**TOC Recommendations for Further Investigations of the Relationship Between Water Management and Water Quality in the Refuge.**

(Compiled during the 1/25/05 TOC Meeting)

1. Explore L-40 berm extension and/or enhancement to south of the G94B structure. This enhancement would allow for water supply deliveries to southeast Palm Beach County without impacting the Refuge interior.

2. Investigate in general the relationship between water supply operations and water quality. Evaluate feasibility of diverting water supply release from LO around refuge. *The operational aspect of this issue has been addressed in Section A.1.a.#3*

3. Avoid water supply releases in the periods when the regulation schedule is increasing. This practice forces replenishment of the release by new inflows from the rim canal in order to satisfy the regulation schedule. *In Section A.1.a.#6., an update was given on the request for a temporary deviation from the Regulation Schedule.*

4. Refuge's Regulation Schedule: A few things:

a. Consider deferring the seasonal increase in stage until later in the wet season? The objective would be to "rinse" the marsh fringe areas with rainfall for a period of time and export the initial flush of elevated P water to the rim canal (vs. interior marsh). *The Refuge should work with the CORPS and other others to request deviation or modification of the Regulation Schedule. The same applies to the next two issues in this set.*

b. Explore developing a rain-driven regulation schedule, under which the seasonal maximum stage would be related to rainfall (vs. fixed). A fixed stage requires more inflow from the rim canal in dry years, whereas rainfall satisfies more of the demand in wet years. This is probably the only way to deal with marsh water quality impacts associated with hardness, chloride, and other conservative substances that cannot be reduced by BMP's or STA's.

c. Avoid "double hitches" in the stage. In some years (1999, for one), the stage was suddenly dropped during a period with the regulation schedule was still increasing and then subsequently increased back to the original stage to satisfy the schedule. This could effectively double the intrusion of canal water in some years. The reasons for this are unclear (possibly draw-down in anticipation of large storm events so that the Refuge can function as a flood storage facility?).

> In their letter of November 9, 2004, the principals of the consent decree requested information from the TOC including:
> "… the TOC should analyze the relationship between the current water management practices and water quality compliance, as well as opportunities to alter water management to improve water quality while maintaining water quantity benefits. The Principals anticipate further recommendations from the TOC regarding these additional measures."

Under oligotrophic conditions typical of the refuge, phosphorus is quickly sequestered into the biotic and abiotic pools. Significant reduction of water column phosphorus occurs within a few days under these low phosphorus conditions. Thus, it is reasonable to expect that when water that is high in phosphorus moves relatively rapidly toward the refuge interior, it may raise phosphorus concentrations within the plants and soil. This, in turn, can result in community change and eutrophic impacts.

Evidence from a number of lines of evidence and reasoning suggests that water operations within the refuge that cause water stage to rise then fall back to near initial levels over relatively short periods of a week or less may contribute to elevated phosphorus concentrations in the fringing, and possibly in the most interior marsh. The significance of the short-term stage fluctuations as a mechanism enhancing phosphorus impact relative to other mechanisms of movement of phosphorus (longer-term advective and dispersive transport) is not well understood at this time. However, in the absence of constraints or significant additional costs, it is prudent at this time to implement operational changes that minimize short-term stage fluctuations.

At the November 30 TOC meeting, three operational changes that should reduce these short-term stage fluctuations were proposed for further consideration:

*5.. Extend the daily duration of pumping to 24-hours*

The G-310 and smaller G-251 pump stations at STA-1E deliver treated stormwater to the L-7 Canal within the refuge. The G-310 pump station houses two 10 cylinder, opposed piston, 2 cycle diesel engines, two 6 cylinder, opposed piston, 2 cycle diesel engines and two electric motors at 200 horsepower each. The 10 cylinder engines are capable of pumping 950 cubic feet of water per second (CFS), the 6 cylinder engines pump 470 CFS, and the electric motors pump 100 CFS (SFWMD 2004). The electric pumps are capable of remote operation without on-site staff. The diesel pumps, however, require on-site staff for operation.

*Note - This item was addressed in section A.3.1 in the draft Progress Report*

In the past, routine STA discharge pumping operations have been limited, when feasible, to operations during the day work shift to minimize staffing

requirements and costs. This daily on/off pump operation does cause a measurable fluctuation in canal stage over the period of each day of operation. Addressing the concerns described above, recent operational changes at the G-310 pump station will reduce daily fluctuations in STA-1E discharge by increasing the use of the electric pumps and extending pumping hours.
*Note - This item was addressed in section A.3.2 in the Draft Progress Report.*

*6. Coordinate the operations of pumps and gates to minimize stage variation and intrusion*

The major structures that release water from the refuge to the southern Everglades, the S-10 gates (Gates A, C, D and E), are located along the L-39 Levee and Canal. Staff from the Corps of Engineers Clewiston office manually operate the S-10A, S-10C, and S-10D gates. The smaller S-10E gate is not a Corp project, and is currently never open. Pumped inflow to the refuge is controlled by the SFWMD. It is conjectured that a more predictive operation of the S-10 structures coordinated with pumping operations could reduce fluctuations in the perimeter canal stage. More timely control of gate opening related to pumping events might require installation of equipment for remote operation at the S-10 gates. Coordination of gate operations and pumping will be discussed among agencies at the Quarterly Water Coordination Meeting (participating agencies include the A.R.M. Loxahatchee National Wildlife Refuge, Jacksonville District of the Corps of Engineers, South Florida Water Management district, and the Lake Worth Drainage District) to be held on January 19, 2005.

A related water quality/operations issue deals with the distribution of flow through the individual S-10 gates. Water quality monitoring in the headwater area of the gates reveals a strong gradient of total phosphorus often exists from the highest values at the more western S-10E and S-10D, to lowest values at the more eastern S-10A. It appears from water quality monitoring data, that the S-10D discharges more pumped stormwater while the S-10A discharges more rainwater drawn for the refuge interior. This implies that preferentially discharging from the S-10D might reduce impact on the pristine areas of the refuge by bypassing more stormwater south into the already impacted area of WCA-2. The refuge hydrodynamic and water quality model will be used, when available, to evaluate alternative gate operation scenarios that may be more protective of pristine refuge areas. It has also been suggested that intensive field studies associated with controlled gate opening events might support better understanding.
*Note – The above items could be part of the evaluation described in A.4.in the draft Progress Report..*

*3. Reduce the time period for preceding water supply deliveries*
Under some conditions, the refuge water regulation schedule requires that an equivalent volume of water be supplied to the refuge must preceding water supply deliveries from the refuge. There is now a concern that under high stage conditions this process may enhance movement of phosphorus into and across

the impacted fringe marsh as a result of water level fluctuations. At present, water supply accounting is routinely performed on a seven-day cycle. It has been suggested that this period be reduced to a daily accounting, or that the regulation schedule be revised to allow simultaneous inflow with water supply deliveries. Since December 2004, Calvin J. Neidrauer, Chief Engineer in the Water Control Operations Section, South Florida Water Management District, has been providing regular detailed water supply accounting to refuge and SFWMD personnel. These reports will support an evaluation of the need for alteration of water delivery procedures.
*Note – The above item could be part of the evaluation described in A.4. in the draft Progress Report.*

**Citation:**

SFWMD. (2004). "Pump Stations: West Palm Beach Field Station." < *http://www.sfwmd.gov/org/omd/division/540_wpb/geo1b_pump_wpb.html* >.
- End insertion from the Refuge -