APPENDIX 1-1
Peer Review Panel Final Report

F I N A L

R E P O R T

of the Peer Review Panel Concerning the

2002 Everglades Consolidated Report

Review Panel:
Jeffrey L. Jordan, Chair, University of Georgia
Joanna Burger, Rutgers University
Donald M. Kent, Environmental Idea Bank, Inc.
Richard Meganck, Organization of American States
E. Joe Middlebrooks, Environmental Engineering Consultant
Rebecca Sharitz, Savannah River Ecology Laboratory
Robert Ward, Colorado State University

Submitted October 17, 2001

INTRODUCTION

The responsibility of this panel was to review and prepare questions on the draft of the 2002 Everglades Consolidation Report (the Report), dated September 2001. In addition, the panel's responsibilities included the consideration and inclusion of input from the public workshop conducted September 24-26, 2001, where relevant. All comments noted on the Web board by October 15, 2001 have been considered in writing this final Report. 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 Everglades 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 application were employed, if all relevant data was used, and if the Report's findings were a logical consequence of the science and the data.

In reviewing the draft Report, the general questions 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 does the panel recommend to enhance document's validity and utility?

3. Are there other interpretations of the data and findings that should be considered and presented to decision makers? Is there available information that the authors have not considered?

4. Are there data summaries and analyses that should be included in future annual peer-reviewed Reports to the governor and legislature?

General Panel Response to the Draft Report

The draft 2002 Everglades Consolidated Report is generally well written and well considered. It is clear that the panel's review of the 2001 Report was considered and incorporated into this year's work. The 2002 Report is a much-improved document.

In past Reports, the 14 to 15 chapters were organized to meet a number of reporting purposes associated with the Everglades Forever Act and other requirements. Consequently, the panel organized its review differently than the organization of the Report. The 2002 Report has been substantially reorganized. The 14 chapters from the 2001 Report have been consolidated into eight chapters, and material that was previously spread across a number of chapters has been considered as a whole. The result is a more coherent and useable document. The panel recognizes the effort of the chapter authors to reorganize the 2002 Report and commends the work necessary to produce this year's document. Likewise, the public workshop provided the panel with a substantially improved process in which to aid our review.

While the organization of the written report was vastly improved this year, the panel notes that the response by chapter authors to the review questions posted by the panel prior to the workshop was not improved. In most instances, chapter authors did not respond to the questions posted, and in some case the authors failed to even access the questions from the Web board. It was clear that some of the chapter authors viewed the workshop process not as an opportunity for peer review, but as a reporting requirement that had to be gotten over. The unfortunate result is the authors missed an opportunity to gain new insights or exchange ideas with the panel. The panel also notes that there are a number of issues from past years' reports that remain outstanding. The following review will highlight these as appropriate.

Summary of Recommendations

The following are the recommendations suggested by the panel in reviewing the 2002 Report. The chapter in which they appear is noted for each.

1. The international importance of the Everglades restoration district should be highlighted (Chapter 1).

2. Carefully define a standard compliance methodology that is based on sound science, peer reviewed, and geared to producing management-oriented information. Further, there is a need to clear up confusion in the report regarding how ambient water quality management operates, particularly with respect to definitions of water quality "criteria" and "standards" (Chapter 2).

3. There is a need to establish clear data-analysis methods and procedures to guide staff and consultants in developing comparable and consistent water quality information across management programs and across areas of the Everglades and its larger watershed (Chapter 2).

4. More citations should be added, making it clear when statements are assumptions, rather than fact, and making clear what reflects the work of the District and what is formed elsewhere (Chapter 2).

5. Two issues not previously addressed that could be considered are: 1) an examination of wader populations in Florida generally, and in the Southeast, and 2) an in-depth description of the relationship of methylmercury with respect to sulfur, temperature, pH, other metals and drydown regime (Chapter 3).

6. To improve the performance of agricultural BMPs, phosphorus budgets are needed, along with reduction of particulate phosphorus for the EAA (Chapter 3).

7. Combine performance and compliance information into individual, STA-based discussions. This approach could be proceeded by a summary of performance irrespective of the individual STAs (Chapter 4A).

8. Both 12-month moving flow-weighted mean concentrations and monthly flow-weighted mean concentrations should be provided in future Reports (Chapter 4A).

9. Performance should be considered from the perspective of a treatment train and STAs as a system (Chapter 4A).

10. STA performance could be given a context by referring to the condition of downstream biota and the potential impacts from MeHg production (Chapter 4A).

11. Any additional test cell experiments should include SAV and periphyton treatments (Chapter 4B).

12. Additional investigations should use the STAs as much as possible (Chapter 4B).

13. P removal should be monitored for each P species in each STA cell (Chapter 4B).

14. STA cell biological communities should be determined, periodically monitored, and compared to P removal observations (Chapter 4B).

15. An investigation of P cycling in the STAs should be initiated (Chapter 4B).

16. An investigation of STA cell hydraulics should be initiated, and hydraulics reconsidered using actual HRTs (Chapter 4B).

17. Hydraulic studies of the STAs should be expanded to include all units (Chapter 4C).

18. Conduct sampling at intermediate points in the STAs after correcting the byrraulic deficiencies. It is likely that the STAs could be reduced in length and still accomplish the same degree of treatment. Portions of STAs probably are reintroducing phosphorus to the water at the lower ends of the systems. Intermediate sampling in the other types of treatment systems also is important (Chapter 4C).

19. If not already accomplished, optimize the advanced treatment systems (Chapter 4C).

20. A peer-reviewed policy for establishing standards and for measuring standard violation or compliance should be established for the EPA to insure that consistent management information is produced across water quality constituents (Chapter 5).

21. Hydrological research should be both applicable to the CERP and focused on maintaining critical water levels for important EPA ecosystem components, such as the tree islands, and resolving the ponding of water in the southern parts of the WCAs (Chapter 6).

22. The muck fire/bird colony index should be subjected to rigorous internal and external review if it is to be used to manage EPA hydrology (Chapter 6).

23. Next year's chapter should be cognizant of the readership and the authors' understanding of the peer-review process (Chapter 6).

24. More consideration should be given in the CERP plan to the use of forested wetlands and other natural systems (Chapter 7).

25. The SERTF Working Group's non-native animal report and other syntheses of ecological effects of invasive animal species should be completed and made available as soon as possible (Chapter 8E).

CHAPTER 1: Introduction to the 2002 Everglades Consolidated Report

This chapter is concise and well written. Chapter 1 will serve as a "stand alone" document for many readers interested in gaining an overview of the area and its principal management issues.

The section describing the District and other governmental agencies is particularly important to a more complex understanding of chapters 7 (Restoration) and 8 (Other Everglades Programs). The introductory section to the restoration issue, beginning on page 1-9 is very well written, particularly paragraphs two and three. We suggest adding the following brief paragraph after the quote from the Florida Legislature on page 1-10 as a justification to the statement on the international importance of the restoration activities in the Everglades:

> The recently completed IV Inter-American Dialogue on Water Management (Iguazu Falls, Brazil, September 2-6, 2001) held a special session on the Everglades-Pantanal Initiative. The Final Report of that session concluded:
>
> "The South Florida Water Management District and the U.S. Army Corps of Engineers are implementing a comprehensive restoration program in the Everglades region -- the largest undertaking of this nature ever attempted. The experience gained in this endeavor will, overtime, provide areas such as the Pantanal not only a wealth of data on water quality parameters, management of exotic species, and public involvement processes, but will also help those with wetlands-management responsibilities avoid problems encountered in this process over the long term." (IV Inter-American Dialogue on Water Management, Final Draft Report, Inter-American Water Resources Network, Washington, D.C., September 2001).

The entire section entitled, "Achieving Long-Term Water Quality Goals," beginning on page 1-12, is also well written. However, a clearer statement indicating progress to-date (trends) in meeting long-term goals would be helpful.

During the public comment session of the workshop, it was suggested that the potential of associated economic and environmental risks be removed from the text of the Report. The panel believes the Report must alert the public to this possibility. It would be simplistic if one simply assumed that any program as complex as the CERP can be implemented without encountering secondary effects or cross-effects which will require adaptations to both the CERP process and the associated funding requests and timetables. This is the first time that a program of this nature and scale has been attempted and, therefore, in a very real sense, implementing the CERP is itself a research effort.

CHAPTER 2: Water Quality in the Everglades Protection Area

Chapter 2A: Compliance with Water Quality Criteria in the Everglades Protection Area

Chapter 2A is well organized and presented. The material flows in a logical and easy-to-read style. The descriptions of the data being analyzed and the data analysis methods are thorough and concise. The results of the water quality standard compliance assessment are summarized in the chapter, with more detailed results presented in the appendix. The explanations of the excursions are well written and easy to follow.

Given the chapter's excellent organization and presentation, the following comments should be viewed as clarifying the terminology and broadening the scientific context of the assessment. Several of these issues; however, if not addressed soon, may result in a variety of methods being used in EPA criterion development and compliance assessment, resulting in non-comparable and confusing information being presented to managers and the public.

Confusion with Definitions of Criteria and Standards

Chapter 2A states its purpose - to report on the status of compliance with water quality criteria (standards?) in the Everglades Protection Area (EPA) for water year (WY) 2001 (May 1, 2000 through April 30, 2001). There is some continuing confusion regarding *comparing data to criteria to determine compliance* (as the title of the chapter states). Criteria are usually defined as scientific descriptions of concentrations needed to protect a use of water. The use can occur anywhere and is independent of a particular water body. A standard is created when a water body, for example Water Conservation Area 1 or the Everglades National Park, is classified as having a particular use and is combined with criteria, scientifically determined, needed to protect the use. Thus, the assessment described in Chapter 2A is checking compliance with applicable water quality standards in the EPA, not water quality criteria, unless criteria are defined differently.

The Glossary in the 2002 Everglades Consolidated Report provides definitions of "Water Quality Criteria" and "Water Quality Standards" as follows:

Water Quality Criteria – Constituent concentrations, levels or narrative statements representing a quality of water that supports the most beneficial use of the resources.

Water Quality Standard – Standards are composed of the most beneficial use of water, water quality criteria applied to that use, and the Florida antidegradation.

The expression "most beneficial use" in the definition of water quality criteria appears to involve consideration of a range of uses before a criterion is selected. As noted above, each use has a criterion, scientifically defined, to assure it is not impaired. The classification identifies which use a water body will support, and thus which criterion should be assigned.

The U.S. Environmental Protection Agency (http://www.epa.gov/waterscience/pc/revcom.pdf) defines criteria as follows:

> "Section 304(a)(1) of the Clean Water Act requires EPA to develop and publish, and from time to time revise, criteria for water quality accurately reflecting the latest scientific knowledge. Water quality criteria developed under section 304(a) are based solely on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects. Section 304(a) criteria do not reflect consideration of economic impacts or the technological feasibility of meeting the chemical concentrations in ambient water. Section 304(a) criteria provide guidance to States and Tribes in adopting water quality standards that ultimately provide a basis for controlling discharges or releases of pollutants."

Proper use of the term "standard" appears on page 5-42 of the report when reference is made to development of the "P water quality standard." In the heading to Table A2-4, the term "Class III Standard" describes the current 5.0 mg/l DO limit being applied to the Everglades. The wording is correct here. A consistent use of the terms in the report would help readers follow the development of new DO and P standards, based on field data, that indicate need of site specific South Florida DO and P marsh criterion.

Such confusion might be reduced or eliminated if the promised description of applicable Class III water quality criteria (number one in the 'Purpose' section of Chapter 2A) was presented and discussed. As noted in Chapter 1, there are many uses of water in the EPA that must be considered in establishing water quality standards. There is a need to describe the standard setting process employed in the entire watershed so that the process to classify water uses (i.e. segment water bodies) in the watershed, and EPA, is understood. Chapter 2A immediately enters into a detailed description of the data acquisition without providing insight into the 'goals' (criteria and standards) against which the data will be compared.

Little Evidence in Literature on How to Conduct and Evaluate Standard Compliance

There is an emerging concern in water quality management today, generated in many ways by the Total Maximum Daily Load (TMDL) listing debates, regarding the procedures by which monitoring data are used to determine water quality standard violations. This concern, however, has not reached the point where widespread agreements exist on how data should be analyzed to determine standard compliance over large spatial and temporal scales. Many of the factors in this debate were recently summarized in the National Research Council (2001) report on TMDLs. To address these emerging concerns, the 2002 Everglades Consolidated Report needs to clearly describe (employing the exact wording in the regulations) the EPA applicable standards beyond the brief statement of the standard provided in the "Results" section. Such a description, presented at the beginning of Chapter 2A, will indicate that the Report's authors have little or no guidance on how to convert monitoring data, over the entire EPA for an entire year, into an assessment of standard compliance. Lack of a definition of

compliance within current expressions of standards indicates why the authors had to develop and clearly document an "excursion analysis" protocol for use in the Report.

Prior Report Findings – Future Reporting Formats

Briefly summarizing prior standard compliance assessments in Chapter 2A assists in comparing changes in water quality standard compliance over time. Tables presenting changes in the percentage of samples violating standards in each "concern" category further elaborate on the temporal, as well as spatial, changes in compliance. To gain an overview of standard compliance in the EPA requires pouring over seven pages (2A-13 to 2A-19). The panel was asked to comment on data summaries and analyses that should be included in future annual peer-reviewed reports to the governor and legislature. There is a need for an additional summary of Chapter 2A's findings so busy citizens and their elected representatives can quickly gain an understanding of water quality standard compliance in the EPA and how it may be changing over time (ala the one-page Consumer Confidence Reports produced under the Safe Drinking Water Act amendments of 1996). The seven pages cited above provide such information, but not in a manner that allows lay users to quickly grasp the nature of the findings. Unfortunately, there are no widely accepted formats for presenting water quality standard compliance information in a shorthand manner, though the Consumer Confidence Reports may be pointing the way.

The SFWMD should undertake a study to develop index and graphic means to quickly and conveniently convey EPA water quality standard compliance information to citizens and their elected representatives. Models for such a study include stock market and weather-reporting methods, where large volumes of data are synthesized via peer reviewed protocols into index and graphic information displayed in newspapers. It is anticipated that such a report would be a further synthesis of the information reported in the Everglades Consolidated Reports. In other words, the water quality chapter in the Everglades Consolidated Report will "backstop" the public information for those interested in reading the details behind the graphics and indices. Such work may be a part of the RECOVER effort, but this is not clear in the Report.

Standard Compliance Determination

To conduct a standard compliance assessment for an area the size of the EPA and over a year's timeframe requires an extensive monitoring effort and huge amounts of water quality data. To conduct the assessment, the Report's authors combine data from a number of monitoring efforts throughout the EPA. In order to help explain the results of the assessment, the authors classify monitoring locations into categories of similar hydrological settings in the EPA (i.e. inflow, interior and outflow sites). In merging data from various hydrological locations and monitoring programs together, for purposes of any data analysis, there is always a concern that variation in the data may be the result of hydrological or laboratory differences, and not actual changes in water quality conditions. The concern is that variations in the data, and information from the data, may reflect changes in the design and operation of the monitoring system, rather than changes in water quality.

A stronger scientific foundation could be placed under a water quality standard compliance assessment if it was based on data obtained exclusively for the purpose of measuring standard compliance. However, it is acknowledged that the cost of a specialized "standard compliance" monitoring program for an area the size of the EPA would be considerably more than the District currently spends assessing water quality standard compliance. Thus, as the report notes, existing data from a number of monitoring efforts is "mined" for the desired information.

There are no widely accepted data analysis protocols currently available to support water quality standard compliance assessments (Griffith et. al., 2001; and National Research Council, 2001). Within the constraints of the above situation, the authors of Chapter 2A have documented their chosen approach to conducting the EPA water quality standard compliance assessment. One topic not documented is the management implication of the Excursion Categories (i.e. "Concern," "Potential Concern" and "No Concern"). The discussion of the excursion analysis results indicates that the violations are watched to see if the trend continues (or an SSAC is contemplated), but it is not clear what other management implications evolve from, for example, a site and constituent being placed in the "Concern" category. For example, are discharges deemed to be causing a "concern" to be permitted as part of a TMDL analysis?

The excursion-analysis approach employed in the Report defines "concern" as existing when there are >5% excursions beyond the standard. The justification for the choice of 5% is that it "parallels the common scientific practice of allowing a 5-percent rejection limit in statistical analysis." The U.S. Environmental Protection Agency's guidelines for Section 303(d) listing of water bodies for Total Maximum Daily Load (TMDL) purposes requires that >10% of samples violate the standard before a water body is judged to have its protected use impaired sufficiently for 303(d) listing purposes. The National Research Council (2001), in commenting upon the U.S. Environmental Protection Agency's *raw score* approach (simple proportion of samples exceeding a standard) for determining water quality standard violations for TMDL listing purposes, notes the reason for a 10% limit is to allow for uncertainty in the decision process. The excursion analysis protocol employed in the 2001 Everglades Consolidate Report appears to be a 'tighter' requirement than that recommended by the U.S. EPA in creating TMDL lists.

With the percentages of samples in violation of a standard (the raw score approach) computed from different sample sizes, there is concern that the information produced may not be consistent across all sampling sites. The National Research Council (2001) states the issue this way:

> "…one limitation of the raw score approach is that it does not account for the total number of measurements made. Clearly, 1 out of 6 measurements above the criterion is a weaker case for impairment than is 6 out of 36."

The National Research Council (2001) suggests that the *binomial hypothesis test* could be employed to take sample size into account in standard violation assessments. However, it is noted that:

> "In general, alternative statistical approaches transform questions about the proportion of samples that exceed a standard into questions about the center (or another parameter) of a continuous distribution. It should be noted that new approaches will bring new analytical requirements that must be taken into consideration. For example, if there is a requirement to specify a distribution, sufficient data must be available."

The National Research Council (2001) does not recommend any particular statistical method for analyzing monitoring data to determine standard violations. As noted earlier, this recommendation is consistent with the Griffith et al. (2001), finding that the peer-reviewed literature does not project agreement on methods to compute water quality standard violations.

On page 2A-13, mention is made of a new "Impaired Waters Rule" that may influence future water quality standard assessments. Is it possible (desirable?) to provide a brief summary of the data analysis methodologies being recommended in the rule? Is the Impaired Waters Rule the same as the proposed Chapter 62-303 of the Florida Administrative Code mentioned in the National Research Council (2001) report? This panel is not sure why a possible new rule is mentioned in the Report if it is not summarized and implications to the current Report discussed.

Computation of "Mean" with Records Containing Non-detects

The Chapter 2A authors are to be commended for describing how the data were "screened" prior to performing the excursion analysis. For example, if no problem with a sample could be documented, the observation was included in the analysis. This means, for example, that no statistical method was used to remove outliers.

One concern with data preparation remains, however. The method employed converts "less than" descriptors into the detection limit for purposes of computing the mean (comparing the last sentence on page 2A-11 with results in Table 2A-2). The issue comes to the fore when the Refuge inflow silver mean is computed from 10 numbers that contain observations between <0.05 and 0.074. The resulting mean of 0.06 includes 10 numbers that must range from 0.05 and 0.074, regardless of how many of the observations were, in fact, <0.05. Also, the discussion of the one diazinon exceedance (page 2A-36) implies that the detection limit is preventing an understanding of the severity of the problem.

Two issues arise in this situation. First, if the laboratory must report "less than" numbers, why is the detection limit used in computation of the mean? This appears to bias the mean toward a higher average reading. Second, is it possible to obtain an estimate of the "less than" observation's numeric value from the lab? Such an estimate could be flagged in the data management system as having considerable uncertainty associated with it, but at least in the data analysis and interpretation phase the above bias could be reduced. As it is now, data analysts, as data records are prepared for water quality standard compliance assessment, have to insert a number for the "less than." Such adjustments

between the lab and data analysis are not the "best estimate" of the true value. The best estimate comes from the lab. Another option is to use ½ the detection limit – a common data preparation practice for "less than" conversions for data analysis purposes. This issue may be discussed in documents supporting the design of the monitoring system, but is not included in the 2002 Everglades Consolidated Report. If this is the case, a reference to the supporting documents would be helpful.

Data Quality Concerns

The Report devotes attention to ensuring data consistency and comparability. The discussion on page 2A-4, under "Sources of Water Quality Data," implies that the data in the District's DBHYDRO database come from many sources. While a Quality Assurance/Quality Control (QA/QC) protocol is followed by the District, the impression is left that not all laboratories follow the District's protocol. A recent study of potential data differences is cited (Lin and Niu, 2001), but no overall summary of the findings is provided. Information about the comparability of the data would be helpful in evaluating the data analysis presented later in the chapter. There is concern that the data, because of differences in the monitoring system itself, may contain differences unrelated to water quality conditions

One way to help quantify differences among data collection efforts would be to consider, if it has not already, employing the recently recommended data elements of the National Water Quality Monitoring Council (NWQMC) to electronically store water quality data. The data elements provide the "meta data" necessary to insure that data obtained via different sampling and/or laboratory analysis methods are not mixed in ways that distort the results. The data elements recommended by the NWQMC can be found at the following Web page address: http://wi.water.usgs.gov/pmethods/elements/elements.html.

SSAC and Class III Criteria Comparisons for Dissolved Oxygen

Development of the dissolved oxygen (DO) Site Specific Alternative Criterion (SSAC) for the Everglades marsh establishes a strong scientific foundation for a realistic DO criterion to be applied to the EPA. Comparison of the WY2001 data with the SSAC standard provides additional insight into how the new South Florida marsh DO criterion and EPA DO standard may function once formally approved. As with any new standard, there is a need to carefully evaluate how the standard's compliance will be measured, and the 2002 Report begins this discussion.

The differences between SSAC and current condition, at some sites, are quite large: CA28 (0.89 actual compared to 2.15 SSAC); X1 (0.69 actual compared to 3.04 SSAC); and Z1 (0.92 actual compared to 2.85 SSAC). The reasons given, for outflow sites, were disturbance of bottom sediments and the intrusion of low DO ground water into surface water. The reason given for interior sites was phosphorus enrichment. With reductions in phosphorus discharged to the EPA, standard compliance at interior sites should improve. However, it is noted that the causes of noncompliance at inflow sites, being caused by human influence, cannot be controlled or abated and will need to be addressed

separately. Since the issue of future, projected noncompliance is raised, the Report would be more complete with a brief discussion on how this issue will be addressed. Are there plans to further refine the SSAC to account for the DO impact resulting for the permanent human "footprint" on EPA DO concentrations? This is of great concern to the panel, given the National Research Council's (2001) statement that ambient-focused water quality management (as exists in the Everglades) "is dependent on the setting of appropriate water quality standards." The implication is that if standards are not set properly, the entire management system does not operate properly.

Excursion Analysis Results

Explanations of the excursions recorded in WY2001 are thorough, yet concise. With the excursion analysis well documented early in the chapter, the results of the analysis are straightforward, needing only an explanation of the factors influencing the excursions.

Several observations of the explanations are as follows:

Excursions for pH within the interior of the marsh are being explained (on page 2A-24) as the result of background conditions. Are there plans to develop SSAC for pH? Likewise, are there plans to develop an SSAC for iron per the observations presented on page 2A-38 and the top of page 2A-39 (i.e., natural causes behind violations)?

1. The conclusions regarding potential drought effects on un-ionized ammonia standard compliance would be strengthened with supporting literature citations (last paragraph on page 2A-27).

2. The inclusion of phosphorus in the excursion analysis assists in exploring options for composing a P standard that includes a definition of a violation relative to the data and information that monitoring, over the entire EPA and over an entire year, can provide. The P compliance assessment provided in Chapter 2A, however, employs the proportions of samples above the various limits being considered, and not the geometric median P criterion being discussed in Chapter 5. The two different standard compliance methodologies represent two fundamental different ways to determining compliance. The methods of Chapter 2A do not seem to be those being planned for P compliance determinations. Why different methods would be used for different water quality constituents is not explained. From a management perspective, will different criteria-setting methodologies and different standard compliance methodologies confuse public and manager interpretation of the findings?

3. Table 2A-7, by displaying concentration data, indicates, in one sense, that there is a possibility that the outflows from WCA-2 and WCA-3 contain more phosphorus than the interior. In both areas, the percent of samples above 10 mg/l increases from the interior to the outflow. A plot of the phosphorus load would help define the exact meaning of the concentration percentages.

Editorial Comments:

1. As noted above, the description of Class III water quality criteria that apply to the EAP is missing (after indicating in the "Purpose" introduction to Chapter 2A.

2. Page 2A-4: Reference is made to Appendix 2A-1, but it is missing.

3. The appendices are numbered differently at the end of the report than cited in the text. The text places an "A" in the appendix number while no "A" appears in the numbering of the appendices at the end of the report. For example, on Page 2A-21, Appendix 2A-4 is cited, but it appears as Appendix 2-4. The chapter and appendix numbering scheme results in a confusion of numbers and letters. To illustrate, consider that on page App.2-4-2, Table A2-4 refers to the fourth table in Appendix 2. While on page 2A-21, Table 2A-4 refers to fourth table in Section A of Chapter 2. "A" is being used with two separate meanings that tend to confuse the reader.

4. Page App.2-4-2: From the text in Chapter 2A, it is assumed that WY 2001 data are used to compile Table A2-4? Table heading should indicate this fact.

5. Use of the word "Parameter" is confusing in the text and the definition provided in the Glossary does not clarify the situation. "Parameter," a term from mathematics, is defined in the Webster's Dictionary as: "A quantity to which the operator may assign arbitrary values, as distinguished from a variable, which can assume only those values that the form of the function makes possible." In many ways, the word "parameter" is being used in the report as a "variable." The word "constituent" is used without definition. It appears the two words, parameter and constituent, are being used interchangeably (see page 2A-11, second paragraph). Careful consideration should be given to providing a clear definition of terms and with consistent use throughout the report. It is acknowledged that the word "parameter" is widely used in water quality monitoring discussions, but it is monitoring "slang" that fails to suggest strong science underpinning a water quality standard assessment.

6. On page 2A-15, under the "Water Year 2001 Results," the word "only" is placed before the word "eight" when noting how many 'parameters' had excursions. The word "only" should be removed as it implies a judgment of the significance of the number.

7. What should be Table 2A-7 on page 2A-36 is mislabeled Table 2A-1.

Recommendations

1. The review comments on the 2001 Everglades Consolidated Report noted two items requiring attention: (1) The need to carefully define a standard compliance

methodology that is based on sound science, is peer reviewed and is geared to producing management-oriented information, and (2) The need to clear up confusion in the Report regarding how ambient water quality management operates, particularly with respect to definitions of water quality "criteria" and "standards." Both comments remain valid for the 2002 Everglades Consolidated Report.

Both these issues were thoroughly discussed and highlighted in the recent National Research Council (2001) report on TMDLs. The authors of the 2002 Everglades Consolidated Report are encouraged to carefully read the NRC report.

2. It is obvious that different data analysis methods (e.g. means versus raw score in determining standard compliance) and units (e.g. loads versus concentrations) are being employed in what are, in effect, highly linked management efforts. There is a need to establish clear data analysis methods and procedures to guide staff and consultants in developing comparable and consistent water quality information across management programs, across areas of the Everglades and across its larger watershed.

References

Griffith, L.M., R.C. Ward, G.B. McBride and J.C. Loftis. 2001. Data Analysis Considerations in Producing "Comparable" Information for Water Quality Management Purposes. Technical Report 01-01, National Water Quality Monitoring Council, U.S. Geological Survey, Reston, Virginia, February, 44 pages.

National Research Council. 2001. Assessing the TMDL Approach to Water Quality Management. National Academy Press, Washington, D.C.

Chapter 2B: Mercury Monitoring, Research and Environmental Assessment

This chapter is an excellent overview of the mercury problem in the Everglades and reflects the problem faced by many agencies dealing with mercury in fresh waters. The authors are to be commended on writing a chapter that is very readable and accessible to a broad range of readers. It accurately and fairly reflects the state of the knowledge about mercury fate and effects, mercury cycling in the Everglades and the potential for receptor problems, including humans who consume fish from these waters. The risk to human consumers initially drove the fish-consumption advisories and the lowering of mercury in the Everglades system.

The Report accurately reflects the two main issues with mercury in the Everglades: the relative contribution of local versus long-distance atmospheric transport of mercury into the Everglades system, and the factors that affect the transformation of mercury into methylmercury. One of the main research studies listed examines the factors affecting

methylation, and this may be extremely important within the context of understanding how to reduce methylmercury in biota, once maximum source-control has been achieved. The report mentions the contribution of surface water inflows to both mercury and phosphorus, but apparently deems this source much less important than atmospheric. At the same time, the input of phosphorus is evidently of great importance.

The authors have placed a great deal of effort on the models that examine the mercury budget for the Everglades (inputs and outputs), as well as for understanding mercury cycling within the Everglades. As these models are being refined, ongoing validation or "ground-truthing" is needed, especially the comparison of model results with measured mercury in the different physical and biotic compartments. The value of these efforts will increase if they are able to model the effects of different levels of sulfur in conjunction with the hydrology, water quality (phosphorus, oxygen) and restoration activities. It is critical to understand the possible synergisms.

One of the main issues addressed in the Report is how to set mercury water quality criterion. The specific criterion set for the Everglades is overlain by the recent surface water criterion published by EPA of 0.3 ppm in fish tissue. This represents a departure from the traditional approach of using a water concentration. The fact that Florida's current criterion of 12 ng/L is insufficient to keep fish-tissue mercury at a low level is stressed. Although the complexities of timing and how this will be functionally implemented are not the main focus of this document, it should be further examined here. For example, what percentage of the key, top-level predator fish are currently above this level, and from what areas of the Everglades? Should the criterion be based on fish regularly eaten by humans, or on the species with the highest levels? A table with this information (from historical data, as well as today) would be valuable. The realization that the effects of atmospheric deposition of mercury in the Everglades may need to be minimized through management of water quality and quantity is a major breakthrough and will greatly influence future work of the groups. One caveat that seems clear, however, is that MeHg in fish correlate more strongly with sediment values than with surface water, making it imperative to consider this problem. A table of the management options being discussed might be a useful way for the District to consider the options.

The authors are to be commended for their conclusion that while atmospheric sources of mercury are the primary cause of the problem, reductions may not be possible and alternative methods of methylmercury control within the Everglades may be necessary. This dual approach is laudable, and a further discussion of the methods to do this should be the focus of work in the coming years. The fact that reduction of mercury from local atmospheric sources may not further reduce the mercury problem for the Everglades is key to much of the future work.

There is activity in the United States to address regional pollution problems, but being in a prevailing Easterly zone, this may not impact Florida as much as it would help the northeastern states. How much would efforts to reduce Hg emissions in Texas, the Gulf States, North Florida, etc., contribute to reducing deposition in and around the Everglades? It might be useful to examine this aspect.

The research in progress is extremely important to the work and represents a broad range of problems, from fate and transport to effects on biota that are most at risk. The work being undertaken at Patuxent is extremely important. This work would benefit greatly from collaboration with the Fredericks/Spalding work with these species in the field, and with the work of other ecotoxicologists who have looked at sublethal behavioral effects with colonial birds.

From the discussions at the workshop, it is clear that work with eggs is important, but problematic. There were methodological problems with the studies on the effects of mercury on wader eggs. These problems, however, do not negate the importance of finding out what the effects of low-level mercury are. While injection of mercury has proven difficult for technical reasons, it may be possible to experiment with recently hatched chicks, mimicking the amounts of mercury the chicks might obtain from the eggs.

In this regard, it should be noted that the conclusion that there is no evidence that wading birds are affected by mercury needs to be stated more cautiously. Given all the factors that affect reproductive success, it is very difficult to show effects of contaminants unless there are massive declines (as there were with DDT), or physical abnormalities (as there have been in the Great Lakes with colonial nesting birds). The Spalding/Fredericks work clearly shows that, when fed fish containing mercury at levels that occur in the Everglades, there are some effects. Further, they have shown that the potential for accumulation in the feathers somewhat buffers them. Nonetheless, statements about potential effects need sufficient caveats.

Generally, it is important to bear in mind that the effects of a contaminant, such as mercury, might be expected to be subtle and neurobehavioral at low doses. Similarly, at low doses there might be sufficient variation in the populations so that only a small number of young is adversely affected. When there are so many other biological causes of lowered breeding success (prey problems, nesting habitat, foraging distance, predators), chemical effects would be masked, except when they become severe. However, the absence of a clear, marked effect does not mean there is no effect. Rather, the effect of chemicals may be additive to other, more obvious biological effects. However, this small increment could be having a big effect. That there is no obvious population effect may be partly due to the adaptive nature of organisms. For example, if the first egg of a clutch has the highest levels of mercury, there may be a lower hatching rate, but this would not be obvious if the same number of chicks fledge (what has changed is the young that survive). For further discussion, see Burger and Gochfeld, 2001 ("Effects of Chemicals and Pollutants on Seabirds," in *Biology of Seabirds*, CRC Press, Boca Raton, FL).

The statement is made that MeHg is coming from new inorganic mercury rather than from soil releases. The data should be presented in a clear pattern (or at least a citation). This finding is still somewhat controversial (in a broader, global context) and seems to require more data presentation and justification. It is an extremely important finding,

with implications for control. Further, on page 2B-19 it is mentioned that reflooding following drawdown results in an increase in mercury. Is this due to mercury already present in the soil (formerly sediment) becoming available? Is it due to some re-vitalization of the bacterial community? Is it due to direct access to new atmospheric deposition? The time period of the drawdown would suggest that it could not all be coming from atmospheric deposition on the exposed soil.

Further, the new and exciting work presented by Gilmore at the public workshop, but not available in hard copy, suggests that the methylation of mercury from new water partly explains methylmercury levels in biota, but not entirely. There are clearly location differences in the strength of the response that bear further study. It is extremely important to understand why, with similar levels of rainwater having similar rates of atmospheric deposition, more methylmercury is converted in some regions than in others. These new data should be clearly presented in next year's Report, with appropriate management implications discussed. Further, the relationship between "new" mercury, and mercury in the sediment, to methylation needs to be clearly discussed.

The relationship between MeHg production and fish mercury concentrations is obviously critical to understanding and predicting mercury problems in the Everglades system since fish are eaten by many organisms, including humans. However, as the Report points out, these relationships are complex, dependent on the presence of other contaminants and chemicals, as well as pH, temperature, and so on. It seems there is a need for more research on the effects of temperature on mercury methylation, particularly with respect to the sulphur cycle. pH is key to setting both water criteria and future research and management, and perhaps deserves more detailed treatment and experimentation in the Everglades.

Both methylation and the uptake of methylmercury in fish are related to sulfur, and these relationships are quite complex. The management implications of reducing sulfate input is important, and further small-scale research on effects may be necessary and timely. Because of the implications for agriculture in the region, it may be essential to test models on a small scale to examine the effects on uptake of mercury by fish.

Finally, the regulatory compliance issues are clearly discussed and adequately examined. The "suggestive" evidence that methylmercury could be reduced by internal water quality management should be explained further. This is an area that would benefit by a clear section next year, particularly about compliance with the new EPA Class III surface water criterion (0.3 ppm in fish).

The Report is very scholarly regarding the treatment of mercury problems and would be better served by more citations. It is not always clear to the reader, and certainly not to the public, which statements are fact, which statements are conjecture and which come from Everglades research versus other research. There is a substantial list of citations at the end of 2-7 (however, papers by Bill Fitzgerald are not cited), but there are virtually no citations in the text. However, some statements beg for citation support. For example, it

may not be clear whether statements are supported by "the literature" or by recent (and still unpublished) work in South Florida.

Further, an attempt should be made next year to include more recent data on mercury, particularly since this is an area of the report that is changing rapidly. Research in this area is at the forefront of mercury research worldwide, especially on factors affecting methylation, and at much should be included as possible. This could be handled by having a few paragraphs that describe on-going research, with preliminary finding.

Recommendations

More citations should be added to clarify when statements are assumptions, rather than fact, making clear which reflect work of the District and which are from elsewhere, including discussions of the relationship between new mercury and other, more data substantiating the relationship between new mercury and that from the soil, a clearer description of the relationship between new and old water, a clearer description of the wader data that indicates the trends, a clear description (perhaps an appendix) of the wader index, and some justification for the continued use of only ibises in the index. Snowy Egrets seem to be in more difficulty in terms of the data shown, and this needs to be addressed. The presentation of new data not able to be incorporated into the Report could be handled by a more complex research-in-progress section, particularly on the mercury dynamics experiments.

Two issues not previously addressed that could be considered are: 1) an examination of wader populations in Florida generally and in the Southeast, since the ornithologists consider this one mobile population that moves and breeds within the area, and 2) an in-depth description of the relationship of methylmercury with respect to sulphur, temperature, pH, other metals and the drydown regime. Information relative to these two have been presented in past Reports, though the former has not been undertaken. They would provide a needed background to the Report.

CHAPTER 3: Performance and Optimization of Agricultural Best Management Practices

An excellent summary of the Best Management Practices implemented in the EAA basin is presented in this chapter. It is encouraging that these practices have been very effective in reducing phosphorus mass and concentration emanating from the EAA. It is unfortunate that similar reductions in phosphorus have not occurred in other contributing areas. With the implementation of similar programs throughout the area, much greater improvement in water quality entering the Everglades would be expected.

An attempt should be made to explain the significant drop in phosphorus mass being discharged from the EAA. Consideration should be given to the suggestion that a significant part of the decrease may be attributable to the decline in the phosphorus fertilizer industry. Apparently, it is not necessary for farmers to add phosphorus

annually; therefore, some of the decline in phosphorus discharges from the EAA may be attributable to economic conditions.

It is likely that the points of clarification asked for by the peer review in the 2001 Everglades Consolidate Report are explained in other chapters of this report, but it would be helpful to the reader if the explanations were briefly mentioned in this chapter. Points needing a brief statement include.

a. Does evidence exist to show whether phosphorus from the EAA originates from subsidence and mineralization of organic matter or from application of inorganic fertilizers?

b. Was a phosphorus budget established for the EAA, or is one planned for the future?

c. Is the biogeochemical relationship between mercury and sulfur to be considered in the BMPs?

d. Are hurricane effects taken into account when computing the annual baseline TP load?

e. Why is phosphorus load, rather than phosphorus concentration, not used as the measurement for restoration goals? This is a common practice in other pollution-control programs.

Within the chapter summary, a brief statement about the results of the silicon-amendments experiments would be helpful. Regarding EAA Basin Annual Phosphorus Measurement and Calculations, a brief description or example of the method of calculation would be helpful in understanding this section. A statement explaining the calculation rules and the three-year cumulative loads would also be helpful to readers not familiar with the regulations. In the "Water Year 2001" section, EAA Phosphorus Concentration (PPB), a brief description of Rule 40E-63 and the method of calculation is needed.

In the "Findings and Future Directions" section, are future reductions in TP from the EAA to be modified, i.e., a cumulative percent reduction with some maximum reduction, at which point further reduction is not expected?

Conclusion

1. The BMP program has been very successful in reducing the TP mass and concentrations reaching the Everglades.

Recommendation

1. To improve on the present program, it appears that phosphorus budgets are needed, along with reduction of particulate phosphorus from the EAA.

CHAPTER 4: Stormwater Treatment Areas and Advanced Treatment Technologies

Chapter 4A: STA Performance and Compliance

The objective of this section of Chapter 4 is to provide an overview of STA status and compliance with water quality criteria and Florida Department of Environmental Protection permit conditions. The section includes data and summary analyses, including areas and time plots and a discussion of factors contributing to excursions.

Four of the six STAs (1W, 2, 5 and 6) are operational. However, drought conditions eliminated the need for significant flow-through operations in two cells of STA-2. In addition, the drought conditions during Water Year 2001 resulted in lower-than-anticipated average inflows to the STAs. Emergency water deliveries were required to protect some wetland vegetation communities. SAV in STA-5 Cell 1B is still maturing. STA vegetation communities are dominated by cattail (*Typha sp.*) or submerged aquatic vegetation and epiphyte.

The STAs were in full compliance with all permits. Twenty-four metric tons of phosphorus were removed during the water year, at an overall removal rate of 65 percent. Mercury levels in the STA inflows and outflows were highly variable, with occasional periods of net export. Also, mercury concentrations in fish were highly variable. Mercury concentrations in mosquitofish and sunfish in STAs 2 and 5 exceeded U.S. Environmental Protection Agency guidance levels.

In general, the section is presented in a clear and reasonable manner. The section authors responded to some of the panel's initial comments by revising the figures and text (provided to the panel during the public review session on September 25, 2001). The figures were much improved and now more clearly indicate STA configurations, inflow and outflow structures and flow directions. The tables summarizing STA operations and contrasting outflow TP, monthly and 12-month moving averages are also a welcome addition. Regarding the latter, the legend seems to be reversed. Table 4-1 in the original draft, which summarizes STA-1W parameters other than P, should be retained, and analogous tables for the other STAs should be provided.

The text was revised to present information on each STA in a consistent manner, and the text is more consistent in this regard. However, the original text provides much more information. In addition, discussions about performance are still presented separately from discussions about compliance for each STA. The panel recognizes that this may be a requirement of permit conditions or legislative directive, or the District's interpretation

of conditions of directive. However, separation of performance and compliance are intimately related and are worthy of joint discussion.

Reporting system TP removal performance using 12-month moving averages is useful from an operational standpoint, but it obscures the STAs' response to unusual events. For example, the effects of the drought are easier to interpret from monthly flow-weighted mean concentrations than 12-month moving flow-weighted mean concentrations. Both types of information should continue to be presented. The impacts, especially the duration of excessive P discharge, from post-dryout flushing should be discussed.

The STAs are achieving the interim 50-ppb TP performance standard but are not achieving the proposed 10-ppb TP criteria. A discussion of impacts, if any, to downstream biota would provide a useful contextual reference. Outflow DO levels should also be part of this discussion. Also, there is some value in considering the STAs as part of a treatment train that includes the EAA BMPs and the discharge zones. Moreover, individual STAs are components of the STA system, and the collective performance of the STAs merits as much attention as individual performance.

Mercury, especially MeHg, continues to be an issue for STA operation. Present findings indicate that MeHg may be a risk to wading birds in some of the STAs, although conclusions seem somewhat speculative. The District intends to prevent an extended period of standing water level to reduce the risk to wildlife. Additional discussion about operational protocols or other activities to avoid or minimize risk of Hg poisoning to wading birds and other wildlife is warranted. Conversely, the potential effect on STA performance from efforts to reduce poisoning of wildlife should be addressed.

Conclusions

The section presents performance and compliance information in a reasonable manner, but readability may be improved.

The summary tables for parameters other than P for STA-1W are valuable.

The revised figures constitute a significant improvement to the original draft.

Both 12-month moving flow-weighted mean concentrations and monthly flow-weighted mean concentrations are necessary to interpret P removal performance.

The section does not provide performance and compliance information within the context of impacts to downstream biota and potential risks to wildlife from MeHg production.

Recommendations

The authors should consider combining performance and compliance information into individual, STA-based discussions. This approach could be preceded or succeeded by a summary of performance irrespective of the individual STAs.

Both 12-month moving flow-weighted mean concentrations and monthly flow-weighted mean concentrations should be provided in future reports.

Performance should be considered from the perspective of a treatment train, and STAs as a system.

STA performance could be given a context by referring to the condition of downstream biota and the potential impacts from MeHg production.

Chapter 4B: STA Optimization

The Everglades Forever Act requires the South Florida Water Management District to optimize the nutrient-removal performance of the STAs. This section of the Everglades Consolidated Report provides information about the District's efforts in this regard. The objective of the section is to present new findings and analyses and update ongoing studies. Findings and analyses presented include:

- STA-1W performance
- STA test cell optimization experiments
- The marsh dryout study
- The STA-5 dryout study
- Performance evaluation of STA-6
- Dynamic Stormwater Treatment Area (DMSTA) model development.

Recent STA-1W construction activities are described and water and phosphorous budgets are updated. Cell 1 was combined with the buffer cell, and Cell 5 began discharging water. Drought conditions decreased total annual inflow and outflow. STA-1W has retained 95 metric tons of TP since 1995, and TP outflow concentrations have ranged between 18.9 and 26.6 ppb during this period. Test cell experiments found that increasing HRT had little, if any, effect on TP retention, and TP removal decreased when the HLR reached 10.4 cm/day. The marsh dryout study found that muck soils always released sediment P upon reflooding. Sediment core analysis suggests that STA-6 should not readily release P into the water column upon reflooding after a dryout. The base code for the DMSTA model has been written and is being calibrated.

The section provides a reasonable review of optimization activities during the past year. The STA-1W phosphorus budget is discussed for water years 1995 through 2000. This provides context for the past year's performance. However, the past year's performance

can only be determined by interpreting Figure 4-12. The discussion could be improved by incorporating text specific to the most recent year's phosphorus removal performance. Also, the text would benefit by discussion of changes in individual cell performance through the years. For example, recent performance of Cell 2 appears to have declined, while Cell 3's performance has improved. Have changes in vegetation occurred, or have hydraulics been modified?

Test cell experiments were conducted to determine the effect of changing HLR on P removal. Baseline data was collected at an HLR of 2.6 cm/day and a depth of 0.6m, consistent with STA design criteria, and HLRs were either decreased or increased. A comment about the practical HLR limits for the STAs would help the reader assess the relevance of the experiments to STA operation and performance. Also, this may be an appropriate place to mention the minimum and maximum operational guidelines for the STAs. Nevertheless, the results observed (no improvement in TP removal by decreasing HLR, decreased removal with higher HLRs) may be a reflection of the biological community, cattails, as much as a response to varying HLR. Evidence has been accumulating for some time that SAV and periphyton are better at removing TP than cattail. Walker has come to recognize the importance of the biological community, as evidenced by his community-based "k" values for the DMSTA model. The experiment should be repeated with SAV/epiphyte before concluding that decreasing HLR has no effect on TP removal.

The marsh dryout study was designed to quantify the effects of nutrient loading, seasonality and the vegetation community on P flux from dried wetland sediments during reflooding. As might be expected, P was flushed from dried wetlands during reflooding. Of particular interest are the vegetation affects on P discharge at the north site (i.e., SAV exports more PP, while emergent exports more SRP). Flushing effects were less pronounced and vegetation effects nonexistent at the south site (lower P loads). The experiment was also very useful for helping us understand the species of P retained and released during dehydration/rehydration events. This information should be useful for STA optimization and operation. For example, we have verified that dryout of SAV systems will result in relatively rapid breakdown of plant material and the consequent discharge of PP. Also, emergent systems appear to be less adept at using SRP than SAV.

The panel heartily endorses the District's plan to monitor water quality during dryout events at STA-5. Given the results of the marsh dryout study, we might expect significant P export during reflooding. Although an effort should be made to prevent dryout of STA-5, any dryout events should be carefully monitored to verify predictions based upon the mesocosm study and examination of STA-5 biogeochemistry.

The low soil P content and the small fraction of potentially mobile P may bode well for STA-6 given the expected dryout periods. However, the prediction that STA-6 might be a nutrient sink is not yet supported by P data. Monthly P flow-weighted mean outflow concentrations at G-354 and G-393 in March and April 2001 are near, or in excess of, 50 ppb. These measurements occurred after a dryout event in January and February. These are also new outflows, so it is not possible to determine if this is a flushing effect

associated with outflow hydraulics, or a response to reflooding. For this reason, and because the highly mineralized soils and different vegetation communities provide an opportunity to broaden our knowledge about P removal dynamics, STA-6 water quality should be monitored closely.

The panel is unable to comment extensively on the DMSTA modeling effort presented in the Everglades Consolidated Report. The panel recommends that the model be presented for review if it is to be the mechanism for optimizing and operating the STAs. We recommend that Bill Walker make a presentation summarizing the model during the public session next year.

The mesocosm and test cell experiments are undoubtedly helping the District address STA optimization issues. But using mesocosms and test cells to predict STA performance requires some understanding of how results will translate from the small-scale experiments to the full-size STAs. It is not clear to the panel whether mesocosm and test cell experimental results are consistent with observations of STA performance. This issue deserves attention and discussion in the Report. In addition, the mesocosm and test cell experiments were necessary prior to STA operation. Now that the STAs are being operated, we urge the District to prioritize information gathering from the STAs themselves.

Simplistically, the treatment train consisting of the EAA BMPs, STAs and the impact areas in the EPA are effective at reducing TP to 10 ppb or less. Unfortunately, using the EPA to provide the final reduction may be inconsistent with the Everglades Forever Act and the desires of various stakeholders. Therefore, the treatment provided by the EPA must be accomplished further up in the treatment train, either by improving the performance of the STAs, the EAA BMPs, or both. The panel believes that STA optimization must be informed by knowledge of the P removal efficiency of the biological communities, P cycling in the STAs and STA hydraulics. In addition, we recommend that as much work as possible be conducted using the STAs themselves.

The realization that biological communities perform differently with regard to P removal is becoming clear. Bill Walker is now recognizing these differences in performance in the DMSTA model. The panel has been urging the District in its reviews of the Everglades Consolidated Reports to focus research effort on P removal related to differences in biological communities in the STAs. We again urge the District to define the communities in the STAs and to compare these communities with TP removal observations.

P cycling is a second critical issue for STA optimization. Presently, much of the STA performance work assumes a black box approach - inflow minus outflow TP. We cannot realistically optimize the performance of the STAs without knowing if the entire STA is responsible for removal, or if the majority of the removal occurs in a lesser part of the STA. Nor do we know the extent that P is regenerated within the STA. This information is critical, and should be collected for each species of P in each STA cell. Consideration should also be given to the importance of each P species relative to biotic impacts. That

is, 10 ppb TP may be less relevant than some lesser concentration of another P species. Determining this is necessary to optimize biological community selection and to evaluate potential downstream impacts.

Finally, STA hydraulics is quite likely the most important component of an STA optimization program. Cell 4, coincidentally a relatively efficient remover of TP, was found to be hydraulically inefficient. All of the STA cells should be tested using dye tracer studies as has been recommended by the panel in the past, and hydraulic inefficiencies corrected. Modeling of STA hydraulics should also be revisited using actual HRTs rather than theoretical HRTs. Use of theoretical HRTs may lead to gross over-estimates of the acreages needed for treatment. As noted above, 10 ppb TP is being achieved. If P cycling investigations indicate that removal is largely affected by the front end of the STAs, then reconfiguration may be in order. For example, further dividing the cells with levees (additional tanks in series) and revising the inflow distribution systems, coincident with maintaining the existing HRTs, may be sufficient to meet treatment goals.

Conclusions

1. The section provides a reasonable review of optimization activities during the past year.
2. The application of the test cell experimental results to STA optimization is somewhat difficult to assess with the information provided, and may be limited by the occurrence of cattail communities.
3. The marsh dryout studies provided potentially useful results.
4. The prediction of P holding by STA-6 soils is encouraging but needs to be verified.
5. The DMSTA model should be subjected to panel review.
6. The efficacy of translating mesocosm and test cell experimental results to STA performance should be discussed.

Recommendations

1. Any additional test cell experiments should include SAV and periphyton treatments.
2. Additional investigations should use the STAs as much as possible.
3. P removal should be monitored for each P species in each STA cell.
4. STA cell biological communities should be determined, periodically monitored, and compared to P removal observations.
5. An investigation of P cycling in the STAs should be initiated.
6. An investigation of STA cell hydraulics should be initiated, and hydraulics reconsidered using actual HRTs.

Chapter 4C: Advanced Treatment Technologies

The ATT investigators are to be commended for collecting significant quantities of phosphorus removal and hydraulic data for the various biological and chemical processes evaluated. These data will be very useful in deciding the best treatment options available

to the state of Florida in restoring the Everglades. It is unfortunate that more detail is not provided about many of the experiments. In general, Chapter 4C is sketchy and could be improved greatly if more detail about the experiments were provided. Dimensions of experimental units, influent flow rates, hydraulic residence times, graphic symbol definition, etc. are frequently omitted. As a minimum, it is suggested that the diagrams of the various treatment processes used in the 2001 Report be included in the 2002 Report. It is difficult to read a chapter that constantly refers to another for tables and diagrams.

A summary table showing the experimental conditions and results for the various treatment methods would be useful. As the report currently stands, there is too little detail to make a judgment as to whether or not any of the experiments have been performed at optimum conditions.

It is understood that most of this information is available in other documents, but that does not help the reader with only the current chapter. It is unfortunate that space is limited and consequently the general reader of the report misses many of the pearls of the studies.

The investigators are beginning to approach the analysis of the various unit processes investigated along the lines of the way an Environmental Engineer would analyze the situation: model the reactor using basic mass balance and reaction kinetics/stoichiometry principles. Again, the lack of detail in the report about the data analyses leaves the reader wanting more information to fully understand the results of the various evaluations.

It is encouraging that some of the ATTs can reduce TP to less than 0.010 mg/L and cost estimates have been compiled for these processes. It is critical that cost estimates be made for other options available so that various scenarios can be developed to determine the ultimate combinations that are applicable to restoring the Everglades. A table comparing all treatment alternative costs (e.g., STAs, STAs with ATTs) would be helpful.

The list of technologies should be reordered to match the text presentation.

General Comments

Where hydraulic loading rates (HLR) are given, it would be helpful if the hydraulic residence times also were presented, because it is difficult to determine if flow rates or surface areas were varied to maintain equal loading rates.

Section Comments

Comments and questions for each section of Chapter 4C are presented in the following paragraphs.

Submerged Aquatic Vegetation (SAV), Mesocosm Research

Effects of variable water depth

It would be helpful if hydraulic residence times in the mesocosms were reported along with the number of hydraulic residence times there were between the changes in depth. What was the HLR in each mesocosm? Were the number of hydraulic residence times between changes adequate to achieve "steady state" operating conditions?

Effects of Pulse Loading on Phosphorus Removal Performance by SAV Communities

Were the depths held constant during these experiments and flow rates varied to maintain the HLRs? Were tracer studies conducted?

The use of the phrase 'no-flow period' in the discussion of pulse loading effects is a bit confusing. Is it correct in assuming that inflow was curtailed, but that there was sufficient water in the mesocosms to continue outflow?

The pulse-loading experiment HLRs were two orders of magnitude greater than the design HLR for the STAs. Why conduct an experiment with so little potential for extrapolation to STA operation?

Effects of Filter Media Size and Type on P Removal Performance

Briefly describe the filter media in the text. Were statistical calculations made to determine differences in the mean values?

Why did the Fe-coated sand columns release large quantities of SRP when flow was initiated?

In Table 4-20 the characteristics of the media should be added, i.e., effective size or average size of media, void space, specific surface area, ion exchange capacity of media, etc.

Please describe Pro-Sil Plus. Were outflow TP concentrations significantly lower for the limerock and Pro-Sil Plus than for the quartz treatment?

Effects of Calcium/Alkalinity and Soluble Reactive Phosphorus Concentrations on Phosphorus Coprecipitation

Is the hydraulic retention time the nominal or measured value? TDP values are discussed in the text but do not appear in Table 4-21. This is confusing to the reader who may not be overly familiar with the various forms of phosphorus. Why not include TDP in the table?

Removal of phosphorus in reactors that approach first order kinetics is a function of the influent concentration; therefore, greater mass removal would be expected at higher influent concentrations. Modeling of these processes would be very useful in the design of full-scale units.

Characteristics of particulate materials

Were the organisms among the particulates identified? If so, what contribution did they make to the P?

Test Cell Research

Presenting the hydraulic retention times and depths for the test cells would be helpful. In the last sentence on page 4C-10 reference is made to "a slight export of TP." How much is "slight" and why did this occur? Under what conditions were outflow TP concentrations < 10 ppb observed?

Figure 4-25 would better illustrate the differences if scales for TP were the same on both graphs. It also would be helpful if the HLRs and depths were shown on the figure.

Field Scale Research, STA-1 West

Cell 4 hydraulic Optimization

The District is to be commended for its efforts to assess the impact of flow patterns in the STAs. After making the changes in Cell 4, have any changes in phosphorus removal been observed or is it too early to tell? Drought conditions probably have not been conducive to an evaluation, but if available it would be interesting to include the material.

STA-1W, Cell 5

What would be the consequences if a die-off of the Najas and Ceratophyllum occurred? A table or diagram showing the variation in SRP concentrations with the standing crop biomass would be useful. Perhaps the SRP concentrations could be superimposed on Figures 4-26 and 4-27.

Forecast Model Development

A brief description of the dynamic simulation model for the ASV/LR treatment systems would add materially to this section. As a minimum a plot of predicted versus measured output would be helpful.

Future Research

Proposed research appears to be appropriately directed; however, I would strongly encourage further evaluation of the impact of hydraulic optimization on P removal in STAs. It is likely that with optimization of the hydraulics of the STAs, it would be possible to accomplish the same degree of phosphorus removal in approximately one-half of the existing surface area and have the remaining for a transition or mixing zone.

Summary

Were there changes in hydraulic detention times as the water depths were varied? An explanation of the way the depth experiments were conducted would be helpful here and in the above section.

Periphyton-Based Stormwater Treatment Areas (PSTAs)

In the first part of this section, it would be helpful if the treatments were described. It is know that the information is available elsewhere, but a minimum of information is needed to follow the discussion.

Define STSOC. Were TP outflow concentrations significantly higher for the peat mesocosms than the shellrock mesocosms? A table listing P by compartment in the Porta-PSTAs would be helpful. Do peat systems export more particulate matter than shellrock systems?

PSTA Mesocosms

It would be helpful if a paragraph or two were added describing the effects of depth, plant community, etc. Are there statistical differences in the means shown in Table 4-22?

PSTA Phase 2 Tracer Studies

It is good to see results of tracer studies. Without these results, there can be considerable questioning of all removal data.

As currently written, it is doubtful that the public will get much from this section. A brief statement in simple terms about the effectiveness of the tank hydraulics would be very useful, i.e., how long before appearance of tracer in the effluent and what does this mean, meaning of the percent recovery of tracer and why all was not accounted for, what number of tanks means in English, what the nominal and mean HRT represents, etc.

Was the flow rate reduced when the depth was changed? In the last sentence, the statement that "the decreased operating depth" may have had an effect on the increase in the "N" value would likely be incorrect unless the flow rate was reduced assuming that the HLR was kept constant. A change in depth at the same flow rate would result in an

increase in the velocity in the reactor and would most likely reduce the N value. Did the time of first appearance of tracer vary between tracer studies?

PSTA Field Scale

This is an excellent project and should yield significant design information.

Summary

The statement that preliminary evidence suggests that vegetation was the major P storage compartment needs modifying. This was correct for one but not the other.

The summary states that the peat-based periphyton system is not as efficient at reducing P as the shellrock-based system. In addition, the summary states that peat-based outflow TP concentrations often exceeded inflow concentrations. Yet the discussion of the PSTA Field Scale refers to 'encouraging preliminary test cell data' as the justification for including a peat-based treatment. Do the summary and field scale statements contradict each other, or is there other information not provided in this chapter? Did not DB Environmental Laboratories achieve promising results with peat-based periphyton systems?

Managed Wetland Treatment Systems

Current Status of Managed Wetlands

Please characterize the vegetation in the cells. Figure 4-33 suggests that the wetland portion of the treatment train is removing the bulk of the TP, and that the chemical treatment is providing little removal of P. Why was no reduction in TP observed in the North Control Test Cell? The North PACL plant stripped SRP, but the South PACL did not strip SRP. Conversely, the SPACL stripped TDP, but the North PACL did not strip TDP. Please comment.

The Paired Watershed Experimental Design Analysis states that, at the North site, the PACL treatment cell showed a larger reduction in TP than the $FeCl_3$ treatment cell. However, Table 4-26 indicates that the PACL treatment cell removed 0.041 – 0.036 = 0.005 mg/L (12%) and the treatment cell removed 0.089 – 0.038 = 0.051 mg/L (57%). Could you explain how calibration can produce this seeming contradiction?

The summary states that the MWTS treatment system reduces P outflow concentrations better than a wetland system alone. The results suggest that the gain is marginal at best. In addition, cost and chemical disposal/toxicity considerations would seem to negate these gains.

The summary states that a pond-based treatment system sized for solids storage would provide effective P removal. Are not the STAs providing the same treatment?

STA-1 West Test Cell Research

The fourth paragraph would be much clearer if a drawing were included. A summary of the coagulant dosages, pH values, contact times, etc., is needed. Without these data, it is impossible to interpret the results reported in this section. A brief statement about preliminary tests, such as jar tests results, used to arrive at the dosages used in the test cell is needed. The chemical formula for PACL should be presented, as is the ferric chloride formula.

Experimental Results

Is there any reason that the results are qualified in several places as "about" some range of values? Do you not have the ranges of values and the averages?

It is implied that the results are based on an optimization of the processes. A statement to that effect or a caveat is needed. Table 4-26 would be more useful if pH values, chemical doses, etc. were included. The pH value is definitely needed because phosphorus removal with coagulants is a function of pH. With an incomplete data presentation, it is difficult to determine the efficacy of the approach. Are the residual aluminum concentrations in the PACL system unusually high for a system operating optimally?

Paired Watershed Experimental Design Analysis

More discussion is needed. With higher influent concentrations, greater mass removal is expected. Were the coagulant dosages the same at the north and south sites? As the concentration of P decreases, the concentration of coagulant required to achieve the same percentage removals as those obtained with higher concentrations of P increases significantly. A table showing design and results is needed.

Evaluation of Toxicity

A brief description of the procedures would be helpful to the reader.

What alga species was used in the Algal Growth Potential tests? With a low nutrient water, the standard alga may not be applicable.

What range of pH values were used in the Leaching Procedure?

Low Intensity Chemical Dosing (LICD)

Project Results

Were there any consequences from releasing Al to the Everglades in the concentrations observed in this experiment?

A comment as to why P was not reduced by LICD would be appropriate.

Chemical Treatment

Would a chemical treatment facility placed in STA-2 have sufficient capacity to treat all P-laden runoff to the Everglades, or just that runoff now directed to STA-2?

A treatment facility does not provide the ancillary benefits (e.g., wildlife and fisheries, recreation) that an STA could.

Conceptual Design

Explain why there are such large differences in acreage required for post-BMP and post-STA chemical treatment. Were estimates of sludge production made from the results obtained in experiments or were general rules of thumb used?

Present Worth Costs

Chemical Treatment/Microfiltration

A flow diagram for the process would be helpful in interpreting the following discussion. As currently presented, it is not clear as to what pretreatment is to be used, what levels of P reduction are expected in various processes, etc. It is difficult to determine what the costs represent.

Chemical Treatment/Microfiltration Summary

As far as the summary goes, it is good, but it could be expanded considerably to make it clearer and complete.

Conclusions

1. Large quantities of data have been collected by the Advanced Treatment Group, and the group is to be commended for their gigantic effort.
2. Considerable work remains to be done in interpreting the data and compiling accurate cost estimates for all types of treatment processes.
3. It is not clear that optimization of the treatment processes has been accomplished.
4. It appears that some of the advanced treatment processes can produce an effluent with a TP concentration of 10 micrograms/liter; however, the costs and environmental impact of discharging these effluents to the Everglades has not been established.
5. It appears that with optimization of the STAs (primarily hydraulic improvements), it may be possible within the existing systems to produce a TP effluent of 10 micrograms/liter prior to discharge to the protected areas.

Recommendations

1. Hydraulic studies of the STAs should be expanded to include all of the units. It is recognized that this type study is expensive, but without these data, it will be extremely difficult to develop accurate models of the systems.
2. Conduct sampling at intermediate points in the STAs after correcting the byrraulic deficiencies. It is likely that the STAs could be reduced in length and still accomplish the same degree of treatment. Portions of the STAs probably are reintroducing phosphorus to the water at the lower ends of the systems. Intermediate sampling in other types of treatment systems also is important.
3. If ot already accomplished, optimize the advanced treatment systems.

CHAPTER 5: Development of a Numeric Phosphorus Criterion for Everglades Protection Area

Criterion

This is a well-written chapter. The authors do not repeat data or analyses presented in previous years' reports, but rather use this previous information, along with rather limited additional data, to show that numerous ecological responses occur when total phosphorus levels above ~10 µg/L are maintained in the Water Conservation Areas and the Everglades National Park. The additional data on water column phosphorus levels, collected since October 1999 in WCA-3 and the Park, which reflect both a short period of sampling and a time of drought conditions, are interpreted conservatively in the context of comparisons with patterns and responses shown in other areas where there are longer periods of record. Similarly, changes in periphyton composition and in the macrophyte community that are noted along transects in WCA-3 and the Park are similar to those documented for other areas of the Everglades. The chapter presents a convincing case, based upon data collected from different parts of the Everglades Protection Area, and for different periods of time, that the structure and function of the periphyton and macrophyte communities are adversely affected by phosphorus enrichment. Furthermore, they show that these changes occur generally in areas where phosphorus levels begin to exceed annual geometric means of 10 µg/L.

The data presented in this chapter are used to support the default P-criterion of 10 µg/L established by the Everglades Forever Act, as being protective of the flora and fauna without being overly protective. However, as stated in the chapter, "…an upper bound must be established for this value which takes into account the natural spatial and temporal variations in the P concentration … without being so high as to allow imbalances in the native flora and fauna." Data from this report and previous ones show

that total phosphorus (TP) levels in water column samples from any given point can vary quite a lot, and frequently exceed 10 µg/L in areas where the long-term geometric mean value is lower. The issue of daily and seasonal variation needs to be more clearly discussed in the context of this standard and exceedences. Spatial variation also needs to be discussed more in light of the temporal exceedences. Given the present absence of a cost-effective means for treating runoff to 10 µg/L, it behooves us to understand how high and for how long the biota can be exposed to levels above the 10 µg/L TP level without the occurrence of imbalances, and whether the biota can revert to its pre-existing state when TP is decreased to 10 µg/L or less.

Regulatory

In developing a Phosphorus criterion for South Florida marsh conditions, eventually to be applied to the Everglades in establishing a phosphorus standard for the EPA, the definition of terms, as it was in Chapter 2A, is again an issue.

Referring to the review of Chapter 2A, there is concern that the terms 'criterion' and 'standard' are not being used in a manner consistent with current water quality management practices. In Chapter 1 a number of uses of water, particularly in the Water Conservation Areas, are articulated: water supply to urban areas; flood control; and supply of water to the Everglades National Park. The P criteria required for each of these uses is different. For purposes of establishing a standard, what use criterion will be selected – the most restrictive use or the largest use? Setting appropriate standards is critical to effective water quality management as noted by the National Research Council (2001). Carefully defining uses of water is key to setting appropriate standards.

When a site specific dissolved oxygen (DO) criterion/standard was developed for the EPA in the 2001 Everglades Consolidate Report, it was noted as a Site Specific Alternative Criterion development effort. No such terminology is employed with the P criterion development. There is no explanation of why different methods are being employed with DO and P criteria/standard development. Is it the fact that P has specific legislative directives?

Why is DO criterion development based on physical and chemical processes while P criterion development utilizes statistical measures of central tendency? Why is compliance determinations for DO based on proportion of samples violating the standard over a year while P compliance utilizes the geometric mean? The variation of criterion and standard compliance methodologies employed across water quality variables may lead to management confusion if not carefully coordinated and justified.

The above discussion begs a larger question: How is the entire watershed of the South Florida Water Management District to be segmented for purposes of classifying water in order to establish water quality standards? If the Water Conservation Areas are identified as a separate segment, the question of which 'use' is selected for development of a water quality standard can be addressed from a watershed perspective, recognizing changing uses and ecosystem needs as water moves from the most northern portion of the

watershed to the Everglades National Park. Thus, the standard setting process requires a segmenting of water from a watershed perspective, assignment of uses, and selection of criteria to protect the selected use in the segments. The recently published National Research Council report on TMDLs notes that the large number of TMDLs suggests the process may not be operating properly. The question arises: Is the standard setting process incorporating site specific conditions and local community priorities? Is it recognizing the transition of water quality conditions that occur naturally across the watershed? For example, the P concentration in urban storm water discharged to the EPA appears to decrease from north to south. Is this the result of natural conditions, given that urban impacts are constant? How does the setting of P standards properly recognize the transition of P across the entire watershed? As the National Research Council (2001) report stated, as noted earlier in the Chapter 2A review, an ambient-focused water quality management program 'is dependent on the setting of appropriate water quality standards.' Are the standards being considered for the EPA 'appropriate' given the water quality evidence?

To better 'context' the P standard setting effort described for the EPA, the report should summarize the larger watershed standard setting strategy/policy employed in the watershed, paying particular attention to the inadequacies described in the National Research Council (2001) report.

In Chapter 5, page 5-2, the report notes that: 'The EFA further requires that compliance with the P-criterion be based on long-term geometric mean concentration levels to be measured at sampling stations representative of receiving waters in the Everglades Protection Area.' It appears the confusion, between definitions of criteria and standards, may be embedded in law if the EFA is referring to criterion for a water body – the Everglades. Again, criteria refer to protecting a use without reference to a specific body of water. Standards protect a water body. Or is this a site specific alternative criterion development effort?

The above quote indicates that, legally, the data analysis method employed to determine P standard compliance is the geometric mean. This implies that the underlying statistical distribution of P in the Everglades is lognormal. Has this assumption been tested using the most recent data? How is the geometric mean computed? Has any consideration been given to using non-parametric methods or the current 'Excursion Analysis' methods employed for other water quality constituents? Or does the legal statement force use of the geometric mean?

The following statement on page 5-24 is not clear in its meaning, nor implications, to establishing a P-criterion.

> "…the adoption of the EFA default P-criterion of 10ug/l to be measured as an annual geometric mean, may not be statistically differentiable from alternative numbers in that range identified through further research."

It seems to say that because we cannot accurately measure a statistical difference, say, between 10 ug/l and 13 ug/l, it does not matter which we choose as the criterion. In other words, no further research on the topic is warranted because we cannot measure differences in this range anyway. While this is an extremely important topic to be discussing, the exact meaning is not clear and should be explained in more depth.

The statement on page 5-42 (last sentence of fourth complete paragraph) indicates that the methods to perform a compliance test are still unresolved, even though the above statement implies that regardless of how the P-standard is measured, it will not be accurate to within a 'range'. The panel feels very strongly that considerable thought and attention needs to be devoted to defining the means by which P-standard compliance is measured and calculated (over the entire EPA and over an entire year) with data from multiple sampling programs. There is concern that a variety of statistical methods will be examined until one, that appears to provide a 'reasonable' result, will be selected. If a variety of compliance methods are selected, there will be no consistency or comparability across water quality variables and confusion in management information may result.

Conclusions

1. Analyses of the limited chemical and biological data from sites in WCA-3A and the ENP suggest biological responses to P enrichment similar to those previously documented inWCA-2A and WCA-1.
2. The multiple studies cited support 10 µg/L P as a standard that would be protective of natural flora and fauna in the EPA.
3. In establishing a P standard, an upper bound also must be established which takes into account natural spatial and temporal variations in P concentrations.
4. Considerable thought and attention need to be devoted to defining the means by which P-standard compliance will be measured and calculated, over the entire EPA and over an entire year, with data from multiple sampling programs.

Recommendation

A peer reviewed policy for establishing standards, and measuring standard violation or compliance, should be established for the EPA to insure consistent management information is produced across water quality constituents. If this is not feasible, each constituent's standard compliance method should be carefully justified and compared to other the methods selected for other constituents. In developing such a policy, it should be acknowledge the National Research Council's (2001) observation that 'water quality standards must be measurable by reasonably obtainable monitoring data.' Perfect data will not be available, thus a standard compliance policy must acknowledge monitoring realities.

Reference

National Research Council. 2001. Assessing the TMDL Approach to Water Quality Management. National Academy Press, Washington, D.C.

CHAPTER 6: Hydrologic Needs – Effects of Hydrology on Everglades Protection Area

The objective of Chapter 6 is to provide an update on the multidisciplinary approach to better understanding and managing the EPA hydrologic patterns. The focus of the chapter is on the hydrologic trends and ecological assessments in relation to the drought. Issues discussed in the chapter include general hydrological trends, a new theory for the creation of tree islands, the hypothesized relationship between groundwater movement and chemistry and tree island health, wading bird nesting, indices for wading bird nesting success and muck fires, and drought effects on Florida Bay.

Despite the regional drought, the rainfall patterns in the EPA were not significantly lower than the 32 year average. Rainfall was reduced 23 percent, and structure inflows to the WCAs were reduced 45 percent, but average weekly water levels in the WCAs were 0.4 to 0.7 ft higher than average. Water conservation and active management held water in the WCAs.

Tree island investigations found that the islands contain sediments from the Miami Limestone and the Fort Thompson Formation, and that rainfall is the greatest influence on both surface and groundwater levels around tree islands. The District has also developed a theory that tree island development is related to nutrients released from groundwater or from a small island head. Nutrients leach downstream to form a nutrient-rich substrate for island head and tail expansion.

Wading bird nests increased by 40 percent over 1999, mostly because of an increase in white ibis, wood stork and snowy egret. Most other species decreased from the previous year. Nesting efforts differed among regions, with the overall increase primarily the result of increases in WCA3. The District hypothesizes that the overall increase in wading bird nests is because of an influx of birds prior to the breeding season, a wet start to the dry season, and a rapid and prolonged dry down.

A muck fire/bird colony suitability hazard index was developed. The risk of a muck fire is predicted based upon soil TP, water level, vegetation type, soil type and burn history. Wading bird colony suitability is based upon surface water levels and proximity to foraging sites. Neither muck fires nor wading bird colony suitability appeared to be correctly predicted by the index.

The District found no evidence of freshwater flowing from the Everglades to Florida Bay. Bay salinities were found to be higher than normal.

The chapter adequately describes the basic hydrology of the EPA during the past year relative to average conditions. However, focusing on average conditions can be misleading and potentially detrimental to ecological function. For example, periodic low water concentrates prey and may be critical to successful foraging. In addition, periodic

dry down may allow seedlings to germinate. The panel suggests that the District focus attention on hydrological temporal and spatial variability so that the importance of variability can be ascertained. Another hydrologic issue deserving attention, and not addressed, is the continued ponding in the southern part of WCAs and the relative dryness of northern WCAs.

The panel was not provided with information to competently judge the efficacy of the District's nutrient theory of tree island development. Quite honestly, the theory is not intuitively obvious. Critical to the theory is an understanding of groundwater nutrient levels, evidence of groundwater upwelling, and some other evidence that nutrients are the limiting factor in tree island formation, and not simply coincident. To the panel's thinking, ground elevation relative to water elevation is the critical factor necessary for tree island formation. Nutrients in pore water, and the drift of nutrients from island heads and tails, seems to be a secondary contributor if not incidental. One way to consider the issue is to ask what will cause tree island formation, dumping fertilizer or a pile of dirt into the EPA? Perhaps more importantly, the panel is not clear on the relevance of this line of research. EPA hydrological management appears to be a far more critical issue for tree island protection than nutrient levels in pore or drift water.

Regarding wading bird nesting, this issue is relatively straight forward. However, the panel suggests that future surveys and analyses consider each wading bird species separately.

The muck fire/bird colony suitability hazard index is another section the panel finds difficult to properly evaluate. The index contains many assumptions, few of which are supported in the text. In addition, the seeming inconsistencies between index predictions and observations are not addressed. We urge the District to give serious consideration to the index before using it as a management tool.

Finally, the discussion of drought effects on Florida Bay is somewhat abbreviated and leaves the reader wanting more information. In addition, the seeming incognity between District salinity data and the AOML data referred to in the agreement of Department of Interior's comments should be addressed. In the future, the section should be expanded to include, at a minimum, context and explanation for the findings.

Conclusions

1. Water levels in the EPA were not affected by the drought because of water management and rainfall patterns.
2. The District has proposed a theory for tree island formation that is not intuitively obvious and is not well supported in the chapter.
3. Some wading birds nested in greater than average numbers compared to last year.
4. Caution should be applied before using the muck fire/bird colony index to manage water levels.
5. The drought may have impacted Florida Bay but insufficient information is provided to reach a conclusion.

6. The chapter has editorial deficiencies, many of which were previously noted by the panel.

Recommendations

1. Hydrological research should be applicable to the CERP, and focused on maintaining critical water levels for important EPA ecosystem components like the tree islands, and resolving the ponding of water in the southern parts of the WCAs.
2. The muck fire/bird colony index should be subjected to rigorous internal and external review if it is to be used to manage EPA hydrology.
3. Next year's chapter should be cognizant of the readership, and the authors understanding of the peer review process. In the future, the panel recommends that chapter authors provide sufficient information to allow informed comment and guidance from the panel and stakeholders. The panel understands the peer review process and the public workshop to be an opportunity for the panel and stakeholders to provide informed comment and guidance to the District and its partners in their efforts to restore the Everglades. Insufficient information was provided in the chapter or presented during the workshop to offered informed comment and guidance about the nutrient theory of tree island development, the muck fire/bird colony suitability hazard index, and the effects of drought on Florida Bay. As such, the District and its partners are unable to benefit from effective peer review of these issues.

CHAPTER 7: Comprehensive Everglades Protection Plan

The overall purpose of this chapter, particularly in terms of how it relates to the previous chapters addressing monitoring and evaluation of a number of water quality parameters, is not clearly stated.

If a clear relationship can be drawn between the CERP and the many individual activities aimed at improving water quality and habitat, this chapter will become key to the public understanding and acceptance of this restoration effort. The general public will judge the effectiveness of expending so many millions of dollars based on how well the comprehensive restoration plan is perceived, based in large part upon the RECOVER protocols. Together these protocols may set a new standard for preparing a comprehensive strategy and for ensuring a high degree of compliance with restoration goals in a general sense, but the details for making that assessment are not presented. If the interrelationships between these protocols are not yet understood, it should be stated. Future updates can present more detailed information on this topic.

The panel believes that the iterative monitoring process proposed involving the National Academy of Sciences indicates the serious manner in which the District wants to approach the entire CERP planning process. However, it is not clear if the Academy will be evaluating what the review panel has already analyzed or if the Academy will only deal with evaluating the effectiveness of the protocols in terms of the overall CERP. In addition, if the Academy is to evaluate the plan in September, indicators or other

measures of success must have already been developed. Yet they are not presented in this chapter.

We commend the District for taking the initiative to develop a comprehensive restoration program, rather than simply implement a series of independent activities. This is the first time that such an effort has been attempted on a scale (landscape/regional) of this size and complexity. We recommend that a flow chart indicating the relationship of the various monitoring and evaluation programs to the overall goals of the CERP be included in the report.

The methodology of pilot projects, feasibility studies and project implementation reports represent a logical strategy to test the effectiveness of technologies for broader application in the future. The six pilot projects seem to cover a variety of technologies and geographic areas. The logic of undertaking a regional-scale hydrological analysis should be strongly supported as it will offer an updated baseline to measure effectiveness at some scale of either individual or program-wide projects. However, indicators used to judge either science or management success of the pilot projects are not adequately discussed.

The framework for addressing several criteria listed in the feasibility studies on page 7-3 is very important in meeting criteria at the project level. This process will be a much more direct one than simply understanding the interactions of projects at the landscape scale and particularly in terms of overall cost/benefits – even if the process is driven by science criteria. There are simply too many unknowns that will remain so for the foreseeable future.

The Restoration, Coordination and Verification section of the report reads very well. The objectives of the RECOVER program are logical if not ambitious in terms of their comprehensive and integrated nature, however criteria and indicators must be included in the text of the chapter. Some reference to the RECOVER program should be made early in this chapter.

The institutional implications of the last RECOVER objective "Develop a consensus…" is critical to future management of the region and should be given priority from the outset so as to catalyze joint ownership of the program. The adaptive assessment protocol referred to on page 7-5 should be further defined, as institutional policies will be as important to overall success as is the quality of the science. The success of this ambitious inter-institutional effort is apparently based on developing a proactive partnership where no one agency controls decisions. As the results of pilot projects and other field trails and investments (policy or infrastructure) become clearer, adjustments affecting certain programs and agencies will be required. This, in turn, requires true institutional collaboration. The interagency MOU could be attached to this report as an annex.

The concept of an annual CERP "report card" is an innovative one that will overtime provide a timetable of the RECOVER program effectiveness and adaptations, however

the bases for such a report card must be clarified. We do not want to give the impression that scientific work is being either repeated or second-guessed.

The discussion of the conceptual ecological models on page 7-8 is excellent but does lead to a number of questions, most importantly as to how data will be integrated and presented to decision-makers. The iterative nature of the monitoring program noted on page 7-9 presents a strong defense of the quality of the model(s) proposed.

Recommendations

The comments made by the representative of the Marshall Foundation on the Waldo experiment require a greater level of examination by the District as a potential technology to help address the issue of water quality in the Everglades system. In addition, there does appear to be an under-consideration of the benefits of natural systems, especially trees, in the CERP plan. Some consideration of forested wetland pilot projects would seem appropriate at this stage. A tree experiment in Wellington could provide useful information.

CHAPTER 8: Status of Other Everglades Programs

8A: Achieving Long-Term Water Quality Goals

The methodology for the water quality improvement strategies testing are appropriate to the complexity and scale of the proposed plans. They set a new standard for measuring water quality compliance levels by integrating several improvement strategies into a comprehensive plan. Most restoration plans undertaken to date in the U.S. have measured the impacts of one or two management parameters rather than the combination of BMPs, STAs, and ATTs proposed by the District. In addition, the scale of the process being implemented will provide a wealth of new science and management data, which will be of extreme importance for other wetland systems in the world. The Everglades-Pantanal (S. Brazil, N. Bolivia) initiative being sponsored by the Inter-American Water Resource Network, the Brazilian Secretariat for Water Resources and the Latin American and Caribbean Center for Water Management in the Humid Tropics (CATHALAC) is following the CERP process closely. Responsible officials will undoubtedly adapt strategies which prove successful in the planning process recently initiated in the Everglades for that region in South America.

The list of 13 key gaps in the information based for making decisions is useful. The chapter could be greatly strengthened, if for each of the 13 items, additional information was provided. Specifically, it would be helpful if the report would provide a summary (for each item) of how big the gaps are, what needs to be done to fill the gaps, a time line for doing so, and the funding needed to complete the work. Also, putting the 13 items into a priority listing would aid in the evaluation of what is needed to bring sound science to the decision making process.

Chapter 8B: The Everglades Stormwater Program (ESP)

The goals of the non-Everglades Construction Project (ECP) permit schedules and strategies are clearly stated. Figure 8B-1 presents important information on the extent of the Everglades Protected Area (EPA) as well as a wealth of information on discharge/water quality data collection points that I have always felt need to be better communicated to the general public.

The description of the USFWS property on page 8B-6 is well presented, however the implications of it being "isolated" are not clear. The authors' note that the usefulness of the TP data collected is being evaluated, but I am not clear what we gain if there is not positive outflow.

The discussion of public outreach initiatives is important and should somehow be highlighted and continued to be expanded. We believe that the potential weaknesses as well as future problems associated with not meeting the 2006 deadline for P levels should be included in public outreach efforts. We also feel that an effort to communicate the integrated nature of the actions being undertaken should be included in public education materials.

The updates presented on the activities in the ESP basins provide some additional information, but much of it may be better summarized in a tabular format. It is positive that remedial responses to particular basin-level issues are also included in the text.

Chapter 8C: Land Acquisition in Support Projects in the Everglades Region

Our analysis of the acquisition program is that the District is behind schedule. The information provided is not sufficient to determine if lands being acquired are priority for infrastructure or for watershed management purposes.

The public relations aspects (positive or negative) in continuing to acquire private lands is not discussed but should probably be addressed in the public outreach section of this chapter.

Chapter 8D: Managing Fiscal Resources

This section of chapter 8 is a straightforward presentation of income and expenses. I have no basis to criticize any specific aspect of this report.

Chapter 8E: Comprehensive Exotic Species in the EPA

Invasive exotic species are a most serious problem in the Everglades, and this is an important section of the report. As it points out, the general consensus is that control and management of non-indigenous species is a critical component of ecosystem restoration in South Florida. The text provides a clear and strong statement of this complex problem and its relationship to the District meeting CERP goals. An important point that is made is that restoration efforts in the Everglades will not necessarily reduce needs to control exotic species. It is very likely that control efforts will be ongoing for many years, if not forever. As one environmental parameter is implemented to control a given species, it may catalyze proliferation of another. In addition, the very works introduced to control the principal environmental problem of TP levels may "provide additional conduits from points of introduction into the Everglades for other exotic plants and animals".

This is also an important chapter for the general public, as most would probably not recognize many species as being exotic or characterize the presence of such species as a major management issue. This opinion is undoubtedly prevalent in spite of public education efforts undertaken to date. It is necessary to educate the public and policymakers that control of invasive exotic species will be an ongoing effort, and that new introductions need to be stopped. The chapter has been reorganized since the 2001 report and presents the information in a way that will be more useful for a general audience.

The chapter gives an overview of organized efforts to assess the environmental problems caused by invasive species (chiefly plant species), supported through numerous agencies and mandates. There clearly is a need for a comprehensive plan that coordinates different agency mandates and efforts into a consistent strategy. The Noxious Exotic Weed Task Team (NEWTT), established in 1999 by the South Florida Ecosystem Restoration Task Force (SERTF) has been charged with developing such a strategic plan covering the issues and problems of exotic pest plants. A similar effort is needed for invasive animal species. As recognized in the chapter, there is a need to establish an Animal Task Team (NEATT) to undertake a similar effort for invasive animal species. The SERTF non-native animal report is being developed to provide a broad picture of the status of non-indigenous animal species, but progress appears to be slow.

The majority of section 8E, on management and control efforts, addresses non-indigenous plant species, since this is where the greatest efforts in control have occurred. Sections related to animal species generally point out that there is limited information and that much more research is needed. Thus, the animal sections provide little information.

It is apparent that future efforts to control exotic plants will continue to require a multifaceted effort of biological control, herbicides, manual and mechanical removal, cultural practices, prescribed burning and water level manipulation. In addition, a lack of thorough knowledge of the impacts of any given control method and the responses using a combination of several methods, coupled with insufficient human and financial resources, point to a need for an ongoing effort if restoration goals are to be attained. Without question the method of identifying and monitoring control of priority species, as is proposed by the District, is the only way to proceed with such a complex program.

Invasive exotic species are a most serious problem in the Everglades, and this is an important section of the report. As it points out, the general consensus is that control and management of non-indigenous species is a critical component of ecosystem restoration in South Florida. An important point that is made is that restoration efforts in the Everglades will not necessarily reduce needs to control exotic species. It is very likely that control efforts will be ongoing for many years, if not forever. As one environmental parameter is implemented to control a given species, it may catalyze proliferation of another. In addition, the very works introduced to control the principal environmental problem of TP levels may "provide additional conduits from points of introduction into the Everglades for other exotic plants and animals".

This is also an important chapter for the general public, as most would probably not recognize many species as being exotic or characterize the presence of such species as a major management issue. This opinion is undoubtedly prevalent in spite of public education efforts undertaken to date. It is necessary to educate the public and policymakers that control of invasive exotic species will be an ongoing effort, and that new introductions need to be stopped.
The chapter gives an overview of organized efforts to assess the environmental problems caused by invasive species (chiefly plant species), supported through numerous agencies and mandates. There clearly is a need for a comprehensive plan that coordinates different agency mandates and efforts into a consistent strategy. The Noxious Exotic Weed Task Team (NEWTT), established in 1999 by the South Florida Ecosystem Restoration Task Force (SERTF) has been charged with developing such a strategic plan covering the issues and problems of exotic pest plants. A similar effort is needed for invasive animal species. The SERTF non-native animal report is under development.

The majority of section 8E addresses non-indigenous plant species, since this is where the greatest efforts in control have occurred. Sections related to animal species generally point out that there is limited information and that much more research is needed. Thus, the animal sections provide little information.

It is apparent that future efforts to control exotic plants will continue to require a multifaceted effort of biological control, herbicides, manual and mechanical removal, cultural practices, prescribed burning and water level manipulation. In addition, a lack of thorough knowledge of the impacts of any given control method and the responses using a combination of several methods, coupled with insufficient human and financial resources, point to a need for an ongoing effort if restoration goals are to be attained. Without question the method of identifying and monitoring control of priority species, as is proposed by the District, is the only way to proceed with such a complex program.

Conclusions

There is a strong need for a comprehensive plan that coordinates strategies for management of invasive species among agencies, and also develops strategies for developing partnerships with private landowners.

1. Much more information must be obtained and made available on invasive animal species, including their biology, ecological effects on other organisms, means of spread, habitat requirements, and methods of control.
2. Public education about invasive species and the threats they pose to South Florida ecosystems is critical to long-term success in controlling exotic species.

Recommendation

1. The SERTF Working Group's non-native animal report and other syntheses of ecological effects of invasive animal species should be completed and made available to as soon as possible.

Chapter 8F: The Lower East Coast Regional Water Supply Plan

This is a well constructed discussion of the water supply plan for the LEC. The panel supports the recent efforts of the District to implement a comprehensive water conservation and reuse program.