Meeting Summary

WILLARD SPUR SCIENCE PANEL MEETING

This Science Panel meeting was held over a period of two days on January 28-29, 2013 at the UDEQ building at 195 North 1950 West, Salt Lake City, Utah. The following represents a summary of discussion on the first day, January 28. It is not intended to represent meeting minutes. An audio recording of the meetings may be found at http://www.willardspur.utah.gov/panel/meetings.htm.

JANUARY 28, 2013

NAME/AFFILIATION

Jim Hagy*	U.S. EPA, Office of Research & Development
John Luft*	Utah Division of Wildlife Resources
Theron Miller*	Farmington Bay/Jordan River Water Quality Council
Jeff Ostermiller*	Utah Division of Water Quality
Suzan Tahir	Utah Division of Water Quality
Toby Hooker	Utah Division of Water Quality
Jodi Gardberg	Utah Division of Water Quality
Chris Bittner	Utah Division of Water Quality
Bill Johnson	University of Utah
Ramesh Goel	University of Utah
Mitch Hogsett	University of Utah
Joel Pierson	University of Utah
Susan Kissell	University of Utah
Heidi Hoven	Institute for Watershed Sciences
Sarah Jane Rushforth	Rushforth Phycology
Larry Gray**	Utah Valley University
David Richards**	EcoAnalysts ,Inc.
Jeff DenBleyker	CH2M HILL

* Indicates Science Panel member

** Attended by telephone

INTRODUCTION

Meeting attendees were introduced and Jeff DenBleyker reviewed the meeting's agenda for both days. The objective of the first day was to review results from the various studies and how they addressed program objectives. The objective of the second day was to review and discuss recommendations for further work from the investigators and make final recommendations for work to be completed in 2013. Discussion moved immediately into a review of results from 2011 and 2012.

HYDROLOGY & NUTRIENT LOADS

See presentation slides at: http://www.willardspur.utah.gov/documents/SP01-2829-13/Hydrology_Loads.pdf

Jeff DenBleyker provided an overview of the two key questions to be addressed by the hydrologic studies:

1. What are the hydrologic characteristics of Willard Spur?
2. Does effluent from the Perry Willard Regional Wastewater Treatment Plant (Plant) reach the open waters of Willard Spur?

The work completed needs to address these questions as well as provide the information required by the linkages defined in the Research Plan.

Jeff summarized the inflow characteristics of 2011 and 2012 highlighting that the two years were remarkably different in terms of inflows, outflows, and water levels. 2011 inflows were significantly higher than in 2012. Water levels in turn also reflected this pattern. An attempt was made to measure outflows from and estimate water volumes within Willard Spur. Next steps will be to estimate water volumes and outflows for various water levels measured within Willard Spur. This will then be used to estimate nutrient loads leaving Willard Spur. The Science Panel indicated that understanding the nutrient load that is exported is critical to understanding how new inputs could impact Willard Spur. Jeff summarized the various discharge locations used by the Plant during 2012 and the observation that the Plant's effluent may have evaporated and not reached the open waters of Willard Spur during the period of mid-July to mid-October, 2012. If the effluent did not reach the open water then the Plant's nutrient load did not influence the conditions that were observed within the open water during this period.

Jeff then summarized the methods used to answer the question: what are the sources of nutrients entering Willard Spur and what is the relative significance of these sources? Nutrient loads were estimated for all inflow sources for both 2011 and 2012 assuming that the load measured for the source reached the open waters of Willard Spur. In light of the discussion summarized above, this estimate of nutrient load is likely conservative, i.e., the estimates are higher than what may actually have occurred if evaporation played a significant factor in the inflow that reached the open waters. The Science Panel agreed that a key goal will be to estimate the actual nutrient load from the Plant that reaches Willard Spur. A second key question that was to be answered was: what are the nutrient loads in the effluent with and without nutrient removal processes at the Plant? Jeff summarized methods and assumptions used to estimate these loads; noting that the plots that were shown assume all of the Plant's nutrient load reaches the open waters of Willard Spur.

The Science Panel agreed that in general the Plant's discharge and nutrient load could be quite trivial given the effluent may not always reach the open waters of Willard Spur, there may be significant uptake of the effluent's nutrients before the effluent reaches the open water, nutrient loads from other sources greatly surpass the Plant's input, and Willard Spur appears to be processing the overall nutrient load with minimal impacts. The only caveat is that if the effluent does reach the open water of Willard Spur with no uptake of nutrients between the Plant and open water the Plant's nutrient load could be important during critical months (July – September) during very dry years (e.g., 2012). The Science Panel agreed that further work to understand nutrient uptake and evaporation rates of the effluent prior to reaching the open water is important to resolve the potential impact of the Plant.

Water Chemistry

See presentation slides at: http://www.willardspur.utah.gov/documents/SP01-2829-13/WaterChemistry.pdf

Jeff Ostermiller provided a summary of the experiments and analytical results from work completed by DWQ in Willard Spur in 2011 – 2012. The stated goal of much of this work was to understand the biogeochemical patterns and processes occurring within the open waters of Willard Spur. How is Willard Spur cycling nutrients and how might those processes and the environment change with different nutrient loads?

Jeff reviewed and compared analytical results between 2011 and 2012. In general total dissolved solids (TDS) concentrations were fairly consistent in 2011 but increased throughout 2012. TDS levels actually bordered on estuarine conditions in 2012. Water temperatures were generally higher in 2012 than in 2011. These observations are possibly as a result of less inflow, no outflow, and shallower water depths in 2012. It was noted that these changes could have an impact on nutrient cycling and submerged aquatic vegetation (SAV). Total suspended solids (TSS) concentrations were higher in 2012 vs. 2011, highest in late summer of 2012, and generally higher in eastern sites than western sites. As expected in a wetland environment, total volatile solids (TVS) concentrations indicate that more of the TSS is likely organic as you go downstream, (i.e., east to west). There was an increase in chlorophyll-a, particulate organic phosphorus, and organic nitrogen in August through October in both years, although it was much more pronounced in 2012 and the increase in organic nitrogen began earlier than the others (in July vs August). Sarah Rushforth added that diatoms were observed to be dominant in September 2012; this explains increase in organic nitrogen but not chlorophyll-a. Diatoms do not seem to be linked to chlorophyll-a. Jeff said total nitrogen (TN) was generally higher but more variable in 2012 vs. 2011. TN began to increase in June/July of 2012 and total phosphorus (TP) began to increase in August 2012. Westernmost sites had the lowest TN and TP concentrations. TN and TP patterns seem to indicate internal cycling of nutrients. Both inorganic nitrogen and phosphorus were observed to be higher near inflow sites (e.g., Willard Bay outlet and Harold Crane Wildlife Management Area (HCWMA)) but it seems to be rapidly assimilated within the open water sites. Ammonia was similarly

high near inflow sits but also dissipates quickly. Organic nitrogen was significantly higher in 2012 vs. 2011. Jeff noted that anoxic conditions were observed in 2012, thus denitrification processes may have been impaired and nutrients were recycled within the system.

Jeff summarized pelagic nutrient limitations completed by DWQ during the "green water phase" in 2012. Jeff noted that these experiments reflected just a snapshot of conditions that could change month to month. Experiments showed that the pelagic zone was nitrogen limited at the time of the experiment, i.e., a response was observed with added nitrogen but not with added phosphorus. The benefit of this experiment is that it may help identify nutrient concentrations that trigger a response and thus are useful for long term monitoring. Theron Miller said he had reservations about focusing upon only the pelagic zone has it is only part of the picture. It was agreed that DWQ would continue the experiment in 2013 but with the addition of looking at the benthic zone, looking at temporal changes, and use different forms of N and P.

Jeff summarized biological responses. Chlorophyll-a responses were similar year to year but the peaks were much higher in 2012. SAV cover was consistently higher in 2011 vs. 2012 but SAV declined significantly in August 2012 vs August 2011. Generally SAV in 2012 declined earlier (July) and had less coverage than in 2011. The SAV did appear to begin to recover in September 2012 but dropped again in October. The Science Panel discussed how SAV cover is estimated and means of making these estimates when waters are turbid. There was discussion regarding the role percent cover may have in triggering overall senescence. There was also discussion about the role salinity, water depth, and water temperature may plan in stressing the SAV. Biogeochemical processes may speed up in such conditions. It was suggested that the data be re-evaluated by looking at degree days vs. calendar days. Anecdotally it appears that there was more algal mat coverage in 2011 vs. 2012. Heidi Hoven noted that she has not been able to correlate algal mats to SAV senescence.

Jeff summarized DWQ's evaluation of gross primary production (GPP) and community respiration (CR). Both GPP and CR dropped significantly in August coincident with SAV cover declining and chlorophyll-a increasing, i.e., we saw the open water shifting from an SAV to a phytoplankton system. Similarly we see that organic N and P seem to coincide with chlorophyll-a. Jeff said they will be looking at this evaluation more closely to try to isolate the source of the changes. All generally agreed that internal processing is very important and happening rapidly within the open water system.

Jeff concluded by highlighting the significant dynamics of the Willard Spur system and how the system's resiliency seems to allow it to bounce back. Our goal should be to prevent changes in the system that affects this resiliency. The Science Panel concluded the morning with an informal discussion of various topics: should best management practices be identified to maintain inflow to the Refuge's Unit 6 (i.e., Willard Spur)? What is the local effect of high P in adjacent wetlands? Was Willard Spur driven to N limitation by historically high P? Should sediment cores be extracted to determine historical rates of P deposition to answer this question? What is the rate of N cycling and is it permanent? Is N cycling causing low dissolved oxygen and impacting other organisms? What is the appropriate level of productivity?

MACROINVERTEBRATES & ZOOPLANKTON

See presentation slides at: http://www.willardspur.utah.gov/documents/SP01-2829-13/Macroinvertebrates.pdf

Larry Gray was unable to attend the meeting in person but was able to call in to the meeting and discuss a presentation he had prepared summarizing his results and observations. Key observations noted by Larry were as follows:

1. The biomass did not change too much between years but the number and size of the taxa did. Taxa were much smaller in 2012.
2. Larry saw a significant increase in the total count per sample in July 2012 and then a drop in October 2012. Most of this increase can be explained by the number of chironomidae's. The loss in October could be due to stagnant conditions in Willard Spur. Larry noted that chironomids like detritus; there was a lot of ditritus that coincided with their increase in numbers; perhaps the same with their decline?
3. The overall composition of macroinvertebrates was similar 2011 vs. 2012 but there were more chironomids in 2012; linked to SAV.
4. Larry previously developed a metric that links macroinvertebrates to SAV called % PMI. A comparison of %PMI in 2011 vs. 2012 shows that this metric tracks the condition of SAV in both years quite well.
5. %PMI in 2011 saw the following trends: saw it decline in the fall with loss in SAV but saw increase in downstream sites at same time when it is thought that a new generation took over

6. %PMI in 2012 was increasing everywhere until mid summer when it began to crash with SAV, starting in upstream zones first – possibly due to water depth at sites or inflows? Larry said he would expect an increase in %PMI in the fall that would then carry into the next year
7. Snails were observed to be reproducing in June 2012 and then died off after September, egg masses need DO; perhaps the loss in September was due to low DO and stagnant conditions? Similar pattern was observed with damsel flies and mayflies. Winter generation appears to have been wiped out in the open water; could be slow to recover in spring 2013. Willard Spur may not be as resilient if it didn't have upstream wetlands to repopulate it. That raised the question of whether the low total count of macroinvertebrates in 2011 was a result of conditions in 2010.
8. Larry said the numbers of macroinvertebrates in 2012 were more representative of what he would expect in a system like this than what he saw in 2011. He noted that salinity should not be too significant of an issue with macroinvertebrates unless it was a chronic condition.
9. Larry then shifted to discuss his analysis of zooplankton. He noted that Cladocera are strongly correlated to vegetation; specifically Simocephalus and Scaphaloberis will track along with SAV, i.e., as SAV increase they increase. Moina, however, like stagnant conditions and track closer to increases in detritus. These zooplankton tracked with the condition of SAV both in 2011 and 2012.

Nutrient Cycling Study

See presentation slides at: http://www.willardspur.utah.gov/documents/SP01-2829-13/NutrientCycling.pdf

The nutrient cycling study is a multi-disciplinary, multi-year effort to document how Willard Spur's system changes during the year and in response to added nutrients. The end objective is to define the processes at play and triggers that may be implemented in a long term monitoring plan. The year 2012 was the first year of this two year study.

Joel Pierson began with a summary of water and sediment chemistry results:

1. They observed increases in phosphate and nitrate in the water column due to water column treatments but less than the target concentrations. They saw a decrease in dissolved P across sites likely due to a loss of nutrient lease due to lower water temperatures. A similar pattern was observed for dissolved N.
2. They observed an increase in sediment N and P due to sediment treatments but less than the target concentrations. Results were more variable likely due to sampling method, i.e., nutrients concentrations in sediment are likely connected to distance from the fertilizer bags (small bags with fertilizer were buried in sediment) and the cores may have been taken at different distances from the fertilizer bags.
3. They observed increases in $\delta^{15}N$ isotopes in sediment amended plots.
4. Theron Miller emphasized that P values in the insitu sediment are very, very low. There was an action item to investigate and confirm USUAL's method for analyzing sediment for P to confirm the correct methods are being used.

Mitch Hogsett presented the results from their daytime nutrient dynamics/flux experiments. Mitch noted that all of their work was completed during the daytime using clear chambers with all SAV excluded from the chambers. The experiment is only looking at flux within the water column and between water and sediment. The water column and sediment were observed to be a sink for nutrients during daylight hours. Mitch noted that they identified the presence of Anammox in the sediment. The sediments appear to be taking up all of the nutrients they can get. There was discussion about the use of dark chambers to separate primary production from the sediment as well as doing the experiment over 24 hours, using different nutrient concentrations, and experimental methods. It was agreed that these would be discussed further during the next day's meeting. A key question is at what point does N exceed the system's ability to process it? Defining the denitrification rate will be important for the overall nutrient budget.

Heidi Hoven provided an overview of the observed vegetation responses in the test plots:

1. Heidi observed an increase in $\delta^{15}N$ in the sediment but a decrease in the plant's leaves. This indicates that the plants are likely getting their nutrients from the sediment rather than the water column.
2. Heidi observed a good start in the year with foreageable SAV. SAV in the water amendment plots began to decline in May and were gone by July. She observed some re-growth in August but it also seemed to die off at the end of

August. The total SAV measure was a bit different in that the increase continued into the fall due to "coontail" recruitment.

3. Responses:
    a. Branch density – Heidi already began to see less density in the high treatment plots in May. This seems to be a very sensitive metric of SAV condition.
    b. Did not see much algal mat development until July with no difference between plots.
    c. Epiphytes – saw epiphytes on treatment sites beginning in May with a big jump in late May. This continued through the summer, only decreasing because of the loss of SAV.
4. Heidi noted that it is difficult to compare chemical data to plant response. Water column additions appear to sweep into the biology very quickly and sediment values are so stochastic due to sampling methods. May need to look at $\delta^{15}N$ in algae too.
5. Heidi noticed lower C14 in plants with higher epiphytic loads. Macroalgal production and chlorophyll-a increased in July – September; perhaps connected to SAV die-off.
6. Light penetration data didn't show any patterns or lack of light.
7. The drifting SAV may have had an impact on the test plots in May-June but it is hard to quantify. A transect completed outside of the test plots also saw high epiphytic loads in July but also saw higher foreageable SAV than any test plot area.
8. Foreageable SAV, branch density, and epiphytic cover were all sensitive measures prior to July. Biomass of tubers/drupelets lower in Willard Spur than in other impounded wetlands. The Science Panel discussed why this might be the case. Is it nutrient limited?
9. Heidi pointed out that late April to mid to late June is the critical window we need to focus upon to understand why the SAV are declining.

David Richards provided an overview of the responses observed in macroinvertebrate assemblages:

1. David noted that the assemblages were very similar to what Larry had observed, primarily determined by season.
2. David observed the same seasonal trends Larry did.
3. He observed a large increase in biomass in September and October.
4. Taxa richness was highest in July and lowest in October.
5. David did not observe any treatment effects upon taxa or functional feeding groups
6. David noted that scrapers and collecter/gatherers should respond more than other functional feeding groups

Sarah Rushforth provided an overview of the responses observed in the phytoplankton assemblages:

1. Sarah noted that diatoms were observed to be dominant in all seasons. Numbers dropped from July to August but increased significantly in September.
2. Season seemed to be the most important factor; not much difference observed between treatments. Phytoplankton was correlated to seasonality.
3. Sarah recommended that we look at types of diatoms and how they respond to nutrients. This could be done in conjunction with DWQ's pelagic nutrient limitation experiments.
4. It was asked that if Willard Spur is so N limited, why don't we have N fixing species like cyanobacteria?
5. Sarah noted that benthic diatoms have been collected and stored but have not been analyzed yet. These may be helpful in looking at year to year variation.

Bill Johnson closed the presentation with their team's recommendations for the second year of the study. A key recommendations was that the 2013 work focus upon the first half of the growing season to better understand how and why the SAV decline. This would included starting earlier in April to better document changes in SAV. Due to budget constraints and results from 2012, work should focus upon only sediment amendments. Several other recommendations were made in terms of methods. Bill also summarized recommendations for the nutrient flux experiments. Key to this work will be to deploy the chambers overnight to determine the complete picture on denitrification rates.

The Science Panel concluded the day with a general discussion of their observations. Key question noted were: are nutrients from the Plant reaching the open water of the Spur? Perhaps we should look at isotopes from the Plant? Jeff DenBleyker concluded the meeting on January 28 with thanks to all for their participation and input and an overview of the next day's agenda. The meeting adjourned at 5:00pm.