Appendix 1-4: Final Report of the Peer Review Panel for the 2003 Everglades Consolidated Report

With the Exception of reformatting some of the information for better readability, the appendices were not edited or spellchecked by the ECR production staff and appear as posted on the District's WebBoard.

FINAL

REPORT

Of the Peer Review Panel Concerning the

2003 Everglades Consolidated Report

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INTRODUCTION

The responsibility of this panel was to review and prepare questions on the draft of the 2003 Everglades Consolidated Report (the Report), dated September 2002. In addition, the panel's responsibilities include the consideration and inclusion of input from the public workshop conducted September 24-26, 2002, where relevant. All comments noted on the web board by October 3, 2002, 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 applications were employed, if all relevant data were 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 that the panel addressed included:

1. Does the draft document present a defensible scientific account of data and findings for the areas being addressed? Is the synthesis of this information presented in a logical and complete manner?

2. Are the findings and conclusions supported by "best available information" or are there gaps or flaws in the information presented in the main body of the document? What additions, deletions or changes are recommended by the panel to enhance the validity and utility of the document?

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

4. Are there data summaries and analyses that should be included in future, annual peer reviewed reports to the Governor and Legislature?

General Panel Response to the Draft Report

The draft 2003 Everglades Consolidated Report is generally well written and well considered. It is clear that the panel's review of the 2002 Report was considered and incorporated into this year's work. The responses of authors to review comments during the public workshop were generally direct and sufficient. The panel found the presentation at this year's workshop to be the best of the past few years. The public comments were also helpful in the review process.

Summary of Major Recommendations

1. Methods to *obtain* data follow strict controls. The review panel strongly recommends that statistical methods used to *analyze* water quality data should be documented in protocols similar to those in the SFWMD Quality Assurance Manual and Monitoring Operating Procedures (chapter 2A). This also applies to issues of phosphorus monitoring (chapter 5).

2. Work should continue on the sources of mercury into the Everglades, including further understanding of the relationship between local, regional, and global sources of atmospheric mercury (chapter 2B).

3. A future report would be well served to present a detailed model for the relationship between mercury, sulfur, phosphorus, biodilution and other factors, with some indication of the magnitude of the effect of each on methylmercury (chapter 2B).

4. Variances and standard deviations should be reported when presenting statistical data, particularly with regard to the impact of BMP programs (chapter 3).

5. The Review Panel believes that the a body of scientific evidence supports the view that meeting the 10 µg/L P level will be protective of the natural flora and fauna of the Everglades. However, scientific evidence does not support the view that this is the only level of P what would be protective of the Everglades biota, nor is there scientific evidence that the 10 µg/L standard is appropriate throughout the entire EPA (chapter 5).

6. Although a 10 µg/L P criterion has been proposed, based upon extensive field transect data, the realistic application of a fixed criterion within a large and heterogeneous wetland ecosystem must be very carefully considered. In particular, the question of the likelihood that existing and near-term future technology can achieve the proposed P criterion of 10 µg/L must be answered. The application of a uniform P criterion across the entire Everglades may not promote patterns of variability that are naturally characteristic of this system (chapter 5).

7. The panel supports the concept that the District begin a long-term study to evaluate the role of trees historically and as a BMP south of the STAs both as a means of P removal and as a means of controlling contaminant movement. This could be undertaken on a pilot basis with a relatively small investment. Trees could be considered as a stand alone BMP or could be applied in combination with other BMPs.

CHAPTER 1: Introduction to the 2003 Everglades Consolidated Report

Given the increasing level of public interest and scrutiny regarding the Comprehensive Everglades Restoration Plan (CERP), this chapter takes on more importance than in previous years.

Overall, the Review Panel found this chapter to be concise and very well written. The eight-chapter format continues to be logical. This year's draft report is better organized than the 2002 version. 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 without having to wade through the technical chapters of the report. The other chapter that may be read by the general public is chapter 7, which presents the CERP. The geographic description, progressing to a more detailed summary of each chapter is logical.

Since first included in the 1999 report, the section describing the District and other governmental agencies has been improved. It is it critical to understanding chapters 7 (CERP) and 8 (Other Everglades Programs). The organization of the sub-sections is also logical. Table 1.1 helps clarify a number of issues related to understanding the current status of research and pilot project investments and should be updated annually. It also helps tie the entire report together with references to specific chapters and their content.

The Panel notes efforts of the District in considering comments made at the 2002 public hearing on the consolidated report and presented in the "Environmental Alteration and Restoration of the EPA" section of the 2003 report. We are particularly encouraged by the inclusion of the sections discussing the "Environmental Challenges to the Everglades" as well as the "The Everglades Restoration Strategy" in the introductory chapter. These two sections in particular will help build both understanding and confidence by the public.

Chapter 2A: Status of Water Quality in the Everglades Protection Area

Chapter 2A, in the 2003 Everglades Consolidated Report, is again well organized and presented. The 'status' of water quality is defined by compliance of samples with applicable water quality standards for 19 constituents.

Compliance with criteria, rather than standards, continues to be described in the text of Chapter 2A, if not in the title, as it was in the 2002 report. The confusion this generates will not be discussed again this year as it was discussed in the *Final Report of the Peer Review Panel Concerning the 2002 Everglades Consolidated Report*.

Chapter 2A clearly acknowledges that changes have been made in the way data are analyzed to determine water quality standard compliance. The data analysis method changes in Chapter 2A, in many ways, reflect maturation of water quality monitoring as the Everglades restoration program moves from a strong research orientation toward a more long-term management focus. While the effort to introduce a means to quantify risk in making statements about standard excursion rates are to be lauded, the manner in which the change has been made raises concern (i.e. with what appears to be little exploration of the existing literature on the subject). This concern is discussed below.

It must be pointed out that the science behind standard compliance determination is not well defined (i.e. there are no widely agreed upon methods). There are many alternative methods available to analyze data to determine standard compliance and there is a lively debate underway on which method is 'best'. Different authors and groups advocate, promote or suggest specific methods for standard compliance determination. In choosing *a* method for the Everglades water quality management program, the science behind the debate surrounding that method should be summarized with an explanation of why a specific method was chosen over the many others available.

When a new method is used in preparation of Chapter 2A, is this method also being used in other standard compliance calculations, e.g. BMP and STA performance measurement, within the Everglades restoration program? Was the change in Chapter 2A agreed to by authors of other chapters? If not, how will the difference in standard compliance computations be acknowledged in the report?

The apparent ease with which changes are made in the data analysis methodology create concern regarding the consistency and comparability of data and information used for management decision making in future years.

Chapter 2A begins by noting that standard violation rates computations are no longer calculated using the 'raw score' approach of previous reports, but rather will be calculated using the binomial hypothesis test. The reasons for this change are to use a methodology "designed to be consistent with other state ambient water programs and U.S. Environmental Protection (USEPA) guidance." (page 2A-2) The references, cited to justify what other states and the USEPA are currently employing for excursion analysis, are the USEPA (1997), National Research Council (2001) and Smith, et.al. (2001).

As noted above, the subject of these recommended changes is a major point of discussion in the scientific literature. Griffith et. al. (2001), U.S. Environmental Protection Agency (2002), and numerous texts on environmental statistics and standards (e.g. Gilbert, 1987; and Barnett, V. and A. O'Hagan, 1997) present an overview of the many data analysis

alternatives, both proposed and in use, to perform standard compliance assessments. It is beyond the scope of this review to delve into the depths of the debate surrounding the use of statistics in standard compliance assessments, but a few overview comments will be provided.

One change described in Chapter 2A, that can be readily confirmed by reading USEPA guidance documents (e.g. U.S. Environmental Protection Agency, 2002), is the more common use of 10 percent rate of excursions from applicable water quality standards to delineate impaired water bodies. Use of the binomial distribution is not recommended within USEPA guidance nor is a statistical method recommended in the National Research Council (2001). To be specific, the National Research Council (2001) states:

"While the committee does not recommend any particular statistical method for analyzing monitoring data and listing waters, the binomial hypothesis test could be required as a minimum and practical first step (Smith et al., 2001)."

Smith et.al (2001), after discussing several methods, make the following statement:

"Given the information routinely used in an assessment, the binomial method should replace the raw score approach."

Smith, et.al. (2001) describe the raw score approach as the EPA method. Thus, when Chapter 2A indicates a change to the binomial approach, the claim of consistency with USEPA guidance does not seem to be confirmed by a close reading of the two references that were checked. Furthermore, when other references are examined, such as Griffith et al (2001) and the U.S. General Accounting Office (2002), both of which surveyed state monitoring programs, the lack of consistency in methods used to determine standards compliance is further highlighted. Thus, the reasons for the 2003 Everglades Consolidated Report to change methods for computing standards compliance do not appear to be confirmed by current practice. The previous Everglades Consolidated Reports, using the EPA accepted raw score approach, are more inline with current practice. This is not to say the raw score approach should continue to be used, but in terms of a peer review of the changes, the reasons provided for the change do not seem to be confirmed by a close examination of current practice.

Use of the binomial distribution assumes observations are independent and the probability p of any particular event remains constant for all trails (Sachs, 1978). Are these assumptions valid for the excursion analysis performed in Chapter 2A? How will differences in the number of samples at each sampling site affect the comparability of conclusions regarding standard compliance? In forming the hypothesis, was a

comparison made between testing for compliance and testing for violation (was consideration given to characterizing the burden of proof)?

It is not clear how the development of the Impaired Waters Rule, mentioned on page 2A-12, impacts the choice of methods to analyze data in Chapter 2A. Apparently, this 'rule' will define the binomial hypothesis test to delineate impaired waters in Florida. The implication is that the State of Florida will require use of the binomial method, thus the change in methods between the previous Everglade Consolidated Reports and the current draft is done for consistency within Florida, not with other states or the USEPA. The raw score approach is the most common method employed by states (Griffith, 2001) and is accepted by USEPA. In general, the selection of a method to compute standard compliance is left to the data analyst, resulting in the 'inconsistent' methods employed by state agencies, reported by the General Accounting Office (2002). The need for a state-of-the-art, widely agreed upon, assessment of methods to compute standard compliance has been suggested by the National Water Quality Monitoring Council, but, at present, the work on the U.S. EPA's CALM Guidance appears to be the most active effort toward such a goal.

The Process of Changing Data Analysis Methods

The issues raised by the change in data analysis methods in Chapter 2A require further comment. In Chapter 2A, the methods used to obtain *data* follow strict protocols (e.g. SFWMD Quality Assurance manual and Standard Operating Procedures), but the methods to *analyze the data* do not appear to be documented in protocols outside Chapter 2A. Is this the case? If so, why are data collection and laboratory methods documented and strictly followed, while the methods for analyzing the data are not documented outside Chapter 2A? Also, it is noted that the SFWMD Quality Assurance manual and Standard Operating Procedures are 'reviewed and updated annually'. Is the annual review of Chapter 2A by the Peer Review Panel the only external review of the data analysis methods employed in Chapter 2A?

If, in fact, there is no carefully documented data analysis protocol to follow in computing standard compliance, did the change in authorship between the 2002 and 2003 Chapter 2A influence the choice of data analysis methods? Will another change in authorship result in another change at some later date? The issue being raised with such questions relates to whether the acquisition of information regarding standard compliance is viewed as a 'research' activity or a 'monitoring' activity producing consistent and comparable data and information.

There is a tension in the field of water quality monitoring between those who feel sound science forces the data analyst to retain the right to use any data analysis method that can be supported by the data. The determination of standard compliance, from this

perspective, requires the analyst to explore available data, using the most current data analysis methods, to extract information.

On the other hand, there are those who feel that achieving consistency and comparability in water quality information over time and space, particularly in support of fair and equitable management decision making, requires development of a scientifically sound data analysis protocol that is strictly followed in producing water quality information from data. Monitoring protocols apply to not only sample collection, laboratory analysis, but also to data record preparation and data analysis.

In the former case, the definition of sound science implies that a 'research' approach is taken to analyzing water quality data. In other words, peer review occurs after the data are analyzed (as is the case with the data analysis employed in the Everglades Consolidated Report for standard compliance). A criticism of this approach is the fact that any other scientist can come forward with a competing data analysis method and challenge the conclusions of the original analyst. Using the 'research' approach to data analysis forces the selection of a data analysis method to occur at the same time the data analysis results are presented. If the results are challenged, the selection of the data analysis method is often the basis for the challenge. Unfortunately, the 'research' approach also tends to produce variable information statements over time, thus confusing managers seeking consistent and comparable information. In some ways, the General Accounting Office (2002) is documenting the inconsistencies created when each analyst is able to choose the methods employed to produce *management* information. The inconsistencies prevent management from obtaining a comparable picture of management results and consistent evaluation of needed future management actions.

In the 'monitoring' approach, the data analysis methods are selected and peer reviewed, as part of the overall design of the monitoring system in support of management. The design is completed and reviewed before the data are collected. The methods are selected based on the need for consistent and comparable information for management decision making and not the 'research' need for freedom of the analyst to select the method. In this case, a data analysis protocol is prepared, using the general statistical behavior of the water quality variables being measured, and is peer reviewed for the science it incorporates in providing *management* information. Economists, in developing indices and indicators of the behavior of the economy, employ the latter approach, as do those that report weather data and information. This issue is discussed in more detail by Ward (2002).

From a narrow peer review perspective of Chapter 2A, it appears that the new method is employed in a scientifically sound manner, but there is concern that the method is not widely accepted for the use to which it is being put. To be fair, Griffith et al (2001) note that evaluating and reporting of alternative methods of data analysis, before selecting a method to analyze water quality data for management purposes, is rare.

Did the methodology for evaluating pesticide results include the changes for the other constituents? It does not appear that they changed. Why is this the case? Is it because of the small sample size? This apparent exception to the new methodology needs more explanation.

The minimum number of samples for beryllium was not available to support the new standard compliance methodology for this water quality constituent, but determination of standard compliance was made anyway. Should the calculations be expanded to include this situation? This same situation appears to occur in Table 2A-2, where, for the WCA-3 inflow, the excursion analysis was performed with less than 20 samples. Is this the case? The same situation appears to occur in Table 2A-3 for inflow, total silver; interior, total copper and total lead; and rim, total iron.

Adkins (1993) reviews the use of data analysis protocols in various aspects of society and outlines and illustrates how the concept could be used to enhance the acquisition of water quality information in a transparent and auditable manner.

Sample Size Considerations

On page 2A-12, a problem noted with the raw score approach used in previous Everglade Consolidated Reports is its inability to account for sample size. Yet, in describing application of the new data analysis method, sample size is restricted to a minimum of 20 (page 2A-13). Would a similar sample size restriction make the raw score approach more comparable to the binomial approach? It should be noted that the CALM Guidance document, in Appendix D, suggests a minimum of 28 samples to make a standard compliance determination using the binomial distribution method and concludes that the binomial model is no panacea for inadequate sample size. Thus, it appears that regardless of the data analysis method, employing small sample sizes to assess standard compliance, is a problem.

This is further confirmed by the Water Quality Academic Advisory Committee (1998) which prepared an assessment of methods to measure water quality impairments required by Section 303(d) of the Clean Water Act for the Virginia Department of Environmental Quality (DEQ). The report notes:

"… in the long run the DEQ should increase sampling frequency at its monitoring stations. Increasing sampling frequency, i.e. sample size, would make differences between the methods less important and reduce the chance of making a false decision about impairment."

A follow up report of the Virginia committee in 2002 continues to explore the statistical issues surrounding measuring standard compliance and sample size and is an example of the literature developing around this topic.

Data Preparation for Analysis

The discussion of data screening and handling on page 2A-11 raises several questions. The term 'statistical outliers' is mentioned, but no explanation of the use of statistical screening methods is provided. Are the data screened for statistical outliers, even though outliers are not excluded? Was the impact of employing an arithmetic mean to be the one observation for multiple samples, acquired in one day, on the variance of the observation, compared to other single observations, evaluated? Why was half the detection limit chosen for summary statistics purposes? How are missing values in the data record handled? Is there concern for a string of missing values in a key season biasing the results?

More generally, are the methods for screening data documented? Are references to support the decisions for preparing data records for statistical analysis provided? Given the changes in data screening this year, how are future changes to data screening methods considered and approved before incorporating them into the results of the report?

Adkins (1993), again, illustrates how such documentation could be assembled into a data analysis protocol.

Monitoring System Design for Standard Compliance Determination

With the changes made in this year's data analysis methods, and the related issue of small sample size, there is a need to revisit a recommendation made by this panel last year.

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. Sampling size differences could be eliminated and a minimum sample size could be instituted. Last year concern was expressed for the cost of a specialized 'standard compliance' monitoring program, for an area the size of the EPA. However, to obtain the consistency and comparability of monitoring information for fair and equitable management decision making, the issue of developing a monitoring strategy that creates a scientifically sound data record for compliance determination should be revisited. Instead of 'mining' data for standard compliance assessment and struggling with differences in information created by differences in sample sizes, a subset of the total EPA monitoring program could be used to create a more uniform data record for the specific purpose of standard compliance, using peer reviewed methods through out the water quality information system and across Everglades restoration programs.

Editorial Comments:

1. Smith et al (2001) reference is missing.
2. Is there a report number for U.S. EPA (1997) or an office that produced the report?
3. On page 2A-24, is there a reason why the hypothesis test reported here does not test WY 2002 with the base period1978-2000? The WY 2002 is tested against the median of 1994-2001. The implication is the test reveals a flow related relationship, but this is not stated directly.
4. On page 2A-12, National Research Council (2001) and NRC (2001) appear to be the same report being cited in the same sentence.

References

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Chapter 2B: Mercury Monitoring, Research & Environmental Assessment

This year's chapter 2B is an excellent overview of the mercury problem in the Everglades, and how the SFWMD has addressed concerns about environmental problems in this ecosystem. The data, models and conclusions reflect the complex problem as faced by many agencies dealing with mercury in freshwater ecosystems. 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. While, the risk to human consumers initially drove the lowering of mercury in the Everglades system, concern for piscivorous wildlife quickly came to the fore.

This year the report is organized to more directly address the major concerns of agencies and stakeholders regarding the sources, fate and effects of mercury (and methylmercury) on the food chain in the Everglades. It is much clearer, more readable, and easier to follow than in previous years. The initial summaries and conclusions fairly represent both the current state of knowledge, as well as identifying unanswered questions and research needs.

The report is a very scholarly treatment of the problems of mercury, and would be well-served by more citations to the original references. It is not always clear to the reader, and certainly not to the public, which statements are fact versus conjecture, and which come from Everglades research vs other research. That is, the arguments concerning the thorny issues with mercury would be better served by being absolutely clear what is fact (based on experimental studies), and what is conjecture. The increase in the number of citations in the text (compared to the 2002 Consolidated Report) is a major improvement, making it easier for scientists and the lay public to find original sources. However, even more citations to the original literature would be helpful.

Many of the research needs as suggested by the Review Team in 2002 have been initiated. While it is disappointing that results are not yet available on the work at Patuxent Wildlife Research Center on the in-ovo effects of methylmercury, this research is extremely important in identifying sublethal effects that might be difficult to assess or monitor in field studies in the Everglades. Every attempt should be made to obtain a more detailed report of the results of this study, with sample sizes and quality control information. In addition to hatchability and viability, this work should include sublethal behavioral effects in young chicks that might lead to their decreased survival in wading birds in the wild.

The continued study of the relative contribution of global versus local sources of mercury continues to be key to management and reduction of mercury to the Everglades. These

efforts should continue as a major thrust for the SFWMD. The collaboration between state and federal agencies is key, and an important component to understanding mercury cycling in the Everglades and elsewhere. The modeling and data collection phase should continue beyond 2003 as the problem is ever changing. Further, with energy deregulation in the United States, longer-distance mercury transport has proven a problem in the northeastern U.S. Whether there is a comparable signal in South Florida, should be carefully monitored to contribute to our understanding of mercury exposure in the Eastern United States, as well as in South Florida, where there are not prevailing westerlies.

One remaining problem is the relationship of local sources for atmospheric deposition compared to regional or global origins. The report implies that over 90 % of mercury entering the Everglades is atmospheric, and about 50 % is local. This latter percent needs further work. "Local" needs to be defined, and it may be essential to examine regional sources (and regional source reduction) in order to understand not only the pattern of atmospheric deposition, but how to manage or reduce mercury input to the Everglades. In addition, models to predict the effect of human population increases, both on the east and west coasts of Florida, are needed. While EPA regulations would still be in effect, large population increases could swamp the declines due to regulations.

The other on-going research projects are important, particularly refinement of mercury cycling models that are dynamic rather than static. Continued examination of mercury trends in indicator wildlife is critical to continued management of the Everglades as this will provide early warning if there is a new or continuing problem. If the work at Patuxent indicates a more sensitive species, then it should be considered as a bioindicator.

The research emphasis on effect of water quality on methylmercury production is also key to understanding the risks to humans and wildlife from mercury. Many of the findings in this section are at the forefront of research and our understanding of methylmercury dynamics, and the SFWMD is to be commended for its overall research program. The role of passive versus active transport, and the role of iron should be further investigated.

The main body of the chapter accurately reflects the three main issues with mercury in the Everglades. This reorganization makes the report easier to read, and much more informative for stakeholders. Key issues discussed include:

1) the relative contribution of local vs long-distance atmospheric transport of mercury into the Everglades system

2) the factors that affect the transformation of mercury into methylmercury.

3) the effect of current methylmercury levels on receptors, notable piscivorous fish and wildlife.

The Atmospheric Mercury Cycle

Discussion of atmospheric mercury cycling is key to understanding the mercury problem in the Everglades, and this section states the problem clearly. In this regard, the continued monitoring and modelling of local versus long-distance atmospheric deposition is critical to continued understanding of both the mercury cycle and management of mercury levels in the Everglades, particularly because of the potential effect of energy deregulation on mercury loadings in the Eastern United States. Refinement of these relationships is key to management.

Continued refinement of the models to understand the time lag between decreases in mercury emissions and abatement of the mercury problem in the Everglades continues to be an important issue worth examining. Further, local needs to be defined, and the relationship between mercury sources on the east coast and west coast of Florida should be further examined.

Of all the issues in 2B, this is one of the most controversial, largely because it is difficult and time-consuming to obtain the data necessary to answer the key questions. It is also critical from a management perspective. It is not clear why the first bullet on the Everglades coring study is evidence for a local source, since it is not evident that other controls were conducted from elsewhere. This aspect requires further examination and possible study.

While most of the information presented to examine local vs global sources for the atmospheric mercury deposition is straight-forward, I am uneasy with some aspects. Namely, it would be better to have data from the southern US instead of the northern Atlantic since atmospheric wind patterns differ in the northern and southern US. Background sites should be nearer to southern Florida, where atmospheric deposition is more directly comparable. Even with the Davie study, the case is not clear because Ft. Lauderdale is potentially part of the coastal input to the Everglades. In conclusion, the data marshaled are excellent, but more data and analysis are necessary to distinguish sources and to assign a percent to local vs global sources. Perhaps bounds could be placed on the estimates at the bottom of page 2B-15. Source reductions in South Florida, in figures 2B-5 and 2B-6 are impressive.

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.

Phosphorus and Mercury

This section is an excellent idea, as it clearly states the issues involved, and the data that pertain to these issues. It is much clearer and easier to follow, making it more useful for the general public. Addressing the concerns of the sugar growers directly is important, and makes it clear that all scientific ideas and data were considered in the section on the effects of phosphorus. The mesocosm studies are excellent, and can be used to tease apart the variables, which then need to be field tested in some of the STAs.

It will be important to examine as many of the indirect effects of changes in phosphorus levels as possible. The effect on enhanced plant growth, and then on methylmercury could be important. In that regard, further study of Cell 1 to understand the anomalous results of mercury might provide information valuable for the entire system - it suggests some factor is not currently being accounted for. The relative increase in mercury in mosquitofish, compared to sunfish and bass, suggests an unusual effect, and one requiring more explanation. If bass do not equilibrate for 180 days to a year, yet had only a matter of weeks and reached 0.87, then if they were given more time the levels would likely have risen well above 1.0 ppb or even higher. This suggests that the event was really quite severe - and understanding what happened is critical to management.

The implications for management of the mercury event in Cell I should be stated clearly and explored. What can be done to prevent it, and to manage it more quickly once it happens? Although in this case it was not a problem for wading birds, it has the potential for wading bird foraging in the future. Modeling may help provide predictive tools for the future.

Further, the separation of the data and conclusions about the effects of phosphorus on methylation, and on bioaccumulation has clarified the major issues, both for the Everglades, and for scientists generally. It seems clear that phosphorus is not the controlling factor in methylmercury dynamics. The multi-factorial models for understanding mercury bioaccumulation are extremely important to achieving predictive results. It may be important to try to put bounds on the relative percent contribution of the different factors that affect bioaccumulation.

What is the relative importance of sulfur chemistry, drying and wetting, phosphorus chemistry, hydrology and biodilution? More modeling may be required to fully understand these relationships. Sulfur chemistry needs further comment: the effect of sulfur chemistry on mercury/methylmercury should include information on the stored

inorganic reduced sulfide and organic sulfur resulting from sulfate reduction, in addition to free sulfur in porewater. This is because the stored sulfides (inorganic and organic) determine the availability of mercury. These relationships require further explanation, with data from the Everglades system.

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 the possible synergisms that are critical to understand.

The report does not contain sufficient data on biodilution and algae growth to evaluate the relationship. At the least, the data should be presented in graphic form, with appropriate statistics. Further, what happens when the algae is decomposed - this should result in mercury recycling within the system. The "sugar growers" are particularly concerned about the relationship between biodilution, algae growth, and mercury levels, and these do require more explanation in the Consolidated Report. A graph showing mercury levels as a function of some measure of density of algae might help. Models should incorporate biodilution and its potential effect on mercury in fish (while I expect the effect to be small or non-significant, it should be done).

Finally, although not discussed in this chapter, the Phosphorus criterion bears comment. It is unclear to the panel how the decision was made (or what the basis was) for a uniform criterion across the Everglades regardless of present conditions, or past conditions, or achievable goals (and its effects). The problem of soil vs water levels (as is the case for mercury), is an important issue that needs discussion.

Ecological Risk to Everglades Wildlife

Again, the organization of this years Consolidated Report makes the key questions obvious. Ecological risk to wildlife is the primary driver, and to address it directly is ideal. Again, dealing directly with the species (or species groups) at risk is critical. Top-level predatory fish, wading birds, alligators, and humans are the species at risk, and examining both mercury levels and effects in these species is important.

Some attention should be directed to the effects of mercury on the fish populations themselves. Events such as happened in Cell 1 suggest that the fish themselves would have suffered effects; in this case the cell was drained, killing the fish. However, if this had not occurred, then levels in the bass would have continued to increase (since they did

not reach equilibrium when it was drained), posing a problem for the bass themselves (and birds or alligators that ate them).

While it is important to address all stressors on wading birds (and on other indicators), particularly for ranking risks and management issues, it is still key to pursue a research strategy that continues to explore the role (both directly and indirectly) of mercury on behavior, survival and reproductive success. In most cases, as in the Everglades, direct habitat loss trumps all other stressors. However, this does not diminish the importance of understanding the role of mercury, and reducing its effect (as is being done by source reduction).

The results of the workshop by the peer-review panel should be described in a bit more detail. The SFWMD went to a great deal of time and effort to examine these questions, and they should be more fully described. We concur with their findings that other species at risk, such as bats and alligators, should be exposed to rigorous risk assessment. The table (2B-2) on mercury concentrations in alligators is very useful both for scientists and the public - similar tables for mercury in egret feathers and in bass from elsewhere would be useful in the future to put the Everglades picture in perspective.

While at present the risks to wading birds seem small, it is imperative to complete the studies on developing embryos, and on neurobehavioral effects that could affect survival and ultimately reproductive success. 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 and PCBs). The Spalding/Frederick work clearly shows that when fed fish 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. The recent paper by Frederick et al. (2002) on wading birds as bioindicators should be included as it provides additional information on the likelihood that wading birds are no longer at risk. In addition, the work of G. Heinz, presented in an abstract at SETAC, suggests that the eggs of wading birds may be more vulnerable than Mallards, on which most of the risk assessments have been based. A more complete report of this study should be included in the Consolidated Report.

The risks to top-level predatory fish might also bear some experimentation, since it is possible that there are sublethal effects on eggs or young fry.

Conclusions

The report is excellent, and the new organization more clearly addresses the issues. The SFWMD correctly examines the issues that are important, including 1) the relationship of local and global atmospheric deposition of mercury to the Everglades, and 2) the food chain effects of mercury (to humans, wading birds and other receptors). Some factors that affect methlymercury concentrations in fish need to be discussed more fully, including the role of temperature on methylation, and the role of biodilution on mercury levels in receptors (such as bass). The public policy questions are far-reaching: how much should pure science influence policy, how far should phosphorus criteria go toward solving the mercury problem, how much does biodilution influence mercury levels in fish, how much does the sulfur debate influence mercury levels, and how should management take into account the various factors affecting mercury levels in bass and other top predators? While humans can be prevented from fishing in regions with high mercury levels, the flow-through nature of the Everglades makes protection of receptors from mercury difficult. Finally, describing the management actions necessary to reduce methylmercury are critical for the process. The authors of chapter 7 are to be congratulated for examining the mercury problem of the Everglades in a clear and concise manner, and in providing an excellent overview of mercury dynamics, fate and transport, and effects on the food chain.

Recommendations:

1. It would be useful to always present an indication of variances (not only means, but standard errors, and sample sizes).

2. The issue of the relationship between mercury and sulfur requires a clearer explanation in every Consolidated Report, even though much of it has been discussed before.

3. The question of setting a phosphorus criterion of 10 ppb brings up the question of exceedances, and the inability to reach the 10 ppb level. Why must the whole Everglades have the phosphorus standard of 10 ppb? Put another way, how will the variations be accommodated?

4. The designations of "use", which in turn affects the phosphorus criterion, needs clarification.

5. A fuller section or chapter on statistics, variances, protocols, and statistics is needed.

6. Anomalous events that produce unusually high mercury levels need to be studied extensively to help understand the mechanisms of methylation.

7. While the overall effect of mercury on biota seems to be low, the continued high levels in bass under some conditions in the STAs suggest there could be problems for consumers, including humans and non-human receptors. Bass did not become a problem because water levels were lowered, and these fish died. However, had this not occurred, levels in bass would have continued to rise because they had not yet equilibrated.

8. The overall effect of differences in levels and species of sulfur on methylation continues to be contentious and important to understanding methylmercury levels in biota. The fact that this issue continues to surface suggests a lack of clear scientific evidence of the effect of phosphorus on uptake of methylmercury (not just on conversion to methylmercury).

Chapter 3: Performance and Optimization of Agricultural Best Management Practices

As in past reports, an excellent summary is presented of the best management practices implemented in the EAA basin. It is encouraging that these practices have been very effective in reducing phosphorus mass and concentration emanating from the EAA, but 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.

A summary of total phosphorus data from the cities and industries would be helpful. When compared with information from the EAA, this may encourage other groups to participate in the BMP program.

An attempt should be made to explain the significant drop in phosphorus mass being discharged from the EAA. It was suggested in 2002 that a significant part of the decrease in phosphorus mass discharge may be attributable to the decline in the phosphorus fertilizer industry. Has an attempt been made to quantify the reasons for the decline?

Some issues remain from past reviews, including:

1. Does evidence exist to show whether or not phosphorus from the EAA originates from subsidence and mineralization of organic matter or from application of inorganic fertilizers?
2. Is the biogeochemical relationship between mercury and sulfur to be considered in the BMPs?
3. Are hurricane effects taken into account when computing the annual baseline TP load? If so, what is the impact?
4. Have statistical analyses been performed to determine if the differences in base and BMP years are statistically significant? It is understood that these data are sums for the water year, but when the individual flows are multiplied by the 23-day average TP concentrations to obtain the mass of phosphorus removed, there probably are statistical implications that need an explanation.
5. Are data available, other than rainfall, to assess annual percent variations in load variations? If such data are available, a brief summary would be helpful.
6. More discussion of impacts of other phosphorus contributors would be helpful in interpreting the impact of BMPs.

General comments for various sections of the chapter are presented in the following paragraphs.

EAA Basin Annual Phosphorus Measurement and Calculations

Have statistical analyses been performed to determine if the differences in base and BMP years are statistically significant? It is understood that these data are sums for the water year, but when the individual flows are multiplied by the 23-day average TP concentrations to obtain the mass of phosphorus removed, there probably are statistical implications that need an explanation. Obviously, the legal requirements have been satisfied.

EAA Permit-Level Monitoring Results

Adding a sentence or two explaining sample processing and calculation procedures would be helpful to the reader.

What impact does the use of the average concentration multiplied by the intermittent flow rates have on the projected mass loading?

Update on Everglades BMP Research

The update would have been improved by presenting data from the studies. After 10 years of study, there should be many interesting results that could have been summarized in tabular or graphical format. Although much of the particulate phosphorus is in the form of biological growth, is there any indication as to how much of this growth is attached growth and transported due to turbulence or the mass that reproduces in the water body by extracting phosphorus?

Findings and Future Directions

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?

Conclusions

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

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

3. Better statistical analyses of the TP reduction data are needed.

Chapter 4A: STA Performance and Compliance

This section reports the performance and compliance of the four operational STAs with respect to water quality criteria and Florida Department of Environmental Protection permit conditions (P removal, mercury status and other parameters) during the WY02. It also reports the status of the two STAs under construction and the expected completion dates.

The four operational STAs continued to remove, on average, 71% of the inflow total P load, an improvement over the 65% average in WY 2001. To date, the four operational STAs have reduced P concentrations to less than 35 ppb, well below the designed target of 50 ppb. The data of performance and criteria of compliance were well presented. Documentation of the vegetation and hydrology is commendable because they are elements key to the stabilization and performance of the STAs. While the current composition of vegetation was documented, little was mentioned as to the history of vegetation development such as species structure and density change over during the course of stabilization. Several times "stabilization" of a STA was mentioned in the chapter. It would be more meaningful to discuss stabilization in terms of performance, vegetation and soil status. The water flow data were presented but water depth was not. Some important hydrological parameters such as water retention time thus could not be calculated from the data presented. Presentation of water depth would also make interpretation of hydrological elements more complete. The magnitude of evapotranspiration in the water budget of STAs must be quite large judging from the water deficiency of the cells in WY2001. Inclusion of evapotranspiration data and discussion of its effect on water depth and performance of STAs could be valuable. Last year's review recommend an overall comparison of the performance of the four operational STAs. This has not been done in this year's report. It is highly recommended that an overall comparison of the performance of the STAs and a discussion of the difference in terms of vegetative, hydrological and other factors.

Dissolved oxygen is a concern among the parameters monitored but there was little discussion on the major factors affecting the level of DO in the STAs.

This report described the anomalous mercury event in the Cell 1 of STA-2 and the approach and measures used to deal with the problem (p. 4A-20 and p.4A-29-30). The results of those approach and measures were not clearly reported. For example, did the flow-through approach on August, 2001 work? Apparently not, because following was a drawdown and dryout of Cell 1 in December, 2001 to prevent the mercury from entering the food chain. What was the mercury status after the drawdown and dryout? Whether conclusive or not, those results need to be mentioned in the report. Also, since the mercury problem only occurred in the Cell 1 of the STA-2, a comparison among the cells may be in order to identify the problems. In any rate, mercury is an important issue in the Everglades, full treatment to this issue in this chapter or cross-referenced to other

chapter(s) is recommended. Also suggested for future studies that would answer the following questions: How fast MeHg moves up through the food chain to small fish and ultimately bass, bowfish and sunfish? What is the lag time, and how early is it essential to identify the beginning of Hg increase in Cell 1 (or elsewhere), and is there sufficient monitoring to detect it in other cells?

According to Fig. 4A-23, there was no outflow (G-402) during August, September, November and December, 2001 in the Rotenbergeer Wildlife Management Area, how could Fig. 4A-25 show outflow TP concentrations in those months?

Summary

1. The presentation of the performance and compliance according to water quality criteria and FDEP permit conditions is clear and comprehensive.

2. Documentation of vegetation and hydrology should include a brief history of vegetation structure and density over the period of stabilization; water depth and the magnitude of evapotranspiration.

3. Stabilization should be discussed in terms of performance, vegetation and soil status.

4. There should be a comparison of the performance of the STAs and a discussion on the differences with reference to vegetation, hydrology and other factors.

5. The factors affect the DO in the STAs should be discussed.

6. Mercury problem is highly variable in the STAs. A comparison of Hg among the cells of STAs is recommended. Mercury problem has been addressed extensively in Chapter 2B, cross referencing of Hg problems of STAs to Chapter 2B is also recommended.

7. Summary on temporal changes of the STAs in terms of, performance and factors affecting the performance would be a valuable addition to this chapter.

Chapter 4B: STA Optimization

Chapter 4B reports studies pertaining to the optimization of the nutrient-removal performance of STAs. That is, the performance evaluation of STA-1W, STA-5 and STA-6 and the optimization experiments performed in STA-1W. Basically, Chapter 4A reports performance evaluation of each STA as a whole, Chapter 4B gives details in each component cells or pathways of a STA. While individual cell's performance was evaluated in detail, overall comparison among the cells has been minimal. Also some concerns are raised as to the extrapolation of results obtained from the 0.4 ha. test cells to much larger STAs. In the future studies the scaling problems of the experiments should be addressed.

This year, Cell 1, 2 and 3 of the STA-1W experienced exporting TP rather than retaining TP for several months but corrected itself over the water year. Cell 4 of STA-1W continued to increase outflow P concentration since its low in WY 1998 and 1999, although the outflow P concentration (33 ppb) remained well below the 50 ppb designed target. Performance evaluation of Cell 5 (STA-1W) was not made because of the uncertainty of the water budget. This chapter gives a good update on the WY2002 performance of the STAs. Also commendable are the sections devoted to the future monitoring needs. The future monitoring section is in line with the comments made by EPS in the Review Panel Workshop that the report should address the implications of findings to management decisions. The section should also include future research needs. The STA-1W optimization experiments in WY02 indicated that low water depth decreased TP retention while high water depth did not improve TP retention compared to the controls. Those results are in line with last year's finding that higher HLR decreased TP retention while with reduced HLR did not improvement TP retention. Those results imply that the HRT of 36 days in the controls was long enough to achieve the optimal TP removal (in terms of HRT) and the HRT of 9.5 days (of the low water depth) was too short for optimal TP removal. Then, what is the minimal HRT for the STA that optimizes TP removal? Answers to those questions should be addressed in the section of "Management Implications" of the chapter.

The presentation of the pulsed experiment is not clear. A description of the pulsed experiments and how mean HLR were calculated would help the readers to understand the meaning of the experiments.

Performance evaluation of STA-5 had a unique opportunity to look at the factors of vegetation species structure and abundance on P removal optimization (p. 4B-18, 19). Unfortunately, little of those results were presented and discussed. The northern path of STA-5 had significantly improved TP retention in WY01-02 (57%) than in WY01-02 (22%), despite a quadrupled increase in the total P loading. The PP and DOP also changed from export to import during the WY01-02 when compared with WY00-01.

How did those changes occur? Was it due to changes in vegetation structure, abundance, hydrology or soil status? A discussion on those issues would be relevant to management.

Performance evaluation of STA-6 presents the composition of soil C, N and P at different cells. Apparently the unit of soil P should have been g/m3 rather than kg/m3. For example, TP of Cell 3, 0-10 cm should be 79.1 g/m3 rather than 79.1 kg/m3 because the latter is even greater than the soil C, which is 66.9 kg/m3. The Chapter 4B of the 2002 ECR also had the same unit mistake on the soil P.

Other comments:

The first paragraph may serve as a summary by adding a brief account of the findings of WY2002.

Fig. 4B-2 and 3. A traditional all-positive side-by-side comparison of the input and output bars would be clearer and easier to figure out the information.

It is encouraging that vegetation and abundance were included in the study. However, little comparison of the performance of the STAs in terms of vegetation and abundance was found.

There is soil N and P data included in the studies of STA-6 but the data is not discussed.

Vegetation is a key element for the performance of STAs, it should be included in the future monitoring and study. Also forms of nutrients (especially P) stored in soil over the course of STA stabilization is important and should be included in this or future reports.

What is the meaning of Fig. 4B-6? If it is important, it needs to be described in terms understandable by readers. If it is not necessary, leave it out.

Some legends of Fig. 4B-7 are missing.

It appears that current optimization of STAs cannot reduce outflow TP below the 10 ppb level. What is the practical lower limit of TP for the performance of STAs? What is the implication of this to management? Those issues need to be discussed.

How is the expected P removal performance in the STAs over time? The dissolved P is mainly in inorganic forms in the STAs. If the proportion of organic P increased, does it affect the P removal performance of the STAs?

Chapter 4C: Advanced Treatment Technologies

The ATT investigators are to be commended for collecting and analyzing significant quantities of phosphorus removal and hydraulic data for the various biological and chemical processes evaluated. Inclusion of a summary table and diagrams of the processes this year helps in interpreting the results. Including a brief summary of process results and costs in the summary table would improve the summary. Modeling results are interesting and show how difficult it is to model such a complex ecosystem.

The lack of detail in the chapter 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 0.010 mg/L and cost estimates indicate that the costs are competitive with other technologies; however, all the processes are very expensive. The cost estimates to restore the Everglades are astounding, and the addition of all treatment alternative costs (e.g., STAs, SAVs and ATTs) to the summary table will give a better perspective to the public of the magnitude of the recovery process.

In the reports on the ATTs, there is virtually no information on how compatible the treated waters will be with the natural flora and fauna of the Everglades. Toxicity tests with treated waters have generally used non-native species and have been inconclusive (e.g., page 4C-45, 4C-57). Furthermore, they have been performed on single species, and no information is given on potential effects of treated waters on the structure and composition of Everglades' communities. These concerns are especially critical in evaluating the potential use of CTSS technologies to reach a 10 ppb P criterion. For example, on page 4C-60, it is discussed that combined CTSS/SAV discharge from a SAV-dominated wetland results in elevated aluminum and chloride concentrations to receiving waters. It is not discussed whether these elevated levels might result in changes in Everglades flora or fauna, and it is not clear that such potential effects have been examined.

What is the realistic likelihood that the green technologies can reach, and sustain, a P criterion of 10 ppb? Are the costs of applying such technologies, economically and ecologically, acceptable?

The addition of HRT along with the hydraulic loading rates (HLR) will be helpful in interpreting the results. Without the HRT, it is difficult to determine if flow rates, depths or surface areas were varied to maintain equal loading rates.

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

SAV Research on Constructed Systems

A brief statement about objectives of the experiments would be helpful. Showing the common names of the plants and a picture would be useful to the average reader. Where should the single asterisks in Table 4C-3 be located?

Sediment Characteristics and Accretion

Why were the averages of P mass removal rate and storage higher in the north test cells? Were these differences statistically significant? If so, the level of significance should be shown. Showing the range of values would be helpful. Did the flow rates into the various cells vary between cells? How deep were the cores?

P Removal Performance from Inflow and Outflow Water

A plot of the individual data points used to determine the means shown in Table 4C-5 would be useful. With such wide fluctuations of influent P, it is probably best to not presented the results as means. As a minimum, show the range of values for each of the factors or the standard deviation. What effect did the HRT have on TP removal?

STA-1W, Cell 4 Sediment Characteristics and Stability

A plot of transects values would be informative. The standard deviation is good to have and it would be nice to report the range of values.

STA-1W, Cell 4 Hydraulic Study

It was good to conduct the dye studies so that the poor hydraulic characteristics of the Cell 4 became evident. The results of the dye studies do not show that the cell behaves more like a CSTR. The results simply show that the system is rife with short-circuiting and perhaps dead space. Using the TIS concept can be misleading in a case where short-circuiting dominates the system. The modifications to the cell simply redirected the flow to other channels. Design of future STAs should not be based on a model of a system with such poor hydraulic characteristics.

STA-1W, Cell 5 SAV Monitoring

With decent hydraulic characteristics, it is very likely that the results would be different.

Process Model for Submerged Aquatic Vegetation (PMSAV)

Background and Objective

The predictive capability of the model may be subject to question because of the lack of hydraulic control when establishing the base data. If the model is to be used to predict the performance of the existing STAs, the model probably will suffice, but to predict the performance of new well designed STAs will likely be inadequate. It would not be overly optimistic to expect a much smaller STA than the current size units with good hydraulic characteristics to match or exceed the performance of the larger units.

Short-circuiting can be modeled, but the model will not predict the effects of a good hydraulic design on other factors such as vegetation, sedimentation, TP removal, etc.

P Cycling Processes

Was an attempt made to include a factor to compensate for the effects that storms and hurricanes would have on the long-term deposits.

PMSAV Limitations

With such poor hydraulic characteristics in the data sets, the hydraulics may be an overriding limitation.

STA-1W, Cell 4 Data Sets

All that the dye studies yielded were that the hydraulic conditions were dismal.

NTC-15 Data Sets

Why were the NTC-15 data picked for modeling? The high TP removals are tied to the high influent TP concentrations. If influent concentrations had been in the range of 100 micrograms per liter, the percent removals probably would have been as high as that observed for NTC-15. Selecting the best results to model may not yield reliable results. The multiple dye tracer studies conducted certainly provided a better model for the hydraulics than that for the STAs.

PMSAV Calibration Results

STA-1W, Cell 4 Hydrologic Model

A figure showing the fits would be helpful.

STA-1W, Cell 4 Hydraulic Model

A figure showing the fits would be helpful. It appears that the poor hydraulic characteristics in STA-1W, Cell 4 were ignored. If this interpretation is correct, the model is useless. An explanation is needed. It appears that the modelers did not like the results, so they changed the results to fit their perceived answer.

Post-STA Phosphorus Removal

It is difficult to understand how a coefficient of determination of 0.31 can be considered a good fit. A coefficient of determination of 0.31 does not indicate a well-formulated model. Figure 4C-6 does not instill confidence that the model fits the data.

NTC-15 Hydraulic Model

It is very good that adequate dye studies were conducted; however, as mentioned in past reviews, showing the classical dye concentration versus time curve will tell the reader much more than a TIS value. Time of first appearance of dye, median and mean HRT, etc. would be revealing; whereas, a TIS value means very little to most readers.

Post-BMP P Removal

Although the simulated versus measured effluent TP yielded a coefficient of determination 0.67 for the calibration period, the fit appears to be erratic. With good hydrology and hydraulic models, it appears that a better fit would be expected.

SAV Standard of Comparison

Full-Scale SAV Conceptual Design

Are the percent bypass assumptions based on bypassing a portion of the flow and blending the effluent from the treatment cell with the bypassed water, or is this an assumption of the efficiency of the hydraulic system? If it is based on the hydraulic characteristics, one should remember that with extensive baffling the ratio of the mean actual HRT to the theoretical HRT time only would be 0.75 to 0.8. Under unrestrained flow, the mean HRT will likely be one-half or less of the theoretical HRT.

Research on Natural SAV Systems

The conclusion that caution is recommended when extrapolating the P-removal from natural SAV systems to constructed wetlands is well founded. Excluding all other variables, the depth of the natural systems is 5 to 10 times that of the constructed systems.

Summary

It is true that the north test cells removed approximately 70 percent of the TP, but it is likely that had the other cells had influent TP concentrations of 100 micrograms per liter TP removals some may have matched the north cells.

How was the sensitivity to natural disasters assessed?

Periphyton-Based Stormwater Treatment Areas (PSTA)

PSTA Forecast Model

The statement that it is currently assumed that higher performance is likely at higher numbers of TIS is accurate, but does not tell the full story. Studies of constructed wetlands have shown that good hydraulic design is essential. Excessive short-circuiting is obviously a serious flaw in any treatment design. When experiments simulate a CSTR, one would expect a CSTR design to describe the system. There appears to be some confusion as to what the TIS number reveals. This number with an examination of the plot of the dye exiting the system versus time will reveal a lot, but to simply rely on a TIS number can lead to misinterpretations.

Calibration Results

Is the water depth interfaced with the HLR and the flow rate so that the HRT is considered in the analysis?

What caused the downward spikes in the GPP plot in Figure 4C-11?

Sensitivity Analysis

PSTA Standard of Comparison Analysis

Methodology

Was the flow rate varied to hold the HLR constant? What was the flow rate?

What were the HRTs for phase 1?

Results

Is expecting a 76 % reduction in TP optimistic? Removal appears to be tied to influent concentration; therefore, a constant 76 % reduction in TP appears to be optimistic.

Why do costs increase with an increase in bypass? Again, are we talking about a correction for hydraulic efficiency or a bypassing and blending?

The Level of TP Concentration and Load Reduction Achievable by the Technology

Is it realistic to assume that a TP concentration of 12 micrograms per liter can be achieved?

Compatibility of the Treated Water with the Natural Population of Aquatic Flora and Fauna in the Everglades

In the second paragraph the definition that failure occurs when algal growth is less than that in the control system is illogical when the objective is to reduce P to such a level that it becomes the limiting nutrient. Obviously, as stated, the validity of the test for ATTs should be addressed.

Were studies performed to determine the effect of ATTs effluents on plant growth?

Cost Effectiveness of the Technology

Were any of the PSTA systems capable of consistently producing a TP effluent concentration of 12 micrograms per liter?

Is it realistic to expect 50% reduction in TP when the influent concentration is 25 micrograms per liter? The percent removal appears to be a function of influent concentration, decreasing as influent concentration is lowered.

Table 4C-18. Are there data to indicate the optimum depth of shellrock? The 50- year Present Worth should be Millions of $. Should the total volume of water passing through or around the system be used to calculate the $/1000 gallons?

PSTA Field-Scale Project

Hydrology

Were all depths the same? If not, are the HRTs to be used in analyses? Were all surface areas equal? Were the dikes dividing the second cell from the right in Figure 4C-12 taken into account?

It appears that all areas were considered equal. With dikes dividing one of the cells, there is a considerable loss in area.

What does TP mass balance show when based on HRT?

If all depths were not equal, hydraulic head would affect the seepage.

Nutrient Removal Efficiency

Are the mean concentrations from the various cells statistically different?

In Figure 4C-14 what caused the spikes during December? The title may read better if in the last sentence "remaining seven months of the" was inserted between "the and water year."

Summary

On the fourth line, it is stated that seepage may be a significant factor. Is it positive or negative or both depending on the cell?

Chemical Treatment/Solid Separation (CTSS)

Were tests performed to determine the effects of the effluent on plant growth?

Results

Water Quality

In the first paragraph are you referring to a clarifier overflow rate or a weir overflow rate?

Conceptual Design and Costs

Do the 50-year present-worth costs include costs for sludge disposal?

Chemical Treatment/Submerged Aquatic Vegetation Research

Objectives

Increasing the size of the experiments is commendable, but it is doubtful that the results will be dramatically different because water treatment operators control the processes by performing tests in small jar test apparatus.

Chapter Recommendations (4c)

1. Potential effects of treated waters on the structure and composition of Everglades' communities must be completed. All tests to date have used single species and non-native species.

2. Hydraulic improvements in the STAs should be expanded to include all of the units. It is recognized that this type construction is expensive, but without these modifications, it will be extremely difficult to develop accurate models of the systems.

3. Conduct sampling at intermediate points in the STAs after correcting the hydraulic deficiencies. It is likely that the STAs could be reduced in length and still accomplish the same degree of treatment. With good hydraulic characteristics in STAs of the current size, it is likely that portions of the STAs would reintroduce phosphorus to the water at the lower ends of the systems. Intermediate sampling in other types of treatment systems also is important.

4. If not already accomplished, optimize the treatment systems and attempt to improve the fit of the models.

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

This well-written chapter summarizes and analyzes data in support of establishing a numeric phosphorus criterion for waters of the Everglades Protection Area (EPA). It provides a synopsis of the Florida Department of Environmental Protection (FDEP) efforts to derive a numeric P criterion and describes proposed P criterion measurement methodology. Analyses of phosphorus data from field transect monitoring, supported by data from dosing studies and information from literature reviews are used by FDEP to make the case for accepting a long-term average annual geometric mean total phosphorus concentration at or below 10 µg/L as "…protective of the natural flora and fauna without being over protective or below background levels." The data used in these analyses have been presented in previous Everglades Consolidated Reports (ECRs) and documents, which this chapter cites appropriately. The efforts of the South Florida Water Management District to update this chapter by responding to the comments raised in the public session in 2002 is obvious in this year's report more than in those of previous years. This issue has certainly been one of the most contentious in the ECR evaluation process.

Phosphorus Criterion Development

A vast amount of technical data that has been presented over the years in previous ECRs has been compiled in developing the recommended numeric P criterion. The majority of the data come from water chemistry measurements in WCA-2A and WCA-1 which have received elevated levels of phosphorus-rich runoff for as long as 40 years. These data were taken over a period of 5 or more years by the District and other researchers along transects extending from non-enriched to enriched sites. Biological and water chemistry data were evaluated for statistically significant departures from the normal unaltered structure and function of the ecosystem. The conclusions regarding the biological responses to water concentrations of total P are confounded by the gradient of soil P concentrations, however, which makes it impossible to attribute effects solely to surface water concentrations.

The results of analyses from WCA-2A and WCA-1, presented in Tables 5-1, 5-2 and 5-3 are used to make the case that a surface water P criterion of 10 µg/L would be protective of the biota in these systems. The further evaluation given in Figure 5-2, using the 75^{th} percentile, also supports this criterion. It is very true, as stated, that the effectiveness of the numeric P criterion in preventing imbalances in the Everglades biological communities will largely depend on how the criterion is applied. The chapter makes a case for the establishment of an upper annual concentration limit of 15 µg/L and for maintaining the 5-year average annual geometric mean at or below 10 µg/L.

The Class III narrative nutrient criterion states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna." In determining an imbalance, it might be appropriate to consider the nature of the harm to the system. For example, degrees of imbalance or harm occur over a continuum (e.g., a negative effect that is very temporary, a negative effect but over time the system will recover, and a negative effect that is permanent), and some imbalances occur naturally. In establishing a P criterion, should consideration not also be given to the type of imbalance that is occurring under phosphorus enrichment at different levels and in different parts of the Everglades system? It is also unclear why a mixing zone in the Everglades wetlands is not considered acceptable. Is there a scientific reason for this? Such mixing zones are common in the monitoring of effects in aquatic systems.

The Review Panel believes that the body of scientific evidence supports the view that meeting the 10 µg/L P level will be protective of the natural flora and fauna of the Everglades. However scientific evidence does not support the view that this is the only level of P what would be protective of the Everglades biota, nor is there scientific evidence that the 10 µg/L standard is appropriate throughout the entire EPA. The Everglades is now, and was in the past, a heterogeneous wetland ecosystem, with spatially and temporally variable water flows, levels, and chemistry. The application of a uniform P criterion across the entire Everglades may not promote patterns of variability that are naturally characteristic of this system.

FDEP has examined reanalyzed data from dosing studies performed by the Duke University Wetland Center and reported that they are consistent with the 10 µg/L criterion. The Review Panel is not convinced that the two pieces of research are consistent in supporting this criterion. There is obviously a difference of opinion, and FDEP and District scientists are encouraged to meet with DUWC scientists to review the data analyses and work to resolve differences of opinion. For example, it might be appropriate, in the data presented in Figure 5-3, to remove the % diatoms (plexiglass) from the analysis and recalculate the geometric mean change points and 95% confidence levels. It also may be necessary to recognize that because of natural heterogeneity in the Everglades ecosystem, as well as differences in experimental or sampling procedures, there may be differences in responses to levels of P loading.

Furthermore, at the Public Workshop, additional critiques of the development of the 10 µg/L criterion were presented by the Community Watershed Fund, and these comments should be considered by the District. Additionally, an alternative to the 10 µg/L P standard was presented by the sugar industry. This material has not been peer-reviewed or presented in the open scientific literature, and thus the Panel cannot comment on it. The continued debate around the 10 µg/L recommendation of the FDEP, that of DUWC at 15.6 µg/L, and that of the sugar industry of 16 µg/L should somehow be resolved. All of these recommendations are supported by research. Some practical agreement must be reached to this issue and the sooner the better. It has been publicly stated that if a firm

number is adopted, it should be applied in the context of long-term management and cost realities and by using averages over an appropriate and rolling time period, allowing for levels to exceed established limits in a given timeframe.

The Summary, in the second paragraph, mentions a three-pronged research agenda consisting of field transect monitoring, field dosing experiments, and laboratory experiments. No further information about laboratory experiments, or data from them, appear to be used in the development of the numeric P criterion, or in supporting the 10 μg/L. Were data from such experiments used in this effort?

On page 5-24, the section labeled Adaptive Management does not describe an adaptive management approach. It only describes a review 10 years after the adoption of the P criterion. Adaptive management would use information gained from the first years of application of the P criterion to inform the management process and make adjustments as needed. It is not clear if or how this will be carried out.

Phosphorus Measurement Methodology:

Pages 5-23 and 5-24 describe and justify a proposed P 'criterion' measurement methodology. Included in the methodology is information about how the data will be prepared for statistical analysis and how the legally required computations will be interpreted to reach conclusions regarding compliance with the new phosphorous standards. Providing detail on the methods by which compliance will be measured and quantified is critical to producing consistent and comparable information to support future *management* decision-making. The following questions arise in reviewing the methodology.

What methods, statistical or otherwise, will be used to 'optimize' the current monitoring network to provide 'adequate' spatial coverage? How is 'optimize' defined in this context (i.e. what is the objective function for the optimization process)? How will 'adequate' spatial coverage be defined and quantified?

The sampling frequency discussion on page 5-23 is confusing. What does 'six monthly samples' mean? Is it expected that as much as six months each year it will not be possible to obtain valid samples? How does this apparent low sample size mesh with the goal of at least 20 samples required for standard compliance computations described in Chapter 2A? Cross-referencing P measurement with methods used for other water quality constituents avoids confusion if the methods are different, and they appear to be in this case.

How is "statistically significant departure" determined? Is the current year's data tested against all previous data, or only the previous year's? Has the role of different numbers of samples in testing two populations been considered?

Are the only reasons that outlier data may be deemed 'not valid' listed at the top of page 5-24? Or is the analyst reserving the right to identify other reasons to declare data to be invalid? If the latter is the case, what stops stakeholders, displeased with the findings, from requesting other data be declared 'not valid' for reasons they deem sufficient? How will such differences of opinion be resolved in producing widely accepted agreement on P standard compliance in the EPA?

The proposed measurement methodology is declared objective and scientifically reliable on page 5-24. Has the methodology been peer reviewed? Or is the judgment based on the example presented in Table 5-5?

On page 5-23, it is noted that a 'District Technical Publication' will be prepared that describes the monitoring network and Standard Operating Procedures to be used to obtain samples form the network. It is hoped that questions like those above will be addressed when more effort is devoted to precisely defining a total phosphorus standard compliance monitoring program, from sample collection through data analysis and interpretation. Once drafted, before it is formerly used to produce a standard compliance assessment, will the publication be peer reviewed?

General Comments:

The overall water quality goal of requiring a numeric P level of 10 µg/L on a system wide basis for the Everglades region has been discussed since the public review process was initiated. The Review Panel's understanding is that the FDEP supports adoption of this criterion on a landscape scale (end of pipe with no mixing zone) rather than supporting the opinion that a mixing zone is logical. A system-wide single criterion also presents problems in not recognizing the variability found in all natural systems. The Panel continues to express concern as to the logic, given time and cost restrictions, of trying to restore a very complex and large area to a given point, as driven by total P, and then trying to maintain it at that point for all of South Florida. Natural systems continue to evolve and are not static. While to some this seems to be a very effective manner in which to judge the success of the restoration effort, it may result in inordinate costs to the District and a number of related environmental risks and management difficulties. It also provides only a snapshot of a given area at a point in time and says little about the long-term management of the region. Furthermore, the ability at an operational scale to treat water to the proposed criterion has not been demonstrated.

It is still not clear the public understands that the Restudy Bill authorized the District to construct pilot projects to help determine the feasibility of technologies included in the comprehensive plan (2001 Everglades Consolidated Report, page 10-1, summary, paragraph 2). The current report should clearly state that testing these technologies does not imply that they are proven. The District runs the risk of bad press and misunderstanding on the part of the public, environmental risks, and wasting money if assumptions are made based on either incomplete science or unachievable goals.

Even though the Review Panel understands the position of the National Park Service, presented in the Public Workshop, that "The demonstration that the 10 µg/L criterion is supported by a variety of approaches is particularly effective," some members of the Panel still consider the numeric P criterion a general goal rather than a legally binding definition of success, and recommend using a range of numeric values based on a number of environmental and managerial criteria, along a transect north of the ENP. Further, they note the need to recall that a given technology may be locally feasible, but not viable within a different context or larger region. Some effort should be made to explain this context if only in a footnote.

The NPS raises a very interesting point concerning the validity of Figures 5-4 through 5-7. If the network was not designed to measure compliance in the existing marsh network, then continuing to collect data at these locations without expanding the spatial coverage may not be adequate for validating compliance in the long-term.

Conclusions:

1. The scientific evidence supports the view that meeting the 10 µg/L P level will be protective of the natural flora and fauna of the Everglades.

2. The Review Panel does not support the view that this is the only level of P that would be protective of the Everglades biota, or that there is scientific evidence that the 10 µg/L standard is appropriate throughout the entire Everglades Protection Area.

3. Additional comments and critiques of the 10 µg/L P criterion presented during the Public Workshop, as well as comments regarding the Duke University Wetland Center (C. Richardson letter) must be given full consideration by the FDEP in proposing a P criterion.

4. The issue of a mixing zone in the WCA's within which the P levels will meet the accepted criterion needs to be resolved.

Chapter 6: Hydrologic needs-effects of hydrology on the Everglades Protection Area

This chapter was designed to provide the information on the multidisciplinary approaches currently in place to better understand and manage the hydrologic patterns of the EPA. A wide variety of hydrologically related issues were discussed in this chapter, including freshwater flow, salinity, nitrogen load, algal bloom, crayfish, wading birds, Rotenberger restoration, tree islands, ridges and sloughs, soils and sediments, topography, remote sensing and modeling trends. It must have been quite a job just to put together those diversified subjects in a single chapter, let alone to synthesize them into a comprehensive conclusion. Nevertheless, research on the hydrology of Everglades must be encouraged because it is, after all, a major driver to most biological and biogeochemical processes of a wetland. This complicated research task requires a great deal of scientific skill and experience. The efforts of the workers are appreciated, even though as stated by the authors, "this report does not, as this time, quantify the hydrologic needs of the Everglades". Many questions and comments were raised during the review process. The authors responded to most questions and comments although many remain open speculation pending verification of further studies.

The authors agreed to add specific objectives for each study and discuss their relevance to CERP. A general comment expressed by the peer review panel was that those studies must be more focused and address the relevance and implication to the management of Everglades. A brief review of hydrological inter-connection among elements of interest in each study such as: hydroperiod and wading birds; dissolved oxygen, hydrodynamics and decomposition; erosion, sedimentation and topography; salinity and vegetation etc. is recommended. A consistency in units (metric or English) throughout the chapter is necessary. Following are specific comments and suggestions:

Hydrological Trends

Hydraulic retention (or residence) time is an important hydrological parameter of any wetland system. It should be monitored and included in the interpretation of DO, decomposition and many other related issues.

Salinity patterns in Florida Bay

The report stated "Salinity in the eastern and central bay was not well correlated with freshwater flow from the southeast Everglades." According to Fig. 6-6, correlation between the freshwater flow and the salinity was very good. The relationship, however,

probably had a phase shift (out of phase in terms of time) and that may have messed up the correlation analysis. The flow vs. salinity relationship needs to be analyzed with phase shift in mind. The phase shift of the relationship is also an important piece of information in the study.

Crayfish

What is the ecological significance of the burrow depth of crayfish? Does it affect the food chain or something significant in the Everglades?

Herpetofauna of Tree Islands

The literature review and preliminary investigation on the herpetofauna of tree islands are to be encouraged because they provide vital ecological information of Everglades in terms of effects of altered hydrology and other impacts. It is an important to get more baseline information such as this for future reference.

Soils and Sediments

Fig. 6-8 and Fig. 6-9 should be under the sub-heading of **Soils and Sediments** not under **Herpetofanna of Tree Islands**.

6-30, Soil organic matter formation is from both aboveground and below ground production, not just belowground production.

6-31, Para 5, I could not see from Fig. 6-8 that negative elevation change had occurred. The statement of the last sentence is contradictory to the results of statistical analysis.

6-32, Those results suggest that the dry, marsh and flooded environments were generally keeping pace with the relative sea-level rise by sedimentation and OM building (within the margin of errors). I do not see how hurricanes can help to explain the accretion of the wetland. Hurricanes may deposit and wash out sediments. Did you see the white marl layers in soil columns all over the place as the feldspar marker layer showed in the experiments?

Peat Microtopography and Spatial Pattern in the Ridge and Slough Landscape

Hydrodynamics (water flow) may be important to the decomposition and vegetation of the sloughs. Faster water flow and submerged vegetation may increase DO, which enhances decomposition. The decomposition would lower the peat accumulation that feed back to increase the flow. The flow, however, will increase erosion and provide a negative feed back effect. Flow, microbiology and vegetation may interact to create the observed spatial pattern (Fig. 6-10) of the slough and ridge landscape. Lack of water flow probably, on the other hand, would result in the patternlessness of Fig. 11, according to the above reasoning. Those speculations could be resolved by further studies.

Decomposition

One of those titles of Fig. 6-12 or 13 is in error.

The interpretation of this section is quite confusing and needs to be presented in a clear manner.

Vegetation

The statement of the last sentence in 6-39 is contradictory to what the data said (P has effect on at least one species).

How do the biomass of *E. celluosa* and *R. tracyi* compare to those of sawgrass and cattail? This information may be important to predict the rate of peat accretion under different species.

6-45, Was there any seed bank problem found in the changeover of obligate and facultative species?

Tree Island Ecology

Some discussion on the tree species-water regime association should be given.

Remote Sensing and Modeling Trends

Can aerial photographs and satellite images differentiate tree species in Fig. 6-21? If the resolution of Z of remote sensing is not good enough (considering most elevation differences in Everglades are within 1 m), vegetation species could be a valuable indicator to the micro-topography (because the association between hydroperiod and topography) of the Everglades.

Chapter 7A: Update on CERP Implementation

Overall this is a highly readable and understandable chapter. The Summary section is excellent. The overall purpose of this chapter is clearly stated in the first two paragraphs. It is implied that many of the responses to improved timing and distribution of water are not always known. If we have learned anything about trying to manage natural systems and particularly in trying to restore or somehow reverse the impacts of mismanagement, it is that little is predictable. This is particularly the case when the natural system is being impacted by agriculture and urban development (legally receiving precedence over natural values). The public must also be clear that the positive impacts may take decades to be seen. There is no quick fix in this regard and the District should make that very clear. Finally, noting the role of pilot projects is important to avoid misunderstanding by the public over the long-term implementation of selected technologies.

If the public understands the relationship between the CERP and the many individual activities aimed at improving water quality and habitat, this chapter will become key to understanding and acceptance of this restoration effort. The general public will judge the effectiveness of expending so many millions of dollars on how well the comprehensive restoration plan is perceived, based in large part upon the application of RECOVER protocols. The Panel feels that together these protocols may set a new standard for preparing a comprehensive strategy and for ensuring a high degree of compliance with broad restoration goals (with ranges of criteria) in a general sense, but the details for making that assessment are not presented.

The District should be commended for its 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. The Panel believes that while every effort will be made to be as scientific as possible, several aspects of this program will be subjective for many years. The Project Development Team (PDT) is logical but should involved some outside review process to ensure that all technical aspects can be evaluated by the team proposed. The Project Management Plan (PMP) is essential for monitoring activities as implementation proceeds. The Project Implementation Report (PIR) is equivalent to a

pre-feasibility level study and the Design Documentation Report (DDR) is to be completed at the feasibility level.

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 Washington Post series on the Everglades specifically address several points of the CERP by asking about the viability of the technologies being tested. I think the District may want to make a very clear statement as to the reality of testing technologies including the cost implications.

Based on the comments on chapter 2A by the representatives from the U.S. Fish and Wildlife Service and the National Park Service on the compatibility of their agency mandates (referring to protocols and reporting procedures for managed alkalinity, dissolved oxygen and water quality goals/levels, etc.) with those of CERP, some members of the Panel expressed concern as to the cumulative potential impact on the CERP as it relates to the ability of District to make decisions that will actually render the result desired. The discussion at the public review meeting did not resolve this issue. Simply bringing to the attention of the District that a discrepancy exists in indicators is not solving the problem.

The framework for presenting the status of Program, Project and Pilot Project activities is excellent and very clear.

Finally, the Panel commented that some effort should be made to explain what are the goals of the long-term land use plan for the West Coast of Florida. If, as some predict, intensive urban development will continue to push south and over time look like the east coast of the State, then all bets are off for the CERP. Even though it is highly speculative, the District owes it to the public to raise awareness of the potential of unfettered urban expansion and the goals of the restoration program.

Chapter 7B: RECOVER Activities

First and foremost, the relationship between RECOVER and CERP is clear. This is important for the general public as it is to the RECOVER team that they will logically turn when faced with a question or issue that requires further information. The Panel supports the long-term goal of a total ecological model to evaluate the interactions among the regional models and the upstream and downstream effects of transboundary (pilot project limits) actions.

The RECOVER process, developing and implementing an adaptive management program for the CERP, is a critically important part of the overall CERP program, and must be based on a well-designed and well-supported program of monitoring, assessment and research. So far, most of the development efforts appear to have focused on identifying ecological indicators. The chapter gives a good general description of the RECOVER process to date, but leaves open numerous questions that are perhaps beyond the scope of this report. For example, have clear restoration goals and targets been established? Do they recognize possible ecological trade-offs among various elements of the Everglades system? How are exogenous forces in the South Florida region (such as population growth, economic changes, land use changes, sea level rise, etc…) incorporated into the identification of indicators and the establishment of goals?

Figure 7B-1 and the explanatory text provide a very good basis for public understanding of how the CERP process will be monitored and adapted over time. However, it is always suspect to make statements that purport to fully understand the impacts of applying a number of management strategies on any system at the landscape level.

The concept of setting interim hydrologic restoration stressor-based performance measures is a good one. Obviously the District cannot wait until all of the hydrologic works are completed before beginning to determine their impact on the system. The targets identified by the Alternative Evaluation Team will logically give an indication if restoration efforts are proceeding in the proper direction. This is a valid goal and one that does not require additional definition, in my opinion, at the outset of this process. Some limited and qualified data are better than no data at all. Adapting the model and redefining measurement points and criteria, as new data become available, is the only logical way to proceed. However, transferring results from the site level to the landscape level may present difficulties as there are a number of related indicators that may differ between scales.

The institutional implications of the last RECOVER objective “Develop a consensus…” noted in the 2002 Consolidated Report continues to 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 MAP is logically presented and needed. The Panel suggested a sixth section to the MAP, one identifying potential management implications of the monitoring efforts. The Adaptive Management Program detailed on page 7B-10 is a very important tool that will permit the District to keep the public informed as to tangible progress on the restoration effort. 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 CERP Annual Report Card continues to be a useful approach to document and report progress toward recovery of elements of the ecosystem, and for informing the general public. It should not be considered adequate to communicate with decision-makers or various stakeholders, however. It will be important to recognize that some of the variation in the performance measurements may be the result of unexpected influences not related to CERP activities. Thus, it would seen critical that monitoring of the indicator elements of the report card include research to establish cause-effect relations between the performance and CERP activities vs. effects of environmental variation or other external influences.

The milestones noted in Table 7-1 on page 7B-13 seem logical but will need further explanation to ensure that the public understands the reason for these interim goals. For example, why is it important to extend the climatic period of record from 31 to 36 years? Also it may be of interest to note how these milestones related to the overall monitoring program.

Chapter 8A: Achieving Long-Term Water Quality Goals

The strategies noted on page 8A-2 for improving water quality in the basins identified (STAs and WCAs) have been discussed in prior years. The methodology for the basin-specific feasibility studies is appropriate to the complexity and scale of the proposed plans. 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.

It is not clear to me how the District will actually decide what combination of management strategies is best at the basin level given that so many outside influencing factors will continue to require adaptations in order to be able to maintain water quality. The results of these field tests are very important for other wetland management programs in the hemisphere. In addition, the relationship between the basin specific studies and the CERP is not clear, particularly in terms of sequencing investments.

Over the years there has been mention of the role of trees as part of the overall suite of BMPs available to reduce total P levels as well as other contaminants. There is a wealth of research that indicates that tree buffers along streams greatly reduce concentrations of certain contaminants even from agricultural areas immediately adjacent to the buffers. The panel supports the concept that the District begin a long-term study to evaluate the role of trees historically and as a BMP south of the STAs, both as a means of P removal and as a means of controlling contaminant movement. This could be undertaken on a pilot basis with a relatively small investment. Trees could be considered as a stand alone BMP or could be applied in combination with other BMPs.

The Arthur Marshall Foundation has made several presentations to the Review Panel since 1999. Each year they have stressed the value of forests (and reforestation) as an important component in meeting overall CERP goals presented in table 5-1 (2003 draft consolidated report). In reviewing their most recent statement at this year's hearing, the review panel finds the reported P reduction ratios of 4:1 for the pond apple to be of great interest. The Marshall Foundation reports this ratio to be "average" and consistent with data reported across the spectrum of STAs in projects undertaken by the district using other technologies. In addition, the panel finds it interesting that the District has not asked for more specific information concerning P correlation with below ground root mass as well as the potential of forests to physically act as filters to the movement of a number of contaminants. The panel continues to feel that the value of restoring forests in areas where they can be demonstrated to have existed historically, and planting new forests in areas that have been dedicated to meeting the overall goals of the restoration effort, is an under-considered element of the P-reduction equation.

The Everglades-Pantanal (S. Brazil, N. Bolivia) initiative being sponsored by the Inter-American Water Resource Network (IWRN), the Brazilian Secretariat for Water Resources (SRH) the Brazilian Water Authority (ANA) 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 that prove successful in the planning process recently initiated in the Everglades for that region in South America.

There is a real concern that the District has not given sufficient consideration to alternative measures to meet the P levels in the STAs that do not meet the standard. The CERP is not a fixed plan, but rather an iterative strategy that will require many adaptations as implementation proceeds.

The discussion on challenges to achieving long-term water quality goals on page 8A-9 is very relevant to understanding the risks associated with expending public funds based on somewhat limited field testing.

Chapter 8B: The Everglades Stormwater Program (ESP)

The goals of the non-Everglades Construction Project (ECP) permit schedules and strategies as stated in the summary and introduction sections to this chapter are clearly stated. The Panel noted with particular interest the mention that public outreach efforts have been expanded to address certain issues of interest to the general public. 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 need to be better communicated to the general public.

The section of the report dealing with the status of progress of implementing the ESP beginning on page 8B-4 is very well written and presented in a logical manner.

The Panel continues to 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, and particularly maintaining those levels over time. We also feel that an effort to communicate the integrated nature of the actions being undertaken should be included in public education materials.

The education/outreach efforts in relation to the ESP format represent a solid effort to involve all sectors of civil society and should be replicated by other agencies involved in the restoration planning process.

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

This chapter describes the land acquisition efforts and strategies used to acquire 21,254 acres of land during WY 2002. The majority of the acquisitions are for CERP needs. The report provides an adequate accounting of the land acquisition activities.

Chapter 8D: Managing Fiscal Resources

This Chapter fulfills the requirements of the 1999 Everglade Oversight Act regarding fiscal information for the ECP. The chapter describes the revenue sources for all projects. Updated project estimates and cash flows were reported as unavailable, and thus cannot be reviewed. Unfunded mandate estimates were also not provided.

Chapter 8E: Exotic Species in the EPA

Invasive species are clearly a major problem in the Everglades, and this chapter is an important part of the Everglades Consolidated Report. It is especially sobering to recognize that South Florida has more introduced animals than any other region in the United States (estimated 26% of mammals, birds, reptiles, amphibians and fish are non-native) and yet there has been so little research to understand the extent of the ecological problem or to develop effective controls.

The chapter describes efforts to date, and initiatives, of various agencies and organizations to control exotic invasive species. It clearly points out the lack of meaningful information concerning the effect of non-indigenous species in South Florida. Major issues are inadequate support for scientific investigations to develop effective controls, lack of funding to apply control methods to problem species, and lack of consistency in responses. There is clearly a need for a comprehensive plan that coordinates different agency mandates into a consistent strategy.

The Noxious Exotic Weed Task Team (NEWTT), established in 1999 by the South Florida Ecosystem Restoration Task Force (SFERTF), has been charged with identifying the highest priority invasive plant species and developing a comprehensive interagency strategy for their control. A similar effort is desperately needed for invasive animal species. It is encouraging that the Department of Interior has recommended establishment of an exotic animal task team as part of the Comprehensive Everglades Restoration Plan (CERP), and that the SFERTF is establishing the Noxious Exotic Animal Task Team (NEATT). It is to be hoped that the activities of NEATT will be given broad support and funding priorities. As this chapter clearly points out, detailed species-based management plans have been developed for several of the invasive plant species, but there are neither

funding or staff to coordinate efforts and control non-indigenous animals in the Everglades Protection Area. In the sections on information gaps and coordination efforts, it is made very clear that an effort similar to NEWTT is needed to assess the threat of exotic invasive animals and coordinate agency efforts in developing strategies for their control.

Good descriptions of invasive plant management tools are given, with complete descriptions of the biology and life history of the seven primary plant species of concern, as well as efforts undertaken in their control. It is encouraging that The Area-wide Management Evaluation of Melaleuca (TAME Melaleuca) has been established and that this project will demonstrate multiple control tactics to land managers and allow work to be initiated on private lands, defraying some of the cost of melaleuca control for private landowners. As described at the end of the chapter, one of the major needs is developing incentives for private landowners to control invasive species, which may require expenditure of public monies on private lands or property tax breaks. The need for public education efforts is also clear. An example is the opposition to removal of Australian pine along the Florida coastline where it has crowded out natural vegetation.

On page 8E-16, it is stated that the District plans to conduct experimental herbicide applications for Old World climbing fern on tree islands in the Refuge in 2001. Has this been done?

What effort is being made to coordinate invasive species management plans with the CERP, and to assess long-term changes resulting from CERP activities on their future management? The description of research needs suggests that this is not being addressed, and perhaps this should be pointed out more directly as a need.

Obviously, the literature cited section is incomplete and needs to be finalized.

Conclusions:

1. Invasive plant and animal species pose an extremely serious threat to the ecosystems of South Florida. Recent efforts focused on several of the more serious invasive plant species have shown some success (e.g., Melaleuca), and the NEWTT effort to identify the highest priority invasive plant species for control and develop a comprehensive interagency strategy for their control is critical.

2. A similar comprehensive effort is desperately needed for invasive animal species. It is to be hoped that the activities of NEATT will be given broad support and funding priorities

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

The section of the report dealing with water for the environment is a welcomed addition to the report and clarifies the issue of assignment of water to enhance natural systems rather than to consumptive uses.

Recommendations

1. As mentioned in previous reviews, there is a strong need for a comprehensive plan that coordinates strategies of management of invasive plant and animal species among state and federal agencies, and also pursues strategies for developing partnerships with private landowners.

2. Much more information needs to 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.

3. Public education about invasive species and the threat they pose to South Florida ecosystems is critical to long-term success in their control.