

**Comments on “A.R.M. Loxahatchee National Wildlife Refuge Enhanced Water Quality
Monitoring and Modeling – Interim Report” dated 4/19/05
Florida Department of Environmental Protection**

General Comments:

- Our compliments to the authors of the report for compiling analyzing and describing a significant amount of information in a fairly short period of time. One of the report objectives should be to assess the adequacy and appropriateness of the program to achieve its objectives. We should begin the process of assessing that now. The continued periodic assessment of data from this program is essential to the continued adaptive implementation of the program to ensure that the program will contribute a wealth of critical information toward our restoration efforts for the Refuge.
- The November 2004 letter from the Principals noted that the Parties are implementing “monitoring measures designed to assist us in gaining scientific understanding of historic and future exceedances...” The report is silent on this objective. We believe the data in the report demonstrates the complex nature of the factors affecting phosphorus concentrations within the Refuge, as evidenced throughout our specific comments. Future reports should focus on developing a better understanding of historic and future exceedances.
- The general theme running throughout this report is that intrusion of rim canal water into the Refuge is occurring and that the intrusion is a function of relative water levels in the canal and adjacent marsh. The first point has been well known for a long time; therefore, this report does not provide any startling new revelations in that regard. Unless discharges to the Refuges are terminated completely and it is turned into an exclusively rainfall-driven system, this condition is essentially unabatable. In addition, management of water in the Refuge must be considered, not in isolation, but in the context of an overall hydrologic restoration for the Everglades Protection Area. Because of the size of the Refuge and the necessity of establishing a hydraulic gradient for water to flow from north to south, a certain degree of intrusion is probably necessary in order to avoid extreme, unnatural releases to WCA-2, causing adverse environmental impacts to that area. Within that context, however, the effect can probably be reduced through the development of appropriate regulation schedules and operational strategies for inflow and outflow structures, which the report correctly points out. We believe the implication that intrusion is a function of relative water levels in the canal and adjacent marsh is overly simplistic, which is clearly represented in the data of this report. The report should focus on identifying all of the factors involved and their relationships to intrusion. This can probably be done only through the accompanying modeling efforts of this project.

Specific Comments:

- P. 2, second paragraph; Page 22, Figure 11 – The authors incorrectly indicate that the sediment contour map provided as Figure 11 was derived solely from the 1991 UF/Reddy data. The contour map was actually derived from a compilation of data including the 1991 UF/Reddy data, the SFWMD transect data, and the 1994-96 REMAP data collected by the USEPA. Finally, the Department is in the process of analyzing the additional soil sampling data for the Refuge recently performed on behalf of the District as noted in the report. We will be happy to discuss our preliminary conclusions in the near future.

- The Background section on p. 3 discusses effects from ions and nutrients. The two effects need to be discussed separately, without flip-flopping back and forth between issues (e.g. “Conductivity is a simple field measurement that provides a surrogate for concentrations of major ions. Therefore, there are concerns that increases in canal water intrusion into the Refuge interior may cause negative ecological consequences because canal water is higher in nutrients.”)
- P. 4, first paragraph states that “If a line is drawn to connect all the outer-most compliance stations, approximately 60% of the Refuge marsh is inside that region.” Drawing a line to connect stations is not a technically-rigorous means to define the area of which a series of stations is representative. Furthermore, the spatial extent of this imaginary line is not clear to the reader. The authors should include a figure depicting the representative areas for each station as well as the technical basis for the delineation of these areas.
- P. 6, second paragraph indicates that UF-IFAS is under a cooperative agreement to conduct a series of canal hydrographic surveys and synoptic water quality surveys in the perimeter canals of the Refuge. Has the refuge shared the Scope of Work for this project with the Department and the District? How does this work relate to the LOXA monitoring programs? How will the results from this work be integrated with those from the LOXA program?
- It would be helpful in Figure 1 (p. 7) to draw and label lines along the transects consistent with those used in the subsequent analyses and plots (i.e. NE, NW, SW and Central).
- P. 8, first paragraph – we recommend stating that rainfall and ET are approximately equal, rather than very similar as stated.
- We’re not sure of the purpose of Figure 2 (p. 8). While it’s true that overall the year 2004 is generally dry, that overlooks the fact that, if assessed more synoptically, 2004 contained storm events that represented exceptional conditions.
- P. 8, last sentence states that Refuge rainfall is heterogeneous, with higher mean rainfall typically occurring on the eastern side of the Refuge. While we generally agree with the first part of the statement, it is apparently based on March 2004 – February 2005 data, which may not depict spatial patterns seen in other years. In addition, there is sufficient uncertainty in the resolution of the method that even the depicted pattern may not be significant for the reported year.
- P. 10, second paragraph – What is the basis for the statement “Periods of net inflows to the Refuge often correspond to periods of positive hydraulic gradients into the marsh.”? If it is from Figure 6, while it seems logical that when there is a positive elevation gradient between the STA tailwater level and marsh stage, there would likely be a net flow into the marsh, that cannot be demonstrated without actually measuring flows into the marsh. In addition, it is not clear which marsh stage gauge is being used. If it is the average of the 1-7, 1-8C and 1-9, that is not necessarily indicative of the marsh stage in the vicinity of the STA-discharge structures. The issue of the 3-gauge average was pointed out in the DEP presentation at the 11-8-04 TOC meeting. We suggest that the STA-1W discharge be compared to the 1-7 gauge, while the ACME discharge might best be compared to the average of the 1-7 and 1-8C gauges. In either event, that still does not demonstrate actually flows into the marsh.
- P. 11, Figure 5 – How were the inflows and the net inflows determined. It is assumed that these are calculated values. If so, please specify the data (structures) used to

calculate both inflows and outflows. Also, the figures show a peak inflow to occur in October 2004, yet the net inflow is shown to have a negative peak during the same period indicating that nearly twice as much water is being discharged as is entering the rim canal. Is this correct?

- P. 13, second paragraph – it is the general practice to either refer to specific conductance or conductivity. Specific conductivity is not a term typically used.
- P. 13, third paragraph – while it is true that sulfate is generally less conservative, the statement that elevated conductivity is evidence of canal water intrusions, while elevated sulfate concentration is evidence of recent canal water intrusion is an over simplification. Both are affected by a number of factors. In fact, a comparison of the October 2005 conductivity and sulfate data indicates they both penetrate a similar extent into the marsh along the NE, NW and SW transects. In addition, sulfate can accumulate in the sediments in areas receiving canal water inputs with this sulfate being refluxed to the overlying water as the canal inputs diminish and concentrations start to decrease. Because of the complexity of the factors involved in controlling sulfate concentrations, it is very difficult to determine how recent the canal water intrusion occurred. Also, it is not clear what is meant by the statement that “Understanding gained in future modeling efforts will better quantify these qualitative assessments.”
- P. 13, final paragraph – We recommend striking the term raw from the second sentence. Also, change to “specific conductance” or “conductivity” in the third sentence.
- P. 15, first paragraph – it is assumed the third question is intended to be “Are these patterns different in different parts of the Refuge, and do they change seasonally?”
- Pp. 15, 16, Tables 2.b) & c) – it is worth noting that the effect of the storm events is clearly seen in the September and October canal data and in marsh data in proximity to canals.
- P. 17 – the transect analysis section needs to refer back to a map showing the location of the transects.
- P. 17, second paragraph – the statement is made that “Patterns of conductivity versus distance from canals shows that there is greater marsh intrusion of high conductivity on the west side of the Refuge than on the east side.” This statement is not supported by the data. The east and west transects correspond fairly well with each other for both the October 2004 and January 2005 events and for both the central transect and the NE, NW and SW transects (Figure 7). The same pattern can be seen in the sulfate data (Figure 9).
- P. 21 – the discussion indicates that “The same general patterns were observed, along with a greater penetration of high conductivity water into the marsh fringe along the eastern side of the Refuge.” This is actually the opposite of the pattern described earlier. We believe this serves to illustrate the fact that these patterns are a function of a number of complex variables.
- P. 22, second paragraph – the schedule for inclusion of the new topo data into existing water management models and new hydrologic models being developed for the Refuge needs to be provided.
- P. 22, final paragraph – the paragraph states that other sources of data (i.e. X, Y and Z transects) are not included in this report and that DEP has used these data to better understand potential water quality impacts on Everglades wetlands. It is worth noting that DEP has been and will continue to report annually on all water quality data for the Refuge through the peer-reviewed South Florida Environmental Report.

- P. 23 , first paragraph – the paragraph states that “nutrient-rich and high conductivity water from the canal has the potential to negatively impact Refuge plants and animals.” While we believe it is true that high conductivity water has the potential negatively impact periphyton communities in the refuge, we have not seen any data that indicate that higher plants or animals may be affected.
- P. 23, Figure 12 – it would be interesting to test whether the canal data populations are different from each other. It would appear that the NW & SW canal data may differ from the NE and that all three NW stations appear to be similar. What is the time step depicted in this plot, daily values?
- P. 24, first and second paragraphs – there is a statement that “In general, there was an increase in conductivity values in the interior marsh from November 2004 through February 2005.” Is this based on a statistical comparison or just a visual observation of Figure 13. If it’s the latter, it would be preferable to refer to it as an “apparent” increase. It is also instructive to note that this is not accompanied by an apparent increase at the LOXA104 STA-1W inflow site; further illustrating the fact that marsh conductivity and other parameters are a function of a number of complex factors.
- P. 25, Figure 14 – in this case conductivities at the LOXA135 STA-1E inflow site appear to be increasing from November 2004 through February 2005, but this trend doesn’t appear to be accompanied by a trend at the nearest marsh site (LOXA136), again underscoring the apparent complexity of these patterns. Since the same change is noted for all sites regardless of distance from the canal, it suggests that the slight increase observed during this period is a natural phenomena associated with the dry down of the marsh following the large rain water inputs during the hurricanes and not related to influence from the inflows. This could be demonstrated by plotting the changes in water level with the changes in conductivity.
- P 27, first paragraph – we (and probably the vast majority of the citizens of South Florida) strongly disagree with the statement that none of the 2004 hurricanes should be considered extreme natural events. Why was a three-day period used in the evaluation? What was the duration of the rainfall associated with the hurricanes? Is the same conclusion reached if a one or two day period is used? In addition, while the evaluation of the individual storms may indicate none of them alone to be considered extreme natural events the evaluation as performed ignores the cumulative impact of three consecutive storm events in a relatively short span of time. This impact is clearly seen in both the rainfall data if 30-day cumulative amounts are considered. In addition, rainfall alone is an overly simplistic measure of the impacts. The cumulative inflow volumes resulting from rainfall in upstream basins must also be taken into account. We believe the extreme nature of the events is clearly reflected in the rainfall, flow and resulting water quality data.
- P. 30, Figure 17 – it is again instructive to note that during the period of discharges from the S-362 structure in September through October 2004, the conductivities at LOXA135 are actually at their lowest values, again underscoring the apparent complexity of these patterns.
- P. 33, final paragraph – while we agree that formal reports may be produced on an annual basis, we believe the data should be assessed on an ongoing basis and that the ongoing assessments should be used to modify the monitoring plans as appropriate in a true adaptive management process.

- On a final note, we observe that many of the parameters being analyzed have not been reported. We recommend that all sampled parameters be evaluated for their utility and that parameters be revised if they are determined to not be providing useful information. For instance, a complete set of ions is being analyzed, but conductivity, which is a fairly good predictor for the individual ions, is the only parameter being analyzed. That would indicate that individual ions could potentially be dropped and the extra money used to either sample additional stations or extend the program.