Appendix 1A-5: Final Report of the Peer Review Panel for the *2006 South Florida Environmental Report – Volume I*

With the exception of reformatting some information for better readability, the Chapter 1A appendices were not edited or spellchecked by the SFER production staff. They appear as posted on the District's WebBoard.

FINAL REPORT

Of the Peer Review Panel Concerning the

2006 South Florida Environmental Report

Review Panel:

Jeffrey L. Jordan, Chair, University of Georgia
Neal E. Armstrong, The University of Texas at Austin
Joanna Burger, Rutgers University
JoAnn Burkholder, North Carolina State University
Yuch Ping Hsieh, Florida A&M University
Richard Meganck, United Nations University for Water Education
Ellen van Donk, NIOO-Center for Limnology
Robert Ward, Colorado State University

Submitted October 21, 2005

INTRODUCTION

The responsibility of this Panel was to review and prepare questions on the draft of the *2006 South Florida Environmental Report* (SFER), dated September 2005. In addition, the Panel's responsibilities included the consideration and inclusion of input from the public workshop conducted September 27-29, 2005, where relevant. This Report summarizes the Panel's findings regarding the key facts presented during the workshop and conclusions and recommendations on the subjects raised by the report authors and public participants.

The Report and this peer review are part of an open Panel review and public hearing to ensure that all involved are given an opportunity to be part of an open deliberation before a Panel of objective experts.

Constructive criticism of the SFER programs and projects were sought from the Panel. However, this review by its very nature and constraints is not designed to evaluate detailed aspects of research and monitoring. The Panel's task was to determine if the appropriate scientific models and applications were employed, if all relevant data were used, and if the SFER findings were a logical consequence of the science and the data.

In reviewing the draft SFER, the general questions that the Panel addressed included:

1. Does the draft document present a defensible scientific account of data and findings for the areas being addressed? Is the synthesis of this information presented in a logical and complete manner?
2. Are the findings and conclusions supported by "best available information" or are there gaps or flaws in the information presented in the main body of the document? What additions, deletions or changes are recommended by the Panel to enhance the validity and utility of the document?
3. Are there other interpretations of the data and findings that should be considered and presented to decision makers? Is there available information that has not been considered by the authors?
4. Are there data summaries and analyses that should be included in future, annual peer reviewed reports to the Governor and Legislature?
5. What chapters or sections of chapters can be reduced, consolidated or eliminated? What analysis can be eliminated or done more effectively?

In addition, the Panel was asked to provide a review of the three models that were described in the appendix to Chapter 12, "Modeling Freshwater Inflows and Salinity for Evaluation of Restoration Alternatives of Northwest Fork of the Loxahatchee River.

General Panel Response to the Draft Report

The draft *2006 South Florida Environmental Report* is generally well written and well considered. The move from an Everglades Report to a more comprehensive discussion of all South Florida water systems continues in this second year and improves the reporting process.

The responses of authors to review comments during the public workshop were generally direct and sufficient. The Panel found the presentation at this year's workshop to be stimulating and helpful. A few general comments on the SFER include:

1. Each chapter author should include a one-page summary of the material. The key would be to place on one page the major findings and recommendations of the chapter. Then, a second page could be included that listed new results---what did you find out this year? These one-page summaries could be included in the report, but could also form the substance of the presentations made at the annual public workshops.

2. A similar format should be used for the beginning of each chapter: state objectives, explain how the work reported in that chapter relates to short and long-term goals of CERP, briefly state methods, and briefly state results.

3. More diagrams and tables should be used to relate objectives/goals/findings between different studies and chapters to provide some overviews of the results and findings and to recovery (an example of this is contained in the Chapter/Topic Integration Opportunities section below) .

4. A summary chapter or section should be added that synthesizes different chapters, for example, mercury, phosphorus, nitrogen and sulfur cycling, including their interrelationships. And perhaps add a section relating contaminants and hydrology; some aspects to highlight are the role of dry-downs and of excessive water.

Given the extensive coordination requirements involved in integrating over geographic areas and institutional arrangements, the *2006 South Florida Environmental Report* continues a major step forward in improved water management. It also represents a major challenge to those who collect data, develop information, support decision-making and establish policy.

Suggestions for 2007 Report

In responding to the request in the Panel's Statement of Work for report focus and organization suggestions, to optimize the SFER reporting process, the following thoughts are offered.

First, it should be noted that the Panel appreciates that the SFER is a compilation of a number of reporting requirements, many of them legally mandated. The following comments are offered as a way to improve the effectiveness of the reporting associated with managing water and water-related resources in South Florida, without regard for legal requirements.

Thoughts on 2007 Cross-Cutting Themes

During the Panel's discussions this year, the second year of the integrated SFER, it became obvious that the monitoring systems in the different areas need to be more clearly explained and better connected with each other. A suggested theme for the 2007 SFER would be water monitoring across South Florida – the vision, the mission, the strategy, and the information product. In other words, what is the overall water information system design for South Florida? Is it possible to outline a water information strategy with a summary of results in the 2007 SFER? Such an effort would help the Panel address its concerns regarding consistency, comparability, and efficiency across the 54 monitoring programs presented on the Water Quality

Monitoring Project Area website. Also, a list of all monitoring programs (e.g., birds, fish) and how they are related would be helpful. The 2007 SFER Chapter 1B, for example, could attempt to state the monitoring philosophy/strategy that underpins each of the annual Reports.

Other cross-cutting themes that present themselves include: mercury issues across all water systems; the relationships between mercury, phosphorus, nitrogen, and sulfur cycling; the importance of nitrogen in eutrophication; the use of modeling in different programs; an examination of agriculture and its impacts throughout the District; non-source pollution controls, and; measurement issues related to TP across systems.

A Tri-level Review System

The reporting consolidation initiated with the 2005 SFER, as well as the maturation of a number of sections of the SFER reporting process, suggests that it is possible to better target and streamline the conveyance of information in the SFER. By maturation it is meant that some Chapters, or portions of Chapters, in the report are taking on a rather routine reporting nature after being developed and peer reviewed over a number of years. Thus, some aspects of water and water-related resource management in South Florida may now lend themselves to simply updating readers on current-year accomplishments rather than presenting each chapter as exploring unknown aspects of water management in South Florida.

The Panel strongly suggests that the review process for future SFERs can be accomplished using a three-level approach: Progress Review (accountability), Project-level Review (technical), and Program Review (integrative).

Progress Review: Accountability. Where reporting is taking on a routine character (e.g. Chapters 2A and 5), perhaps it would be possible to identify tables or graphs, contained in past reports, that could be refined to readily and quickly convey an understanding of the current year's performance against management goals, established legally or otherwise. The tables and graphs could be prepared each year without peer review – the methods employed in their production are well documented, tested, and readily accessed, thus annual peer review is not needed. Perhaps every fifth year, a peer review of the methodology could be conducted to insure that the information continues to represent the latest science has to offer.

Project Review: Technical. Where there is still a major research component (i.e. collecting data to define water-related processes that are critical to SFWMD meeting a management goal, such as Chapters 4, 6, and 12), the SFER should continue to report methodological detail and explanations of the new findings, subject to an annual peer review process.

Program Review: Integrative. This level of review would explore how the SFER provides information and could include cross cutting themes and the connections between research and water projects (i.e. CERP, etc.).

Exploring this division further, the more routine reporting can be developed where data collection and analysis protocols have been developed, tested, and peer reviewed. In some ways, these portions of water management are operating in an 'accountability' mode – known goals are held up against data for the past year. In other words, did the water measurement being managed meet the goals set for it?

Furthermore, where the protocols are well defined, data handling, analysis, and reporting lends itself to fitting within modern ‘information technology’ applications, thus enhancing the efficiency of staff time in preparing the annual report. In other words, as noted above, the activities required to produce the charts and tables can be automated.

Chapters 2A and 5 appear to contain portions that are becoming routine. Both are summarizing and analyzing routinely collected data from fixed monitoring networks that are compared to established management goals (e.g. water quality standards in Chapter 2 and water supply, flood control, and rain-driven water delivery goals in Chapter 5).

Tables 2A-2 and 2A-3 represent the type of table/graph that could be considered for reporting annual monitoring results for the information contained in Chapter 2. For Chapter 5, there may need to be developed a new reporting format, such as a ‘snake’ diagram of flows for the year compared to goals, each in a different color. Figure 5-76 is an example of this type of graph. Figures 3.3, 3.4, and 3.5 are examples of presentation formats that could be further refined to quickly present annual results on ECP permit compliance and trends in performance. Following the graphic presentations, there will need to be an interpretation of the findings (e.g. explanation of excessive standard violations or below goal deliveries in the rain-driven plan). It would be helpful if representative users of the SFER information could assist in identifying the reporting format that best meshes with their responsibility for ultimate accountability of the District in meeting its water management obligations.

While Chapter 2B had many routine aspects, the new finding of the importance of sulfur in mercury cycling requires considerable attention, study, and discussion in next year’s report, because of the potential to partly manage mercury levels within the Everglades. Protocols needed to monitor sulfur need to be examined and described more fully.

At the technical, or project-level review, Chapter 2C represents a portion of the SFER that describes new developments in water management of South Florida, thus this chapter would continue to receive close, annual scientific peer review. Chapter 7 describes new project development. It is not as obvious that it needs scientific peer review in the same manner as Chapter 2C but, rather, might be more suitable to a peer integrative review.

With the SFER in management goal ‘accountability’ and exploratory ‘research’ modes, the organization of the report must be considered. The accountability portion of the report, in providing brief and to the point information, could appear first in the annual SFER (and would not be subject to annual peer review). The more detailed research presentations could follow and be subjected to annual scientific peer review. The integrative section would focus on water systems and projects.

Chapter 12 presents a coastal ecosystem summary for nine estuaries around South Florida. This chapter, in only its second year of inclusion in the *Report*, is enormous in scope. Clarification of management strategies and quantifiable targets would allow the District to take greater advantage of opportunities to optimize use of estuaries as excellent "integrative natural barometers" in evaluating the overall success of watershed management activities. Three major issues were identified: anthropogenic freshwater discharges, increasing inputs of nutrients and other pollutants, and loss of critical ecosystem habitats and communities. Inclusion of additional key information for each ecosystem would be useful in addressing the second and third of these issues. Integration would be improved by considering interactions of salinity with other important factors, such as nitrogen, in affecting the coastal ecosystems. From an efficiency standpoint, the chapter would benefit from having a common presentation template for each ecosystem and one description of the common monitoring protocols. The differences in the resulting information could then be matched to the site-specific nature of the estuaries. The common template might include specific restoration goals; summary information on invasive and threatened/endangered species; EACs and VECs, in use or planned; an overview of District activities, including water quality data summaries and statistics sufficient to support conclusion statements; and planned District activities.

Chapter/Topic Integration Opportunities

Across Chapters there are several opportunities to better integrate and cross reference findings. For example, Chapter 1B indicates there were serious problems south of Lake Okeechobee as a result of the four hurricanes in WY2005 (lines 74-77), but Chapter 2 says all standards were met, with few exceptions. Were the 'serious problems' in water quality still below the standards or did the water quality improve between the STAs and the WCAs?

Chapter 10 notes no improvement in phosphorus inputs to Lake Okeechobee for the past ten years, despite years of regulatory and voluntary incentive-based programs to control P. Yet, in the EAA and C-139 (Chapter 3), P regulatory and voluntary incentive-based programs seem to be reducing P inputs to WCAs. Why these differences in P control program performance?

Chapter 5 leads the reader on a thorough overview of the water quantity management activities in South Florida, including an assessment of the impact of four hurricanes in one year. The Chapter follows the flow of water through the system, into the Everglades National Park where there is a plan in effect with flow goals, but Chapter 5 does not describe whether the goals are met. When the Panel asked about flow goal accomplishment at this end point in the hydrology of South Florida, the reader is referred to Chapter 6. A statement about flow goal accomplishment in all parts of South Florida, as well as at the ENP, seems appropriate in Chapter 5.

In the author's presentation of Chapter 2A and 2C during the Workshop on Sept. 26th, a map of the EPA was presented with WY2005 Geometric Mean Total Phosphorus (TP) presented in boxes for the WCAs and Park. The Panel indicated during the workshop the need to tie the different levels of TP across the entire South Florida area, from the Chain of Lakes, through the agricultural area above Lake Okeechobee, to Lake Okeechobee itself, to the EAA, to the STAs, and, then through the EPA (rather than the EPA only). This would help the reader gain insight into the sources and sinks of TP across South Florida. To illustrate, Chapter 11 indicates that TP concentrations in the Kissimmee River for WY2005 were 100 ppb at S-65A. Chapter 10 indicates that input TP concentration to Lake Okeechobee are 212 ppb and interior concentration of 141 ppb which can then be compared to Chapter 2A's WCA1 inflow concentration of 68.6 ppb with an interior of 12.8 ppb; WCA2's inflow of 26.6 ppb and interior of 17.9 ppb; WCA3's inflow of 23.9 ppb and interior of 9.6 ppb; and the Park's inflow of 10.3 ppb and interior of 5.1 ppb. This cascading of TP concentration, placed on a map of South Florida, connects monitoring results from different chapters and areas into one picture of P in the entire region. A similar map was produced in prior reports and should be resurrected.

Chapter 8 addresses 'long-term planning' to meet water quality goals and makes reference to Chapters 3 and 6 for more detail about project design and operation. Could Chapter 8 also make reference to Chapters 2 and 5 for water quality and flow data and information that collectively describes how the system is responding to the long-term plan?

Cross-Chapter Recommendations

1. The South Florida Water Management District manages water quantities, as well as related attributes such as water quality and ecosystem health. It appears that water quantity management (i.e. water supply and flood control) are the core operations of the District. Thus, Chapter 5 presents a key description of the core function of the District. Furthermore, a number of times during the discussion in 2C there are explanations of the extreme hydrologic events and the impacts they had on P concentrations. Unfortunately, Chapter 5 is where the explanation of the hydrologic events is presented. In reviewing the two Chapters, it was necessary to read Chapter 5 first. In support of putting more logic into the sequencing of the Chapters, it is recommended to move the hydrology discussion to the front of the 2007 SFER. In other words, Chapter 2 would present the hydrology of South Florida.

2. Chapter 1B, focusing on cross cutting themes, provides an integrated overview of South Florida – an overview that is helpful in gaining a appreciation for the larger context within which many of the more specific details presented in the separate chapters. Maps that provide data summaries for the entire South Florida would greatly improve Chapter 1B's effectiveness in communicating the large picture (e.g. displaying TP mean conditions across the areas of South Florida).

3. Supporting materials (draft reports, websites, etc.) referenced in the chapters should be checked to ensure that the information mentioned is included there, in sufficient detail to support statements made in the SFER.

A Final Word

The restructuring of the SFER over the last two years presents an opportunity not just to revise the reporting process, or to refine a tri-level review system, but to rethink how the work of the

District and all its partner agencies collaborate. In discussing ways to cross reference material in the report the Panel suggests more is needed than simply devising some type of indexing method or hyper-linking text. Cross-agency coordination is required. Priority-setting needs to be better coordinated. What the SFER can provide is an impetus to explore real cross-department or cross agency cooperation. This would mean that authors would have to be in the same room, making plans and deciding what is linked. This cannot be done artificially through the report, but the report can be a catalyst. One model of this may be the mercury program where a person was assigned to coordinate this effort across agencies. As an antithesis of this may be the invasive species (especially animal) program that, while accomplishing a great deal, appears unorganized and chaotic. What we are suggesting is a fundamental change in how communication takes place in South Florida. The CERP/RECOVER chapter may be a place to provide more information on how interagency coordination is attempted. However this effort should pervade the whole reporting process.

The balance of this final report is a chapter-by-chapter review of the *2006 SFER*.

CHAPTER 1: INTRODUCTION TO THE 2006 SOUTH FLORIDA ENVIRONMENTAL REPORT-VOLUME 1

This summary chapter is concise and very well written. The Panel continues to support the need for this chapter and agrees that the information presents “a basic understanding of the governmental, scientific, and legal context behind the 2006 SFER.” In the opinion of the Panel this chapter is of utmost importance, given the increasing level of public interest and scrutiny regarding the Comprehensive Everglades Restoration Plan (CERP). The Panel also notes the line numbering in the left margin of the entire document as an improvement as recommended in the 2005 review process.

Chapter 1A continues to serve as a “stand alone” document for many readers interested in gaining an overview of the area and its principal management issues and results of research for WY2005 without having to have an in-depth understanding scientific principles or the application of the research results in a complex management context.

Chapter 1B as recommended in the 2005 review process is also a positive development as it provides a context for the report in terms of cross-cutting issues affecting large parts of the South Florida region. The Panel found the discussion of the impact of multiple hurricanes on various parts of the region to be exceptionally interesting. The Panel feels that other cross-cutting issues should continue to be presented in future reports.

Recommendations

1. The Panel recommends that consideration be given to preparing a Chapter 1C, noting only the most important research findings. In this manner the chapter would continue to summarize the overall process (1A), plus concentrate on a cross-cutting issue(s) of great importance as well as summarize major findings, providing a comprehensive summary for new readers as well as those searching for the highlights of the previous year.

2. It may be interesting to consider the potential impacts of 100-year storm events on existing structures in particular regions of the District such as the Kissimmee. This modeling exercise may provide an interesting topic for chapter 1B at some point in the future.

3. Another potential cross-cutting issue is the relationship between water residence time in the lake and WCAs, mandatory releases to the EAA and STAs in heavy rainfall years or specific events and any increases downstream from the EAA and the STAs of water quality indicators. As release of water from the lake affects all downstream areas, it can be considered a response transect (north to south) of the entire region in response to rainfall.

4. The importance of this restoration effort cannot be overestimated. It is taking on greater importance internationally and is being cited with greater frequency throughout the world. Therefore, the Panel continues to urge that when possible data should be presented using metric scales rather than, or at least along with, English scales of measurement. In addition, consistency in units is needed throughout the Report.

5. Brief clarification would be helpful about the status of progress in restoring the natural hydrology of the Rotenberger WMA by including discharge from STA-5, including description of the quality of the water being discharged (line 192). Associated problems contributed by high nutrient concentrations and other pollutants in the inflows should be mentioned (lines 429-430). Clarification would also be helpful on biological indicators emphasized in addition to seagrasses (lines 604, 898).

CHAPTER 2A: STATUS OF WATER QUALTIY IN THE EVERGLADES PROTECTION AREA

Chapter 2A is an evaluation of water quality in the Everglades Protection Area (EPA) based on 18 water quality constituents that did not meet water quality standards applicable to the EPA (per Section 62-302.530 Florida Administrative Code); a number of pesticides that exceeded acute and chronic toxicity levels; and a summary of sulfur status and trends. Thus, Chapter 2A provides a summary of water quality 'problems' in the EPA, not an overview of water quality status, as the Chapter title implies. As the authors state in Chapter 2A, the contents are a synoptic view of water quality standards compliance in the EPA.

Chapter 2A does not address water quality in other areas of South Florida covered in the 2006 SFER. Water quality in the other areas is discussed in separate chapters. For example, Chapter 10 discusses Lake Okeechobee; Chapter 11 discusses the Kissimmee River; and Chapter 12 discusses the coastal ecosystems. In each chapter, there is a discussion of water quality. The report could benefit from an integrated overview of water quality, for key water quality constituents, such as TP. Is it possible to place concentrations of key water quality constituents, summarized for each of the major water management areas, on a map of South Florida? The reader of the SFER could then obtain an overview of water quality differences across major areas, even if the concentration estimates used on the map are uncertain. Perhaps the confidence bands could be placed on each estimate to acknowledge the uncertainty.

Chapter 2A provides a defensible scientific evaluation of water quality standard compliance using data obtained from the SFWMD's DBHYDRO database. The binomial test, employed to determine standard compliance in the EPA, was suggested by the National Research Council (2001). Where there are insufficient data to scientifically support correct use of the binomial test, appropriate modifications are made. Use of the methods with different data sets is clearly explained in the evaluation.

Explanations of the reasons for standard violations are logical. Where explanations are not readily available, the authors clearly, and correctly, note the need for further evaluation. The discussion of the constituent-by-constituent standard violations is thorough and well presented, as it has been for several years. This fact, as noted in the introduction, suggests that portions of the water quality monitoring program have reached a consistency and maturity the warrants looking for ways to reduce the year-to-year descriptions of same methods and simply report findings.

In noting that the standard violation evaluation is limited to data located in the DBHYDRO, Chapter 2A highlights the importance of the database. This limitation also raises questions about DBHYDRO. First, why are there insufficient data to support the chosen standard compliance method in some locations? The reason appears to be due to the fact that the standard compliance evaluation reported in Chapter 2A is based on 'found data' – data not collected for the purpose for which it is being used. The authors have made adequate adjustments to scientifically accommodate inconsistencies in the data available for the assessments employed in Chapter 2A. However, the fact remains that the water quality evaluation presented in Chapter 2A is assembled from available data and, thus, is based on sampling networks and sampling processes not scientifically tailored to the information goal of standard compliance. This limitation will not be a problem with the phosphorous compliance monitoring system currently being developed as it is specifically designed, as understood by the Panel, to focus exclusively on phosphorous standard compliance. Once experience is gained with the phosphorous compliance monitoring system, consideration should be given to designing and documenting the monitoring system used in Chapter 2 for all water quality constituents.

Upon closely reading Chapter 2A regarding DBHYDRO, there are assurances that the data in DBHYDRO meet a variety of QA/AC requirements, but those requirements are not explained in Chapter 2A nor are they formally referenced in the Chapter. Also, it is not clear where the data in DBHYDRO originate (from the 54 monitoring projects described on the website: www.sfwmd.gov/org/ema/envmon/wqm?). The data used in the standard compliance evaluations appear to be a subset of the total DBHYDRO data base - is this true? How are the sites selected for conducting the standards evaluation? In the past, explanations for the grouping of stations into the various categories (e.g. inflow, interior, and outflow) were provided, but this information is not cited in this report. Stations are noted on maps in Chapter 2 for the standards compliance evaluation purposes – are there stations in DBHYDRO that are not used? Is the water quality network used for standard compliance purposes defined and documented? Can the network design be referenced? Would it be possible to list formal references, linked to the report, for all the sampling and laboratory methods employed in placing water quality data in DBHYDRO? Is it possible to summarize, via a list, the different sources of water quality data in the database and that subset employed in Chapter 2A? If this information is already available, can it be referenced and linked to Chapter 2A? Can the standard violation evaluation network design be referenced? Having the above cited information readily linked to the Chapter will be necessary to streamline the Chapter in the future.

The methods employed in analyzing data for the standard compliance evaluation appear to be used consistently and, if not, changes are noted and accounted for in the conclusions presented. Assumptions, where they could potentially impact findings, are noted. For example, the assumption of a constant exceedance rate is noted on page 2A-13. It is not clear that data evaluated in Chapter 2A are consistently handled (e.g. how are outliers and non-detects addressed?) in the same way that data used to evaluate water quality in Chapters 10, 11, and 12. This could create problems when water quality data, from the different areas of South Florida, are placed on the same map.

Given that WY2005 was a very unusual year in South Florida (four hurricanes and yet below average rainfall in South Florida), the Panel wonders if the assumption of a constant exceedance rate was valid for WY2005? Chapter 5 presents a picture of a seven-week period of intense rainfall preceded, and followed, by very low rainfall. This rapid swing between wet and dry conditions has the potential to impact standard compliance; however, there was no discussion of the strange hydrologic year on water quality standard compliance in Chapter 2A. There is a discussion of this situation in Chapter 1B. Also, Chapters 10, 11 and 12 describe water quality impacts of the extreme climatic conditions.

In Chapter 2A there is reference to violations occurring where there was no flow at a station (e.g. specific conductance at sites F1, F2, and F3 – line 546) which may have been caused by the unusual hydrologic year, but this fact was not mentioned in Chapter 2A. Is it possible to discuss implications of the unusual WY 2005 hydrology to the standard compliance assessment? Chapter 1B indicates there were not many implications - why? The standard compliance trends presented do not appear to reflect much, if any, impact from WY2005 extremes. This seems unusual, especially given the impact the extreme hydrology had on phosphorous concentrations, described in Chapter 2C. Given the emphasis on the extreme hydrology condition during WY2005 in other parts of SFER and the lack of mention in Chapter 2A, some explanation is warranted.

Conclusions

1. Chapter 2A continues to employ a consistent, scientifically sound, data analysis process to evaluate water quality standard compliance in the Environmental Protection Area.
2. As with many current efforts in the U.S. to evaluate standard compliance, questions arise regarding the quality and appropriateness of the data used. It is not easy for the Review Panel to check documentation regarding the source of the data used, why the data are selected, and the QA/QC methods employed to insure scientifically sound data.
3. The extreme hydrologic events of WY 2005 do not appear to have had an impact on water quality standard compliance in the EPA. Given the impacts elsewhere in South Florida, an explanation of the lack of impact is warranted.
4. Water quality evaluations in the 2006 SFER are not integrated across South Florida. Rather they are presented management-area-by-management-area.

Recommendations

1. The data used in evaluating standard compliance in Chapter 2 needs to be better defined and documented (e.g. why are the data used in the evaluation selected from all that is available and can access to QA/QC methods be made easier?).
2. If a complete monitoring design, that provides the data employed in Chapter 2A, was available and easily referenced, it is possible that much, if not all, of the methods sections in Chapter 2A could be eliminated, thus streamlining the chapter.

CHAPTER 2B: MERCURY MONITORING, RESEARCH, AND ENVIRONMENTAL ASSESSMENT IN SOUTH FLORIDA

This year's chapter is an excellent overview of the mercury problem in the Everglades, how mercury interacts with nutrients, how concerns about the environmental problems in the Everglades have been addressed, on-going research with biota and mercury, and the new initiatives to understand mercury cycling. It clearly delineates the major problems, and what new research is needed to understand how to reduce mercury levels further, particularly in fish. The data, models and conclusions in Chapter 2B reflect the complex problem as faced by many agencies dealing with mercury in freshwater ecosystems. The data generated are proving useful for other aquatic ecosystems throughout the United States, and the rest of the world. In many areas, the mercury research program is a leader that is providing testable paradigms for other aquatic systems. The summary is excellent, and hits the high points. It continues to be a productive collaboration between different agencies in understanding the complex issues of mercury cycling, fate and effects within the Everglades.

The authors are to be commended on writing a chapter that is very readable and accessible to a broad range of readers. It is written in a style that can be easily followed, and that makes the main points clear. This year's summary will be particularly useful to a wide range of stakeholders, including those new to the Everglades process, although there should be more references to where naive readers can find the full documentation for some of the past conclusions and research. Further, the report makes the data readily accessible to scientists not previously familiar with the Everglades. They have effectively used Bass and Great Egrets as bio-indicators of mercury exposure, and have one of the longest running such data sets in the country from one region. The chapter accurately and fairly reflects the state of the knowledge about mercury fate and effects in wildlife.

Unlike many models addressing the fate and effects of mercury, the Everglades Mercury Cycling Model is dynamic and makes use of additional data as it becomes available. This is a key point that will increase our general understanding of mercury cycling. The suggestion that further modeling is required to understand how to reduce mercury still further is a move in the right direction.

The "previous findings" in the summary is particularly useful to provide an overview of the past mercury cycling and effects research conducted as part of the SFWMD work and reports. It highlights the critical issues and findings, especially noting the role of new atmospheric depositional mercury, the role of drying events, and the long-term trends of mercury in bass and wading birds.

The summary section on new findings is helpful to a wide range of stakeholders, from the scientist to the general public, and highlights key issues of concern for the rest of the report. One issue identified is the importance of tracking potential mercury hotspots (even while the mercury In 3A-15 has declined). The high mercury levels in Everglades National Park continue to be a problem that requires additional, targeted research. This clearly illustrates the importance of continued mercury bio-monitoring throughout critical areas of the Everglades system. This bio-monitoring should continue since it forms the basis for many management and research protocols. The continued high levels of mercury in bass suggest the importance of toxicokinetic modeling of mercury bioaccumulation in the fish themselves, including uptake and bioavailability.

Key issues for the mercury research program continue to be the need to understand the spatial pattern of mercury deposition and methylation, along with the failure of mercury levels to drop in Largemouth Bass. This problem is a more general one to some aquatic systems, and every attempt should be made to further understand this pattern.

Research Progress

This year's research progress report is a little brief, without providing enough details on the research itself. The methods of dosing birds require more explanation, since individual birds eat different amounts of food, and thus can acquire different doses of mercury. Should breast feathers be regularly taken to provide some indication of overall dose over the years for individual birds? Similarly, the way the atmospheric mercury studies will be supported is not clear, but this is an important and critical aspect of the overall plan. Any planned research to understand the relationship between mercury levels and sulfur are critical for understanding the Everglades at this point.

Trends in Atmospheric Deposition of Mercury

Understanding the atmospheric deposition of mercury is particularly important given the role of "new" versus old mercury in the cycles of mercury. Further, understanding mercury dynamics within the system (as opposed to from external sources) continues to be a critical component of understanding mercury in biota. The role of atmospheric deposition on Everglades lands in a dry-cycle should be addressed, and the relative effect of changes in the frequency of this wetting/drying cycle should be explored.

Mercury in Fish

Understanding mercury trends in Everglades fish is one of the key bio-indicators for the Everglades, and continues to be particularly important. Such information is necessary not only for understanding (and managing) the risk to fish consumers (both people and other wildlife), but risk to the fish themselves, as well as ecosystem dynamics. The group is to be commended on continuing this program.

A fuller discussion of the EPA 0.3 mg/kg criterion for fish should be included, along with ways to reach this goal for the Everglades. In general, no part of the Everglades system appears to be below this level. This is particularly relevant to the ENP, which continues to show high mercury levels in fish. While it makes sense that fish-eating birds and mammals are still at risk, some overall discussion of the biota particularly at risk, along with levels in these organisms should be added here. The continued high levels in ENP require additional, targeted studies, and should be explored, particularly the role of sulfate. At the least, a more complete bio-monitoring plan should be instituted for the ENP to isolate and bound the problem within the ENP.

Sulfur Pollution

The identification this year of the importance of sulfur pollution in the Everglades is an important addition to the chapter. This section could be expanded since it is a relatively newly described problem for mercury cycling. Since this dynamic is influencing mercury levels within the ecosystem, it should be highlighted with a series of studies to understand fully the dynamics. This problem affects nearly 30% of the Everglades, and requires additional study, including the development of a criterion and management goals to reach safe levels.

The problem of sulfate-induced eutrophication of the Everglades has risen to the fore only because many of the more pressing problems have been addressed. Yet sulfur pollution appears to be leading to changes in the internal mercury cycling, and to overall eutrophication of the Everglades; this has been identified as one of the critical biogeochemical cycling issues within the Everglades. The possibility of faunal effects needs to be examined, and the mechanisms and levels of effects described. The role of sulfur in phosphorus releases should be integrated into the modeling efforts for the Everglades.

The relationships between mercury and sulfur, in both surface waters and pore waters should be explored, both in the text and in figures that are easily interpreted. Partly having a table with mercury concentrations (as well as organic carbon concentrations) by area would help integrate sulfide and sulfate data already presented.

Finally temporal trends in sulfate levels in the Everglades generally, and sulfur/mercury problem has changed over time.

Future Directions

This year's mercury chapter clearly delineates not only past findings, and current research findings, but outlines the mercury program for the future. The major issues remain high levels of mercury in fish, possible effects on wading birds, and the overall cycling of mercury in the Everglades. This requires a series of small scale (internal dynamics, species-specific studies) as well as larger scale mercury modeling (third generation analysis of mercury transport and fate). These studies are essential to both our understanding of mercury dynamics within the Everglades, and to the maintenance of healthy animal populations. This will also require studies on particular problems, such as the high levels of mercury in the ENP, the high levels of mercury in fish, and the possible effects on wading birds.

The identification of mercury in coastal waters is an important new direction, particularly since the waters of the Everglades flow into the coastal systems. Understanding the dynamics of this interface are critical not only for the Everglades, but for the coastal ecosystems of South Florida.

Conclusions

1. Recently, the role of sulfur in mercury cycling has been recognized, and needs to be monitored and integrated into mercury management.

2. The long-term data sets on mercury in bass and wading birds are important and invaluable monitoring dada for the Everglades, and should continue. However, a similar monitoring plan for sunfish and other prey fish would be helpful in understanding the patterns of these higher trophic levels

3. Devote resources to study the eutrophication of the Everglades, particularly the sulfate-induced eutrophication.

4. There is a clear need to synthesize the relationships between nitrogen, phosphorus, sulfur and mercury in the Everglades system (this task relates to the Everglades researchers in Chapter 6).

Recommendations

1. The long-term data sets on mercury in bass and wading birds are important and invaluable monitoring data for the Everglades, and should continue. However, a similar monitoring plan for sunfish and other prey fish would be helpful in understanding the food web relationships that lead directly to higher trophic level mercury concentrations.

2. A micro-emissions inventory of South Florida should be encouraged.

3. Increase studies aimed at understanding further the relationship between sulfur and mercury concentrations, including the plotting temporal patterns of sulfur.

4. Devote resources to studies of the eutrophication of the Everglades, particularly the sulfate-induced eutrophication.

5. The research reported should clearly state the hypotheses being tested, the methods, the expected outcomes, and how it will help manage the Everglades system.

CHAPTER 2C: STATUS OF PHOSPHORUS AND NITROGEN IN THE EVERGLADES PROTECTION AREA

Given the critical role phosphorus plays in the Everglades ecosystem, the constituent has been singled out for the establishment of a site-specific numeric phosphorous (P) criterion for the EPA. Thus, Chapter 2C is an update on P criterion development as well as an overview of the status of phosphorous and nitrogen levels in the surface waters within the EPA during WY2005.

A phosphorous (P) criterion has been proposed for the EPA, debated and reviewed extensively, and finally approved by the U.S. Environmental Protection Agency in July 2005. The criterion includes an assessment methodology that carefully and logically defines a violation of the criterion, given the current understanding of the role of P in the Everglades ecosystem. A monitoring program is currently being designed to implement the P criterion assessment.

The evaluation of P reported in Chapter 2C applies only to the Everglades Protection Area and not the other sources and sinks in the larger South Florida environment. The status of P in other South Florida areas is described in separate chapters addressing the specific areas (e.g. Chapter 10 discusses P in Lake Okeechobee).

The status of P levels reported in Chapter 2C does not address whether the new P criterion is met since the new criterion assessment methodology is tied to a specific monitoring program design which is not yet operational. However, the P assessment reported in the 2006 SFER utilizes some of the provisions of the criterion as a basis for the evaluation. The effort of Chapter 2C authors to bridge the annual P assessment, using previous methods, to the new P criterion methodology is helpful and appreciated. The opportunity to examine the results of Chapter 2C, using some provisions of the new criterion, assist in understanding the challenges facing those designing the P monitoring program. For example:

1. The 32 percent of sites over the entire EPA are at or below 10 µg/L. This fact indicates that the current sample site locations, included in the 2006 update, emphasize areas with high concentration of P (relative to the monitoring program that will determine criterion compliance in the future).
2. On page 2C-21, it is noted that WY2005 P concentrations across all areas and classes of sites were higher than those for WY 2004 and were within the range exhibited during the historical record.
3. The two observations above indicate the importance and sensitivity of future P compliance to the design of the P monitoring program to check compliance with the new P criterion.
4. Given the comparison of P levels with historical trends, will the stations in the new P monitoring program include some existing stations, to take advantage of historical trends, or will they all be new stations?

The data used in Chapter 2A and 2C come from two separate databases: DBHYDRO and the SFWMD's Everglades Research Database. What is the distinction between the two databases? Is DBHYDRO storing only operational data while the research database stores all research data, or does the research database store only data from the nutrient gradient sampling stations? Is there an explanation of the SFWMD data storage and retrieval strategy available for review?

The explanation of the extreme hydrologic events of WY2005 on P concentrations and trends is well done and helpful.

The TP loads to the EPA during WY2005 are noted as being significantly lower than the 1979-1988 baseline period (lines 632-634), yet the loads to the Refuge during WY 2005 are 252% greater than the previous year (lines 653-655). Did reductions in loadings between 1988 and 2004 cause the differences in the above two statements?

Appendix C of the Settlement Agreement identifies several assumptions expected to reduce 80% of TP loads from the EAA to the WCAs (lines 592-597). Would it be possible to develop a table that concisely states progress on each desired performance result, using P concentrations and place this in a summary Chapter, such as Chapter 1B? This would streamline conveying the information regarding load reductions.

At several places in Chapter 2C there is a statement that future evaluations of P status in the EPA will result in an expansion of Chapter 2C to provide a more detailed evaluation of P levels in the EPA, consistent with the requirements of the final criterion rule. Question 5 in the Peer Review Panel's Statement of Work requests guidance on how to optimize the reporting process and maintain value at minimal cost. Thus, the question arises – is it possible to include in the new P monitoring program design a carefully developed, streamlined method for reporting the resulting information about P criterion compliance – with reference back to the design for an explanation of the methods used? It appears that the extensive efforts behind developing the P criterion produced well developed and documented protocols for defining criterion compliance. Such specificity permits automation of data analysis, interpretation, and reporting of compliance, thus possibly reducing the staff time required to prepare a future Chapter 2C. There is still a need for the staff to interpret the violation findings, but more time can be devoted to this very important interpretation task if time explaining the more routine tasks that can be automated and easily referenced (e.g. linked to the Chapter). Furthermore, the monitoring design could be peer reviewed further insuring that the automation of the process is well grounded in science and is well understood and transparent. This would, then, reduce the need for an annual peer review of the P status in the EPA. (The P compliance monitoring design could be presented at the 2006 National Monitoring Conference in San Jose, California, thus providing professional input and a form of peer review.)

If the above streamlining of P reporting could be achieved, perhaps the need for a separate nutrient sub-chapter in the SFER could be eliminated.

Conclusions

1. Chapter 2C updates the reader on development of a site specific P criterion.

2. Since the P criterion was approved in July 2005, the required P compliance monitoring system has not been designed or implemented, thus it is not possible to perform a P criterion assessment in the 2006 SFER.
3. The authors of Chapter 2C do provide a current update on the status of P in the EPA using elements of the new P criterion and this effort is appreciated as it provides insight into the importance on the monitoring design effort currently underway.

Recommendations

1. The new P compliance monitoring design should be thoroughly documented, including sampling methods, laboratory methods, QA/QC, data storage and retrieval, data preparation for analysis, data analysis and interpretation methods, and reporting formats.
2. With such documentation, it will be possible to streamline future Chapter 2C to include only the results – the monitoring methods and protocols can be linked to the chapter for those seeking to review the science behind the assessment.

CHAPTER 3: SOURCE CONTROLS IN BASINS TRIBUTARY TO THE EVERGLADES PROTECTION AREA

This chapter provides a summary of the progress being made in controlling phosphorus in discharges tributary to the Everglades Protection Area (EPA). These controls are to meet permits issued by the Florida Department of Environmental Protection (FEDP) for these discharges. These permits are part of the Everglades Construction Project (ECP) and the non-Everglades Construction Project (non-ECP) permits. Each permit incorporates a comprehensive approach for controlling phosphorus at the source utilizing regulatory, voluntary, and educational programs.

The ECP permit requires that a Best Management Program for total phosphorus (TP) control be implemented in the Everglades Agricultural Area (EAA) and the C-139 basins, the two largest tributary sources to the EPA. The eight non-ECP basins, the remaining basins discharging to the EPA, have voluntary or cooperative source control programs and discharge directly to the EPA

Significant progress (greater than 50 percent reduction in total phosphorus annual percentage load) has been made over the 10 years since the programs initiation in reducing phosphorus loads leaving the EAA with the implementation of BMPs, and based on this report and previous SFER reports, the District appears to be continuing an aggressive program to reduce phosphorus loads as needed to meet regulatory provisions. In C-139, the goal has been to maintain total phosphorus loads at or below baseline levels, and in the three years since the programs initiation the basin has been out of compliance. However, in WY2005 the TP concentration was below 200 ppb for the first time. It is anticipated that the BMPs implemented in this basin in the past three years are beginning to show effects.

For the eight non-ECP basins, the discharge permits require schedules and strategies for maintaining water quality standards taking an adaptive approach. Although other water quality constituents than TP are monitored in the discharges from these basins, TP is the constituent of interest and is a concern in two of the basins, a potential concern in four of the basins, and of no concern in one of the basins.

Several specific issues are of interest, namely, monitoring consistency, BMP “equivalents,” and sources of phosphorus. Regarding monitoring, a concern was raised about compliance monitoring in the EAA with the removal of almost 50 percent of the sampling sites because of hydraulic alterations to the drainage system. Retaining consistency from year to year so that estimated TP loadings reflect actual changes in the system rather than changes in the monitoring is the issue.

The BMP “equivalents” program continues to be an innovative way to provide incentives to BMP implementation to achieve necessary phosphorus load reductions, and it is maturing with use and experience gained through application. Further, the District has mounted a research program to determine the effectiveness of BMPs for phosphorus control so that the scientific basis for future decisions is strengthened.

As suggested in the reviews of the 2004 and 2005 SFERs, the District has added information about other sources of phosphorus in the source basins and phosphorus control activities for them. This information is helpful to understand the major and minor sources of TP and the priorities for dealing with them.

Conclusions

1. TP control via BMPs in the EAA for the past 10 years is proving to be effective, and a key part of that effectiveness is the innovative BMP “equivalents” system devised to encourage voluntary TP controls but backed by the discharge permit requirements. Continued efforts to determine BMP effectiveness and education of those implementing the BMPs are keys to overall TP removal success in the EAA.

2. TP control in C-139 using BMPs over the past three years has not yet been shown to be effective, and continued attention to BMP effectiveness in this basin will be needed. Again, continued efforts to determine BMP effectiveness and education of those implementing the BMPs are keys to overall TP removal success in C-139.

3. Phosphorus control in the non-ECP basins, though dealing with small loads compared to the EAA and C-139, are showing good progress in some basins and not in others. Understanding the contribution of each TP control method within each basin to overall TP removal will be important to lowering TP loads leaving these basins to desired amounts.

Recommendations

1. While the BMP “equivalents” provide an innovative basis for BMP implementation, the Panel recommends that the “equivalents” assigned to each BMP be reviewed periodically in light of additional experience gained with and effectiveness found for each BMP.

2. The Panel recommends that more information be provides so that the calculations that result in the data presented in Table 3-6 can be replicated. For example, the Three-Year Average Phosphorus Load % Reduction is apparently not based on the WY Annual Calculated Phosphorus Load % Reduction, and it is not clear how is it calculated. How is the three-year averaging done – is it a simple or weighted three-year average? Does the average represent the current and previous two years, the current, previous, and next year, etc.? Is the average flow-weighted? More elaboration (including equations as appropriate) in the text for these calculations is needed, and this can be presented in an appendix.

3. The Panel recommends that explanation be added that will clarify how the predicted TP loads given in Tables 3-7 and 3-12 are calculated? Again, equations would help.

4. The Panel recommends that information from the audits performed by FDEP on the various laboratories performing laboratory analyses be provided so that some QA/QC statistics can be calculated. For example, what is the distribution of laboratory performance on known constituent standards such as TP? What percent of the laboratories do not meet QA/QC

requirements of FDEP? For laboratories that are out of compliance, what action is taken by FDEP to bring them into compliance?

5. Achievement of very low TP levels is very difficult, especially for storm water flows which are high and which generate high particulate and hence high TP concentrations. At some point, the desired levels of TP will be achieved or the District and FDEP will have to decide whether such low TP concentrations are achievable and at what cost. The Panel recommends that some thought needs to be given to the basis for making such a decision.

6. The Panel recommends that information be provided that speaks to monitoring consistency from year to year so that estimated TP loadings reflect actual changes in the system rather than changes in the monitoring is the issue.

7. The Panel recommends that more attention be paid to a whole body of work in “sustainable agriculture.” The USDA’s Sustainable Agriculture Research and Education program (SARE), and particularly its Southern Region program, is a valuable source in accessing this literature. This work could better inform the BMP program.

CHAPTER 4: STA PERFORMANCE, COMPLIANCE AND OPTIMIZATION

This chapter is a well written factual description of the performance, compliance and optimization of the STA. The general performance of the STA in removing P loading is very good. That is, operation of the STA has been a success in that P has been effectively and continuously removed from the water column and stored in the sediment. The central questions need to be answered now are: What is the main mechanism responsible for the P removal process of STA? And can this P removal process be continuous and effective on a long-term basis? As the experience of operating the STA grows, more data critical to the answers of the above mentioned questions should be available for analysis.

Some descriptions of the STAs need to be clarified. E.g., both STA-1W and STA-2 are in "stabilization phase" but the STA-1W is "partially functional" and the STA-2 is "fully functional". Does stabilization phase have anything to do with the functionality? If it does, what is the relationship? The STAs are dynamic systems: They change functionally and structurally over time. Those changes are important attributes of the STAs and need to be described accurately along with the discussion on relationships between structural change and functional change of STAs.

Other than P, emerging issues such as sulfate and its relationships to Hg bioavailability and P release need to be addressed in more detail in the chapter.

Recommendations

1. The success of STA indicates that the engineers involved must have done something right in the design and operation of the STAs. A discussion of the philosophy and hypothesis of the design and operation of STAs would be helpful information.

2. Addition of public education and out-reach components to the STA is definitely a plus. Public needs to know their tax dollars are well spent. Children and adults need to be educated in terms of environmental protection and conservation. STA is a unique and great educational show case of ecosystem restoration. More effort should be put in this out reach component. The Panel is aware of some student training programs initiated by the District. The effort is commended and all these may be reported in the chapter.

3. Reference to web sites in the report is a significant improvement of this year's report. Cross referencing among the chapters needs to be strengthened in the future. Meaningful cross reference could be done by author's selective editing of an appropriate cross referencing list.

4. There seems to be a "disconnect" between data that shows large inflows of P into the STAs and what is shown in Chapter 3. More coordination between the two programs is necessary. A resurrection of the TP flow map from previous years is suggested.

CHAPTER 5: HYDROLOGY OF THE SOUTH FLORIDA ENVIRONMENT

Chapter 5 presents an excellent overview of South Florida's hydrology for WY2005. The year's extreme hydrologic events challenged the authors of Chapter 5, but the description is well developed and documented.

Four hurricanes impacted South Florida in WY2005 but the average rainfall was below average! The timing of the rainfall varied greatly over the year and District area.

Where can a reviewer gain access to documentation for the SFWMD hydrometeorologic monitoring presented in the report, noted to be included in a report by Crowell and Mtundu (2000)? The title of the reference is noted as being QA/QC, not a full monitoring program design, thus the question. Is the hydrometeorologic monitoring design based on regulation schedules (line 1121-1123) that guide operation of the pump facilities? Has the hydrometeorologic monitoring design been peer reviewed? Does the design describe the monitoring network (measuring where, when, and how)? Or are there multiple designs? In other words, does each project operate with its own hydrometeorologic network?

Why are the outflows of Lake Okeechobee for WY 2004 and 2005 so much above average (2,832,700 ac-ft and 2,617,958 ac-ft, respectively, compared to the historical annual average of 1,445,558 ac-ft) when the rainfall for WY2004 and WY2005 is close to average? Is it due to the timing of the rainfall over the water year?

Chapter 5 does not connect its description of South Florida's hydrology to the water supply, flood control, and ecosystem health goals. For example, did the ENP flows in WY2005 satisfy the 'Rain-Driven Water Deliveries Plan'?

In the spirit of streamlining the 2007 SFER, the authors of Chapter 5 have reduced their descriptions to current data and findings. It is hard to see how Chapter 5 could be reduced further and still achieve its information goals. However, there are graphing devices that might help convey water flow information more concisely, such as the snake diagrams denoting flow volumes between areas of South Florida where the width of the snake indicates flow volume. There also may be some background hydrology explanations that could be removed to a common location if they were readily available on the web, thus shortening the descriptions.

Conclusions

1. Chapter 5 presents a compelling description of the extreme climatic conditions and resulting hydrological reaction that occurred in WY2005.
2. The description would benefit from more 'connection' with the management goals of the District in meeting water supply, flood control, and ecosystem goals. For example, did the hydrology meet the Park's Rain-Driven Goals during WY2005?

Recommendations

1. Since the South Florida Water Management District has as its core mission to supply water and provide flood protection, would it be possible to organize future versions of Chapter 5 around meeting water supply, flood control, and ecosystem goals? All chapters, in the view of this reviewer, should connect the information derived from their science to management goals and purposes.
2. The design of the hydrometeorologic network should be documented and made easily accessible so that it is not necessary to repeat the network description each year.

CHAPTER 6: ECOLOGY OF THE EVERGLADES PROTECTION AREA

This is an extremely useful chapter, much improved over last year. It could be further improved by making the connections to the CERP clearer for each project. Overall the chapter is clear and concise, and addresses the concerns raised in the 05 report. In response to comments from the 05 report, there is substantial documentation (citations) to previous work. There is still a need to relate the specific research to the goals of CERP - how are the data used in short and long-term goals? How are data used in the "weekly" management meetings? What operations depend on ecological data?

The restoration of the Everglades has as a primary objective the establishment of an ecosystem with appropriate structure and functions. One goal of restoration was to restore, to the extent possible, the natural hydrology of the Everglades, which in turn would restore appropriate structure and function. The SFWMD operations, regulations, monitoring, and science are directed toward restoring the Everglades within the human-dominated South Florida ecosystem, including understanding and managing the hydrology, ecology, nutrient cycling, and contaminant patterns. The ecology research group conducts studies on wildlife ecology, plant ecology, ecosystem ecology, and landscape ecology within a framework of the hydrology of the Everglades. The organization of the last several reports around these four topics has resulted in continuity and allowed building on previous studies to understand the Florida Everglades.

This chapter summarizes their on-going work in these disciplines. The overall research program is excellent, and the studies are important to improving understanding of the function and structure of the Everglades. The authors are to be congratulated on an excellent series of studies, and on their attention to all levels of biological organization from individuals to landscape issues. Understanding the natural ecological processes in the Everglades is an extremely important aspect of the overall work, particularly since so many of the chapters address contaminants and other human-induced changes, or management aimed at correcting anthropogenic forces. Basic ecological work is now essential to understanding the structure and function in its pristine form.

Further, their continued interest in designing experiments within each discipline to move the science and management further along is to be commended. This scientific strategy leads to adaptive management whereby experiments move the science forward at the same time as answering mechanistic questions that can be used for planning and management. The addition of 31 bench markers is an important step forward and will provide a method of examining a whole range of ecological questions that should be explored more fully now, at the beginning.

Ecology by its very nature involves complex interactions, making it difficult to demonstrate clear-cut cause and effect relationships. Thus, the SFWMD approach of addressing particular indicators of the health of the system is appropriate, although a full description of this rationale would help (this information is in previous reports, but difficult for someone to find as it is in several places). Since it is not possible to examine all species, species assemblages, and processes, indicators must be selected for examination and monitoring. Five key indicators are examined in some detail in this chapter: hydrological patterns for 2005, wading birds, prey species for wading birds, flood tolerance of tree seedlings, tree islands, and soil mapping. Restoration of the Rotenberger Wildlife Management Area continues to be a key project.

Since hydrology is the underlying driver for many of the ecological processes in the Everglades, it is described in some detail. Wading birds were selected because they are top level predators, are visible, of interest to the public, and can be observed and studied in the field and in the laboratory. Further, a long-term data set for the Everglades provides the opportunity to evaluate long term effects of hydrology. Experiments and data collection to understand the prey base for wading birds provides another level of understanding of the effects of hydrology on wading birds. Seedling tolerance to flooding is a key factor for ecosystem management. Tree islands are important features of the Everglades that must be preserved and re-established, and further examination of elevation and hydrology will help predict future tree island presence and ecology. Finally, understanding soil types is a critical component of the hydrology and ecology.

The summary and introduction of Chapter 6 are well-done, and provide both an excellent overview of the research, as well as an introduction to the details that follow. While the summary states that the research relates to SFWMD operations, regulations, permitting, environmental monitoring, Everglades Forever mandates, and CERP, it is not clear how. It would be useful to know how the data from the ecology group is used in the "weekly" management meetings and decision-making.

Within the summary of each research section, it might help to give the reasons for the findings. For example, why (in one sentence) did wading birds decline? Explaining the relationship between some variables would help - such as explaining the relationship between non-indigenous fish/indigenous fish and wading bird foraging. Providing maps to illustrate both where particular studies are being conducted, and where changes are occurring would be useful. Finally, additional information on statistical analyses, and ground-truthing would be appreciated.

Wildlife

This year’s wildlife section not only focuses on numbers, dispersion, and nesting success of wading birds, but begins to explore the underlying mechanisms of dispersal and success. Three topics were examined: crayfish habitat selection by water levels, distribution of macro-invertebrates in hard and soft water marshes, and non-indigenous fish. All are critical to understanding wading bird ecology and the group is to be commended for this research. Another aspect that should be explored in the future is the causal relationship between indigenous and non-indigenous fish (i.e. are the non-indigenous fish filling different niches or taking over those of the indigenous fish).

Wading birds have always been a key indicator group for the Everglades, in the minds of scientists, regulators, and the general public. Further, there is extensive data for the East Coast on wading birds which provide a context for populations changes. Nesting waders, and their reproductive success, are used as indicators of the progress of the Everglades restoration effort, and will continue to do so in the future. There was a general decrease in the number of waders nesting in the Everglades, partly because of poor foraging conditions in the water conservation areas. What is meant by poor foraging conditions needs to be clearly defined, and the presentation of "foraging conditions" in other years is necessary for evaluating the current poor conditions. Although there is clearly a relationship between these factors, the relationship should be more clearly examined. The timing of the apparent switch of nesting wading birds (White Ibis) from Alley North should be correlated with increases elsewhere to examine the question of movement - incorrect estimates of the number of nesting waders is a problem for understanding the effects of long-term status and trends.

The study of dispersal of crayfish is an excellent beginning to understanding the mechanisms of how hydrology impinges on ecology of wading birds. The study is well designed, with clear objectives and methods. The question of the threshold or lag-time between the movements of crayfish from the ridges to the sloughs is critical to understanding their availability to wading birds, and should be explored further with research. The implications of this study should be described, as well as plans for integration into management. The group is to be commended on this study; it is well-done and leads to further research questions (which could be mentioned briefly).

The study of macro-invertebrate use of soft and hard water marshes is also an important potential factor in wading bird success and dispersion. However, the factors entering the PCAs are unclear, making it difficult to interpret the findings. For example, what is the effect of nutrients? status. At the least, nutrient status should be considered in the models to be sure that changes are not merely nutrient-based. Since this is a new research area, it would help to put the studies from the Everglades within a broader context of findings from other freshwater ecosystems (with appropriate references).

Finally, the study of non-indigenous fish is important, and should be continued into the foreseeable future. It is critical to understand the relationship between weather variables, hydrology, and non-indigenous fish not only for understanding wading bird ecology, but also for fish ecology and the ecosystem in general. This would be an excellent bioindicator to add to the SFWMDs suite of indicators for the Everglades. Some consideration should be given to how these data could be used in monitoring, management, or in understanding the effects of water management regimes.

Plant Ecology

Plants are the critical base for the Everglades ecosystem, and thus should be a very important component of all ecological studies. The experiments undertaken in this section are excellent, and are aimed at understanding the factors that contribute to tree island health and well-being. The two main projects include 1) tree island seedling studies, and 2) plant distribution on tree islands. Both are important to understanding the functioning and structure of the Everglades. Restoration of tree islands in the Everglades is important for overall functioning of the Everglades, and for many different species groups of animals. While the susceptibility of seedlings of tree island species to flooding is a critical series of studies, the overall objectives should be more clearly stated, as well as the length of the study and plans for field experimentation. The rationale for selection of species for study should also be included (perhaps in a table). The possible use of conditions on tree islands as bio-indicators of hydrology and hydrological impacts should be explored.

Ecosystem Ecology

As studies of the Everglades mature, considerably more attention is understandably being devoted to ecosystem and landscape studies. This reflects an increase in our knowledge at the individual and population level, and is an indication of a maturing research program. Major topics of this section include hydro pattern restoration downstream of STAs, Rotenberger WMA, and Tree island ecology. Understanding the complexity of both structure and functioning of the STAs and tree islands is critical for Everglades restoration. The relative importance of tree islands in phosphorus cycling should be explored.

The Rotenberger Wildlife Management Area has been the focus of study for some time, and is now experiencing an improved wet-dry season cycle that more closely resembles a natural hydrology. The plant composition has changed, but requires considerably more time to understand the nature of the changes. Wetland plants persist indicative of a high nutrient condition and information on the lag time for changes is critical to understanding plant ecology on the area. It is also imperative to understand the effect of hydro pattern restoration with nutrient-enriched water on changes in the ecosystems. Continued monitoring of phosphorus movement into the system is important, as is continued monitoring of the spatial and temporal extent of fires within this system.

The information on tree island ecology presented in several sections of the report is beginning to form a pattern for understanding the mechanisms of tree island dynamics. All of the previous research on tree islands and their ecology should be examined, with a synthesis treatment. Increasing the number of different parameters examined is an excellent idea. The differences in TP on different parts of tree islands are critical to our understanding, as are patterns of leaf fall and root biomass. The relative contribution of tree islands to overall TP cycling should also be explored.

Landscape Ecology

The SFWMD landscape scale work in the Everglades is landmark work that provides a paradigm for other very large aquatic ecosystems. The soil mapping in the water conservation areas will help understand the ecology of the Everglades at all levels of biological organization. The objectives, rationale, and management use of these data could be more clearly stated. The construction of 31 benchmarks is an important accomplishment that will greatly aid in our understanding of hydrology and tree island life cycles. This is potentially an extremely powerful tool to use in understanding not only tree islands, but also other aspects of the Everglades ecology and ecosystem. The goals, rationale, and future work should be more clearly examined and designed to ensure maximum use of this tool.

Recommendations

1. Relate the objectives/outcomes of each research project to the long-term goals of CERP.

2. Add a diagram showing how each project is related to the other ecological projects, and to the recovery goals of CERP.

3. Add a table showing how each project relates to SFWMD operations, regulations, permitting, environmental monitoring, Everglades Forever mandates, CERP.

4. Add a section near the beginning of the chapter that explains how data from each of the projects are being used in management decisions.

5. Model the relationship between water levels, rainfall and wading bird nesting.

6. Add a graph to the wildlife section showing the number of wading birds by management region, especially for ENP.

7. Add a graph showing the relationship between abandonment and movement of ibis from one section of the Everglades to another.

8. Add a table of the rationale for target levels of each species.

9. Continue experiments with crayfish to understand the threshold or lag-time between the movements of crayfish from the ridges to the sloughs.

10. Explore the causal relationship between macro-invertebrate dispersion and wading bird nesting/foraging areas.

11. Explore the causal relationship between indigenous and non-indigenous fish (i.e. are the non-indigenous fish filling different niches or taking over those of the indigenous fish).

12. Continue the development of an index of indigenous/non-indigenous fish as a useful bioindicator for the future.

13. Continue the tree seedling experiments.

14. Add a section on burning of the specific parts of the Everglades that shows temporal and spatial trends (perhaps related to water levels).

15. Model the physical and biological parameters that relate to tree island structure.

16. Develop a more extensive rationale and long-term research plan for the use of the benchmarks so that the same data are gathered each year on tree islands.

CHAPTER 7: UPDATE ON RECOVER IMPLEMETATION AND MONITORING FOR THE COMPREHENSIVE EVERGLADES RESTORATION PLAN

Chapter 7A: Comprehensive Everglades Restoration Plan Annual Report (CERP)

The Panel noted that this chapter is presented in a logical and manner and is well written. The link between CERP and the RECOVER programs should be clear to anyone taking the time to study these chapters. CERP goals are clearly defined as preserving South Florida’s ecosystem and providing for the water-related needs of the region – both related to improving the timing, quality, and distribution of water deliveries to the ecosystem. In order to accomplish the goals of CERP, the District must complete the land acquisition program while preparing Project Implementation Reports (PIRs), based on data collected from a host of restoration actions.

The Acceler8 program was launched in FY2005 in an attempt to catalyze existing restoration efforts. The Panel is encouraged that this effort should render tangible benefits to the Everglades and surrounding communities much quicker than originally planned. The Panel also takes note of the many efforts being undertaken and summarized in lines 46-119, and 1025-1145 of the chapter. Achieving 70% of the restoration plan’s goals by 2011 is also noted as being a very positive development.

The Panel is notes (lines 404-420) that a number of technologies and parameters considered fundamental to both CERP and Acceler8 are clearly being refined. The Panel acknowledges the statement (lines 412-413) that it is neither practical nor possible to restore portions of the Everglades to its historical condition. As the Panel has been insisting for several years, restoration is an ongoing process leading to measurable improvements in ecosystem functioning based on defined parameters. The Panel supports the efforts being undertaken by the District to improve restoration efforts (lines 416-432).

The organization of the CERP annual report into 3 sub-sections is noted by the Panel as logical. The tables for reporting sections A and B are also considered to be fundamental for monitoring implementation. Section C is reported in sufficient detail for the general public to be able to follow a specific action based on the principles elaborated (lines 741-750) in the opinion of the Panel.

The section reporting the status of program-level activities is excellent as it clarifies the status and interactions of many CERP programs. Additionally, the Panel notes the establishment of a Construction Institute (line 999) as a positive development in terms of transparency in the management of such a wide variety of programs and projects.

The maps provided to locate the pilot projects are excellent and allow the reader to gain a certain degree of understanding s to the complexity and inter-related nature of the overall restoration program.

The legal framework section of the chapter (line 1814) clarifies the relationship between a specific law and actions / projects / programs. The Panel appreciates inclusion of this material.

Recommendations

1. The Panel recommends that Acceler8 may be an interesting theme for a cross-cutting issue as part of Chapter 1, given that restoration is an overriding goal of the work of the District. One important issue is whether the state-funded Acceler8 has affected the consensus that existed regarding Everglades restoration.

2. The Panel feels that greater emphasis on public reaction to specific activities such as Acceler8 may be interesting to include in future reports. Statistically valid samples of the population of the District or the State can be accomplished without massive contracting services.

3. The Panel would welcome a brief text noting the positive effects of water conservation techniques to the overall water balance/management equation overtime.

4. The Panel suggests that talk of "getting water right" may vastly overstate the abilities of CERP (particularly given federal funding problems). One area where this is a concern is in regards to ASR's. While used elsewhere, the scale proposed in CERP is untested. Another concern is the perceived shift to water supply issues and away from Everglades restoration that is apparent in the Chapter.

5. As part of the CERP program, the Panel suggests that public surveys include questions regarding the valuation of non-market goods (i.e. environmental amenities, etc.)

Chapter 7B: Update on RECOVER Implementation and Monitoring for the CERP

RECOVER is a program to organize and apply scientific and technical information in ways that are most effective in supporting CERP activities. It links science and management in a system-wide planning, evaluation, and assessment process.

The Panel supports the adaptive management program outlined in this chapter. As understood, this strategy is an iterative one allowing adaptations to implementation of activities and management as additional information is generated. The logical process of Box 1 – Box 4 where data is gathered, integrated and passed to decision-makers is logical and consistent with the goals of CERP.

The Panel is curious as to the need for what could be construed as redundant checks to the implementation of CERP and its various components: (1) Box 4 of the adaptive management program, (2) the interim goals and targets reports, (3) the initial CERP update (ICU), (4) the performance measure consistency reviews and evaluations process and its two major components, and the other guidance documents referred to in lines 149, 154, 161, and 166. The Panel realizes that redundancy up to a point is demanded as a great deal of public money is being expended in the CERP process and that there are quite literally an infinite number of possible interactions in the complex of natural and man-influenced systems involved, but at some point it seems logical to allow the interaction of science and management to lead to the best possible decisions. To a degree, the system of checks and balances seems to be more of a bureaucratic reaction (more evaluation is better) than one of true need and efficiency.

Tables 7B-1 and 7B-2 provide excellent summary information for the reader.

CHAPTER 8: IMPLEMENTATION OF THE LONG-TERM PLAN FOR ACHIEVING WATER QUALITY GOALS IN THE EVERGLADES PROTECTION AREA

This chapter takes into account several of the important issues raised in the review of the 2005 SFER report. The chapter is well written and presents logical references to the great number of ongoing projects related to the Long-Term Plan, bringing an understanding to the complexity of this effort.

The Panel notes the progress realized in reducing P levels into the EPA, and particularly the information provided on the combined impact of on-farm source controls in the EAA and the STAs. In addition the information provided on the source controls being employed in the Everglades Construction Project. The Panel also notes that additional measures are necessary to achieve the overall Everglades water quality goal as required by 31 December 2006 by the Everglades Forever Act.

With specific reference to pre-2006 projects and whether the steps undertaken will lead to meeting the TP goal of 10 ppb, the decision to include post-2006 actions as part of the overall strategy is logical. As the report notes additional measures are likely to be necessary to achieve the Everglades water quality goal on a long-term basis. The Panel also supports the concept that CERP activities be coordinated with those related to the Everglades water quality measures, if the institutional aspects can be worked out. This coordinated process may also result in cost savings. It is the understanding of the Panel that many CERP projects are still in the early planning stages and therefore unclear as to how they will impact water quality, yet there was only passing reference to the monitoring program that will obviously have to be in place in order to be able to make specific recommendations for long-term water quality policies.

A review of the Long-Term Plan continues to raise the issues related to monitoring as a way of gathering new data and improving the Plan itself. In Sections 5 “PDE” and 8, “Operation, Maintenance and Monitoring” of the 2004 SFER the operational aspects of monitoring progress towards attaining water quality goals were noted, but neither that report nor the 2005 SFER provides insights as to how such information will be treated either legally or scientifically as implementation of new projects proceeds, in the opinion of the Review Panel. The 2006 report does little to clarify this point.

The Panel greatly appreciates the overview of the challenges to achieving long-term water quality goals and believes that even greater detail as to these issues should be included in future reports.

Recommendations

1. The Panel recommends that the commitment to public meetings to discuss this chapter be continued in the future.

CHAPTER 9: COMPREHENSIVE REVIEW OF INVASIVE EXOTIC SPECIES IN THE SOUTH FLORIDA ENVIRONMENT

This year's chapter marks a major improvement over the last year's report in that relevant and specific information pertaining to the non-indigenous invasive species control in south Florida is provided. This chapter contributes an impressive, comprehensive evaluation of terrestrial, wetland, and aquatic non-indigenous species throughout eight ecological regions, including the Florida Keys, Florida Bay and the Southern Estuaries, the Greater Everglades, Western Big Cypress, Lake Okeechobee, the Northern Estuaries East, the Northern Estuaries West and the Kissimmee River Basin. Among its major contributions, the writing represents the first complete listing with species annotations for those species either known or believed to be a serious threat to Everglades restoration efforts. The changes to the chapter such as the scorecard, the species of interest list, and the increased emphasis of animals are very welcomed. The Panel also wishes to restate its support for continued investment in research programs and control of invasive exotic species of plants and animals in South Florida, and particularly those species that directly impact the EPA. Even though the control of exotics has only become important in recent years, it is now apparent that the agencies involved in control programs are giving this a much higher priority. The Panel understands that large-scale investments in the control of exotic animal species will be delayed for a period of time. However, it is apparent that monitoring and information sharing while being undertaken at some level for all taxa, but the existing programs still fall far short of what is needed in the long-term.

Also, the authors present an inventory of many programs and their vague responsibilities of sometimes-conflicting management efforts to control non-indigenous species. Apparently, there is no one lead program/ entity responsible for coordinating the overall attempts to manage non-indigenous species in South Florida. The chapter pointed out some deficits on budgetary matters.

Without question, issues surrounding management of exotic plant and animal species affecting natural areas should be a priority. The research objectives outlined in this chapter are sound and must be understood by management as an on-going need for the foreseeable future. However, it is apparent that while the problem is understood in a general sense, the complexity and cost of proposed solutions is still not fully understood. And as the hydrological regimen and salinity levels are altered over time, new questions will be raised with relation to exotics and their dissemination that are not fully contemplated today as is intimated on page 9-4 of the 2005 SFER. Therefore we stress the long-term nature of this research effort.

Recommendations

1. To avoid misunderstanding and unnecessary questioning of financial priorities pertaining to management of exotics by the general public, the District should take a pro-active stance in educating the public.

2. A more detailed statement should be added as to the activities undertaken in WY2003 (and up to the cut-off point for new date in WY2004 for inclusion in the 2005 SFER) to control all the species noted in the chapter – either on a species basis or in general as to the progress made in realizing the overall goals of exotic plant and animal control.

3. The Panel recommends that future version of this chapter clearly indicate the protocols utilized in controlling both plants and animals and the relative success of these undertakings.

4. The Panel recommends that the District convene a meeting with principal agencies involved in the management of exotics and consider the possibility of recommending that a lead/coordinating agency be appointed.

5. The Panel recommends that species information from the STAs be included in this chapter in the future. However, the Panel is not certain as to how this would best be accomplished (STA team member or Exotics team member).

CHAPTER 10: LAKE OKEECHOBEE PROTECTION PROGRAM—STATE OF THE LAKE AND WATERSHED

General

This chapter constitutes the sixth annual report to the legislature summarizing the water quality and habitat conditions of Lake Okeechobee and its watershed, implementation activities including the status of the Construction Project, and challenges and unresolved issues. The chapter provides a comprehensive update of lake and watershed conditions from Chapter 10 of the 2005 SFER focusing on phosphorus loading and water levels. Results of recently completed research projects are presented, as well as status updates for ongoing watershed and in-lake management projects.

This is the second year that the SFER has been expanded to include coverage of Lake Okeechobee, the Kissimmee River and the Upper Chain of lakes, and coastal ecosystems in South Florida. Inclusion of these systems is a major improvement. Three major environmental challenges were identified: (1) excessive phosphorus loads; (2) unnaturally high and low water levels; and (3) rapid spread of exotic and nuisance plants in the littoral zone. The hydraulic and TP loads imposed on the lake in 2004 by the hurricanes have provided a unique opportunity to study the impacts of short-term major loads to a lake like Lake Okeechobee and the downstream impacts associated with that loading, as well as the major disruption to the biota and sediments caused by the currents generated during the large seiche created by the hurricane winds.

Nutrient loads

The eutrophication of Lake Okeechobee has received considerable study by the District, and the knowledge base about this system is strengthening. The lake continues to exhibit signs of hyper-eutrophication, including blooms of noxious blue-green algae (cyanobacteria), loss of benthic invertebrate diversity, and spread of cattail in shoreline areas.

The major portion of the chapter deals with the phosphorus loading issue to Lake Okeechobee, and the impacts of the excess P on the biogeochemistry and plant community structure in the lake. The authors state, as in the 2005 SFER, that it may take the lake 20-30 years to respond to reductions in P loads. The Panel again seeks clarification: what is the basis of that estimate? Are the authors confident that the number is accurate, or are they making the point that internal recycling may cause a substantial delay in the response of the lake? If the latter is the case, then it would be better to substitute "decades" for "20-30 years." Are effects of (likely) additional hurricanes included in this time period? The phosphorus loadings from Water Year 2005 were extremely high and directly related to the exceptional 2004 summer season that included effects of four hurricanes. During the three months from August to October, the lake received a volume of water equivalent to an average water year inflow, and 82% of the TP load for the water year. The lake water levels increased considerably and large amounts of phosphorus-laden sediments were re-suspended from the central region and distributed throughout the lake. The increase in suspended sediments was accompanied by an increase in phosphorus to historical highs that reached an average of 442 ppb in December 2004. It was unclear as to the efforts and techniques that were used to quantify the P contribution from the "large amounts of P-laden sediments that were re-suspended from the central lake."

Why did a reduction of water-column calcium occur (p.10-25)? Given that calcium is important in sequestration of phosphorus in the sediment of the lake, why is it not an option to add calcium to the lake sediment, as has been done in other regions of the world (e.g. to mitigate acidification)?

Enhanced sulfate reduction may be an important biogeochemical process exacerbating eutrophication. In field enclosure experiments by Lamers et al. (2002 *Limnology and Oceanography* 47: 585-593), for example, striking responses of freshwater marshes to sulfate were described, especially strong phosphorus mobilization after sulfate additions. Thus, sulfate may play an important role in the "internal" eutrophication process of Lake Okeechobee.

How reliable are the reported estimates of atmospheric phosphorus deposition? Are phosphorus inputs to the lake via atmospheric deposition considered "uncontrollable"?

Why is the information in Figure 10-19 restricted only to inorganic phosphorus, when the writing throughout refers to total phosphorus? What is known about the percentage of the organic phosphorus fraction that is bioavailable, of potential importance to the phytoplankton?

A major technical concern about this chapter is that water quality is virtually synonymous with phosphorus only. Widespread inundation of urban and agricultural lands has resulted not only in an increase in phosphorus runoff during and after the storms (page 10-5), but also an increase in other nutrients such as inorganic and bioavailable organic nitrogen. Yet, nitrogen is only mentioned once (page 10-31, line 388 and Table 10-1) as an important nutrient in stimulating algal growth, especially toxigenic cyanobacteria in Lake Okeechobee. In Lake Okeechobee, phosphorus is the primary nutrient limiting plant growth, but what about nitrogen? The monitoring program for nitrogen species (nitrate, ammonia, organic N) should be described. How high are the sulfate concentrations in the lake? Sulfate can influence not only phosphorus release from the sediments, but also trace metal micronutrient cycling and the methylmercury production. Increased sulfate loads originating from polluted surface water and groundwater, and from enhanced atmospheric input, are a major threat to the biogeochemical functioning and biodiversity of freshwater wetlands.

Other Pollutant Inputs

Except for brief mention of nitrogen, other potential water quality issues are essentially ignored in this chapter. For example, what about organic contaminants (herbicides and pesticides) and their impacts on lake aquatic organisms? These pollutants probably increase in runoff during/post storms.

Land application of sludge (residuals or biosolids) from a wastewater treatment plant was described as another component of the domestic wastewater stream that is regulated under the LOPA. Biosolids are supposed to be applied at agronomic rates based upon the phosphorus content. Four additional land application sites have been approved north of the lake and 15 south of the lake; and two more sites have been approved north of the lake to receive septage (solids from septic systems). Apparently FL DEP is responsible for this monitoring efforts; nevertheless, questions important to management of Lake Okeechobee remain: Is phosphorus in the leachate and subsurface flow monitored? Are pathogenic microbes in the leachate and subsurface flow, or in the lake, monitored? It cannot be safely assumed that current practices prevent substantial leachate of phosphorus or other pollutants, or contamination by microbial pathogens, in waters feeding into Lake Okeechobee unless the assumption is supported by data.

Regarding the Wetland BMP research project in Table 10-7, will long-term maintenance questions to ensure the continued function of the wetlands as pollutant filters be addressed by this project or elsewhere where constructed wetlands are used?

Regarding the dairy lagoon seepage project (p.10-68), it does not seem that only one full dry/wet annual cycle would be sufficient to determine effects on phosphorus movement.

Sediment Management within the Lake

Despite the recognized problems with excessive phosphorus, and the knowledge that the lake response to load reductions will be slow (on the order of decades), large-scale sediment management is described as impractical as an option for accelerating improvements in lake water quality (see the Lake Okeechobee Sediment Removal Feasibility Study from the 2005 Report). The lack of feasibility is attributed to the massive size of such a project, that is, the large size of the lake with widespread distribution of a relatively thin layer of phosphorus-rich sediments, and associated engineering, economic, and ecological constraints. This chapter does not contain information about the feasibility study, however, nor does it include information about evaluation of alternatives for sediment removal.

Primary Producers (SAV, phytoplankton, and periphyton)

The high water levels and high suspended sediments after the hurricanes in 2004 resulted in reduced light availability within the lake's nearshore and littoral zones that, together with the large seiche and high water, caused a significant decline of submersed aquatic vegetation (SAV). The targets for water clarity and algal bloom frequency (including quantitative information on what constitutes a bloom) need to be clarified.

In the summary of processes through which SAV influences phytoplankton biomass and transparency of the lake water (p. 10-33), information is lacking on the role of SAV as a refuge for zooplankton against predation by fish, and for small fish against predation by larger fish. Abundant zooplankton may reduce the phytoplankton biomass and consequently increase water-column transparency. The growth of phytoplankton and periphyton (benthic microalgae) can also be reduced as an effect of allelopathic substances excreted by plants such as *Chara*, the dominant submersed macroscopic plant in the lake. In addition, in their root zone, SAV can stimulate denitrification by associated bacteria.

Water Quality Modeling

While an excellent database exists for Lake Okeechobee on which to base management decisions, there is still much to learn about the lake and managing its water quality. Notably absent from this chapter is a description of a fundamental foundation of water quality management for this lake, namely, the water quality modeling that has been ongoing for many years. Simplified models such as the Vollenweider model have been applied with success for deep lakes without submerged vegetation or appreciable abiotic turbidity, but not for shallow lakes such as Lake Okeechobee with substantial vegetation and high abiotic turbidity. This model has been modified for Lake Okeechobee, however, to include coefficients for high suspended sediments. More sophisticated models such as the EPA model WASP also has been applied to the lake. Are these efforts ongoing? If various management scenarios are to be offered and tested, a series of models from the simple to the complex will be needed to evaluate the consequences of those scenarios.

Does the model being used to project long-term responses of the lake include a dynamic sedimentation coefficient, and possible interactions with declining calcium? This seems like an important point with respect to long-term prospects for restoring the lake.

Fish Populations

Fish populations are important to the lake ecosystem and to the economy of the area, and the fish community also likely affects phytoplankton and other water quality issues. Unfortunately, there is little information about fish populations in this chapter. What are the impacts of the fish community on the lake food web? Are some of these fish planktivorous (consumers of zooplankton) or herbivorous? High biomass of planktivorous fish could decrease water clarity by reducing the zooplankton populations, decreasing the zooplankton biomass, leading in turn to an increase of the phytoplankton production. Additional information on the trophic structure of the lake prior to advanced human development of the watershed would be helpful in interpreting present-day data, and in guiding restoration efforts.

Conclusions

1. This chapter presents a very helpful synopsis of activities by the District in WY2005 for the Lake Okeechobee Protection Program. It provides a comprehensive update of lake and watershed conditions from Chapter 10 of the2005 SFER, focusing on phosphorus loading and water levels.

2. This is the second year that the South Florida Environmental Report has been expanded to include coverage of Lake Okeechobee, the Kissimmee River and the Upper Chain of lakes, and coastal ecosystems in South Florida. It is a major improvement that these systems are included.

3. The hydraulic and TP loads imposed on the lake in 2004 with the hurricanes have provided a unique opportunity to study the impacts of short-term major loads to a lake like Lake Okeechobee and the downstream impacts associated with that loading as well as the major disruption to the biota and sediments caused by the currents generated during the large seiche created by the hurricane winds.

4. Information is lacking in support of important statements, such as the underlying basis for the estimated 20- to 30-year recovery period that is estimated before noticeable improvements to the lake's water quality and aquatic communities will be apparent; considerations about parameters other than total phosphorus, e.g., nitrate, ammonia, and total nitrogen.

Recommendations

1. In this chapter it is stated that it was determined that sediment removal from the lake would not be effective in reducing internal phosphorus loading and that alternative measures, like large pits dug in

the lake bottom to trap P-rich sediment material, are not feasible. Clear reference to The Lake Okeechobee Sediment Removal Feasibility Study should be included and brief description.

2. Research should address the possible role of sulfate on the mobilization of phosphate. It is known that an increase in sulfate can increase mobilization of certain nutrients, especially phosphate, from the sediments. This may be an important part of the internal eutrophication. A monitoring program for measuring nutrients other than phosphorus (especially inorganic N forms, total N) is recommended (compare to the monitor program in the Everglades).

3. Fish populations are important to the substantial fisheries on the lake, and may strongly affect phytoplankton and other water quality issues, but receive little attention in this chapter. More information should be included about the impacts of the fish on the lake food web.

4. Seepage/leachate from land-deposited sludge (residuals or biosolids) and septage should be monitored for pathogenic microbes (e.g. fecal bacteria, enterococci, *Clostridium perfringens*, coliphages) as well as nutrients.

5. Several full dry/wet annual cycles should be included in the dairy lagoon seepage project (p.10-68) in order to determine effects on phosphorus movement.

6. More connections should be made with the other chapters. For instance, the Kissimmee River is a major source of water and materials to the lake, which in turn supplies water and materials to the EPA, the St. Lucie Estuary, and the Caloosahatchie Estuary. These connections should be addressed more explicitly.

CHAPTER 11: KISSIMMEE RIVER RESTORATION AND UPPER BASIN INITIATIVES

General

The Kissimmee watershed is the headwaters to the greater Kissimmee-Okeechobee-Everglades ecosystem. The watershed encompasses a diverse group of wetland and aquatic ecosystems, including more than a dozen lakes, their tributary streams and the Kissimmee River. Major projects in the watershed are the Kissimmee River Restoration Project (KRRP), Kissimmee River Headwaters Revitalization Project (KRHRP), and the Kissimmee of Chain Lakes (KCOL) Long-Term Management Plan (LTMP). This chapter provides an update of activities within the Kissimmee watershed during Water Year 2005 as well as an overview of watershed hydrology and effects of the 2004 hurricanes. As a major source of water and materials to Lake Okeechobee and downstream ecosystems, activities and conditions in the Kissimmee basin can have substantial effects throughout South Florida. Therefore, the Panel believes that the decision, taken two years ago, to include the Kissimmee River and the Upper Chain of Lakes in the SFER report has been very important.

This chapter is well written, and provides both an overview of historical conditions, and present work. The background material presented in extremely useful in developing a picture of past anthropogenic effects. As mentioned last year by the Panel, an outline of the chapter’s contents at the beginning may help to read this chapter. It consists of many paragraphs and it is therefore difficult to get an overview.

The description of hurricane effects should include information on how effects could be managed or minimized. It is unclear how the management of the Kissimmee relates to management of the rest of the Everglades system, and this should be addressed in the introductory information. In what ways are the management options coordinated, and how do the actions in the Kissimmee affect the rest of the Everglades?

The conceptualization of parameters affecting this region, such as the effect of hurricanes on DO, is extremely useful, and can serve as a model for adaptive management. How does the low DO influence the phosphorus release from the sediments? Have there been some measurements on the possible higher release of P (pp. 11-49)? Also, denitrification may increase.

How deep were the sites where DO data were taken (mean depth, ranges)? Why was DO monitored at only one depth (1 m)? Also, what time of day were the DO measurements taken? A serious limitation of the monitoring design is that monthly data, and data collected during the light period, are insufficient to detect DO sags, which are important in controlling the survival of aquatic life.

The 10-year storm event for flood control of the Kissimmee Basin seems much too short, given changing land use, climatic conditions and possible global warming events. The role of increased runoff due to urbanization seems to require extensive modeling and data collection. There is an excellent discussion of the factors affecting hydrology of the Basin, and could be more information about possible solutions or co-management options.

Establishing evaluation programs is extremely important to the overall project, and the care given to this aspect should be commended. This is one of the few restoration projects that have included evaluation as a part of the project, including the establishment of performance measures. A key element is monitoring the effects of the restoration method, that is, how does the methodology employed in the restoration impact the system?

The use of reference streams to evaluate conditions in the Kissimmee River is an extremely important aspect of the study, given that no historical information exists. It would be useful, however, to include a table with a matrix of the evaluation measures that are going be used to evaluate progress. The authors are also to be congratulated on strong use of supporting references in documenting various aspects of the system.

The inclusion of stakeholders in the plans for the Kissimmee Chain of lakes is an excellent idea, and will provide a mechanism for many end users to obtain the necessary information to understand both the biological and human dimensions of the system. It may also help to involve stakeholders in the development of brochures and performance measures.

Was only one control site monitored per study, and if so, why (lines 1020-1021)? Additional information about the reference streams would also be helpful (p.43).

Are data available on the phytoplankton (abundance, dominant taxa)? And, were these phytoplankton (i.e. true potamoplankton, characteristic of large, slowly flowing lower river systems) or suspended microalgae?

The interactions between water-level management and *Hydrilla* control in the lakes should be better described. What are plans for control of *Hydrilla* in these lakes? How will future management of water levels in the lakes affect *Hydrilla*? Will it increase or decrease the problem? Is there no other treatment than chemical treatment possible against *Hydrilla*?

Conclusions

1. Chapter 11 provides an update of activities within the Kissimmee watershed during Water Year 2005 as well as an overview of watershed hydrology and effects of the 2004 hurricanes. The background material presented in extremely useful in developing a picture of past anthropogenic effects. As a major source of water and materials to Lake Okeechobee and downstream ecosystems, activities and conditions in the Kissimmee basin can have substantial effects throughout South Florida. Therefore, the Panel believes it very important that the Kissimmee River and the Upper Chain of Lakes are included in the SFER 2006 report.

2. The conceptualization of parameters affecting this region, such as the effect of hurricanes on DO, is extremely useful, and can serve as a model for adaptive management. However, the DO sampling frequency is insufficient to characterize DO sags.

3. Establishing evaluation programs is extremely important to the overall project, and the care given to this aspect should be commended. This is one of the few restoration projects that have included evaluation as an integral part of the project, including the establishment of performance measures.

4. The information provided on DO is insufficient to enable evaluation of the extent of DO stress, a serious shortcoming that limits the utility of this parameter in assessment of the success of restoration efforts.

5. The inclusion of stakeholders in the plans for the Kissimmee Chain of lakes is an excellent idea, and will enable many end users to obtain the necessary information to understand both the biological and human dimension of the system

Recommendations

1. As mentioned last year by the Panel, an outline of the chapter's contents at the beginning would be helpful for readers. The chapter is quite lengthy and would be strengthened by this additional structuring.

2. The use of reference streams to evaluate conditions in the Kissimmee River is an extremely important aspect of the study, given that no historical information exists. It would be useful to include a table with a matrix of the evaluation measures that are to be used to evaluate progress.

3. The description of hurricane effects should include information on how effects could be managed or minimized. The management of the Kissimmee should be more clearly related to/integrated with management of the rest of the Everglades system.

4. A map of the continuous DO monitoring sites should be added, and DO minima should be included as a metric, as well as means. Depth profilers are also strongly recommended, or at least additional monitoring of bottom-water DO. A sampling frequency is needed that will allow detection of DO sags. DO in the lakes should also be monitored.

5. The mercury information should be integrated as part of the overall evaluation of mercury in the Everglades.

6. Determination of ecosystem water needs should continue to be a high priority, especially in light of increased human development of the region.

7. In stakeholder surveys, include work on valuing non-market goods.

CHAPTER 12: MANAGEMENT AND RESTORATION OF COASTAL ECOSYTEMS

General

This chapter presents a synopsis of management, research, and restoration activities of the SFWMD and other entities in nine coastal ecosystems within the District's purview: (1) the Southern Indian River Lagoon and St. Lucie River and Estuary, (2) the Loxahatchee River and Estuary, (3) Lake Worth Lagoon, (4) Biscayne Bay, (5) Florida Bay and the Florida Keys, (6) Naples Bay, (7) Estero Bay, (8) the Caloosahatchee River and Estuary, and (9) South Charlotte Harbor. The modular structure helpfully provides a separate section for each of the nine ecosystems. Some of the ecosystems are described well, while the information provided on others is very sparse. Three major issues impacting the coastal ecosystems are described (p.12-2): (#1) anthropogenic freshwater discharges, (#2) increasing inputs of nutrients and other materials of concern, and (#3) loss of critical ecosystem habitats and communities.

Several aspects of this comparatively young program are already well developed, especially the efforts to describe the hydrology and salinity regimes of the estuaries through both intensive monitoring and modeling. The District also has targeted certain valued ecosystem components (indicator species, as seagrasses and eastern oysters) that are being monitored to varying degrees in the nine ecosystems as targets for restoration. In addition, the District, together with partner agencies, is engaged in various projects designed to stabilize hydrology, reduce pollutant loads, and restore habitat, and make progress in many needed planning activities.

The description of the District's actions and plans in these nine coastal ecosystems is a massive subject. Completion of the numerous accompanying appendices, alone, would have been a major undertaking. Nevertheless, although the chapter is well written, it seems clear that the authors are still striving toward the difficult-to-attain goal of striking the best balance in determining the materials that should be included to support the writing, versus materials that can be excluded and referenced through appendices, websites, and other reports. Thus, the Panel views this chapter, while generally excellent, as a work in progress. The writing contains important information and insights, but some key information is needed to address major identified issues #2 and #3: For most of the nine ecosystems, the maps do not show many of the sites, sampling stations, and other key features mentioned. Monitoring efforts are well described for salinity, and similar description is needed for other important factors. There is sparse information on water quality (e.g. nutrients, suspended sediments) and statistics to support conclusion statements. Although some of that information is provided in appendices or websites, much of it is not; moreover, information that is described as occurring in appendices and websites sometimes cannot be found there. Some environmental conditions known to support vs. stress indicator species (VECs, valued ecosystem components) are given in excellent, but repeated, summaries. With exception of seagrasses and eastern oysters, the indicator species (VECs) being considered in management goals of the District are unclear.

A clarifying overview of the District's plans to cohesively manage the nine ecosystems, with clearly defined goals and targets, seems lacking. The introductory information explains that one of the District's goals, insofar as possible, is to manage freshwater discharges – timing of delivery, quantity, and water quality – so as to preserve, protect, and restore essential estuarine resources. However, the path toward achieving this goal, and quantifiable targets, are not explained, and other (implied) goals are not defined. Inclusion of this information not only would provide clarification, but would also be helpful in optimizing use of estuaries as excellent "integrative natural barometers" for the overall success of watershed management efforts.

The primary efforts of the District are described as continuing to focus on analysis of freshwater discharges as influenced by human activities, and impacts on seagrass meadows and eastern oyster beds (p.12-1). Sound rationale is given for emphasis on these organisms as VECs. Consistently, however, the impacts of freshwater discharges are considered only as influencing the salinity regime, both throughout the chapter and in supporting information (e.g. draft Northwest Fork report, pp. 7-51). Reduced salinity from increased freshwater discharges commonly is associated with increased nutrient pollution, increased suspended solids, and changes in the dissolved oxygen regime. Repeated focus on water-quality-as-salinity contradicts the Introduction's strong and accurate statement, "Perhaps the severest threat to estuarine water quality is eutrophication by [anthropogenic] nutrient inputs" – there seems to be a disconnect between this statement and the District's coastal ecosystem management and restoration efforts as described (lines 135-142). Although a major focus of the District must be water supply, flood control, and the consequences to estuaries from hydrological alteration of watersheds. It would seem advantageous for the District, in the long run, to also consider interactions between salinity and nutrients/other important factors.This problem may have resulted from the difficult decision of what to include vs. exclude in this chapter covering so large a subject area, given that data on nutrients and other key factors are being taken by the District and various partner agencies.

Additional Comments and Questions

South Indian River Lagoon including the St. Lucie River and Estuary - Does natural dehiscence occur for the seagrass species present, and could it partially explain the data?

Will the assessments being produced be able to provide insights about the extent to which seagrass distributions/abundance has been influenced by hurricanes versus by other factors such as water quality (turbidity, nutrients) and salinity?

Where was the other more than half of the funding directed (lines 397-405), and how much of the funding mentioned came in during this water year?

The website supplementary information includes description of an analysis of 10 core samples (collection locations?) from the IRL. In general, the data were described as suggesting "significant anthropogenic contribution of Pb, Cu, and Cr." How will these data be considered in designing improved management strategies?

Loxahatchee River and Estuary - What is the design of the cypress seedling study (sampling frequency, N values, etc.)? What were the "elevated water quality values" and the "historic norms"? The information given was insufficient to evaluate the available water quality data, and supporting information (Northwest Fork draft report) described very sparse data (p.2-11, p.2-15) that do not seem sufficient for evaluating statistical trends. Are other data available? Are suspended solids, fecal bacteria, and key nutrients planned for monitoring?

Lake Worth Lagoon – This ecosystem, draining a highly urbanized area, was described in supporting information as having a major problem from sediment loading, accumulated as thick muck deposits (sediment accumulation rates ~0.1-0.9 cm/yr). The system also receives high quantities of untreated storm water and other non-point pollution. Are there sewage bypasses as well and if so, what is the extent of that problem? What is the basis for the evaluation of the LWL as having “rebounded” from the effects of the hurricanes?

Biscayne Bay (and supporting appendices) – The writing describes a somewhat unconventional use of salinity as a “conservative indicator of ecosystem health.” Salinity is a conservative parameter, meaning that it is not influenced or affected by biological activity (Day et al. 1989, *Estuarine Ecology*, John Wiley & Sons). It is not used as an “indicator of ecosystem health” *per se*. It is instructive for the District to so consider it, as long as other standard indicators of ecosystem health (e.g. nutrient pollution, turbidity and SS concentrations) are also considered.

Figure 12-20 – Why are water quality sampling stations not located in nearshore waters just offshore Biscayne Bay? Such stations would be helpful, for example, in defining salinities of the boundaries for a water quality model that might be developed for Biscayne Bay.

Can literature data for sensitive larval stages also be included in Table 12-5?

Figure 12-23 – What is the cause of the hypersaline conditions in the southwest portion of Biscayne Bay? Required flows to achieve and maintain lower salinities in Biscayne Bay would have to be substantial (lines, 965-970), given the size of the Bay. Are such flows available and sustainable?

Lines 991-995 – If the anticipated hypoxia/anoxia in Biscayne Bay leads to increased TP flux from the sediments, will this be of concern in a bay of this size?

The water quality evaluations given on p.12-52 do not appear to be well supported by the data. An average ammonia concentration of 800 µg/L in Arch Creek is high, relative to concentrations needed to stimulate algal blooms, and it seems that evaluation of water quality as “generally improved” may be overly optimistic. Similarly, although no increasing trend in NO_x was detected in the Little River, concentrations were quite high, as were NO_x concentrations in Coral Gables Waterway and ammonia concentrations in the Miami River.

Appendix 12-2, 1st paragraph - Did DERM sample the 71 sites monthly? And, 1858 results of a total of how many exceeded Florida water quality criteria? Are data for sediments available?

Appendix 12-2, and Appendix 12-3, Figure 3, and p.12-3-6 – Were these statistically based trends? If not, the writing should be altered.

Appendix 12-3 – The information (lines 1053-1054) suggests a possible sewage signature. What happened to Miami’s WWTPs during the hurricanes (bypasses? for how long?)? Where were the dredge spoils deposited (line 1163), and have associated impacts been considered? How long has ADCP been in operation (lines 1179-1180)? Have the cores (lines 1267-1282) been examined for information on eutrophication history and toxic substance inputs?

Florida Bay and the Florida Keys - Why is information not presented on the Florida Keys (major issues, plans of the District, etc.)?

In this section, in particular, the emphasis on salinity to the virtual exclusion of nutrient pollution seems a shortcoming. The District’s efforts to track salinity declines are surely valuable, and increased freshwater inflow appropriately is considered as a major factor in the functioning of this ecosystem. But freshwater inflows also carry with them many pollutants that are recognized as causing degradation to coastal ecosystems. Consideration of the interactive influences of freshwater flows and the pollutants they carry, especially nitrogen, at this early stage of management efforts will serve the District well by helping to avoid potential confounding problems in management strategies from such pollutants. Thus, for example, the statement in lines 1311-1313 should be altered for balance (see e.g., the 2004 review in *Estuaries* 27:157-164). The District can provide a constructive contribution, through the management activities and balanced research that it conducts and supports, in helping to resolve scientific debate about the roles of elevated salinities versus nutrient pollution in seagrass dieoffs and algal blooms.

Why were only two basins along the northeast coast considered (lines 1440-1443)? It would be helpful to include a brief description of District efforts being conducted elsewhere in the Bay.

Lines 1450-1746, Figure 12-33 – *Thalassia testudinum* actually grows well over a broad salinity range (e.g. high salinities - Tomasko et al. 1999, in *Seagrasses: Monitoring, Ecology, Physiology, and Management*, by Bortone (ed.), CRC Press; and low salinities < 5 to > 30 psu - Tomasko and Hall, *Estuaries* 22: 592-602). Historically, was *Thalassia testudinum* higher in Joe Bay? What is the basis for the apparent shift from *Cladium* to *Eleocharis*? What are the major parameters included in the dynamic model of the seagrass community? What seagrasses historically have dominated the transition zone?

Historically, *Thalassia testudinum* (with very different physiological optima than *Ruppia maritime*, e.g,. in nutrient regimes, and high habitat value differing from that of *R. maritima*) was dominant in Florida Bay. Thus, *Ruppia maritima* may be a suitable indicator seagrass for the transition zone, but not for all
of Florida Bay. Also, What is the basis for description of *Halodule wrightii* as a more valuable? habitat species than *Thalassia testudinum*?

Caloosahatchee River and Estuary - What data were used in support of invoking decreased salinity and water clarity over other factors (lines 2095-2096, 2167-2168) in the SAV decline? What is the salinity tolerance/optima for *Vallisneria americana*, and what is its general ecology?

Are data available for species other than *Halodule wrightii* (Fig. 12-41)? Why are data from only?
4 of the 8 stations included (as in lines 2237-2240)?

Lines 2286-2298 - It appears that a small proportion of the variance in chlorophyll *a* levels is explained by TN loading. Have relationships between chlorophyll *a* and N_i (inorganic N) species also been examined? Or between dominant problematic phytoplankton taxa and N_i concentrations/loadings? Such analyses could yield potentially valuable information.

Southern Charlotte Harbor - How is oyster health assessed (line 2479)?

Conclusions

1. The major goal of the District in managing the nine coastal ecosystems within its purview is, insofar as possible, to manage freshwater discharges – timing of delivery, quantity, and water quality – so as to preserve, protect, and restore essential estuarine resources.

2. Three major issues impacting the coastal ecosystems are anthropogenic freshwater discharges (timing, magnitude), (#2) increasing inputs of nutrients and other materials of concern, and (#3) loss of critical ecosystem habitats and communities.

3. Several aspects of this comparatively young, complex program are already well developed, especially efforts to describe the hydrology and salinity regimes of the estuaries through both intensive monitoring and modeling.

4. The District has targeted certain valued ecosystem components (VECs or indicator species, as seagrasses and eastern oysters) that are being monitored to varying degrees in the nine ecosystems as targets for restoration. Sound rationale is given for emphasis on these organisms as VECs.

5. The District, together with partner agencies, is engaged in various projects designed to stabilize hydrology, reduce pollutant loads, and restore habitat, and in many needed planning activities.

6. Description of these nine coastal ecosystems, and the District's actions and plans in managing them, is a massive subject, requiring the difficult task of determining materials to include versus exclude in the chapter and supporting information. Thus, while the chapter is generally well written and contributes excellent information and insights in describing this large, complex program, some additional key information is needed, especially to address the second and third major identified issues (above).

Recommendations

1. The Panel recommends inclusion of an overview in the Introduction, with charts or tables and supporting text, to clarify the plan in managing the nine coastal ecosystems and plans for changes in the management program (e.g. plans to include other coastal areas as priority coastal water bodies; plans to emphasize some ecosystems over others in a rotating schedule, etc). Coverage should include a description of the District's plans and actions to manage the natural resources of the Florida Keys, which thus far are mentioned briefly but then missing from the information provided.

2. Within each subsequent ecosystem subsection, the Panel recommends including as "up-front" summary information the explicit restoration goals, in numerical terms where possible, and supporting rationale; invasive species and threatened/endangered species; a summary table of District activities; and more complete maps showing the locations, structures, and sampling stations mentioned in the text. For clarification, information on the Caloosahatchee River and Estuary should be separated from the South Charlotte Harbor subsection.

3. The Panel recommends that the importance of freshwater flows and altered salinities be considered together with other important factors in affecting the coastal ecosystems. In particular, it would be helpful to consider the potential importance of nitrogen (loading and concentrations of TN and inorganic nitrogen forms) in contributing to the degradation of these coastal ecosystems, and in compromising their recovery even when problems with hydrology can be corrected.

4. The Panel recommends inclusion of water quality data summaries as key information. In addition, a brief description should be added of the statistical analyses that were performed to support conclusion statements about water quality and indicator species.

5. The Panel recommends that within each ecosystem subsection, the monitoring efforts should be clearly summarized in a table (District and other agencies involved, duration, frequency, parameters, depths monitored, locations/size of sampling areas and transects, ground-truthing

efforts for assessing submersed aquatic vegetation, and N values). Planned improvements in the monitoring programs (by the District and other agencies) should also be included in the summary information.

6. The Panel recommends inclusion of a separate section on EACs and VECs following the Introduction, including clarification by ecosystem of where these criteria have/have not been developed/planned/in progress. This section should include rationale for selection of the targeted VECs, and tables of the range of environmental conditions where the indicator species occur, thrive, and are stressed (e.g. including salinity, nutrients [TP, inorganic N forms, TN], and light for seagrasses and the freshwater/brackish species, *Vallisneria americana*; salinity and dissolved oxygen for eastern oysters). Data from Texas estuaries should also be considered (especially Baffin Bay) in modifying the summary tables.

7. The Panel recommends that for ecosystems associated with highly urbanized areas, the District should encourage development of a plan to examine the history of toxic substance accumulations in the sediments and impacts of toxic substances on the benthic food webs.

8. The Panel recommends that the District continue to develop plans to take advantage of opportunities to coordinate work on south Florida's estuaries.

9. The Panel recommends that cores (as in Appendix 12-3, Biscayne Bay) be examined for information on eutrophication history; or, if such data are available, the Panel recommends inclusion of summary information on this important topic, from which many insights can be gained.

The Panel discussed suggestions for reporting on the District's (massive) coastal ecosystem effort. The Panel did not feel comfortable in stipulating what might be best---rather, the Panel considered that such a decision would best be left to the District---but one suggestion that was favorably received was to rotate on reporting for the nine coastal ecosystems, e.g., with concerted effort on five ecosystems one year, and the other four the next, or perhaps three ecosystems per year on a three-year rotation.

APPENDIX 12-1 MODELING FRESHWATER INFLOWS AND SALINITY IN THE LOXAHATCHEE RIVER AND ESTUARY

In this Appendix, the authors describe the hydrologic and salinity models used in the Northwest Fork of the Loxahatchee River restoration alternative evaluations. Three models were developed: (1) a hydrologic model watershed model (WaSh) to develop flows into the River based on rainfall, infiltration, and transport processes occurring in the watershed; (2) a hydrodynamics and salinity model to relate freshwater inflows to salinity in the Northwest Fork; and (3) a long-term salinity model used to forecast salinities for several decades. The first model is a derivative of the well-known HSPF model modified to include a groundwater component that coupled surface water and groundwater – a feature essential for Florida's soils. This model has a water quality component that was not utilized in this study. The second model is based on the RMA-2 and RMA-4 models, again well known finite element models used for simulating water transport in rivers and estuaries. The third and final model is a management model that incorporates rather straightforward algebraic equations.

The authors present a good account of the work performed, and the work itself has been for the most part performed in a scientifically defensible way. What could be made clearer in the document is a statement of purpose of the effort and how the models were selected for the tasks to be performed and the purpose to be achieved. For the results presented here, some rather sophisticated models have been used to generate some summary results that could have been obtained with simpler finite segment models in a much shorter time and less expense. There are well known mass balance-based, finite segment models that have been used for many decades that could have been applied here and the same overall results obtained.

If the purpose of the work was to model constituents beyond salinity, if time-dependent flows and velocities are needed for later work, and if time-dependent constituent concentrations were indeed needed then the models used were indeed appropriate. Information presented at the hearing indicated that the models were already in place and being used in the Loxahatchee River and estuary, so their use for salinity modeling was appropriate.

Specific comments follow below:

The Panel noted that relatively few stations on streams/canals were available to calibrate and validate the watershed model, and only one groundwater station (a well) was used. Because the HSPF model was being used to model groundwater as well as surface water flow, using only one groundwater station for calibration appeared to be inadequate. Information was presented during the hearing indicating that more than one well was used during the model calibration. The sensitivity analysis showed that evaporation coefficients and infiltration parameters were the most sensitive model parameters in completing the water budget calibrations. If this is the case, then the groundwater model calibration is the most important for the hydrologic estimations. Calibration of the HSPF model using only one direct groundwater measurements appears to be the weakest part of the calibration/validation process.

The Panel noted that it would be helpful to list the performance criteria being used and the values of those measures that would demonstrate that the models were indeed calibrated and validated.

Those performance criteria included the DV, NS, and R^2 and in response to Panel comment information of this type was provided. The Nash-Sutcliffe coefficient (NS), for example, was said to vary between 1.0 indicating a perfect fit (i.e., when Qs = Qm in every case, which is obvious) to 0 indicating the model is predicting no better than the average of observed data (i.e., when Qs = Q in every case, again obvious). But in the application of the model, it is the average that is desired; this permits the average freshwater inflow to be related to average salinity at a given location. Thus, for the question, "Is the goal 1.0 or 0?" the response was the greater the better because it was the time-dependent solution being tested for performance, not the average. For the coefficient of determination (R^2) in response to the Panel's question whether it is being used in a statistical sense (with independence of X and Y) or strictly as a measure, the authors also noted that the Correlation Coefficient (r) would be more appropriate than the Coefficient of Determination (R^2) and that r should be greater than 0.5 for acceptance.

In Table 12-5, the Panel noted considerable difference between the DV values for calibration and validation at almost every station, and it was not clear to the Panel or the authors why such a discrepancy should occur.

In Figure 12-6, the Panel noted significant differences between observed and modeled runoff in summer and fall 1997, in winter 1998, and in fall 1999. The text implies that the differences were related to the quality of the rainfall data, but the Panel was curious whether there was clear reason to suspect the rainfall data and what analysis of other model parameters and/or field data was done to explain the model results.

The text indicates that calibration of groundwater level was conducted as the last step of the WaSh model calibration, and the Panel noted that it was curious that groundwater calibration was not done first given the sensitivity of the model results to vertical movement of water through evaporation and infiltration as noted earlier. Further, the results given in Figure 12-8 indicated significant lag and over prediction of the observed results. The authors noted that the HSPF model surface flow and cell to cell flows had been modified so that the vertical movement of water was not as important as the surface flows calculated in the canals and reaches.

The Panel noted that it was not clear why the RMA models were needed for this work. A simplified model for linear estuaries or a finite segment model could have produced the same results in a much shorter time and less expense. For simplified models, the mass balanced-based model for conservative substances in estuaries can be applied. The equation is:

$$s = s_0 e^{\left(\frac{Ux}{E}\right)}$$

where s = salinity concentration at some point, x, upstream from x_0, s_0 = salinity at an arbitrary downstream point x_0 that represents the "source" of the salinity, U = average net velocity in the estuary (calculated as freshwater flow, Q_{fw} /cross-sectional area, A), and E = longitudinal dispersion coefficient. The values for "b" in Table 12-10 are in essence values of U/E and the values of "a" are close to values of s_0, or 35.5 ppt. Assuming E is constant, then the variation in "b" is due to variations in Q_{fw}/A.

The Panel noted that boundary conditions both at the freshwater inflow end and the ocean end of the system will have considerable impact on the salinities calculated at stations within the estuary and asked at what boundary was the tidal record entered and how well did it match the actual record at some gauging station. The authors indicated that the boundary was a gauging station near the mouth of the estuary and that the 35.5 ppt salinity as the boundary concentration was the salinity of water entering the estuary on the flood tide.

The Panel asked about the fixed elevation value of the salinity sensors providing data shown in Figure 12-14, and the authors noted that the sensors were located in the vertical so that they were always submerged regardless of the tide. A table was provided listing sensor elevations at three stations.

The Panel noted that there was discussion of scenarios and the ecological benefits of each and the freshwater flows needed to realize those benefits. While the flows needed for each scenario were presented in Table 12-15, there was no discussion of these scenarios presented, and the question raised was whether those scenarios were beyond the scope of this particular appendix. The authors noted that the appendix was limited to the technical approach in hydrological and hydrodynamic modeling and that assessment of the modeling results and the feasibility study are ongoing and will possibly be included in next year's SFER.

The Panel noted that driving forces that affect salinity include the phenomena mentioned by the authors but also coastal ocean sub-tidal water level effects, especially storms and meteorological events on the scale of days to weeks, which can add or subtract from the astronomical tide due to offshore/onshore movement of water. The authors noted that they have teamed up with FDEP to develop an integrated 3-D model that would simulate both surface and groundwater movements within the Loxahatchee estuary and that the project also includes a component to address the sub-tidal drive force in addition to astronomical tides.

In this same regard, the Panel noted discrepancies between model output and field observations in Figure 12-14. The authors responded that several factors affect model accuracy: (1) uncertainly in freshwater input; (2) exchanges between groundwater and surface water; (3) reduced estimates of salinity rage between high and low tides with 2D depth-averaged models because stratification is not modeled; and (4) sensor placement in the vertical dimension and the water mass being sampled. They expect the 3-D integrated model to improve salinity prediction accuracy by addressing points (2) and (3).

Conclusions

1. In this Appendix, the authors describe the hydrologic and salinity models used in the Northwest Fork of the Loxahatchee River restoration alternative evaluations. Three models were developed: (1) a hydrologic model watershed model (WaSh) to develop freshwater inflows to the River based on rainfall, infiltration, and transport processes occurring in the watershed; (2) a hydrodynamics and salinity model to relate those freshwater inflows to salinity in the Northwest Fork; and (3) a long-term salinity model used to forecast salinities for several decades. The WaSh model is a derivative of the sophisticated HSPF model and has been modified to address surface water and ground water flows, an essential feature of

any watershed model in Florida. The second model is a sophisticated hydrodynamic model (RMA models) used to estimate average salinities at various distances up the Loxahatchee estuary coupled with a statistical model (for which a simplified estuarine model for conservative substances could have been used) to easily calculate average salinities at those same points, and the third is an empirical model used to transition from one annual average salinity to the next assuming an exponential change between the two.

2. The approach used was a reasonable one given the WaSh and RMA models had already been applied to the Loxahatchee River and estuary and were simply being used to address the question of salinities that would be experienced at various points in the river and estuary for given freshwater inflows.

3. If the purpose of the work was to model constituents beyond salinity, if time-dependent flows and velocities were needed for other work, and if time-dependent constituent concentrations were indeed needed, then the models used were indeed appropriate. Information presented at the hearing indicated that the models were already in place and being used in the Loxahatchee River and estuary, so their use for salinity modeling was appropriate.

Recommendations

1. The Panel recommends that a map of the area showing the geographic features, sampling stations, streams, etc. mentioned in the text and that a bathymetric map of the estuary be included in the chapter.

2. In Table 12-5, the Panel noted considerable difference between the DV values for calibration and validation at almost every station, and it was not clear to the Panel or the authors why such a discrepancy should occur. The Panel recommends that this discrepancy be investigated further.

3. Although the authors noted that the appendix was limited to the technical approach in hydrological and hydrodynamic modeling and that assessment of the modeling results and the feasibility study are ongoing and will possibly be included in next year's SFER, the Panel recommends that the feasibility study results be included in next year's SFER.

4. The Panel noted with interest that the authors have teamed up with FDEP to develop an integrated 3-D model that would simulate both surface and groundwater movements within the Loxahatchee estuary and that the project also includes a component to address the sub-tidal drive force in addition to astronomical tides. It is recommended that this 3-D model be included in next year's SFER for review.

5. The Panel recommends that the clarifications provided by the authors to the various comments made to the Appendix be addressed in the final version of the Appendix.