

FINAL REPORT

of the *Peer Review Panel* Concerning

*Proposed Minimum Water Level Criteria for Lake Okeechobee,
the Everglades, and the Biscayne Aquifer within the
South Florida Water Management District*

Review Panel:

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(Footnote: This document was placed on the Internet ("Minimum Flows and Levels Discussion Board") on September 22, 1998 for public review.

INTRODUCTION

The responsibility of this panel was to review the technical data, methodologies, and conclusions made in the development of the minimum flows and levels (MFL) criteria for three hydrologic systems in South Florida: Lake Okeechobee, the Biscayne Aquifer, and the Everglades. In addition, the panel's responsibilities included the consideration and inclusion of input from the public workshop conducted on August 31 and September 1, 1998, where relevant. This report summarizes the panel's findings regarding the key facts as found in the literature and information presented during the workshop and conclusions and recommendations on the subjects raised by both the South Florida Water Management District (SFWMD) staff and public participants.

In reviewing the draft MFL criteria (prepared by the SFWMD staff and dated July 8, 1998), the general questions that the panel addressed included:

1. Did the draft document present a defensible scientific basis for setting *initial* (emphasis added) minimum flows and levels (MFL) within each of the three hydrologic systems? Were the approaches or concepts described in the document scientifically sound and based on the best available information?
2. Were the proposed criteria logically supported by 'best available information' presented in the main body of the document? What additions, deletions or changes would enhance the validity of the document?
3. Are there other approaches to setting the criteria that should be considered? Is there available information that has not been considered by the SFWMD staff?

In essence, 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 MFL criteria were a logical consequence of the science and the data. In fulfilling this task, it was necessary for the panel to understand the policy and legal issues as set by the Governing Board of the SFWMD. This was particularly important in the case of the definition of significant harm as outlined in the draft report. The panel found the report to be clear and understandable in establishing these concepts.

General Panel Response to the Draft Report

As a general response to the above three questions, the panel recognizes that South Florida water resources comprise an integrated, dynamic water resource system. As such, behavior of each component, beginning with Lake Okeechobee, influences, and often controls, the behavior of other components. This circumstance is clearly acknowledged in the draft document. Additionally, the panel recognizes the numerous and sometimes contradictory functions of the three hydrologic water systems. As is the case in most places in the U.S., there are many legitimate and statutory demands on the three hydrologic systems. From drinking water to agriculture, to the health of the ecosystems

involved, the panel recognizes that the SFWMD must balance, and determine how the hydrologic systems can best serve, the various demands. The panel has found that the draft document presents a logical, well-supported case for the proposed MFL criteria. In general, the recommendations are backed by reference to appropriate scientific findings in published literature and SFWMD experience and research. The SFWMD, however, should identify federal, state, and local regulations that may constrain or otherwise affect the establishment of minimum flows and levels. In some instances, described below, there is concern regarding the physical feasibility of achieving the recommended minimum flows and levels. This suggests the need for thorough monitoring of the MFLs that are implemented.

Whether directly or by implication, the SFWMD has appeared to rank the importance of the water resource functions that are to be reestablished, preserved, or enhanced. From our reading, the draft document implies that intervention and abatement of salt water intrusion in the Biscayne Aquifer is the highest concern regarding integrated management of the water resources under control of the SFWMD. Establishment of minimum levels in Lake Okeechobee is, in part, designed for "protecting the Biscayne Aquifer against salt water intrusion." Similarly, the minimum recommended water levels for the Everglades are designed to "provide ground water recharge and prevent salt water intrusion of the Biscayne Aquifer." If in fact the issue of salt water intrusion is the primary concern of the SFWMD, the draft document should state that clearly and early. The report could state that the focus or primary interest in establishing minimum levels is to control salt water intrusion and that an integrated approach to controlling the levels in Lake Okeechobee, the Everglades, and the Biscayne Aquifer is necessary to accomplish this objective. If other water resource functions are equally important this should also be noted early in the document. Whatever the perceived emphasis of the report, the panel recognizes that the SFWMD must consider and balance all of the competing water resource functions of the three hydrologic systems. Water demands of the environment, water supply, prevention of salt water intrusion, as well as navigation and recreation areas, must all be considered in developing the MFLs.

Regarding data issues, the draft document presents the SFWMD *interpretations* of much of the "best available information" without presenting the raw data. While much of these data are in the Appendix document, more could be included in the main document. There are basic pieces of data that could be included in the draft document that would help the reader evaluate the inferences made by the SFWMD. For example, there is ample discussion regarding the role of rainfall in driving the systems and the effects of seasonal variation in rainfall. There is, however, no chart of long term average monthly precipitation, for any recording station, presented in the draft document. The same holds true for ground water issues.

Overall, the panel found the draft report to be well written, scientifically sound, and adequately referenced. The report made a clear connection between policy foundations and the reviewable technical issues. Particularly, the report made clear the issues of significant harm and the point at which such harm occurs. The report also made clear those indicators of significant harm for each

of the three hydrologic systems. The report should, however, make clear that MFLs are set to prevent the occurrence of significant harm.

The structure and layout of the report was clear. The panel was impressed by the amount, and integration, of information used in developing the MFL criteria. The panel was also impressed with the willingness of the SFWMD staff to accept and encourage any input that would improve the MFL criteria setting process. The bulk of this report will examine the MFL proposals for each of the three hydrologic systems.

REVIEW OF INDIVIDUAL HYDROLOGIC SYSTEMS

Lake Okeechobee

Before construction of the Herbert Hoover Dike, Lake Okeechobee had a larger pelagic and littoral zone contiguous with the Florida Everglades. Output from the SFWMD "Natural System Model," as well as historical data noted in the report, indicates that the lake levels fluctuated between 17 and 23 feet NGVD. Following the construction of the dike, the lake has experienced numerous occasions when lake levels have been below 11 feet NGVD for prolonged periods of time. When the water level is below 11 feet NGVD, nearly the entire littoral zone is dry and not available as a habitat for fish and other aquatic life. This also includes critical habitats such as Moonshine Bay and the peripheral bulrush communities. Further, a short hydroperiod may play a role in determining rates of expansion of exotic plants and the ability to eradicate them. The invasion of exotic species seems to be promoted by water levels lower than 11 feet NGVD. The influence of hydroperiods on invasion of exotic plants is based only on observational data. Experimental ecological research is needed to obtain a more complete understanding of the response of native and exotic vegetation to water levels of 11 feet NGVD and lower. Particularly, the effects of hydroperiod on torpedo grass are not clear. The subsequent secondary impacts on fish and wildlife are even more complex, and require a sophisticated research approach.

Thus, the panel concludes that based on the draft document, and information presented at the public workshop, the MFL criteria of 11 feet NGVD is appropriate given current information. However, the long-term effects and cumulative impacts of low lake levels (less than 11 feet NGVD) are uncertain. The draft report notes that a science-based criterion for return frequency will likely remain elusive, given the long-term (decades) nature of data that would be required to support that attribute.

The panel is concerned about the minimum of 10 feet NGVD allowed in the draft for the period of April 15 to July 15. It is clear from Figure 12 (page 52) that it is not anticipated that the 10 feet minimum would occur for the entire period. Rather, a 10 feet minimum level is anticipated to occur for only a short period around the first of June. The panel does recognize that this minimum level for April 15 to July 15 follows Zone C which moves the district into Phase 3 water restrictions. The

panel also understands that this minimum period is in response to the competing demands for water beyond the littoral zone of the lake.

Given the potential for significant harm (or at least the uncertainty regarding the potential for significant harm), best available information suggests that *initial* minimum water levels to prevent potential significant harm to littoral zone fish and wildlife habitat should be not less than 11 feet.

At best, the draft report should acknowledge the lack of information to support littoral zone, fishery, and wildlife functions at levels below 11 feet. An alternative criteria may be minimum water levels of not less than 12 feet every three years and not less than 11 feet every seven years.

The panel recognizes that other water resource functions of the lake are competitive with the water demands of the environment (i.e., littoral zone). For example, water supply development, prevention of saltwater intrusion, and maintenance of navigation and recreation access, are other water resource functions that must be considered by the District's Governing Board. Maximization of all these functions during a rainfall deficient period will be difficult. Therefore, the SFWMD should describe what tradeoffs and risks among these competing water resource functions were considered by the District in development of the minimum level criteria.

Biscayne Aquifer

In reviewing the MFLs for the Biscayne Aquifer it became clear to the panel that no actual direct minimum water levels for the Biscayne Aquifer were recommended. A surrogate criterion (i.e., a minimum canal stage) is used to achieve minimum water levels in the Biscayne Aquifer. While this approach has merit and is easily implemented, it does not directly address the minimum water levels in the aquifer.

The report should clearly explain the difference in recommending minimum water table elevations (i.e., minimum levels in the Biscayne Aquifer) versus minimum canal levels. The report should also discuss the spatial extent of ground water influence via the Lower East Coast (LEC) canal system and locations where the canals may not directly control water table elevations.

Some water resource functions are competitive. For example, two of the water resource functions identified for the Biscayne Aquifer are water supply development and prevention of salt water intrusion. Presumably, maximizing both functions will be difficult. As in the case of Lake Okeechobee, the SFWMD should describe what tradeoffs among competing water resource functions were considered in developing the minimum levels for the Biscayne Aquifer.

The effect of maintaining minimum water levels in the Everglades, in terms of raising ground water levels in the Biscayne Aquifer along the LEC, should be addressed in the final document. There is interaction between the water levels in the Everglades, canals, and the Biscayne Aquifer, and ground water flow to the coast. The final report should describe to what extent water levels in the

Everglades are hydraulically disconnected from Biscayne Aquifer levels along the LEC via the intervening canal system.

Historic Biscayne Aquifer inter-annual water table fluctuations need to be more clearly referenced and noted in the text. For areas of the Biscayne Aquifer not under the direct influence of canal stage, an analysis of historic water level fluctuations may be an alternative method of establishing minimum water level criteria.

Sonenshein (1997) Figure 1 shows that, at least in Dade County, the landward extent of the salt water interface in the Biscayne Aquifer as estimated in 1995 is not, except for a few locations, significantly different from the estimated position of the interface in 1984. Within the inherent uncertainty in the data, there may or may not be a difference between the location of the salt water interface in 1984 and 1995. An alternative approach to establishing minimum flows for mitigation or abatement of salt water intrusion is to address each individual problem location (e.g., well field), on a case by case basis. The panel recognizes the SFWMD does address these issues as part of their permitting process. However, this can be aided by three-dimensional density dependent ground water flow and solute transport modeling.

The panel also identified a number of technical issues regarding MFLs for the Biscayne Aquifer:

1. Literature coverage and interpretations

There is a wealth of literature concerning the hydrology/hydrogeology of Southeast Florida, the Biscayne Aquifer, and salt water intrusion. Although an exhaustive literature search was undertaken by the SFWMD, it does not appear that an equally exhaustive review of the identified literature was completed. Interpretations seem consistent with the published findings. There is, however, repeated reference to the lack of correlation between fresh water heads and chloride concentrations. Yet, these same data are used to "verify the validity of using the Ghyben-Herzberg relationship as criteria for setting minimum levels for the Biscayne Aquifer."

Parker, et al., (1955) is extensively cited throughout the draft document. While it may be the major early work describing the water resources of southeastern Florida, several more recent publications may incorporate more recent data and interpretations.

2. Evaluation of water level and water quality data from wells and canals

The only ground water level map presented in the draft document is in the appendix (Figure A.2) which shows the average potentiometric surface. Knowledge of the historic inter-annual Biscayne Aquifer water table fluctuation would be useful, especially due to the assertion regarding short term versus longer term water level fluctuations and their relationship to the movement of the salt water interface. Appendix table A.5 in the draft document contains data for intra-annual water table fluctuations. However, these data are not contoured, nor is it clear how these data were used in the development of the minimum water level criteria for the Biscayne Aquifer other than to attempt to validate the Ghyben-Herzberg relationship.

Ground water quality data (i.e., chloride data) were analyzed extensively. The conclusion drawn indicates there is no significant correlation between water level data and chloride concentrations. However, it is ultimately the fresh water head and water extraction that controls salt water intrusion. More consideration could be given to the historic variability in ground water levels and how the modern system may be artificially manipulated in light of pre-development ground water behavior. Rather than an arbitrary minimum level for the Biscayne Aquifer along the LEC, the report could consider how the ground water levels fluctuated prior to development and control. This information may shed light on natural intra-annual variability and offer an alternative to the static levels recommended based on canal levels necessary to hold the salt water wedge at its present location. In essence, more flexibility in minimum levels, especially away from the influence of well fields, may allow a better optimization of the other components of the system.

There is considerable discussion in the draft document regarding the importance of rainfall as the system "forcing" mechanism. No hydrograph is presented for the period of record for any recording station in the area. The draft report should also mention what influence, if any, tidal fluctuations have on the dynamics of the hydraulic behavior of the Biscayne Aquifer.

3. Ghyben-Herzberg relationship

Many of the public comments regarding the Biscayne Aquifer centered on the Ghyben-Herzberg relationship and its appropriate use in this case. In theory, the Ghyben-Herzberg relationship is a reasonable approach for establishing minimum levels for the Biscayne Aquifer to prevent salt water intrusion. However, several factors reduce the appropriateness of the Ghyben-Herzberg relationship for such purposes. The Ghyben-Herzberg relationship assumes static equilibrium and a hydrostatic pressure distribution in the fresh water region with stationary seawater. These theoretical conditions result in a sharp interface between salt water and fresh water. In actuality, static equilibrium does not exist and there are significant vertical ground water flow components associated with well field pumping and Biscayne Aquifer discharge to the sea. Consequently, the sharp interface becomes a dynamic transition zone where salinity concentrations vary spatially and temporally. The coefficient of 40 for the Ghyben-Herzberg relationship ($Z_s = 40 Z_f$), where Z_s is the depth below sea level to the salt water interface, and Z_f is the height of the water table above sea level, is based on the density of open ocean water of approximately 1.025 gm/cm^3 . If the density of coastal sea water is slightly less than 1.025 gm/cm^3 then the depth to the salt water interface estimated by the Ghyben-Herzberg relationship is proportionately greater. For example, if the density of the seawater is 1.020 gm/cm^3 then the depth to the salt water interface is 50 times the height of the freshwater table above sea level.

The SFWMD should clearly explain how the Ghyben-Herzberg relationship did, or did not, influence the recommended minimum levels in the LEC canals and hence the Biscayne Aquifer. The draft document (Appendix A, pg. A-1) states that "Additional water level/water quality information was examined to verify the validity of using the Ghyben-Herzberg relationship as criteria for setting minimum levels for the Biscayne Aquifer." This statement suggests that the Ghyben-Herzberg relationship was used to set the Biscayne Aquifer minimum levels. If this is not the case, as indicated in the public meeting, then the report should more clearly describe how the minimum levels were determined.

4. Movement and duration of chloride and salinity gradients

The movement and duration of chloride and salinity gradients appear to be well documented in the literature (Sonenshein, 1995; Kohout, 1960; etc.). However, from Sonenshein's (1997) analysis, a conclusion can be drawn that, although there has been an increase in developed lands and associated demands for potable water, the ground water system has greater capacity for development without widespread salt water intrusion than may be recognized. The panel is aware that there exists uncertainty regarding this conclusion. For example, Fish (1988; pages 1-2) noted, concerning Broward County, that large scale pumping from municipal well fields will generally lower the water table and induce salt water intrusion. The draft document also cites similar conclusions from Parker, et al (1955).

Figure 17 (pg. 71) in the draft document needs to be more carefully explained. The basis (i.e., data source) for the figure is uncertain. The text discussing Figure 17 states that "When groundwater (sic) levels are depressed for periods in excess of six months duration, permanent movement of the saline interface may result..." However, the schematic diagram Figure 17 does not seem to support this conclusion. The "below minimum level for 180 days" line does return to the 1 ppt chloride line while the "below minimum level for 365 days" line does not return to 1 ppt chloride. However, there is no indication as to when (i.e., between 180 days and 365 days) the system fails to recover. The report only indicates that chloride concentrations do not recover in 365 days.

5. SFWMD Modeling Efforts

No information is provided in the draft document concerning how the South Florida Water Management Model addresses the hydraulic connection and communication between canals and the ground water system. This is a crucial issue because the minimum water level criterion recommended for the Biscayne Aquifer is partially supported by the results of the model simulations. The discussion in Appendix A, (Section III) needs to remind the reader that the "results" presented are from simulations, not observations.

Assuming that there is effective communication between the canals and the Biscayne Aquifer water table, maintaining a stage in the canals greater than the regional water table elevation creates many spatially distributed line sources. The report should indicate, in general, the lateral extent of the influence of the canals on the water table.

Everglades

The panel agrees that the choice of hydric soils as MFL indicators in the Everglades is appropriate because the peat and marl soils are the primary substrates that support the Everglades. These soils support all major plant associations and animal communities that characterize the Everglades.

The MFL criteria are generally supported by the best available information. However, Stephens' (1974) conclusion that peat soil loss (or subsidence) occurs at a ground water level maintained at -1 feet warrants investigation to understand the potential consequences of the proposed MFL. Also, and more significantly, the proposed MFL may allow significant harm in areas with peat soil shallower than 1 foot, and marl soils with depths shallower than 1.5 feet. The MFL process should identify these areas, determine the extent and significance of these areas, and consider modification of the proposed MFL or generation of new MFL for these areas. The Florida Game and Fresh Water Fish Commission and Everglades National Park have offered to assist in identifying shallow soil areas.

Additionally, depending on topographic variations, a minimum water level of 1.0 foot below land surface for peat soils may be hydraulically incompatible with a drawdown of 1.5 feet in marl soils in some locations where the marl soils are in close proximity to the peat soils. This concern may be

particularly valid for an east to west transect from Rocky Glades (marl) to Shark River Slough (peat). It may not be possible to hold water levels at 1.0 foot below land surface in peat soils when water levels drop to 1.5 feet below land surface in adjacent marl soils.

Furthermore, because the water level in the Everglades is a surface expression of the water table or actually the water table (depending on whether water levels are above or below ground surface), the minimum levels proposed for the Everglades are minimum levels for the Biscayne Aquifer where it underlies the Everglades.

The MFL process would likely benefit from comparison to actual water levels, vegetation, and fauna. Soil loss and burn issues as related to water level would benefit from bench-scale or field plot experiments. Also fieldwork and/or laboratory experiments are necessary to analyze the impact of return frequencies of short hydroperiods on the oxidation of peat. Additionally, more knowledge of peat accretion and marl deposition, (the most basic functions of a sustainable Everglades), should be generated in relation to different hydroperiods.

In conclusion, the panel strongly agrees that the use of hydric soils as a indicator of MFLs for the Everglades is appropriate. However, because the soils are diverse, the MFLs will need to be adapted to fit this diversity. Where the organic soils are thick (i.e. over three feet), the one foot depth for 30 days duration or less (1.5 feet depth for 90 days duration with marl) may be appropriate. Because the thinner soils are probably in a higher position in the landscape, a higher ground water level than proposed in this report may need to be maintained. For these reasons, the panel is concerned that the one foot MFL for 30 days for the organic soils and 1.5 feet MFL for 90 days within marl soils may produce significant harm in some areas.

Biscayne and Florida bays

It is clear that MFLs for the Biscayne and Florida bays are beyond the scope of work of this panel and the initial efforts to propose MFLs for the three hydrologic systems. However, it is the view of this panel, given the considerable public comment on this issue, that we must address this issue at least in the context of recommendations to the governing board of the SFWMD.

In dealing with this issue, the panel considered whether MFLs for the Everglades could be set without including the Florida and Biscayne bays. While recognizing that Florida Bay is part of the Everglades, the panel is not convinced that setting *initial* MFLs is impossible without MFLs for the Florida and Biscayne bays. The panel recognizes the systems are integrated and believes MFLs for the Florida and Biscayne bays should be moved up in the process to as soon as possible.

While the panel believes the current effort can continue, the influence, or impact, of the proposed minimum flows and levels recommended for Lake Okeechobee, the Everglades, and the Biscayne

Aquifer on Florida Bay should be estimated. The South Florida Water Management Model and associated performance measures can be used to provide this qualitative insight.

Furthermore, a sufficiency review should be conducted to examine completed surface and ground water data, especially data that illustrates the relationship between upstream water levels and flows on bay and estuary water and salinity levels. Based upon this review, the SFWMD, in conjunction with other stakeholders, should determine the appropriate time and mechanism for proposal of MFLs for these areas. Also, the sufficiency review may provide a qualitative estimate of the potential effects of proposed MFLs for Lake Okeechobee, Everglades, and Biscayne Aquifer.

The final report should address the level of risk of significant harm to the Florida and Biscayne bays if significant harm standards are exceeded in the three hydrologic systems under review. This concern could be addressed using simulations performed by the South Florida Water Management Model. Finally, some public workshop participants noted that new literature on Florida and Biscayne bays has been generated since the current MFL process began. The panel encourages the SFWMD to consider any new data available. However, the panel strongly believes that the term "best available information" means data and reports must be peer reviewed and published to be considered adequate.

Miscellaneous comments on the draft report

Page 12, middle paragraph, second sentence - "The WCAs, located south of Lake Okeechobee and east of the heavily urbanized..." The WCAs are *west* of the urbanized LEC.

Page 16, Figure 3 and the accompanying discussion is not clear. A better map should be found.

Page 30, The report should make clear that MFLs are set to prevent the occurrence of significant harm. The sentence in the first paragraph should read, "at the point before which significant harm would occur."

Page 34 (first full paragraph) While it is large, table F-1 is not only significant, but informative as a summary of the issues. Could that table be edited and included in the body of the report?

Page 35, second paragraph - reference to Figure F-1 in Appendix F as a bathymetry map of Lake Okeechobee is incorrect. Figure F-1 is the location of indicator regions.

Page 42 - Reference to table 1 needs page.

Page 44 (bottom) - Could use brief table showing what phases 1 to 4 entail.

Page 51, third paragraph - text incorrectly refers to Figure 8. It is Figure 9 that contains the Supply-Side Management Zones referred to in the text.

Page 63, Table 3b - "Minimum Depth (feet)..." should be specified as below ground surface.

Page 63, Table 3b (note 1) - there is no Figure F-2 in Appendix F as indicated in the note. The figure referred to is Figure F-1.

SUMMARY OF MAJOR CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION 1:

Regarding Lake Okeechobee, the panel concludes that the long-term effects and cumulative impacts on the littoral zone of lake levels below 11 feet NGVD are uncertain – too uncertain to set MFL below 11 feet even for brief periods. The panel believes that current “best available information” suggests that the MFL criteria of 11 feet NGVD is appropriate for protection of the littoral zone of Lake Okeechobee. However, the panel recognizes that other water resource functions are competitive with the littoral zone demands on Lake Okeechobee. For example, water supply development and prevention of saltwater intrusion are other functions to be considered, although to maximize all three functions will be difficult.

Recommendation 1:

The report should acknowledge the inadequacy of the information to support littoral zone, fishery, and wildlife functions at levels below 11 feet. Alternatively, the report must present more compelling information regarding whether or not significant harm will occur below 11 feet. The report should also state more clearly why the periods below 11 feet are necessary. Issues of salt water intrusion and other water needs met by the lake need to be clarified.

Recommendation 2:

The SFWMD should describe what tradeoffs and risks among competing water resource functions were considered in developing the MFL for Lake Okeechobee.

Recommendation 3:

The long-term effects of a MFL of 10 feet are not immediately evident, and would benefit from a more complete understanding of the response of native and exotic vegetation to this water level. Understanding the relationship between the duration of minimum water levels and potential impacts is especially critical.

Recommendation 4:

The final report should include a graphic showing the average annual water budget for Lake Okeechobee. The budget should include the major components of inflow, storage in the lake, and outflow/loss (i.e., evaporation, transpiration, controlled releases, and ground water interaction directly associated with the lake).

Recommendation 5:

The report should make clear near the beginning that the focus or primary interest in establishing minimum levels is to control salt water intrusion and that an integrated approach to controlling the levels in Lake Okeechobee, the Everglades, and the Biscayne Aquifer is necessary to accomplish this objective.

Recommendation 6:

A chart should be included of long-term average monthly precipitation for any recording station.

CONCLUSION 2:

It appears that no actual direct minimum water levels for the Biscayne Aquifer were recommended. A surrogate criterion (i.e., a minimum canal stage) is used to achieve minimum water levels in the Biscayne Aquifer. While this approach has merit and is easily implemented, it does not directly address the direct issue of minimum water levels in the aquifer.

Recommendation 7:

The report should clearly explain the difference in recommending minimum water table elevations (i.e., minimum levels in the Biscayne Aquifer) versus minimum canal levels. The report should also discuss the spatial extent of ground water influence via the LEC canal system and locations where the canals may not directly control water table elevations.

Recommendation 8:

As with Lake Okeechobee, the report should describe what tradeoffs among competing water resource functions were considered in developing the minimum levels for the Biscayne Aquifer.

Recommendation 9:

The effect of maintaining minimum water levels in the Everglades, in terms of raising ground water levels in the Biscayne Aquifer along the LEC should be addressed in the final document. There is interaction between the water levels in the Everglades, canals, and the Biscayne Aquifer and ground water flow to the coast. The final report should describe to what extent water levels in the Everglades are hydraulically disconnected from Biscayne Aquifer levels along the LEC via the intervening canal system.

Recommendation 10:

For areas of the Biscayne Aquifer not under the direct influence of canal stage, an analysis of historic water level fluctuations may be an alternative method of establishing minimum water level criteria.

Recommendation 11:

An alternative approach to establishing minimum flows for mitigation or abatement of salt water intrusion is to address each individual problem location (e.g., well field), on a case by case basis. This can be accomplished by three-dimensional density dependent ground water flow-and solute transport modeling.

Recommendation 12:

More consideration could be given to the historic variability in ground water levels and how the modern system may be artificially manipulated in light of pre-development ground water behavior. More flexibility in minimum levels, especially away from the influence of well fields, may allow a better optimization of the other components of the system.

Recommendation 13:

The report should present a hydrograph for the period of record for any recording stations in the area to help explain the importance of rainfall as the system "forcing" mechanism.

Recommendation 14:

The report should mention what influence, if any, tidal fluctuations have on the dynamics of the hydraulic behavior of the Biscayne Aquifer.

Recommendation 15:

The SFWMD should clearly explain in the draft document the use of the Ghyben-Herzberg relationship and how it did, or did not, influence the recommended minimum levels in the LEC canals and hence the Biscayne Aquifer.

Recommendation 16:

The final report should provide more information on how the South Florida Water Management Model addresses the hydraulic connection and communication between canals and the ground water system.

Recommendation 17:

The final report should indicate, in general, the lateral extent of the influence of the canals on the water table.

CONCLUSION 3:

The panel strongly agrees that the use of hydric soils as an indicator of MFLs is appropriate. However, because the soils are diverse, the MFLs will need to be adapted to fit this diversity. Where the organic soils are thick (i.e., over three feet), the one foot depth for 30 days duration (1.5 feet depth for 90 days with marl) may be appropriate. Because the thinner soils are probably in a higher position in the landscape, a higher ground water level than proposed in this report may need to be maintained.

CONCLUSION 4:

The proposed MFLs may allow significant harm in areas with peat soil more shallow than one foot, and marl soils with depths more shallow than 1.5 feet. The MFL process should identify these areas, determine the extent and significance of these areas, and consider modification of the proposed MFLs or generation of new MFLs for these areas. The panel further concludes that the minimum levels may not be hydraulically feasible where marl soils exist near peat soils.

Recommendation 18:

Because the water level in the Everglades is a surface expression of the water table or actually the water table (depending on whether water levels are above or below ground surface), the minimum levels proposed for the Everglades are minimum levels for the Biscayne Aquifer where it underlies the Everglades. The draft document should acknowledge this fact.

Recommendation 19:

The MFL process would likely benefit from comparison to actual water levels, vegetation, and fauna. Soil loss and burn issues as related to water level would benefit from bench-scale or field plot experiments. Also fieldwork and/or laboratory experiments are necessary to analyze the impact of return frequencies of short hydroperiods on the oxidation of peat and more knowledge of peat accretion and marl deposition needs to be generated in relation to different hydroperiods.

Recommendation 20:

The panel recommends that more food web studies in the Everglades be conducted. It appears there is insufficient knowledge available regarding the effects of different hydroperiods on the functioning of higher trophic levels in the Everglades ecosystem.

CONCLUSION 5:

While recognizing the integrated nature of the three hydrologic systems and the Florida and Biscayne bays, the panel concludes that it is possible to set *initial* MFLs for the three hydrologic systems under consideration prior to setting MFLs for the other systems.

Recommendation 21:

The panel recommends that MFLs for the Florida and Biscayne bays be moved up in the District's priority water body list.

Recommendation 22:

The South Florida Water Management Model and associated performance measures should be used to help estimate the impact of the proposed MFLs on the Florida and Biscayne bays.

Recommendation 23:

A sufficiency review should be conducted to determine if any new data or information has surfaced that illustrates the relationships between ecosystem water levels, flows, and bay and estuary water and salinity levels.

