Development of Water Quality Standards for Willard Spur

Summary of Science Panel Presentations

Compiled from all Investigator's Presentations 1/28/13

January 29, 2013

Willard Spur Science Panel

Meeting Objective

- **Science Panel focused upon:**
  1. Have we answered the questions we posed?
  2. Do we have an adequate understanding of the system to make a recommendation?
  3. What do we need to do to make a recommendation?

Monday's Agenda

- **Heard updates on:**
  1. Hydrology & Nutrient loading (CH2M HILL)
  2. Water chemistry (Jeff Ostermiller, Toby Hooker, Mike Shupryt)
  3. Macroinvertebrates (Dr. Larry Gray)
  4. Nutrient cycling Study (Dr. William Johnson, Dr. Heidi Hoven, Dr. Ramesh Goel, Dr. David Richards, Dr. Sam Rushforth, Sarah Jane Rushforth, Joel Pierson, Ramin Nasrabadi, Mitch Hogsett, Sarah Kissell)

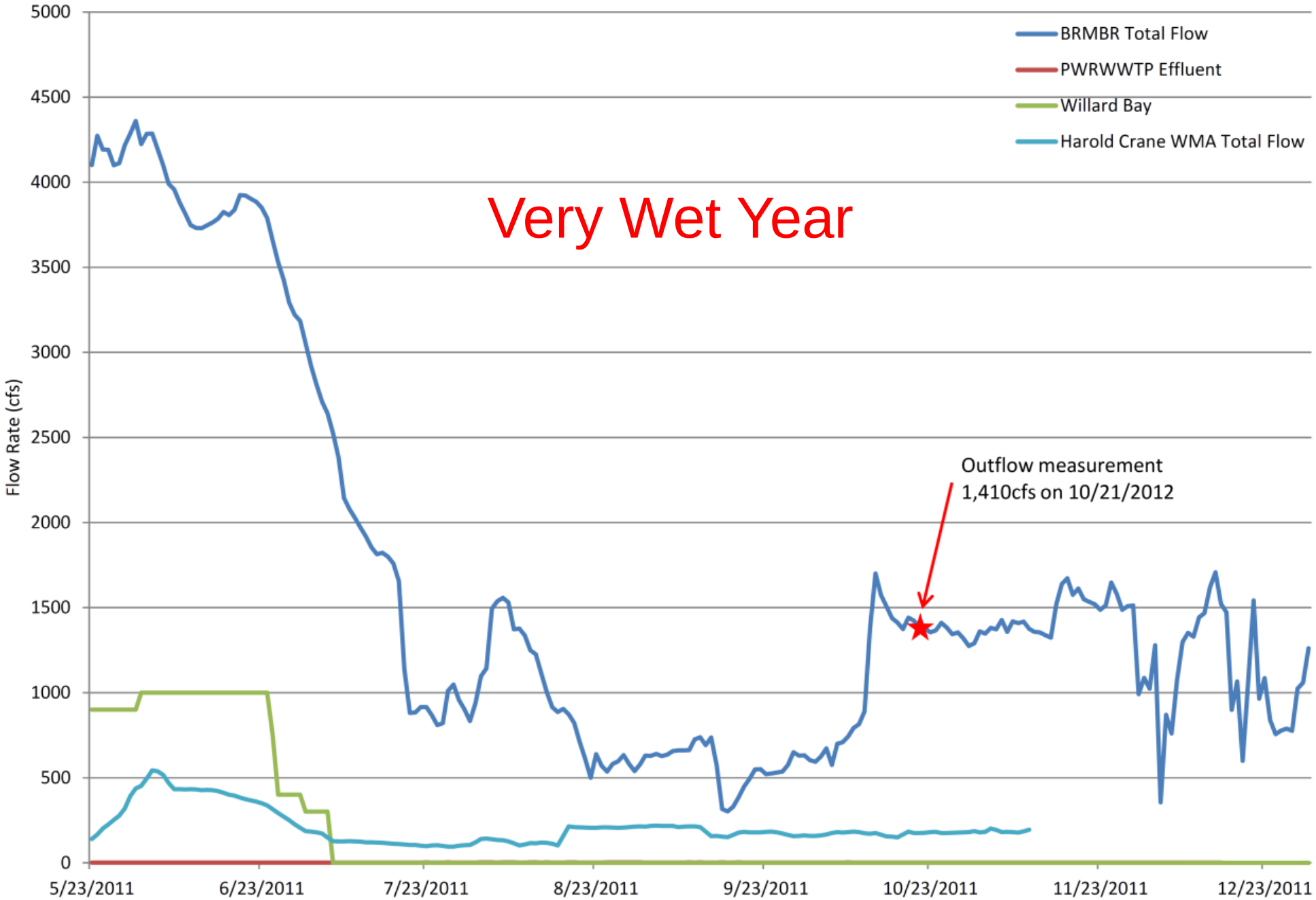
Tuesday's Agenda

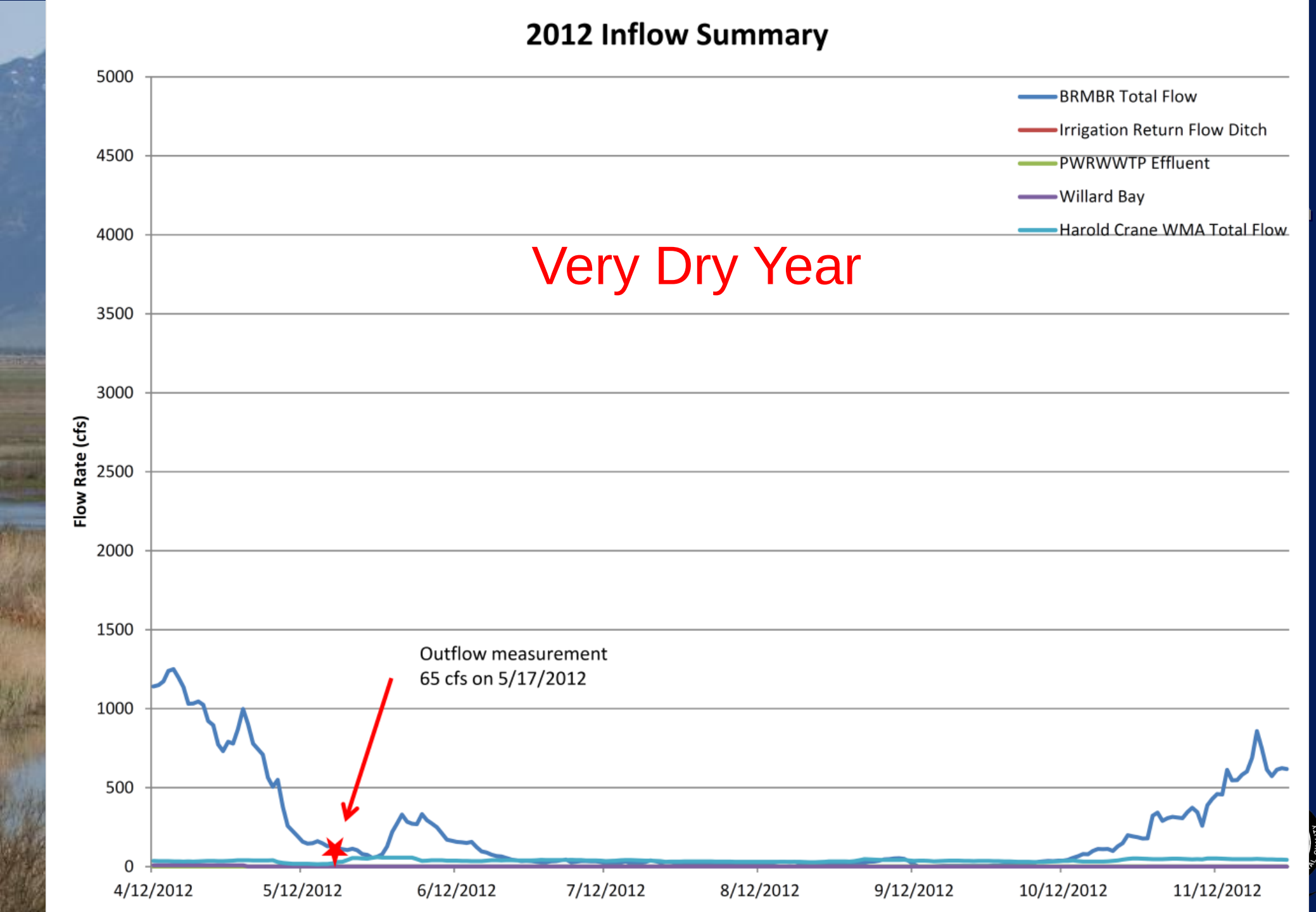
- **Focused upon:**
  1. Defining objectives and framework for nutrient cycling study
  2. Reviewing and narrowing down the "wish list"

Hydrology

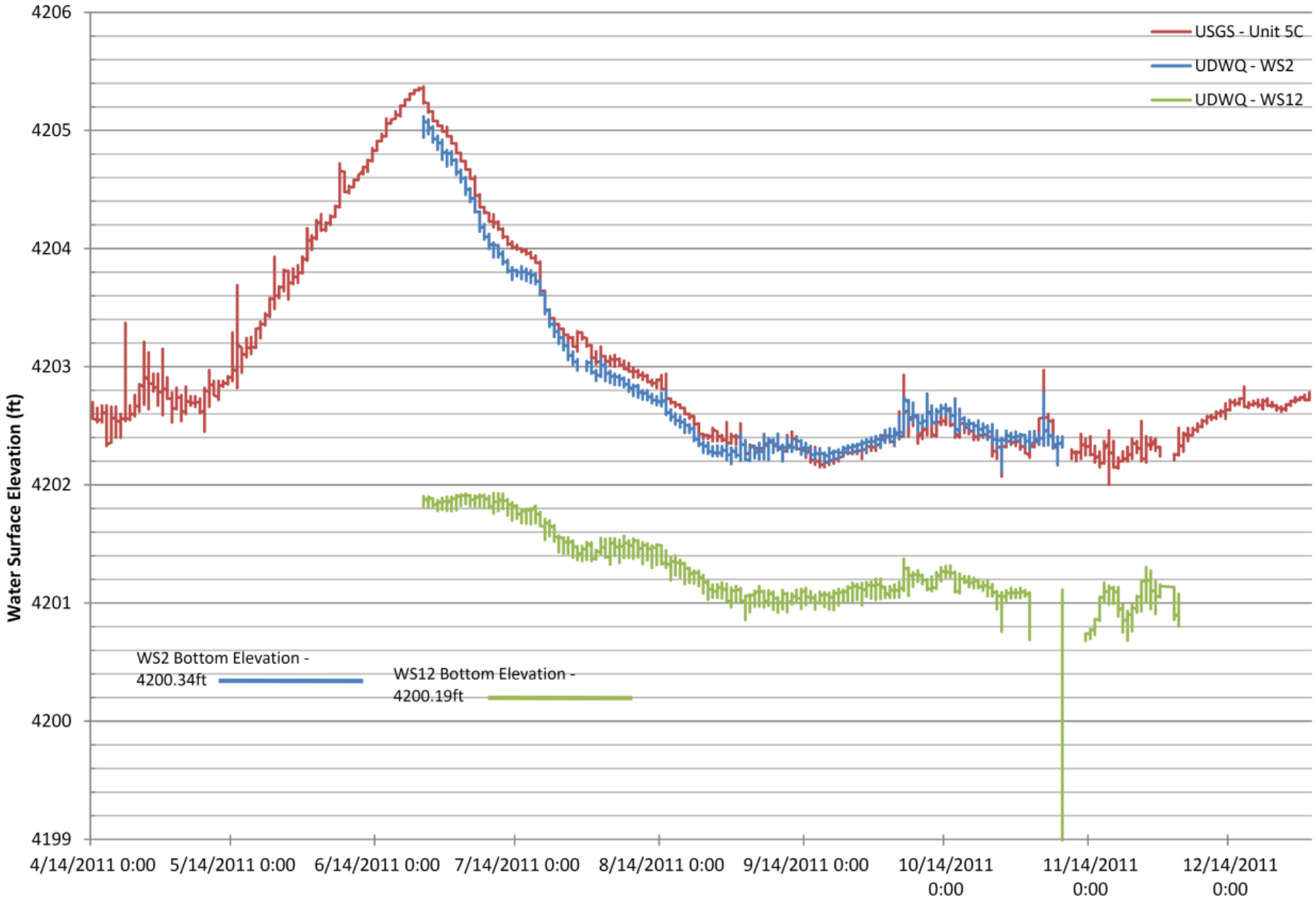
- **What are the hydrologic characteristics of Willard Spur?**
  - Inflows & Outflows
    - *Outflows measured twice – reflected inflows very well*
    - *Outflows governed by inflows, “natural weir”, and GSL water level*
    - *“Natural weir” appears to be at 4201.8ft*
  - Water levels
- **Does the Plant flow reach WS?**

2011 Inflow Summary

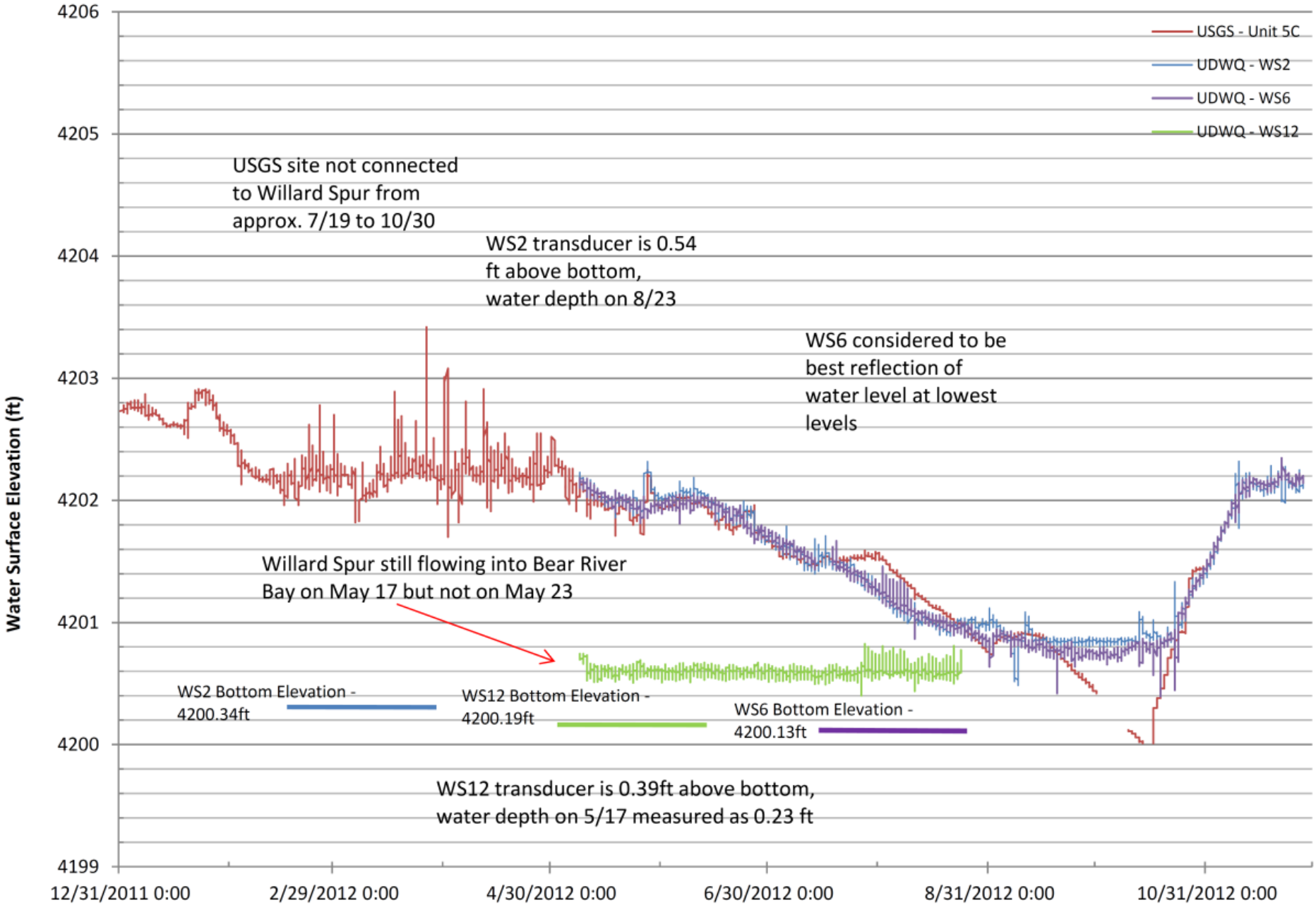



2012 Inflow Summary
Very Dry Year
Outflow measurement
65 cfs on 5/17/2012
Flow Rate (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4/12/2012
5/12/2012
6/12/2012
7/12/2012
8/12/2012
9/12/2012
10/12/2012
11/12/2012
BRMBR Total Flow
Irrigation Return Flow Ditch
PWRWWTP Effluent
Willard Bay
Harold Crane WMA Total Flow

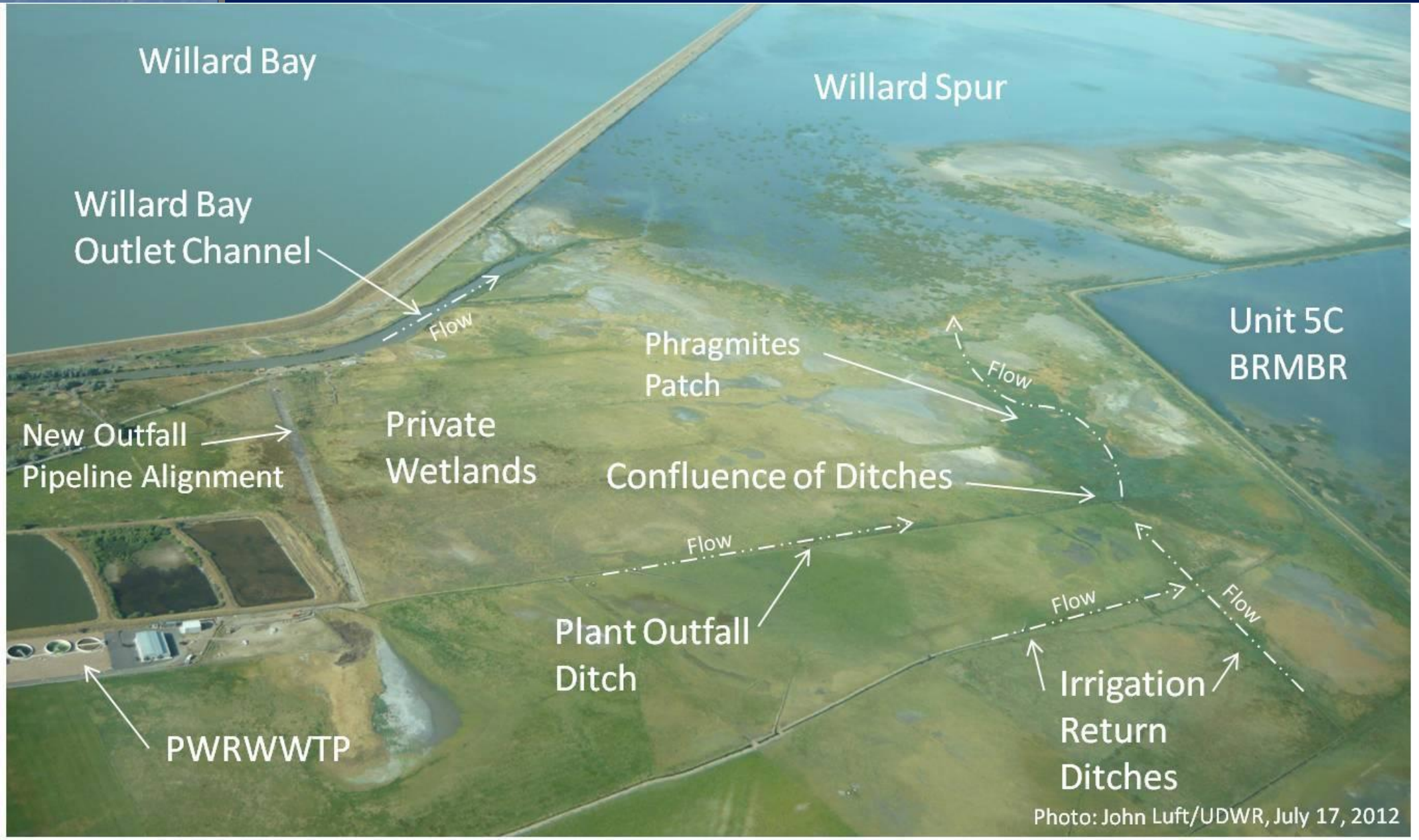
2011 Willard Spur Water Levels



2012 Willard Spur Water Levels



When does the Plant's flow reach Willard Spur?



Nutrient Loading

- **What are the sources of nutrients entering Willard Spur and what is the relative significance of these sources?**
  - Note: these pie and bar charts all assume that the full nutrient load from the Plant reaches the open water of Willard Spur. There is indication that there is uptake in the ditch/wetlands upstream of the open water as well as the effluent possibly evaporating prior to reaching Willard Spur. Thus, these comparisons of load contribution should be considered to be conservative and likely over-estimate the contribution of the Plant at this point. Work in 2013 will verify the nutrient uptake and evaporation questions and allow refinement of loads.
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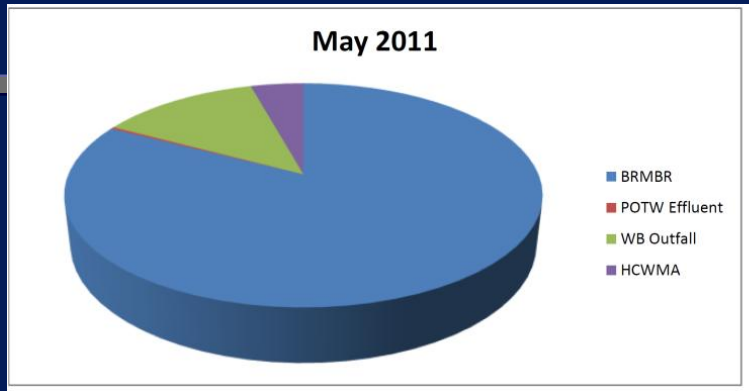
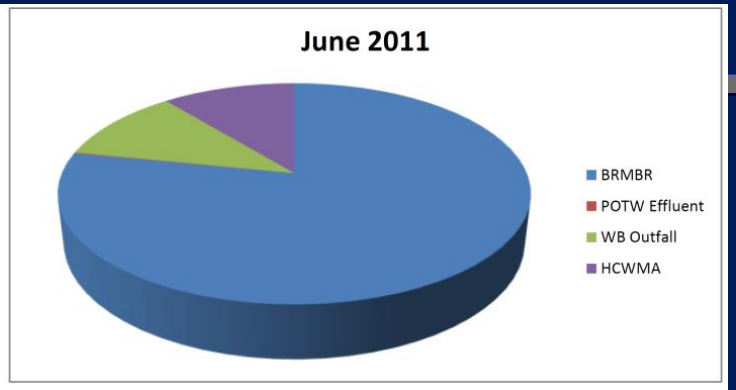
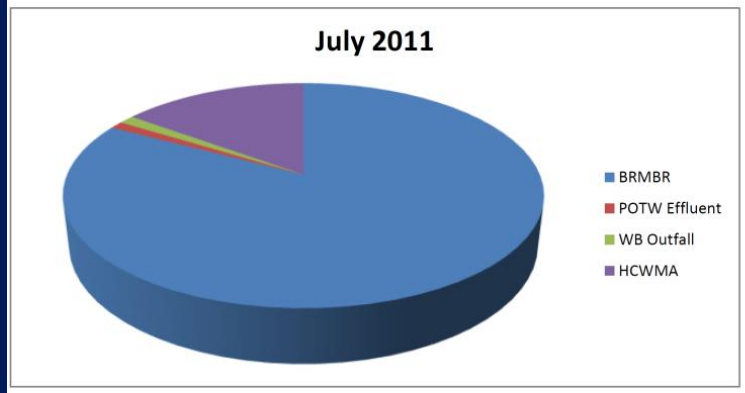
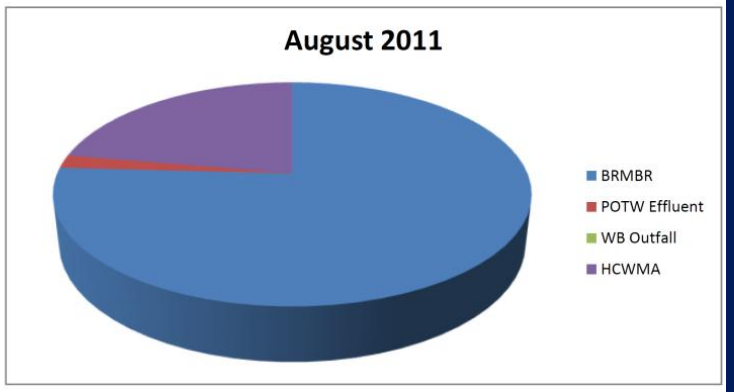
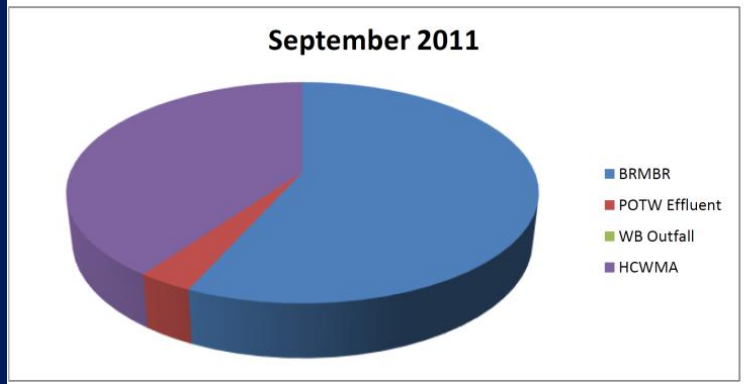
Total Nitrogen Loading - 2011

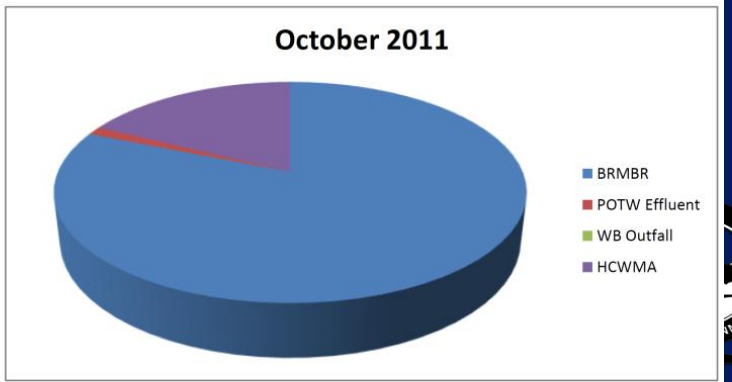




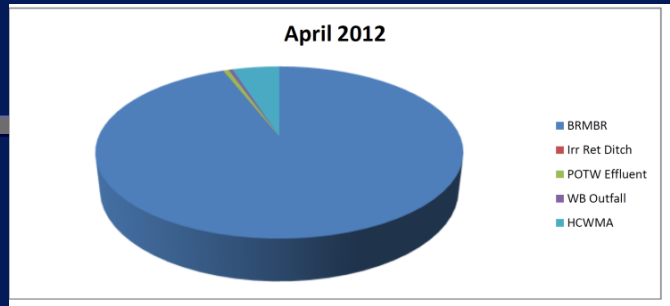


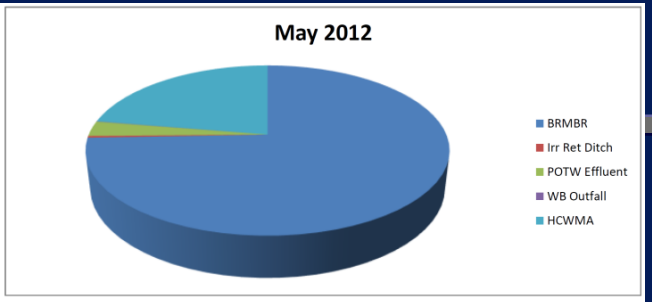


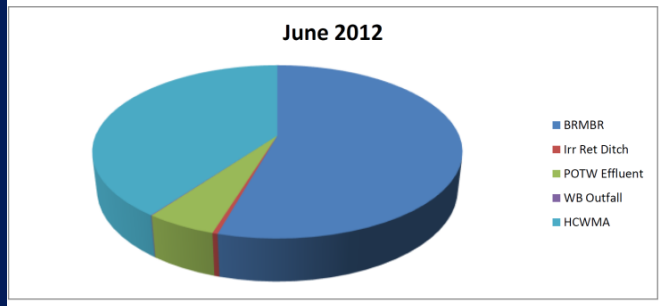


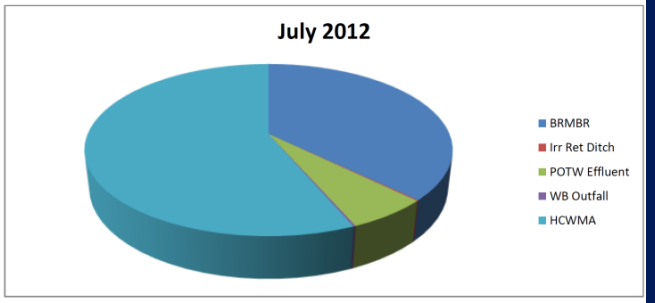


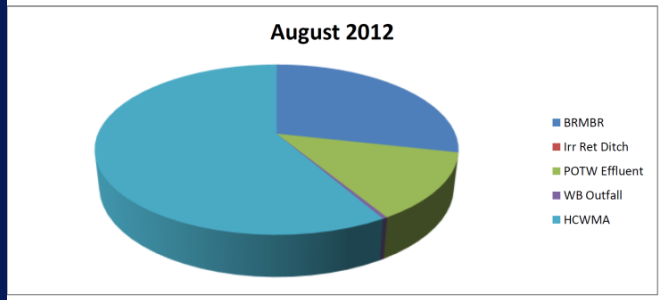
Total Nitrogen Loading - 2012

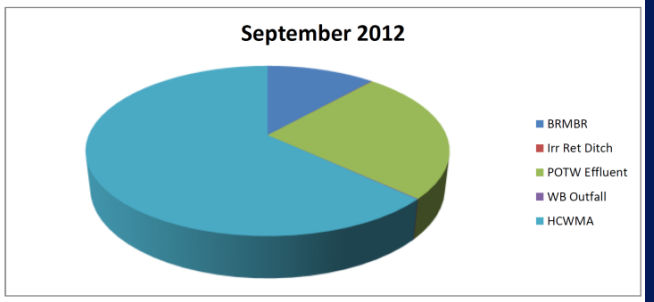


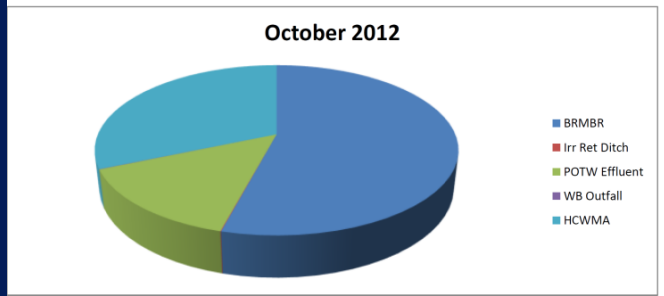


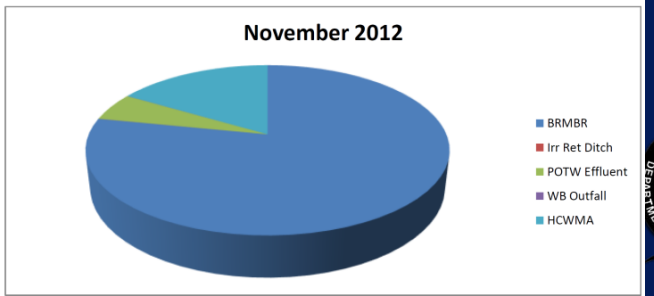






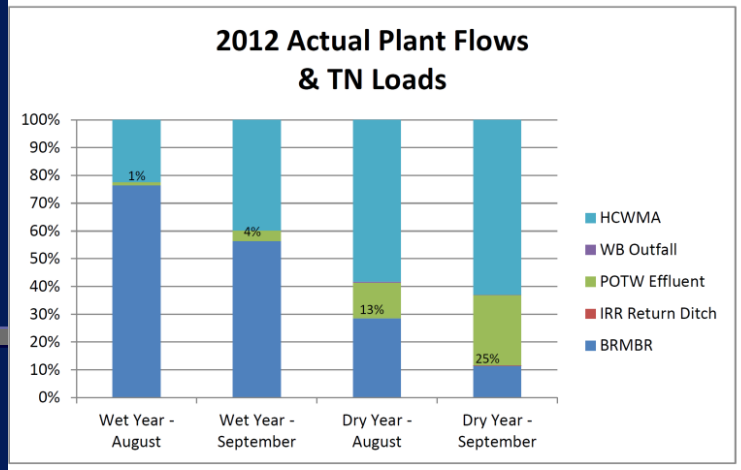


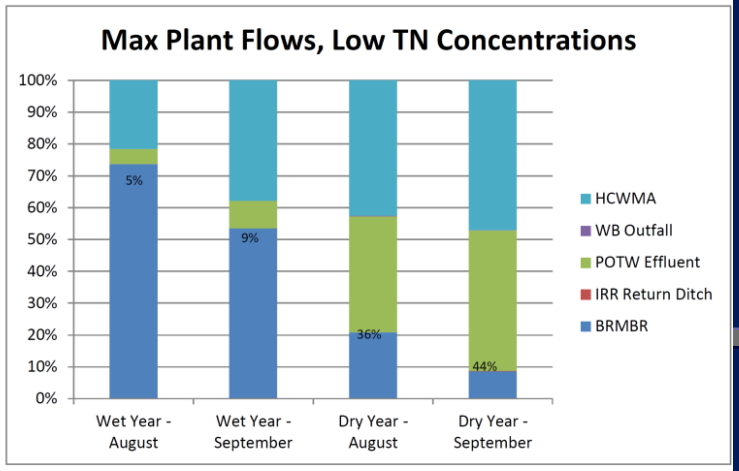


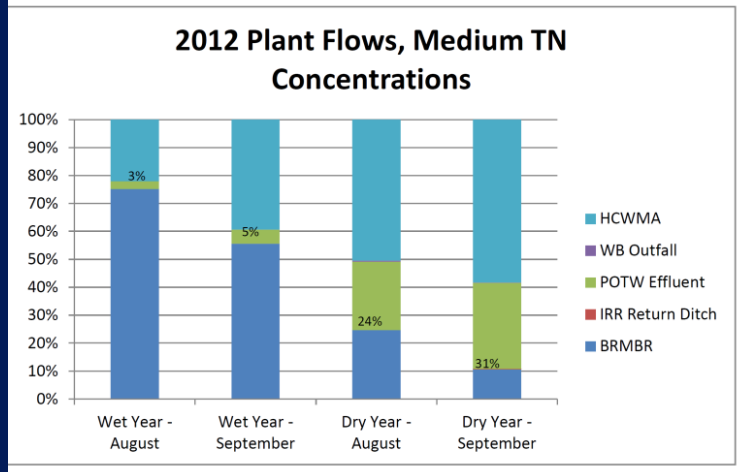


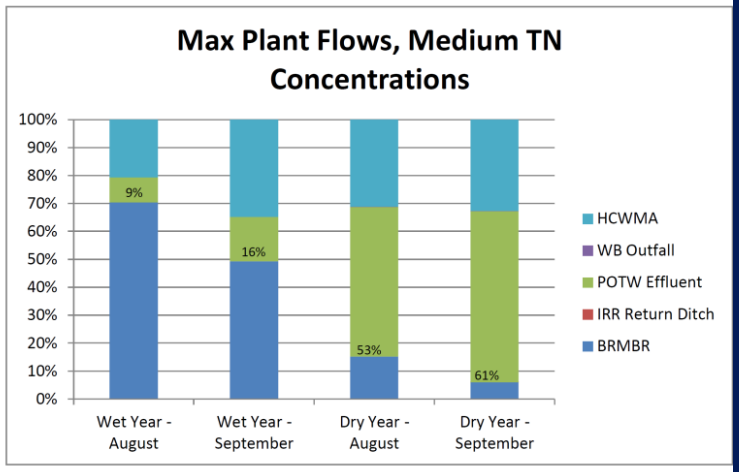
Nutrient Loading

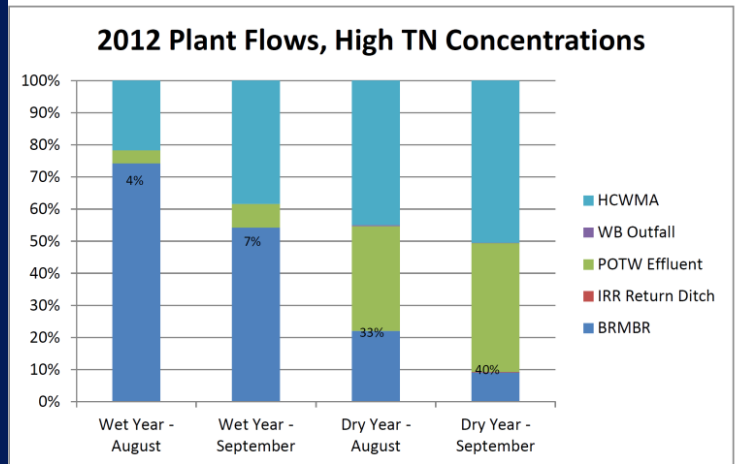
- **What are the nutrient loads in the effluent with and without nutrient removal process at the Plant?**

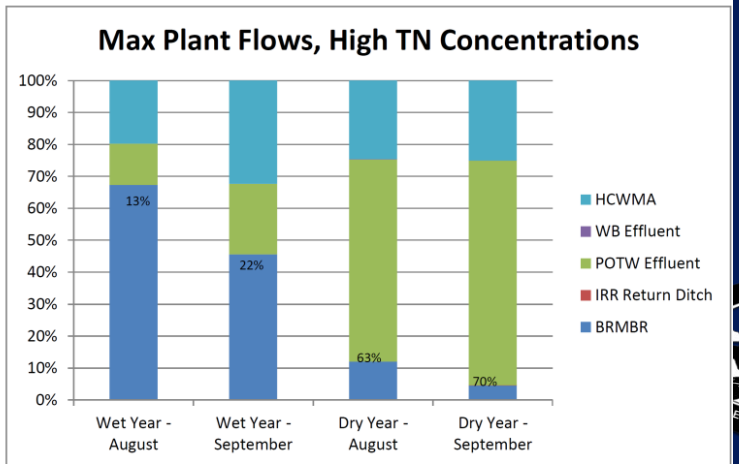

2012 Actual Plant Flows & TN Loads
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1%
4%
13%
25%
Wet Year - August
Wet Year - September
Dry Year - August
Dry Year - September
HCWMA
WB Outfall
POTW Effluent
IRR Return Ditch
BRMBR


Max Plant Flows, Low TN Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
5%
9%
36%
44%
Wet Year - August
Wet Year - September
Dry Year - August
Dry Year - September
HCWMA
WB Outfall
POTW Effluent
IRR Return Ditch
BRMBR


2012 Plant Flows, Medium TN Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
3%
5%
24%
31%
Wet Year - August
Wet Year - September
Dry Year - August
Dry Year - September
HCWMA
WB Outfall
POTW Effluent
IRR Return Ditch
BRMBR


Max Plant Flows, Medium TN Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9%
16%
53%
61%
Wet Year - August
Wet Year - September
Dry Year - August
Dry Year - September
HCWMA
WB Outfall
POTW Effluent
IRR Return Ditch
BRMBR


2012 Plant Flows, High TN Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
4%
7%
33%
40%
Wet Year - August
Wet Year - September
Dry Year - August
Dry Year - September
HCWMA
WB Outfall
POTW Effluent
IRR Return Ditch
BRMBR


Max Plant Flows, High TN Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
13%
22%
63%
70%
Wet Year - August
Wet Year - September
Dry Year - August
Dry Year - September
HCWMA
WB Effluent
POTW Effluent
IRR Return Ditch
BRMBR

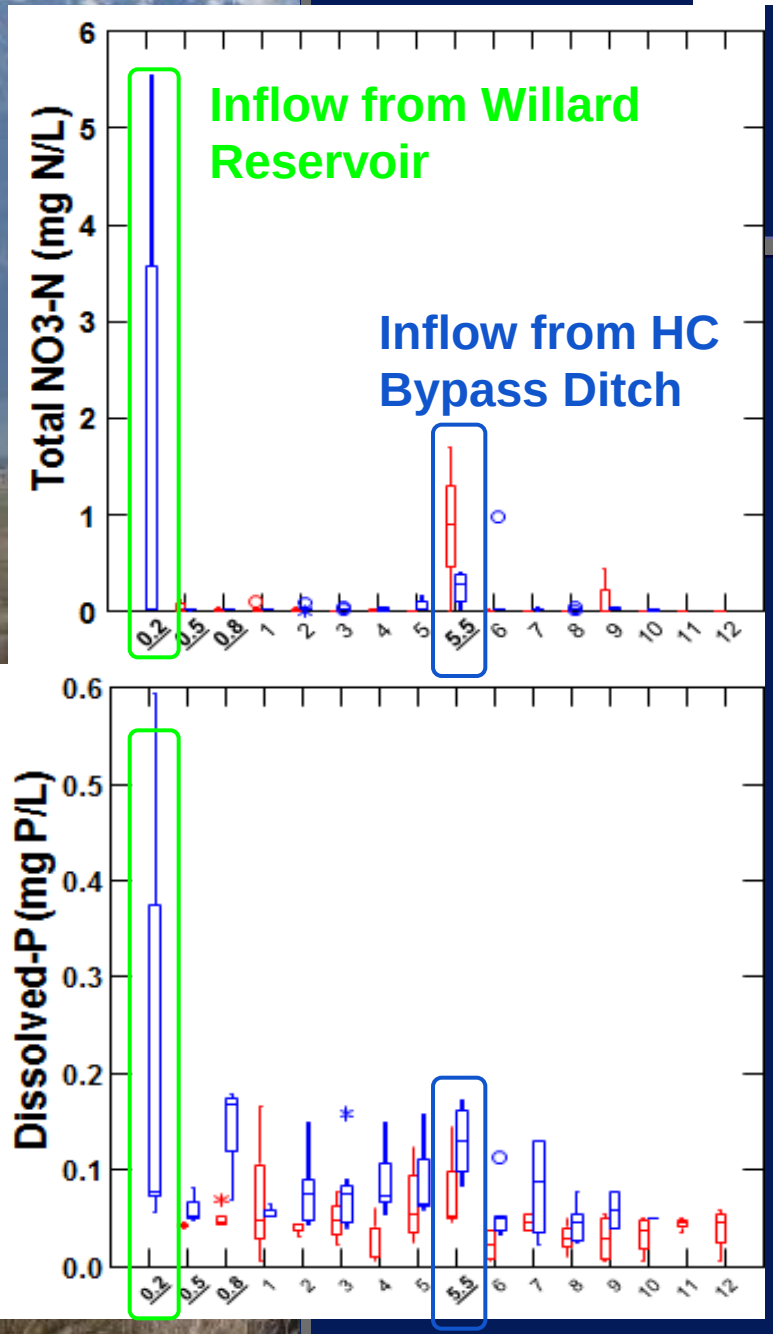
Nutrient Loading

- **Does the Plant's load have an impact on Willard Spur?**
- **On an annual basis it does not appear to have a significant impact.**
- **It may have an impact if:**
  - Full load reaches open water during critical months during critical hydrologic years

Water Chemistry

- **We saw higher salinity and water temperature in 2012 vs 2011**
- **We saw the organic nutrient pool in Willard Spur increase during the year in 2012**
- **We saw inorganic nutrients only significant near inflow sites; but dissipated quickly**
  - Nutrients appear to be assimilated quickly

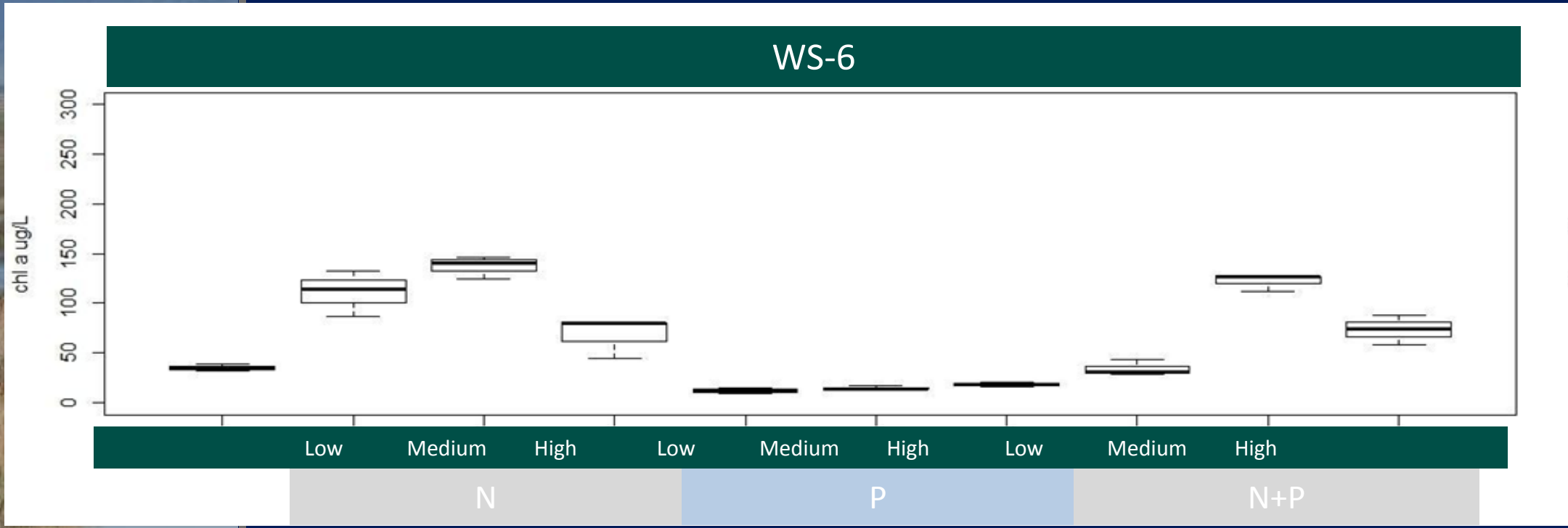
3. Water Column Dissolved Nutrient Pools



- Inorganic N and P pools are generally low
  - Except for sites near inflows

- Given the seasonal increases in TN and TP, this suggests that:
  - Inorganic nutrient cycling is tight (ie that available nutrients are rapidly taken up)
  - ***Nutrient fluxes from inflows are rapidly assimilated within the Open Water sites***

Pelagic Nutrient Limitation



Biological Response

- We saw a much higher biological response in 2012
- Higher increase in chl-a
- Decline in SAV was sooner and coincided with the chl-a and organic nutrients
- Indicates that internal nutrient cycling is very important

Does the plant represent a threat to the Spur?

Probably not, at least immediately…

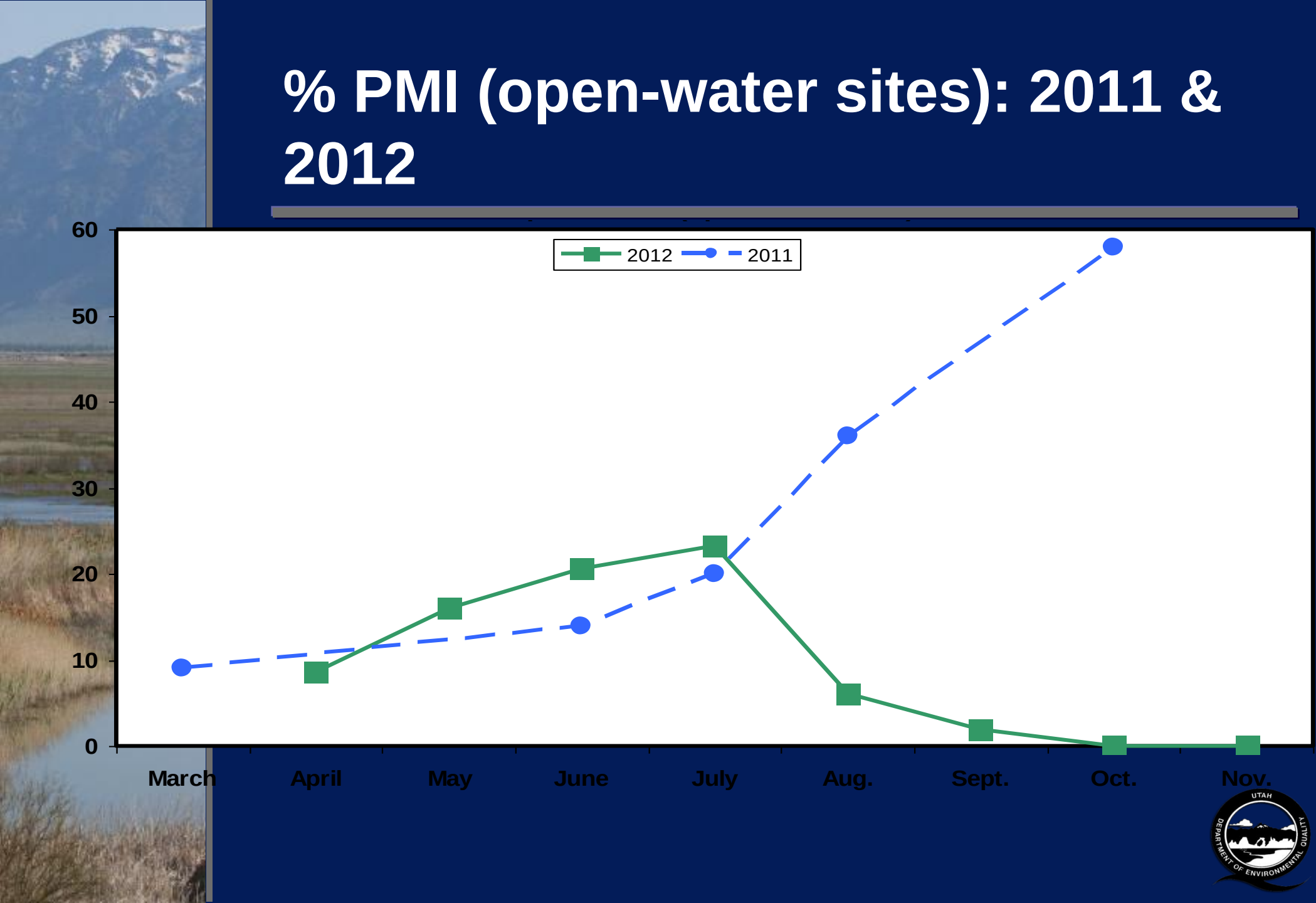
- Any effects—positive or negative—are small and local
  - Importance of local cycling vs. all external inputs
  - Size of discharge small relative to other sources
- Ecological resilience
- Any deleterious effects are likely to be local
  - i.e., rapid uptake of nutrients
- Yearly flushing flows probably decreases accumulation through time
- N-limitation thresholds suggest that were at ~50% assimilative capacity

- but more work needed

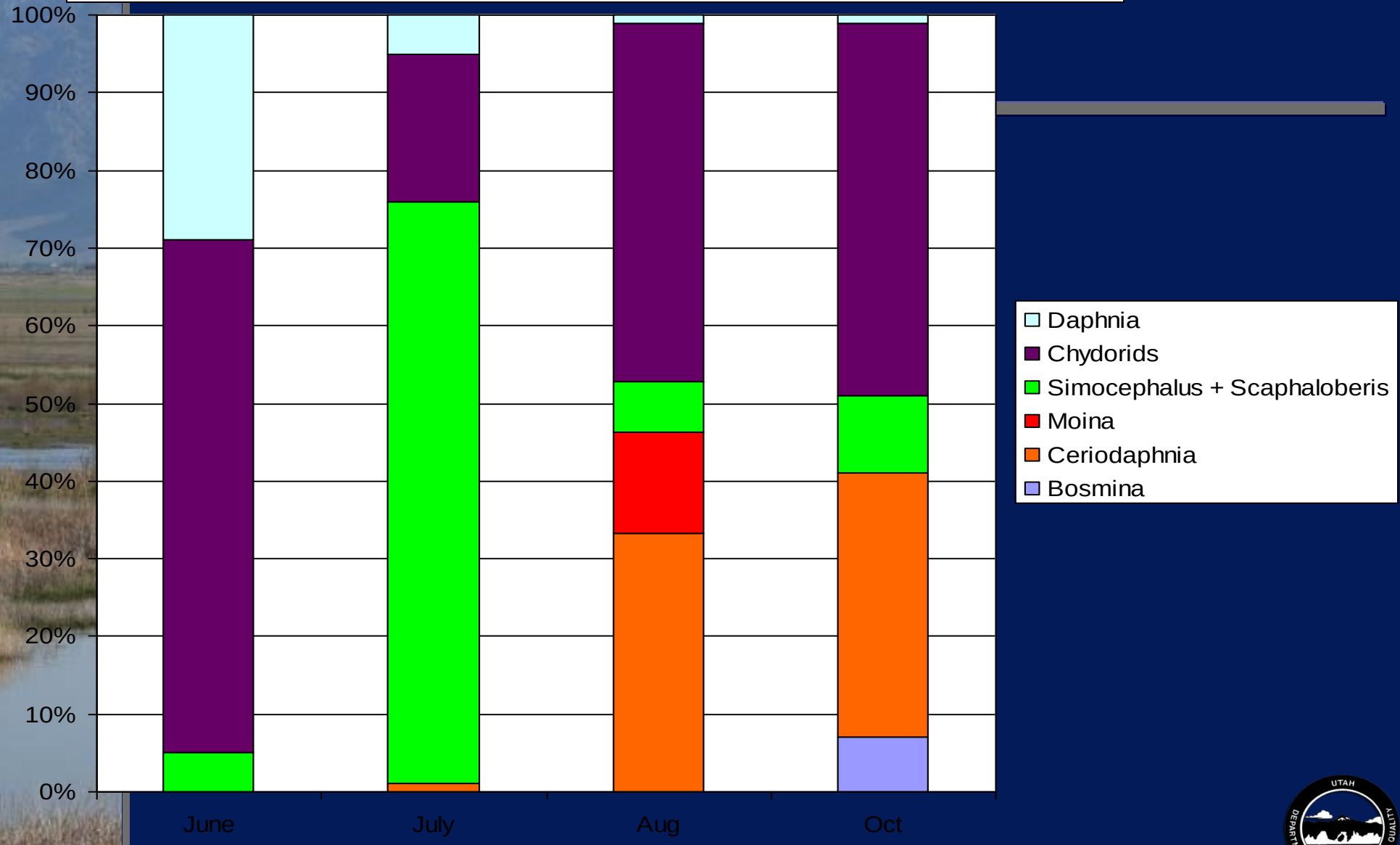
Macroinvertebrates

- Patterns we saw in 2012 reflect other observations in Willard Spur
- Reflect decline of SAV very well

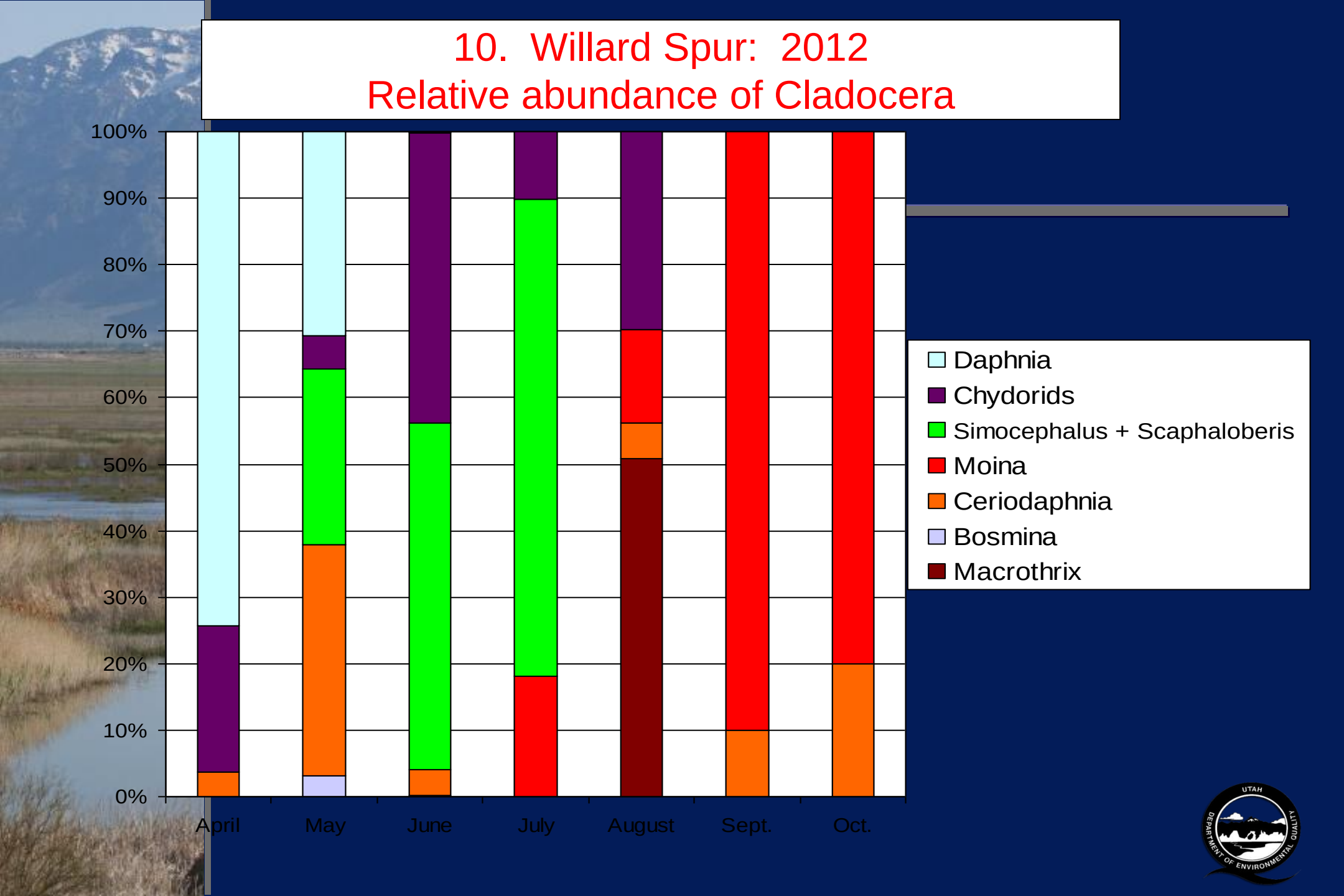
% PMI (open-water sites): 2011 & 2012



9. Willard Spur: 2011
Relative abundance of Cladocera



10. Willard Spur: 2012
Relative abundance of Cladocera



Fish, Birds & Vegetation

- Draft reports are complete and being reviewed by Science Panel
- Fish studies/review complete
- Still finishing review of historical bird survey data
- Vegetation work is largely complete

Nutrient Cycling Study

- We were able to discern the effect of nutrient amendments within the test plots
- We saw that nutrients in water column are rapidly “consumed”
- We see that SAV derive much of their nutrients from the sediment
- We saw many of the same patterns we saw throughout Willard Spur

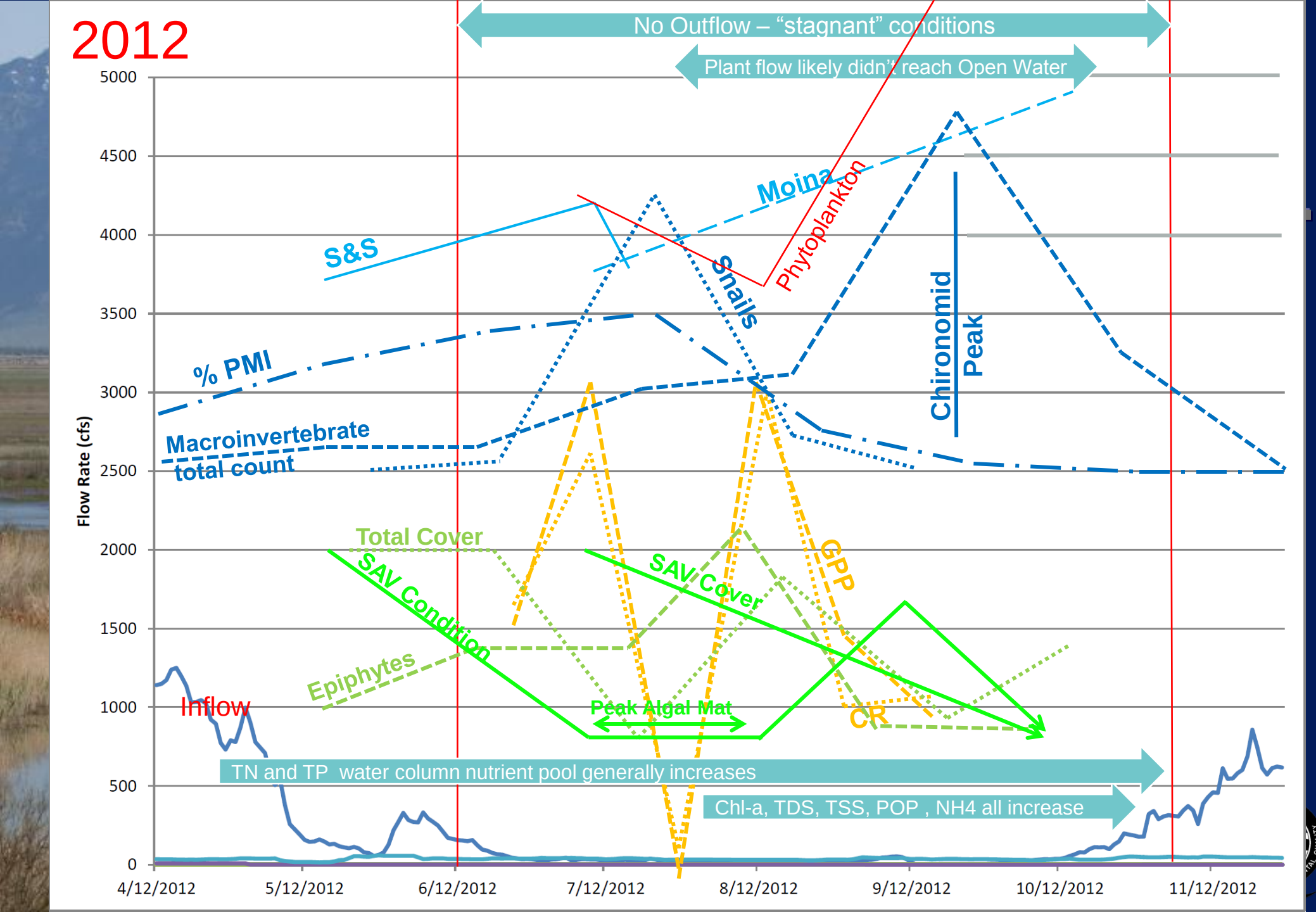
Nutrient Cycling Study

- We saw that a critical period of response is April-May during a dry year
- We identified a number of key indicators in SAV that we want to follow in 2013

How it fits together

- Best means of explaining all of the patterns is to see it
- Bottom line – observations fit together remarkably well

- Note that vertical scale on following slide is only relevant within the particular level you are looking at. Purpose of slide is to show how the system's responses are interrelated


2012
No Outflow – "stagnant" conditions
Plant flow likely didn't reach Open Water
Flow Rate (cfs)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4/12/2012
5/12/2012
6/12/2012
7/12/2012
8/12/2012
9/12/2012
10/12/2012
11/12/2012
S&S
Moina
Phytoplankton
Snails
Chironomid Peak
% PMI
Macroinvertebrate total count
Total Cover
SAV Condition
SAV Cover
GPP
Epiphytes
Inflow
Peak Algal Mat
CR
TN and TP water column nutrient pool generally increases
Chl-a, TDS, TSS, POP , NH4 all increase