USACE Comments on Preliminary Estimates of Loads to the Refuge After STA-1E is in Operation, Draft (Goforth). June 2005.

Stormwater Treatment Area 1 East (STA-1E) is one component of an integrated set of treatment areas to achieve water quality, water quantity and flood protection. STA-1E was authorized, designed and constructed to treat 124,900 ac-ft/yr (191 ppb total phosphorus [TP] feed concentration) to achieve 50 ppb TP. The treatment capacity of STA-1E is estimated to be greater (possibly 150,000 ac-ft/yr) than authorized after optimization strategies are implemented by the SFWMD.

USACE (Corps) will construct a PSTA demonstration project in approximately one third of the eastern portion of Cell 2. The field scale PSTA cell layout was designed to demonstrate the ability of three different substrates to achieve 10 ppb TP for the proportional hydraulic and nutrient loadings anticipated in Cell 2.

This draft only presents the wet year high flow scenarios. Recommend investigating dry-year flow scenarios as well to develop a long-term modeling scenario rather than just wet-cycle scenarios. This is necessary to plan strategically.

Specific Comments on the draft document:

Pg. 1. Executive Summary. Current cost estimate is $286 million.

Pg. 1. ¶3. "Phosphorus loads will continue to be reduced over the next few years as a result of several State and Federal actions, including…"

Add: 8. completion of PSTA pilot and field scale studies.

Pg. 2. Section 2.1, point 3. "(Of historical interest is that the original federal project for the C-51 West basin called for a 1600-acre flood control reservoir that was projected to discharge phosphorus at 191 ppb to the Refuge.)"

This may have been the case originally; before the mandate to change to an STA, a reservoir was designed to temporarily store water and then discharge off-peak to tide. This consisted of an inflow pump station and culverts back to C-51. In addition, culverts were placed through the L-40 to send water directly into the Refuge under very extreme events.

Pg. 2. Section 2.1, ¶4. "The anticipated inflow volume diverted from the C-51 West Basin to the Refuge, approximately 112,513 acre feet per year, will be less than the

volume of water diverted from the Refuge as a result of the S-6 diversion component of STA-2, approximately 133,230 acre feet per year (Burns and McDonnell 1994)."

The diversion of S-6 flows to STA-2 and then WCA-2A does reduce flows into the refuge. However, these flows come into the southern portion (near the outlets) of the Refuge, whereas STA-1E enters at the northern end of the area.

Pg. 2. Section 2.1, ¶5. "There has been a significant increase in water supply deliveries from Lake Okeechobee to the Refuge, estimated to have increased by about 40,000 acre feet per year over water supply deliveries during the 1979-88 base period. This increase may be a result of an increase in water supply demand and possibly as a result of the change in the WCA-1 regulation schedule…"

Add a third factor—the average rainfall for the 1979-88 period of record was 48.5" vs the 52.5" of POR for 1979-2003

Pg. 3. ¶1. "STA-1E will actually help in providing additional treatment area flexibility to treat [Lake Okeechobee] water prior to its discharge."

STA-1E was not designed to handle Lake O water.

Pg. 3. ¶2. "In addition, the Corps will construct a PSTA demonstration project in a portion of Cell 2 that should provide additional treatment enhancement. The Corps has been asked to ensure that PSTA project will be designed and operated to capture and treat the same hydraulic and nutrient loading as the remainder of the STA, thereby ensuring that the other cells of the STA are not overloaded as a result of the PSTA project."

PSTA studies performed by the SFWMD and the Corps indicate that PSTA technology is better suited as a final treatment step to remove phosphorus from the water column at the low nutrient range (20 to 50 ppb TP range). Emergent growth and SAV would be required upstream to bring the water column concentration within the desired PSTA feed range. Therefore, shifting the PSTA demonstration from cell 4S to cell 2 requires greater HRT within cell 1 to achieve an appropriate PSTA feed concentration.

The Corps plans to test PSTA at typical flow regimes and loadings per STA-1E design and period of record within the PSTA demonstration cells. All of Cell 1 and 2 must be utilized for the 18 month test duration to achieve the appropriate feed concentration to the PSTA test. Under certain conditions, feed to cell 1 would be limited to achieve the appropriate PSTA treatment feed range. The Corps will attempt to operate Cells 1 and 2 to minimize system overloading or diverting runoff.

The PSTA field scale demonstration would be able to be operated to handle all the hydraulic and nutrient loadings of the STA if the demonstration were moved to cell 4S as originally planned. In addition, the placement of the PSTA demonstration test adjacent to the SAV in cell 4S, would provide a good comparison of these two technologies attempt to achieve 10 ppb TP.

USACE will require all of Cells 1 and 2 during the PSTA demonstration, not just the PSTA footprint. We need all of Cell 1 to ensure we get to 50 ppb thru various flow scenarios; we need all of Cell 2 to help control seepage during periphyton activation periods. We recognize the concerns that have been expressed that we are taking that flow-way offline; however, we think it worth the limitation for the 18-month experiment in order to reap the future benefits. USACEHQ and the Assistant Secretary of the Army (Civil Works) concur.

Moreover, if only C-51 West End Basin Water and a small percentage from the S-5A Basin are treated the PSTA test facility should not have a problem treating the water. However if we try to move as much Lake Okeechobee water through STA-1E as has been moved through STA-1W the PSTA facility will have problems.

Pg. 3. Indirect Benefits to the Refuge. "Because STA-1W was designed to work in concert with STA-1E, every year that STA-1E is not in operation has resulted in additional phosphorus loads to the Refuge as a result of:
1. reduced performance of STA-1W resulting from inflows above its design range; and
2. the discharge of untreated water to the Refuge resulting from inflows exceeding the hydraulic capacity of STA-1W.

Flow-through operation of STA-1E will decrease the flow and phosphorus loads to STA-1W, consistent with the intended synchronized operation of the two STAs. The 1994 Conceptual Design anticipated that 15.9% of the S-5A basin runoff would be sent to STA-1E for treatment. Similarly, the 1994 Conceptual Design anticipated that 10.9% of the C-51W basin runoff would be sent to STA-1W for treatment. This balancing of flows and phosphorus loads between STA-1W and STA-1E will enhance the performance of both STAs, resulting in lower phosphorus concentrations and loads discharging from STA-1W and STA-1E to the Refuge…"

Two different hydrological analyses were conducted for STA-1E, one for the original Conceptual Design, and another for the South Florida Water Management Model (SFWMM) using analyses from Burns & McDonnell Report, Stormwater Treatment Area No 1 East Period of Record Dry-Out Analysis, June 13, 2000 (99-822-1-001).

Hydrologic simulations were conducted for water years 1979-1988, the "base" period considered in the development of the original Conceptual Design. The period of 1966-1995 included the entire period for which estimates of inflow and other pertinent hydrologic data are available.

Using SFWMM, daily inflow data were provided for the 1965-1995 period of simulation at inflow to STA-1E from G-311. The simulated average annual inflow was 1,406 ac-ft at G-311 for calendar years 1979-1988; the simulated average annual inflow was 2,373 ac-ft for calendar years 1965-1995 (runoff from the EAA-WPB basin).

The simulated inflow to STA-1E at S-319 and G-311, combined, average 104,148 ac-ft per year over the period 1965-1999, and 102,648 ac-ft per year over the period 1979-1988. The estimated average annual inflow to STA-1E presented in the 15 February 1994 Conceptual Design was 124,900 ac-ft per year; of the total, 105,400 ac-ft per year was composed of C-51 West Basin runoff.

Consequently, the Conceptual Design (1994) expected that there would be a net inflow via G-311 of 19,500 ac-ft/yr, while the SFWMM simulation for the period 1965-1995 expected only 2,373 ac-ft/year.
Consequently, the Conceptual Design has 15% of the water coming from G-311, while 85% is from C-51 (new water). In contrast, SFWMM model is 2.2% G-311, and 97.8% C-51 (new water).

More importantly, comparing the amount of water that STA-1E would potentially divert from STA-1W relative to the total amount of water being treated by STA-1W yields compelling results. The Average Annual Inflows and Outflows for STA-1W for Water Years 2002-2004 are approximately 387,000 ac-ft (Table 2.1, Record Inflows and Outflows, STA-1W; Burns and McDonnell report, Everglades Protection Area Tributary Basins Supplemental Analysis [Draft], March 2, 2005). The amount of S-5A water diverted to STA-1E from STA-1W would amount to a maximum of 5.0% of all the water routed through STA-1W (19,500 ac-ft vs. 387,000 ac-ft), or as little as 0.6% of all water routed through STA-1W (2,373 ac-ft vs. 387,000 ac-ft). With the (max.) 19,500 ac-ft diverted to STA-1E, the amount of water routed through STA-1W would still be more than 367,000 ac-ft, or more than twice the operational range for STA-1W (~180,000 ac-ft/yr; Goforth draft, pg. 9). Consequently, it is incorrect to place the blame for the repeated overloading of STA-1W on the delayed start-up of STA-1E.

Pg. 4. 2.4 Diversion of Acme Basin B runoff to STA-1E for treatment. "Presently, approximately 5 tons per year of phosphorus is sent untreated to the Refuge from Acme Basin B. Once STA-1E is in flow-through operation and the Acme Basin B diversion project is completed (prior to September 2007), this phosphorus and water will be treated in STA-1E, resulting in a further reduction of phosphorus loads to the Refuge."

This is currently being investigated as a CERP project utilizing a portion of Section 24 lands as a temporary storage area and then routing to C-51 during off-peak times. However, this is an additional load that was not envisioned in the original design. The ability of STA-1E to take this water has been investigated under the CERP project, and we believe that this will not cause an overloading of STA-1E. However with the additional load from ACME Basin B and the possibility of regulatory releases from Lake Okeechobee an overloading of STA-1E is possible.

Pg. 4. 2.6 Diversion of the L-8 basin runoff north to the CERP L-8 reservoir. "Presently about 50,000 AF/yr of runoff from the L-8 Basin is being discharged to the Refuge, either after treatment in STA-1W (contributing to its overloading) or untreated through G-300/G-301. In addition, about 100,000 - 150,000 AF/yr is discharged to tide through the C-51 Canal. In the future (2010-2015), this runoff will be diverted north to the CERP L-8 reservoir, further reducing phosphorus loads to the Refuge. However, in the interim, when STA-1E begins flow-through operation, this runoff can be sent to STA-1E for treatment, which will improve the performance of STA-1W, thereby reducing the phosphorus loads entering the Refuge from STA-1W."

This does not meet USACE project objectives. The current operation for the L-8 basin is to discharge water through C-51 during off-peak times, and in order to alleviate flooding in the basin a percentage of water is pumped at S-5A (50,000 AF/yr) into the STA1 Inflow Basin. STA-1E was not designed to take L-8 Basin water. A balance of flows from the L-8 Basin and to the C-51 West end basin must be achieved through S-155A to prevent an overloading of the STA.

Pg. 5. 2.8 Estimated Phosphorus Loads to the Refuge. "For the purpose of these estimates, the performance of STA-1W was assumed to be similar to the performance over the last 12 months, with an effective settling rate of approximately 18 m/yr; this is likely a conservative assumption in light of the management activities underway to enhance performance of STA-1W. For the purpose of these estimates, the performance of STA-1E was assumed to be between the performance of STA-1W over the last 12 months and the anticipated performance of STA-2, STA-3/4 and STA-6, with an effective settling rate of approximately 23 m/yr (i.e., halfway between 18 m/yr and 28 m/yr). Using the assumptions listed in Table 1, which excludes any impact of possible WCA-1 schedule revisions, estimates of flow and phosphorus loads to the Refuge were prepared, and these are presented in Tables 2-4 for various scenarios…"

Consider using the settling rates of recent STA-1W performance; values ranged from 23.1 up to 34.7 m/yr. It would be unwise to use a 23 m/yr settling rate for STA-1E until we have operational data from PSTA demonstration project. PSTA settling rates could be potentially higher, but it is better to use higher rates for STA-1W based upon past performance rather than conjecture about how STA-1E will function.

There are 5 phosphorus load scenarios referenced with discussion and graphs. Phosphorus load comparisons are made with Acme Basin B diverted (to STA-1E) and Acme B not diverted. Does "not diverted" imply going back to the natural system untreated?

Note that under a future without project condition Acme Basin B water is assumed to be routed to C-51, then east to tide; Lake O. water would make-up for this deficit (to comply with EFA and Consent Decree).

Pg. 6. Table 1.
Lines 5 and 6: use higher settling rates for STA-1W and lower rates for STA-1E.

Line 20: 4.75 MT/yr of loading from Acme B. This is twice the load cited in the 2002-2003 Basin Specific Feasibility Studies (Burns and MacDonnell). Consider implementing effective and rigorous BMP's as loading to STA-1E has doubled in 3 years. Control of this load is critical as STA-1E will have to bear the brunt of treatment. This will ultimately pay large dividends in future load reduction to the refuge.

Pg. 7. Why do the Tables go from Table 1 on pg. 6 to Table 5 on pg. 7?

Pg. 8. Table 6. Consider using a settling rate composite of past STA-1W performance nearer to 27 m/yr (mid range between 23.1 to 34.7 m/yr).

Consider developing an optimized Scenario 4 alternative with a more effective split of loading between STA-1W and STA-1E; consider other sub-scenarios of 4 (4A and 4B). These alternative scenarios divide flows between STA-1E and STA-1W:

a. Scenario 4 (165,000 ac-ft/yr STA1E, 180,000 ac-ft/yr STA1W) for a base
b. Scenario 4A (155,000 ac-ft/yr STA1E, 190,000 ac-ft/yr STA1W)
c. Scenario 4B (150,000 ac-ft/yr STA1E, 195,000 ac-ft/yr STA1W)

Pg. 8. (L-40 BC improvements). The current USACE proposal is to prevent the direct infiltration of flows into the Refuge at the confluence of the S-362 Discharge Canal and the L-40 Borrow Canal. To accomplish this USACE plans to

a) To hydraulic dredge muck material for a distance of 8200 feet. The concern is that with the operation of the pump station this material may be re-suspended and flow into the Refuge.

b) To turn the flow and to slow the velocity down at the pump station. The canal will be widened and a berm (1000 ft) will be constructed on the Refuge side of the L-40 BC. The canal widening will increase the bottom width from approximately 40 feet to 200 feet for approximately 1200 feet (200 feet downstream of the berm). Then the channel bottom width begins to constrict over the next 1600 feet back to its original bottom width.

Pg. 8. ¶4. "The potential hydraulic impact of the S-362 on the Refuge marsh is presently unknown, but may be significant in the near-field without improvements to the adjacent L-40 borrow canal and western bank. The Corps of Engineers performed steady state modeling in association with the initial pump tests for S-362; however, those simulations probably overestimated the potential hydraulic impacts to the Refuge. This is because…"

We may have over-estimated the impacts, but one of the purposes of doing a steady state analysis is to determine the worst-case scenario. The modeling performed by the Corps for the flow exceedances presented in Figure 3, page 11, shows that the benefits of the L-40 berm improvement are greater when the flow is greater than ~ 500 cfs. During extreme flow events the L-40 berm improvement tends to lower the velocity and shift the flow to the south. Transient analysis may reduce the uncertainty and probably would lessen the benefits of the L-40 improvement.

"i. The durations simulated may greatly exceed the anticipated durations anticipated at the flows modeled – particularly the higher flows…"

We were looking at worst-case scenarios.

"ii. The anticipated discharge hydrographs are highly transient in nature…"

This is very true. It is based on the work schedule of the SFWMD in addition to the amount of rainfall the basin is receiving.

"iii. The model may not have accurately simulated the ~3 ft north-to-south slope of the Refuge or the L-40 borrow canal…"

The topography of the interior of the Refuge was based on the most recent survey data collected in the are which is the USGS Highly Accurate Elevation Data (HAED, or Helicopter data). Where data were present it was used everywhere; otherwise general approximations were made from as-built drawings.

iv. The model may not have accurately simulated the dense vegetation on the west bank of the L-40 borrow canal…"

This is potentially true; we used the same variable depth n-value (roughness coefficient) throughout the Refuge. We could potentially change the n-value along the bank, but as for the penetration of the current cattails into the refuge, we have no idea how far this would extend into the refuge.

v. The initial conditions of the Refuge (e.g., 17.0 ft at the highest discharge rate) represent the worst case scenario – movement of water to the interior marsh will likely be much less at lower Refuge stages.

We evaluated several different stage/discharge relationships.

Pg. 9. ¶2. "In light of the uncertainty surrounding the expected performance of the proposed L-40 canal/bank improvements to minimize movement of STA-1E discharges into the unimpacted areas of the Refuge, it is suggested that transient hydrodynamic

modeling be conducted to properly evaluate the near-field and far-field effects of STA-1E discharges, both before and after the L-40 enhancements are complete."

This is a good suggestion. However, the model would need extensive data for both the L-40BC and L-7BC. Additionally, all inflow points would have to be included into the model to evaluate how all of the inflows impact the Refuge while working at the same time. USACE modeling only examined discharges from S-362.

Pg. 9. ¶4. "1. Discharge of untreated water into the Refuge through the G-300 & G-301 structures should be terminated to the maximum extent practical by diverting the flow through the G-311 structure for treatment in STA-1E prior to discharge to the Refuge, or for discharge to the C-51W canal by gravity through the S-319 pump station and discharge to tide or meet downstream water supply demand."

It should be clarified that gravity discharge through S-319 is performed via reverse siphoning through the pump station. The general statement that water can be discharged via gravity is misleading; sounds as if we have culverts.

Pg. 10. ¶1. "4. Construction and operation of a PSTA demonstration project in Cell 2 must not hinder the STA-1E operation, i.e., the PSTA project must be designed and operated to treat the same hydraulic and nutrient unit loading that STA-1E was designed for."

Agree that the PSTA demonstration project should not hinder the operation of STA-1E. However, treating water from other basins that were not included in the original STA design should not negatively impact the PSTA demonstration. As described previously, Cell 1 will be operated to provide 50ppb water to the PSTA in Cell 2.

Pg. 10. ¶2. "5. Until the L-40 improvements are completed and shown to be effective, and except under upstream flooding conditions, discharges from STA-1E should be limited to reduce impacts to presently unimpacted area. Technical staff have not reached consensus on the magnitude of this limit. There are two fundamental approaches to this…"

The flood control purposes of the project must be maintained and incorporated into any decision regarding reduced discharges from STA-1E.