Development of Water Quality Standards for Willard Spur

Summary of Science Panel Presentations

Compiled from all Investigator's Presentations 1/29/13

January 30, 2014

Willard Spur Science Panel

Yesterday's Objectives

- **Understand the significance of nutrient cycling processes in Willard Spur:**
  1. How do we define the nutrient cycle?
  2. What factors most influence nutrient cycling and uptake?
  3. How do we define a "natural" response in Willard Spur?
  4. Will added nutrients change this?

Today's Objectives

- Discuss potential impacts from the Plant
- Identify potential recommendations for protecting Willard Spur

→ Agree on our path forward

UofU Nutrient Cycling Study

- **General Observed Cycle for Dry Years**
  - April – SAV starting
  - May – SAV dominate
  - May-June – Algae/BDS begin to grow
  - June-July – SAV senesce
  - July – Sept - phytoplankton

SAV uptake

SAV release

Water phases coincide with nutrient cycle

See UofU presentations, January 29, 2014

UofU Nutrient Cycling Study

- **Key treatment effects observed in**
  - % forageable SAV
  - Branch density
  - % cover algae on SAV
- **Key factors for changes**
  - Spring inflows set the clock
  - Available nutrients, turbidity, dissolved organic material
  - pH/HCO3 – may be stressing SAV
  - Impounded/stagnant conditions

Nutrient Cycling Study

- **Tissues indicate N-limitation in SAV and co-limitation in algae**
- **Negative effects observed with treatments**
  - Premature SAV die-off
    - *Alkalinity? Reduction in available nutrients? Algae/BDS?*
  - Algae and BDS on SAV
    - *Available nutrients? Lack of top-down control?*

Nutrient Cycling Study

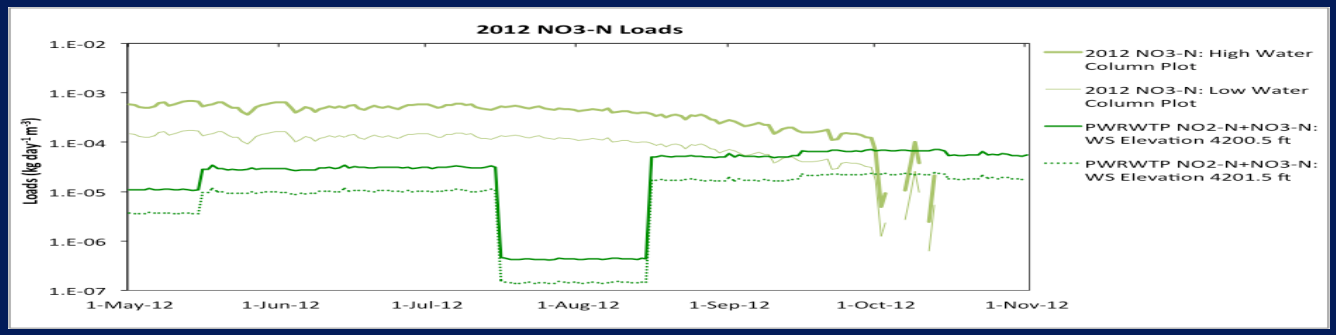
- **Identified 5 possible bioindicators from data**
  - Branch density
  - % total SAV
  - % BDS on SAV
  - % algae on SAV
  - DWQ condition index

Key thresholds focused on:

- Alkalinity
- TDS
- TP
- TN

UofU Uptake Studies

- **Joel Pierson completed experiments to relate test plot “loads” to Plant loads**
- **Confirmed methods and that target levels were appropriate**
  - Higher than potential loads to Willard Spur



UofU Uptake Studies

- Analysis of data/experimentation is ongoing
- Targeting only water column and sediment uptake
- Discovered a release of ammonia at night
- Is biota taking up nutrients than denitrification?

DWQ Uptake Studies

- Monitoring data show that nutrients are rapidly assimilated
- Experiments confirm most likely N-limited
- Using metabolism to estimate primary production/respiration and link uptake rates to the ecosystem
- More to come….

See DWQ presentation, January 29, 2014

DWQ Uptake Studies

- **Completed experiments in June, August, & September**

Determine Uptake Rates

Uptake Studies

- **June findings**
  - Uptake with SAV was generally 3X faster than without SAV
  - Uptake of NO_3 was 5 X faster than for PO_4

Significant assimilative capacity when SAV dominate

Uptake Studies

- **August findings – day time**
  - NO3 Uptake rate “with SAV” was similar to June, but “no SAV” similar to “with SAV’
  - NO3 uptake rates similar to PO4
- **August findings – night time**
  - NO3 uptake rates much higher during night for no SAV, SAV rates were comparable to day time
  - PO4 uptake rates comparable to day time

DWQ Uptake Studies

- NO3 uptake faster in June vs August “with SAV” and “no SAV”
- PO4 uptake faster in August vs June
- PO4 rates didn’t change much with SAV

DWQ Uptake Studies

- **External loading is highest in the spring**
  - But export and uptake are highest
  - Assimilative capacity is highest in spring
- **Summertime internal loading is most important**
- **Risk in Willard Spur is highest when water is impounded & internal loading is highest**

Discussion points

- **Extremely dynamic conditions - unique**
  - Driven in response to hydrology
  - Significant/important link to upstream watershed
- **Nutrients do not appear to be accumulating in this system**
  - Export via winter/spring flushing flows
  - Oxidation due to drying of sediments

Discussion points

- **Resilient ecosystem**
  - "Rebounds" from extreme events
  - Diversity of habitat, plants, processes, and dynamics are unique and critical to Willard Spur
  - Located downstream of an important wetland area with source populations that likely contribute to resiliency
  - "Stabilization" of extremes may reduce diversity/complexity that supports resiliency

Discussion Points

- **Nutrient responses are unique in Willard Spur**
  - Constrained by hydrologic conditions/extremes
  - Impounded condition results in key factors
    - *Conductance/temperature*
    - *Longer low-DO*
    - *Higher ammonia levels*
    - *Higher pH/HCO3*
    - *Reduction in external nutrient load followed by increase in internal nutrient cycling*

Discussion points

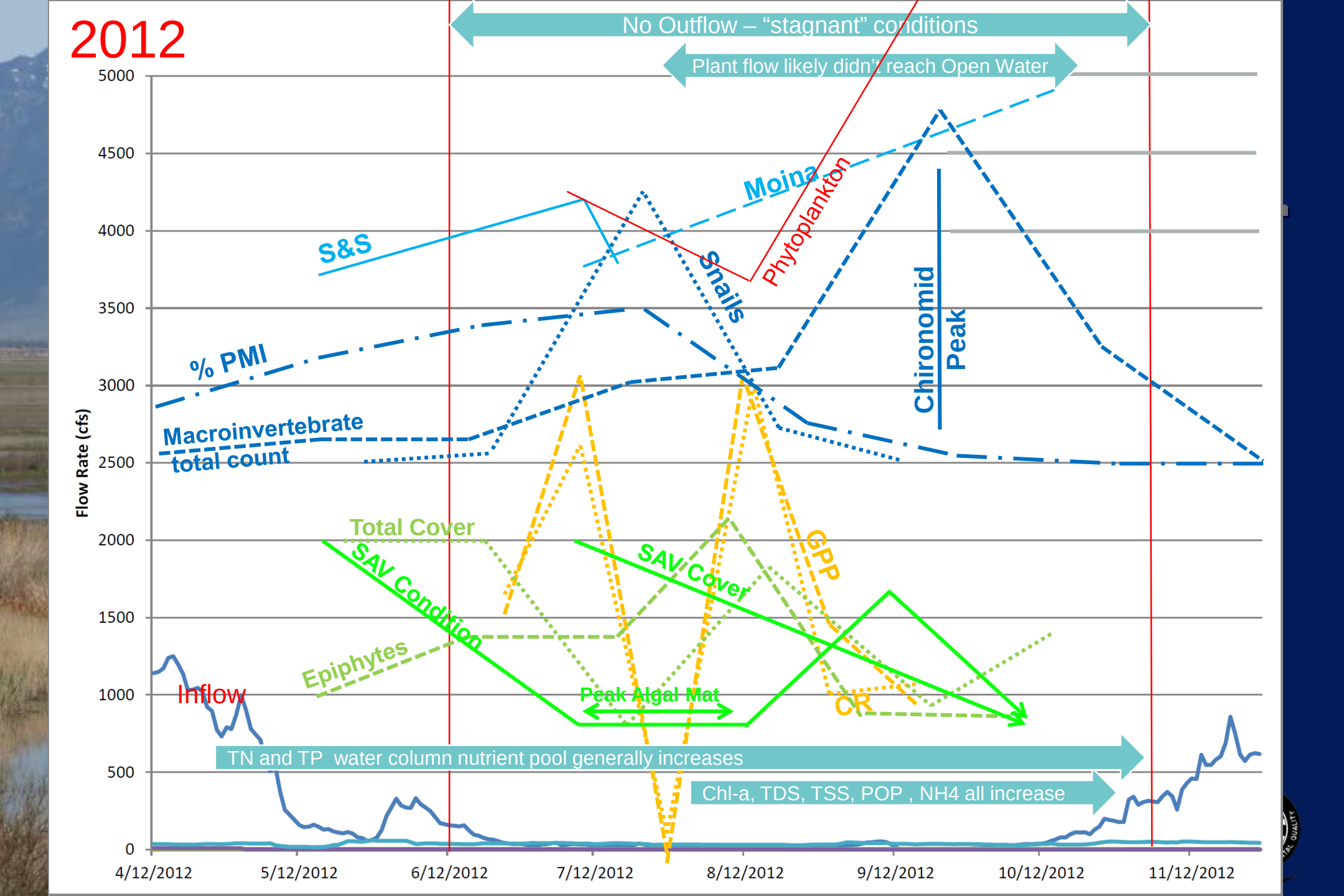
- **Willard Spur shows signs of nutrient limitation**
  - Lack of nutrient accumulation in sediments
  - Size of diatoms
  - Response of SAV

Flow through/flushing flows is a key to resetting the clock every year by preventing accumulation of nutrients

Does the plant represent a threat to the Spur?

Probably not…

- Effluent doesn't appear to reach open water during critical periods in Willard Spur
- Substantial uptake of nutrients between Plant and confluence with Willard Spur – load is reduced
- 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
- Any deleterious effects are likely to be local
  - i.e., rapid uptake of nutrients
- Benefit of water could outweigh nutrient impacts if water is lacking in Willard Spur


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
Peak Algal Mat
CR
Inflow
TN and TP water column nutrient pool generally increases
Chl-a, TDS, TSS, POP , NH4 all increase