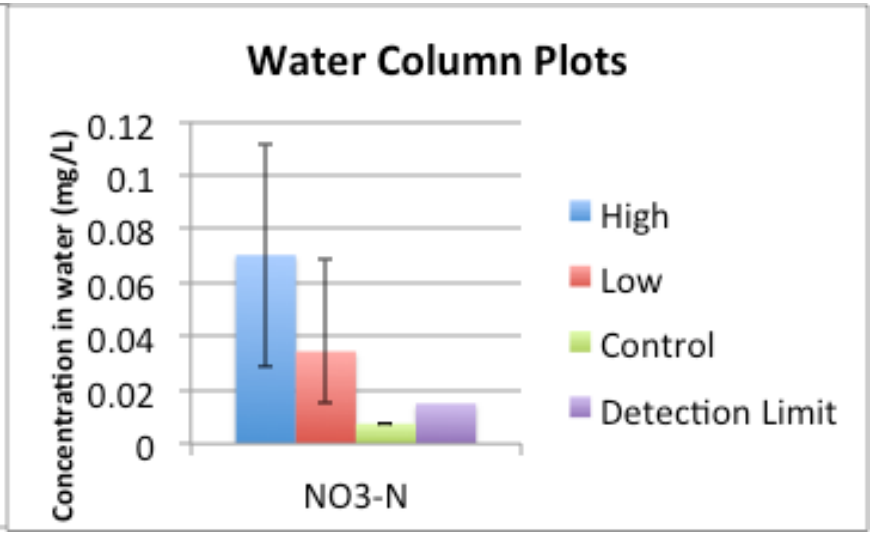


Target Reached?

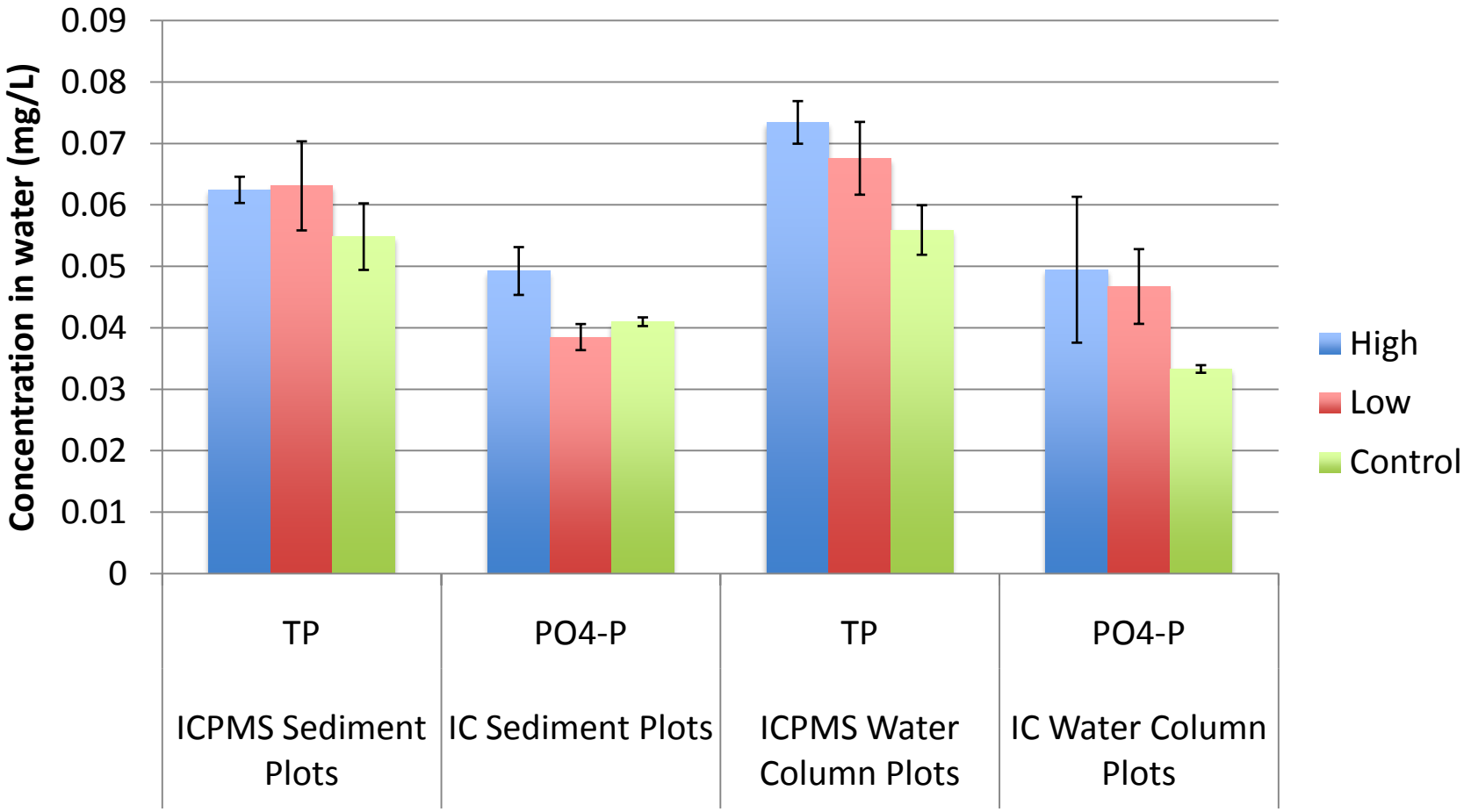


Differences Between Plots?

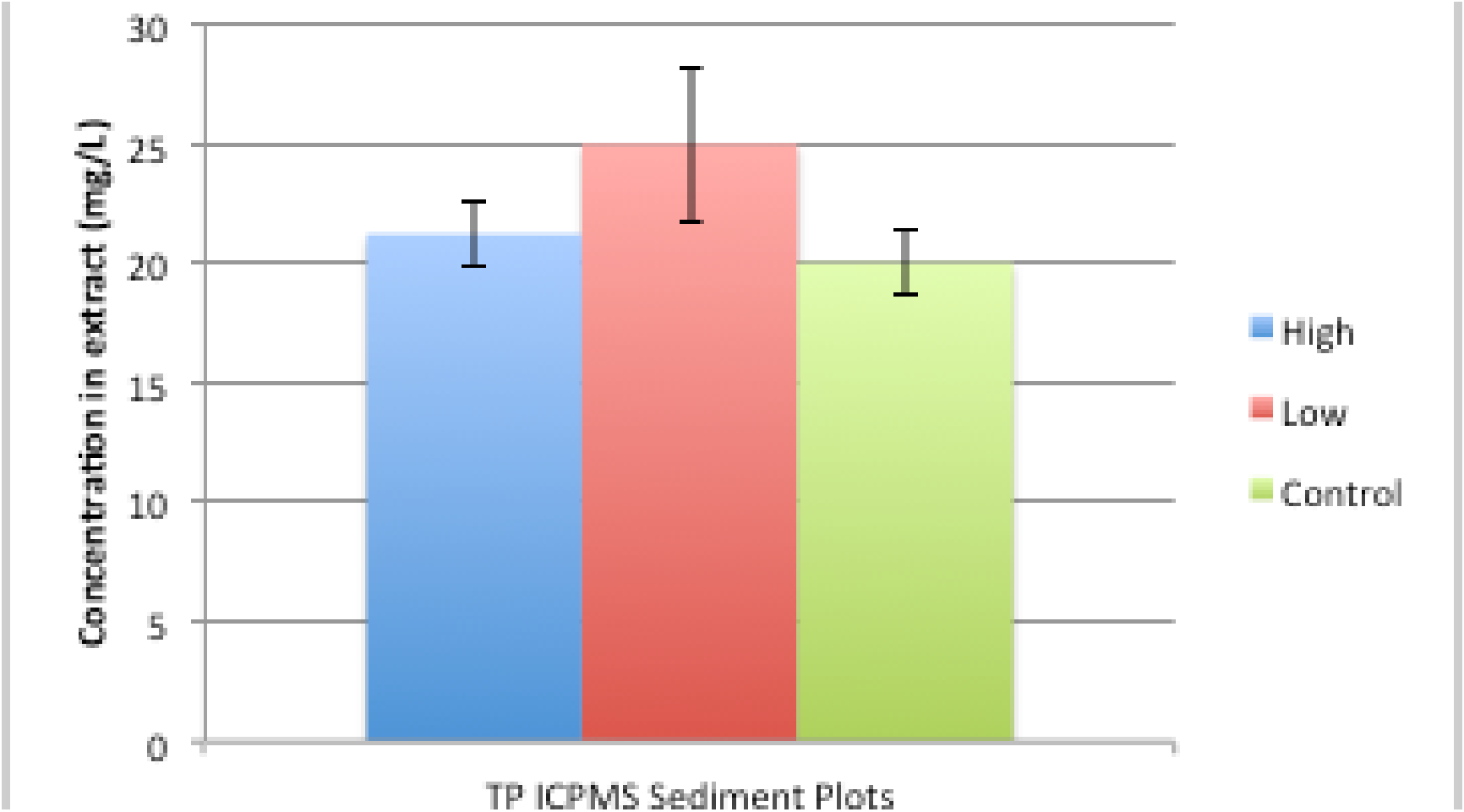




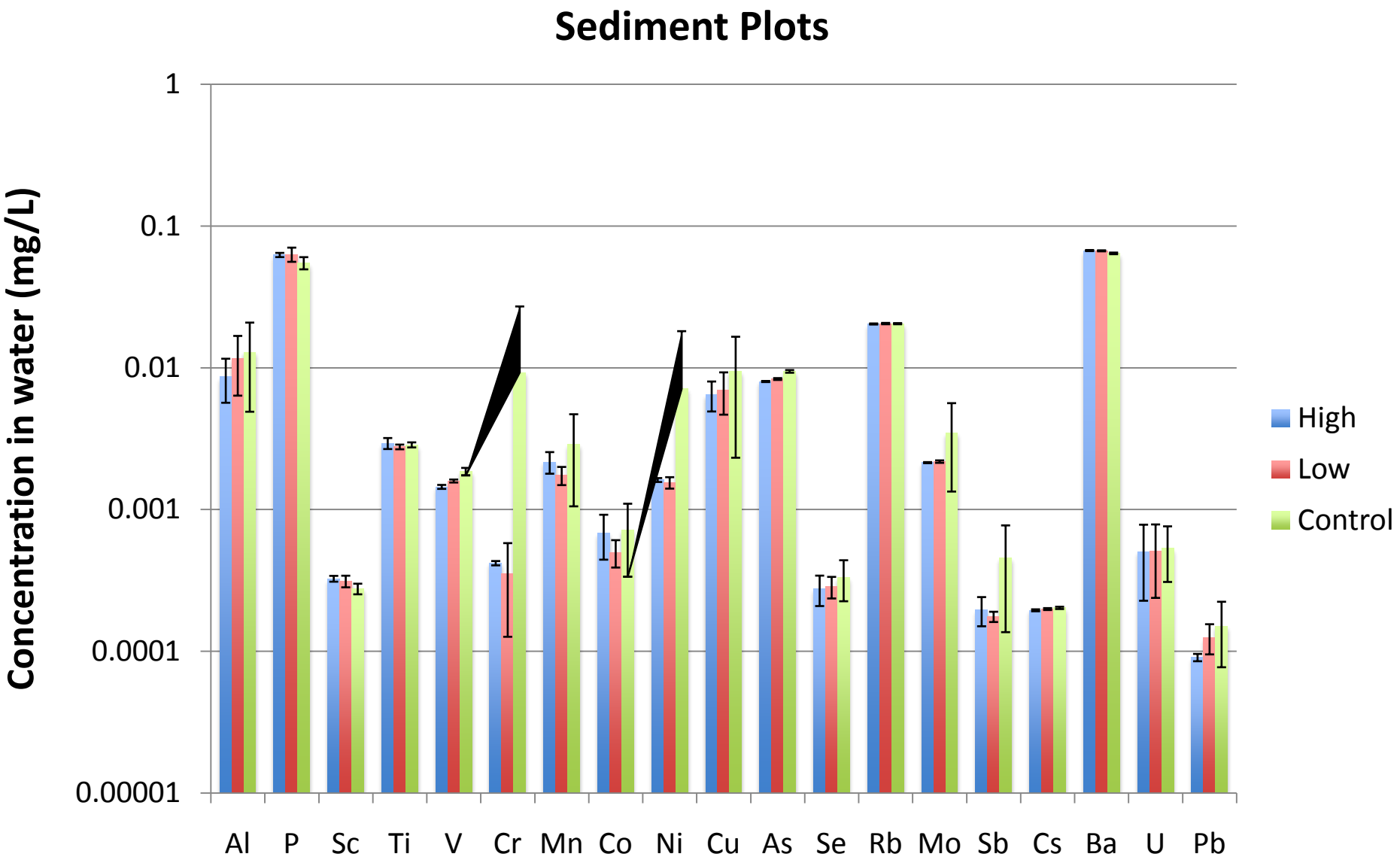
Differences Between Plots?

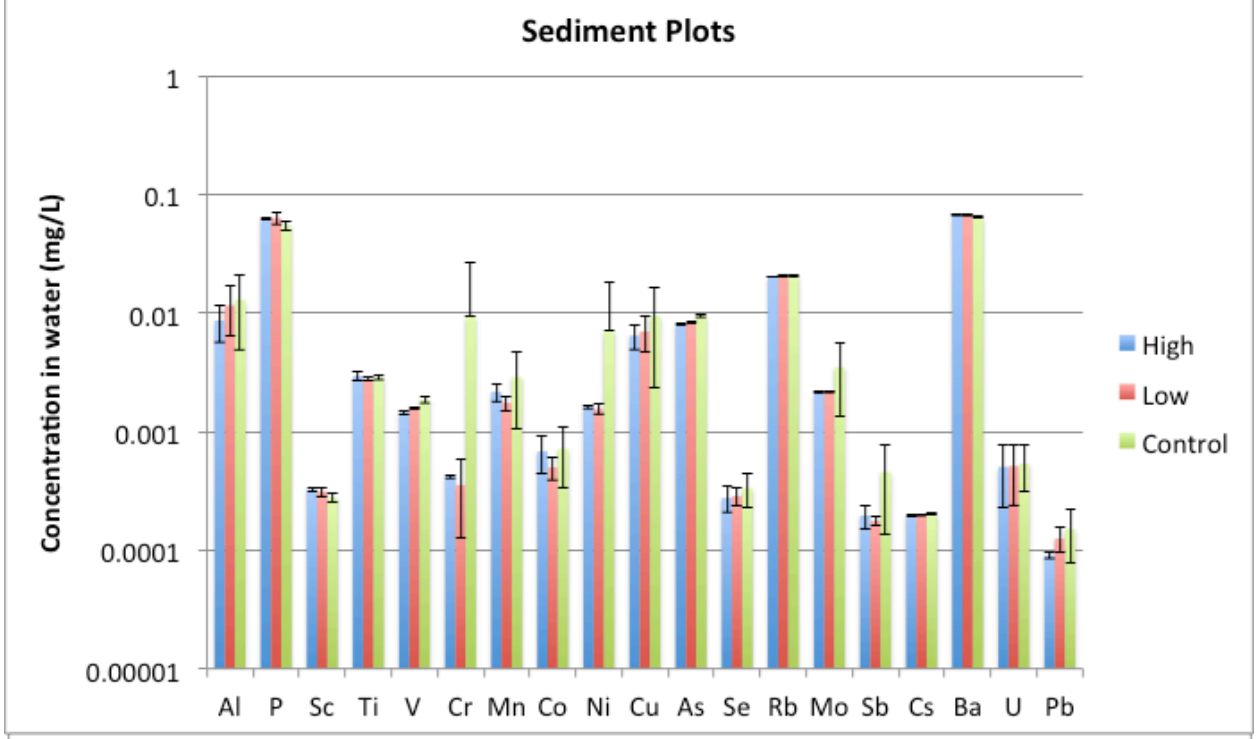


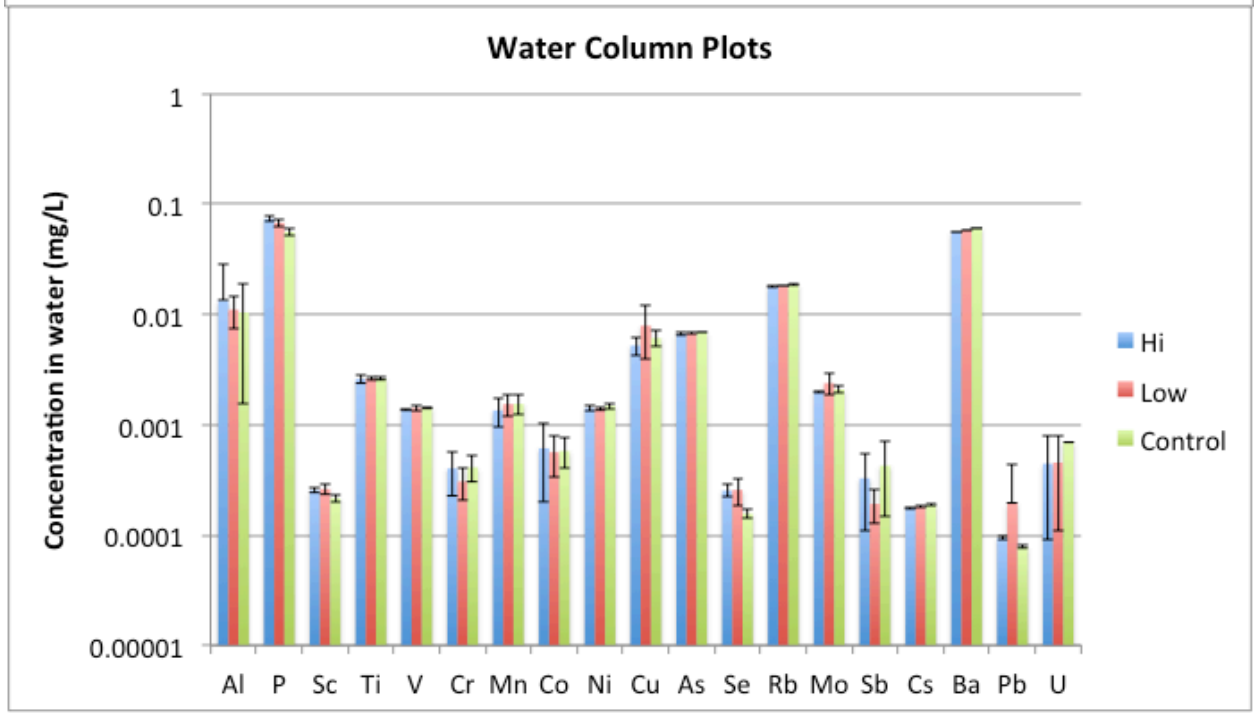
Differences Between Plots?

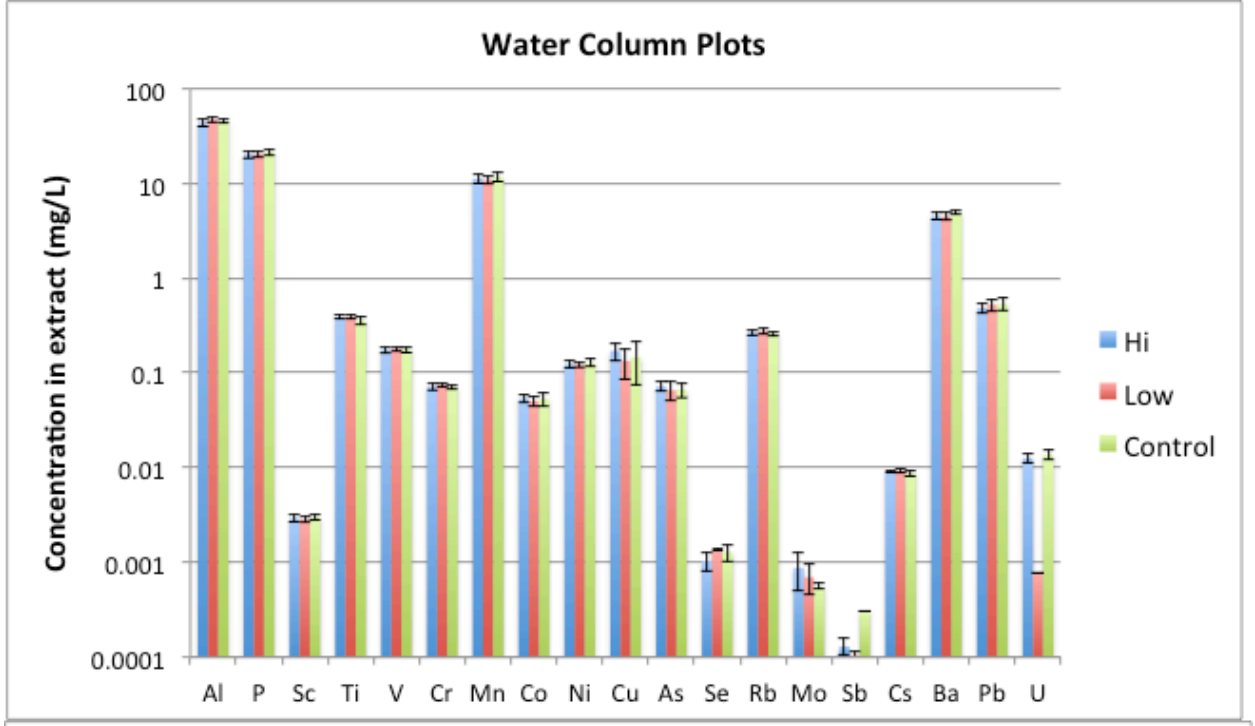


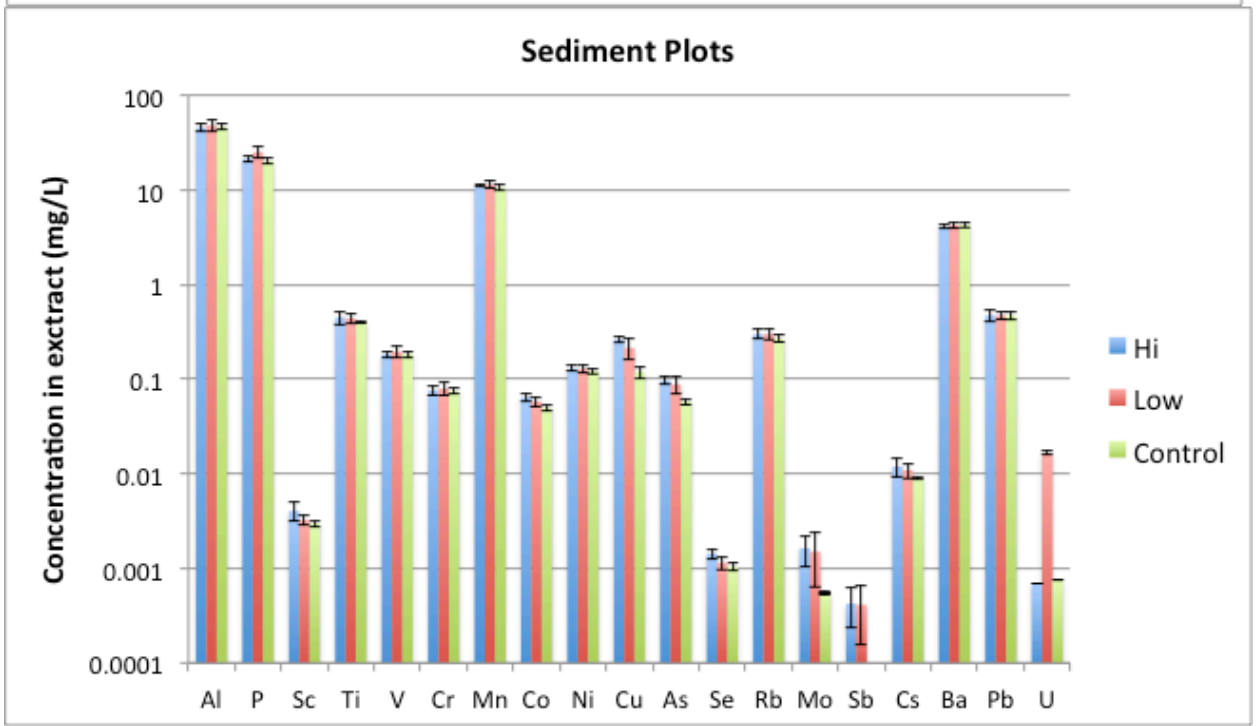
Oversampling?




Sediment Plots
Concentration in water (mg/L)
1
0.1
0.01
0.001
0.0001
0.00001
Al P Sc Ti V Cr Mn Co Ni Cu As Se Rb Mo Sb Cs Ba U Pb
High
Low
Control


Water Column Plots
Concentration in water (mg/L)
1
0.1
0.01
0.001
0.0001
0.00001
Al P Sc Ti V Cr Mn Co Ni Cu As Se Rb Mo Sb Cs Ba Pb U
Hi
Low
Control


Water Column Plots
Concentration in extract (mg/L)
100
10
1
0.1
0.01
0.001
0.0001
Al P Sc Ti V Cr Mn Co Ni Cu As Se Rb Mo Sb Cs Ba Pb U
Hi
Low
Control


Sediment Plots
Concentration in exctract (mg/L)
100
10
1
0.1
0.01
0.001
0.0001
Al P Sc Ti V Cr Mn Co Ni Cu As Se Rb Mo Sb Cs Ba Pb U
Hi
Low
Control