MEMORANDUM

TO: Kirk B. Webster, Deputy Executive Director

FROM: John C. Good, P.E., Water Resources Engineer

DATE: July 9, 2007

RE: Peer Review of Draft Report titled "TECHNICAL REPORT – MFL Establishment for the Upper Santa Fe River"

The referenced report was prepared by the District's MFL consultant, Water Resource Associates, Inc. (WRA), and dated December 2006. Subsequently, an independent scientific peer review was conducted as allowed by statute. The review panel consisted of the following three members, coordinated by a primary contractor, HSW Engineering, Inc.:

- Ken W. Watson, Ph.D., President and Principal Hydrologist, HSW Engineering, Inc., Courtesy Professor, University of South Florida.
- Scott H. Emery, Ph.D., Visiting Research Professor, University of South Florida, Senior Technical Consultant to HSW Engineering.
- W. Michael Dennis, Ph.D., President, Breedlove, Dennis & Associates, Inc.

The review team identified several items to be addressed. The bulk of these were matters of clarification and/or typographical errors/omissions. Based on their comments, the draft report has been revised by the WRA team and made available in final form on the District's web site, along with the peer review.

The conclusion of the peer reviewers is repeated here verbatim:

> "The data used in the analyses appear to be the best available given that protection of "fish and wildlife habitats and the passage of fish" was selected as the most conservative WRV *[i.e., water resource value - jcg]*. The methodologies utilized in developing the MFL are technically sound with respect to the protecting the selected WRV from significant harm, including habitat protection and swimming at O'Leno Park.
>
> Based on the information provided in the report, it has not been clearly shown that the protection of fish and wildlife habitat is the most conservative WRV and therefore protective of the other potentially important WRVs listed in the report."

FINAL REPORT

OF THE SCIENTIFIC PEER REVIEW PANEL ON THE DATA AND METHODOLOGIES IN

MFL Establishment for the Upper Santa Fe River

Prepared for

SUWANNEE RIVER WATER MANAGEMENT DISTRICT
9225 CR 49
Live Oak, Florida 32060

Prepared under Contract 03/04-137
By

HSW Engineering Peer Review Panel
Scott Emery, Ph. D.
Mike Dennis, Ph. D.
Ken Watson, Ph. D.

February 2007

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INTRODUCTION

The Minimum Flows and Levels (MFL) Program within the State of Florida is based on the requirements of Chapter 373.042 Florida Statutes. This statute requires that either a Water Management District (WMD) or the Department of Environmental Protection (DEP) establish minimum flows for surface watercourses and minimum levels for groundwaters and surface waters. The statutory description of a minimum flow is "the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area" (Ch. 373.042 (1)(a), F.S.).

The statute provides additional guidance to the WMDs and DEP on how to establish MFLs, including how they may be calculated, using the "best information available," to reflect "seasonal variations," when appropriate. Protection of non-consumptive uses also are to be considered as part of the process, but the decision on whether to provide for protection of non-consumptive uses is to be made by the Governing Board of the WMD or the DEP (Ch. 373.042 (1) (b), F.S.).

WMDs are to develop priority lists of water courses and water bodies for which to establish MFLs and the proposed schedules to do so. These lists are to be updated yearly and sent to DEP for review and approval. In developing these lists, the WMDs are to examine the importance of the watercourse or water body to the State or region and the potential for significant harm to the water resources or ecology. Beginning in 2003, each priority list and schedule must include all first magnitude springs (Ch. 373.042 (2), F.S.). For such springs within the Suwannee River Water Management District (SRWMD), the District may choose not to establish MFLs on first magnitude springs provided the District submits a report to DEP containing evidence demonstrating that such first magnitude springs are not currently experiencing adverse impacts from withdrawals and are not anticipated to experience adverse impacts during the next 20 years.

The District enlisted a team of technical consultants to develop proposed MFLs, pursuant to the direction and guidance provided within the Florida Statutes (summarized in the preceding paragraphs). Shortly thereafter, the District chose to enlist a separate team of technical experts to undertake a voluntary peer review of the data and methodologies used in the determination of MFLs for the Upper Santa Fe River. The Peer Review Panel consists of Dr. Scott Emery, Dr. Mike Dennis, and Dr. Ken Watson. Resumes of the qualifications of these three technical experts are provided in Appendix A at the end of this Peer Review Report.

The District provided the Peer Review Panel with a set of general review constraints, a specific set of charges, and a specific set of limitations defining what the Peer Review Panel was to consider in its review, summarized as follows.

SCOPE OF REVIEW REQUIRED BY THE DISTRICT

Task 1. Determine whether the method used for establishing the minimum flows is scientifically reasonable.

a. Supporting Data and Information: Review the data and information that supports the method and the proposed minimum flows, as appropriate. The panel shall assume the following:

1. The data and information used were properly collected;
2. Reasonable quality assurance assessments were performed on the data and information;

Note: The reviewers are not expected to provide independent review of standard procedures used as part of institutional programs that have been established for the purpose of collecting data, such as the USGS and District hydrologic monitoring networks.

b. Technical Assumptions: Review the technical assumptions inherent in the methodology and determine whether:

1. The assumptions are clearly stated, reasonable and consistent with the best information available; and
2. assumptions were eliminated to the extent possible, based on available information.

c. Procedures and Analyses: Review the procedures and analyses used in developing quantitative measures and determine qualitatively whether:

1. the procedures and analyses were appropriate and reasonable, based on the best information available;
2. the procedures and analyses incorporate appropriate factors;
3. the procedures and analyses were correctly applied;
4. limitations and imprecision in the information were reasonably handled;
5. the procedures and analyses are repeatable; and
6. conclusions based on the procedures and analyses are supported by the data.

Task 2. **If a proposed method is not scientifically reasonable, the CONTRACTOR shall:**

a. Deficiencies: List and describe scientific deficiencies.
b. Remedies: Determine if the identified deficiencies can be remedied and provide suggested remedies.
c. If the identified deficiencies cannot be remedied, then, if possible, identify one or more alternative methods that are scientifically reasonable, based on published literature to the extent feasible.

REVIEW CONSTRAINTS

CONTRACTOR and the review panel shall acknowledge the statutory constraints and conditions (Sections 373.042 and 373.0421, Florida Statutes) affecting the District's development of MFLs. CONTRACTOR shall also acknowledge that review of certain assumptions, conditions, and established legal and policy interpretations of the Governing Board (hereinafter referred to as "givens") is not included in the Scope of Work. These givens include:

1. the selection of water bodies for which minimum flow and/or levels are to initially be set;
2. the determination of the baseline from which "significant harm" is to be determined;
3. the definition of what constitutes "significant harm" to the water resources or ecology of the area; and
4. the determination of the specific water-resource values considered in development of the MFL.

Instructions:

1. The results of this review are for the use of the District and they are not to be revealed to others without the express permission of the District.
2. By signing this form, the reviewer certifies that the peer review was conducted according to the guidelines listed above and that the opinions and recommendations included in the review constitute an independent review per Chapter 373.042(4)(b), in the discipline noted above.
3. The reviewer also certifies that the review was conducted according to the Scope and Conditions specified above.

The above instructions and limitations were provided to the peer review team as part of a peer review form that the reviewers were instructed to use. The completed forms are included in Appendix B.

TIMETABLE

The Peer Review Panel received a draft document titled: "MFL Establishment for the Upper Santa Fe River" by Water Resource Associates, Inc., on December 6, 2007. That report included six sections and 218 pages describing the approach used to recommend the proposed MFLs, and a comprehensive reference list.

The Peer Review Panel was given a deadline to have its Peer Review Report to the District within 75 days of receipt of the MFL report. This was accomplished on schedule, with a Peer Review Report that provided SRWMD questions about the methods and procedures, suggestions for text and figure clarification, and an assessment of the extent to which the report being reviewed had succeeded in developing scientifically valid methods and procedures.

RESULTS OF PEER REVIEW

The technical report presents that data and analyses that provide technical support for establishing MFLs for the Upper Santa Fe River. The stated goals of the MFLs are

- to implement the intent and policy of the governing board (Board) of the Suwannee River Water Management District (District); and
- to satisfy the requirements of the state water law and policy

The MFL report is divided into six chapters:

1. Introduction
2. Introduction to the Suwannee River Basin and Study Area
3. Hydrologic Analyses
4. Ecological Analyses
5. Ecological Basis for a Minimum Flow for the Upper Santa Fe River
6. Summary and MFL Recommendations

Chapter 1. Introduction provides a brief and concise introduction to the legal basis for establishing MFLs, an overview of the water bodies for which MFLs are being developed, and a discussion of the relevance of specific water resource values that may be considered when developing MFLs. As discussed, Chapter 62-40.473 F.A.C lists ten water resource values (WRVs) that may be considered when developing MFLs. These include:

1. recreation in and on the water
2. fish and wildlife habitats and the passage of fish
3. estuarine resources
4. transfer of detrital material
5. maintenance of freshwater storage and supply

6. aesthetic and scenic attributes
7. filtration and absorption of nutrients and other pollutants
8. sediment loads
9. water quality
10. navigation

The authors use a qualitative preliminary screening method for ranking WRVs and selecting those WRVs that are relevant, important and for which data for evaluating are available. Based on this preliminary screening, selected WRVs are retained for further investigation to identify the limiting conditions for MFL development. These include:

- recreation on and in the water
- fish and wildlife habitats and the passage of fish
- maintenance of freshwater storage and supply
- aesthetic and scenic attributes
- water quality

As stipulated in the peer review instructions, the selection of WRVs for protection is a given and the selection process and rationale were not explicitly evaluated.

Chapter 2. Introduction to the Suwannee River Basin and Study Area contains 63 pages of text, tables, and figures that assist with providing a sufficiently comprehensive, well documented, and well written background of the hydrology, geology, hydrogeology, chemistry and geochemistry, and ecology of the river basin. Cultural practices related to land and water use also are discussed. Much of the referenced literature were texts, peer reviewed journals, and USGS and state water resources papers. These sources generally have internal and external peer reviews. Other internal reports of the water management district and consultants are not subject to the same level of review. In many cases these latter sources were used as corroborating sources. The literature sources were sufficiently comprehensive for this MFL report.

The reviewers found the background information informative and complete, providing the reader with both a technical and visual impression of the basin. The literature cited was current and relevant to project goal of providing analyses for the development of MFLs.

Much of the information was similar to that provided in the MFL document for the Lower Suwannee. Because the information presented is general and methods and procedures are not part of this chapter, a detailed technical review of this section was not performed or warranted. Two of the reviewers provided a few editorial comments.

Chapter 3. Hydrologic Analyses begins the data evaluation and forms the technical basis for establishing base line conditions. Groundwater (well), surface water (stream gages), and precipitation (rainfall gage) data are identified. It is pointed out in the report

that data for springs and water use are sparse or lacking, and gaps in stage and discharge records for tributaries exist.

The record extensions begin on page 3-11 and continue to page 3-47. The authors point out on page 3-11 that the statistical associations developed are for the purpose of record extension (i.e., as an interpolation tool) and not statistical inference and, therefore, autocorrelation is an advantage. Most hydrologic time series data are autocorrelated but it is the serial correlation of residuals that can cause problems when making inferences. A concern raised by one reviewer relates to the probable high degree of association between the independent variables. This occurs, for example, in the equation on page 3-44 in which discharge appears to be negatively associated with h_{1898}. It is understood and we agree that autocorrelation and multicollinearity do not inhibit the predictive ability of the model as long as the predictions are made within the bounds of the independent variable data values.

The review team takes no exception to the record extension techniques.

Santa Fe Spring flow characteristics are provided on page 3-47, and a discussion of relative contribution to river flow is provided on pages 3-52 to 3-54.

A discussion of the HEC-RAS model and its predecessor models for the Santa Fe River is presented on pages 3-54 to 3-61. HEC-RAS was updated with site-specific cross-section information and is used to develop stage discharge relationships along the stretch of river for which the MFL is being set. This is a common and appropriate use of HEC-RAS in MFL determinations and the reviewers concur with its application.

Discharge data as related to MFL development is presented through the remainder of chapter 3. While considerable effort was made in extending records of various gages it appears that the following information was used in MFL development:

- Worthington data were used entirely. Some Graham data were synthesized (Fig 3-7) using Worthington data. The MFLs set at these locations will protect upstream of Worthington to the headwaters of the Santa Fe River.
- Some O'Leno data were synthesized based on Worthington (Q1500), River Rise (Q1910), and Olustee Creek (Q1800). River Rise data were extended by correlation to the High Springs gage. The MFLs are set to protect swimming at the park.

The reviewers found the presentation of the record extension techniques to be reasonably clear and concise; however, the presentation of much of the analyses does not appear to be necessary as the results are not used. We concur that it is important to present the data sources and speak to analyses that were performed, but the report (and readers) may benefit from less information on the extension of data records that are not used.

The chapter ends with a brief discussion of the flowthrough rate at O'Leno State Park. It is discussed that the flowthrough rate of 500 gallons per bather per day is met at a discharge of 0.3 cfs between 81% and 99% of the time depending on the data set used. It also is noted that the swimming is closed when the water appears stagnant.

A policy decision is suggested to set MFL downstream of River Rise (i.e., Lower Santa Fe) to protect flow at O'Leno.

Chapter 4. Ecological Analysis begins with the supposition that the ecological communities of the river channel and adjacent floodplain are structured by the hydrologic conditions of the river. Within the 56 pages of text, there are descriptions and analyses of dissolved oxygen, riparian vegetation, periphytic algal communities, benthic invertebrates, unionid mussels, and fish. Extensive statistical analyses of the macroinvertebrate data were presented, distinct from the discussion of the unionid mussels. The extensive analyses of the benthic macroinvertebrate data utilize the appropriate statistical treatments. These analyses are quite thorough. In the final analysis however, these species were not the critical components for the establishment of the proposed MFLs.

In Chapter 3, the final sub-section provides the reader a description of how the information presented in Chapter 3 will be used in MFL establishment. There is no sub-section at the end of Chapter 4 that attempts to summarize the water quality and biological information in a similar manner. In Chapter 5 the reader is informed as to which biological factors of those presented in Chapter 4 are being used to establish the MFLs. In Chapter 5 it is stated that: fish foraging habitat, crayfish (*Procambarus spiculfer)* habitat (as a primary prey item for the Suwannee Bass, a Species of Special Concern), and habitat (including the putative host species of fish – page 4-49) for select species of unionid mussels (several of which are threatened or endangered) are the important criteria for setting MFLs in Chapter 5. The data and analyses presented in Chapter 4 are sufficient to support the decision in Chapter 5 to concentrate on these factors for MFL establishment. The need to examine all these factors in detail in order to determine which specific factors are most relevant to MFL establishment is clear. However, because much of the results of the statistical analyses related to the concentrations of dissolved oxygen and to the non-molluscan invertebrates were not utilized in establishing MFLs, we suggest that these intensive sets of analyses be summarized in the main body of the report and the detailed analyses placed in an appendix.

Chapter 5. Ecological Basis for a Minimum Flow for the Upper Santa Fe River begins by summarizing the analyses presented in Chapter 4 and concluding that the MFL should be based on the following criteria:

- The maintenance and protection of essential fish foraging habitat, including snag habitat suitable for the crayfish *Procambarus spiculfer*,

- The maintenance and protection of suitable habitat for freshwater mussels, including the threatened and endangered species that occur or have occurred in the New River basin (Blalock-Herod 2000) and the putative host species for their parasitic development stages.

The report goes on to state that a 15% increase risk of reduced habitat availability was defined *a priori* as significant harm to the River. While this value has gained some traction in setting MFLs, we view this statement as a policy decision for this particular MFL.

Three approaches are relied on to provide a weight of evidence of no significant harm under the above definition including wetted perimeter, Ecosystem Functions Model (EFM), and fish passage. Each approach is discussed with regard to the two sections of river where MFLs are proposed.

The review panel asked for and was provided literature on the EFM. This is a relatively new model developed by the California Department of Water Resources and the US Army Corps of Engineers. Based on the recent literature, the model has applicability in MFL development, and its use has appeared in reviewed publications. From that perspective, the review panel concurs with its application. However, there was simply not enough information presented in the report (limited to figures 5-7 and 5-8), nor was the information clear enough to the reviewers, to provide an opinion on its specific application and conclusions. Because the model is relatively new, is being used in place of PHABSM, and is an important determinant in the MFL evaluation, we suggest that more detail be added on this model application, perhaps in an appendix, to supplement the text.

Like the EFM Model, the Wetted Perimeter technique employed in Chapter 5 relies heavily upon the HEC-RAS produced transects. It is suggested in Chapter 5 that many HEC-RAS transects were utilized in the analyses. However, limited discussion of only two such transects is provided in the report (river miles 42.54 and river miles 42.48). None of the other transect information is provided in an appendix. These two transects are spatially quite close together. Additional discussion of why these two closely spaced transects are so critical would be useful.

Based on consistency among the three approaches for establishing MFLs, it is concluded in the report that 2.3 cfs at the Graham gage and 42 cfs at the Worthington gage be set as control points for the MFLs. The MFLs are defined to allow a 15% shift in the flow duration curves for flows in excess of the control points.

In section 5.2.2.1 (page 5-12), the report points out that a reduction of flow from 6 cfs to 2 cfs represents an increased risk of losing up to 15% of available habitat. This seems to be the only reference to the policy decision regarding the definition of significant harm.

Chapter 6. Summary of MFL Recommendations presents a summary of the MFL background information and the procedure and results of the MFL development process. The evaluation procedure is summarized in the text as follows:

1. Compile all "best available information" relative to the water bodies.
2. Evaluate the ten specific water resource values (62-40 F.A.C.) for applicability to the water body in light of the potential for impact and the available data;
3. Evaluate the available information to determine the relationships between flow and/or level and the water resource or related ecology;
4. Identify the limiting target values that, if protected, will protect all other applicable criteria.
5. Recommend an MFL that will protect the water resource and related ecology for significant impact; and
6. Re-evaluate the ten specific water resource values to ensure potentially applicable values are sufficiently protected form significant risk. Consideration of specific WRVs to ensure applicable values are sufficiently protected.

This section of the report concludes with the following language:

"It was determined in the evaluation of the "best available information" that the water resource value that provided the best opportunity to establish a MFL protective of all the identified applicable water resource values was "fish and wildlife habitats and the passage of fish". Hence, even though there was not quantitative information available to discretely evaluate all the applicable water resource values identified in chapter 1 of the report, the MFL recommended for the protection of significant harm to "fish and wildlife and the passage of fish" will be protective of the less conservative water resource values by a qualitative comparison."

Appendix 4-1 includes a description of visual observations made by Blalock-Herod and Williams in 2001.

REVIEW SUMMARY

Specific review comments are contained in the Review Forms in Appendix B. As stipulated in the peer review scope, reviewers focused on data and data analysis procedures, and on whether or not comments would materially impact the MFLs. If the peer review panel was uncertain about the impact of a stated comment or concern, a "yes" was entered in the column reflecting that the comment may identify an issue that could materially affect the MFLs. A "no" generally means that the peer review panel is requesting/suggesting clarification on a subject that would not appear to affect the MFLs, or presenting an observation or commenting that reflects the reviewers understanding of the subject.

The MFL for the Upper Santa Fe River was determined as follows.

1. Record extension techniques are used to extend the records of the gages located in the study area. Two gages (at Worthington and Graham) were selected as best representing the background conditions and of most use in developing MFLs. Baseline flow duration curves were developed for these gages.
2. Three ecological-based metrics are used for developing the MFLs: (1) wetted perimeter, (2) Ecosystem Functions Model (EFM), and (3) fish passage. Based on consistency among the three approaches for establishing MFLs, it is concluded in the report that 2.3 cfs at the Graham gage and 42 cfs at the Worthington gage be set as control points for the MFL. The MFLs are defined to allow a 15% shift in the flow duration curves for flows in excess of the control points.

Task 1. Determine whether the method used for establishing minimum flows is scientifically reasonable.

a. Supporting Data and Information

Overall, we found the report thorough in its data review and presentation of background information.

We note that much of the analyses presented in Chapter 3 and information in Chapter 4 ultimately are not used (or used only indirectly) in the development of the MFLs. Given that the work is very scientific and presented in technical language specific to the appropriate disciplines, we think that the report could benefit from removing this information and only reference that certain types of analyses were completed but that only those directly related to the MFL development are presented. Alternatively, the information might be placed in an appendix. This comment is not a technical deficiency, but each reviewer found it difficult to follow some elements of the analyses that lead to the MFL development and therefore difficult to comment on whether or not it materially affected the MFL development.

b. Technical Assumptions

The peer reviewers found two assumptions/assertions that might materially affect the conclusions of the report.

- 15% increased risk of reduced habitat availability was defined *a priori* as significant harm to the river.

RESPONSE:

This definition has been deleted from the report.

- Flow reduction of 15% at flows above the minimum flows at the two gages is conservative. The MFL recommended for the protection of significant harm to fish and wildlife habitats and the passage of fish will be protective of the less conservative water resource values by a qualitative comparison.

We do not take exception to the 15% value and agree that it has gained some traction in setting MFLs for other Districts, but we view the value as much a statement of policy as a scientifically derived value for this particular MFL.

RESPONSE:
This value is not policy nor is it a scientifically derived value. It is based upon the collective experience of the consulting team's scientific experts for water resource systems that lack extensive amounts of historical data and the subsequent ability to model precise cause and effect relationships of flow versus ecological impacts.

c. Procedures and Analysis

The peer review panel found the methods used for data syntheses, record extension, and correlation techniques to be appropriate. The reviewers provided a number of comments on the statistics but primarily requested only clarification.

The information provided on the EFM was limited and insufficient to provide much peer review. The review panel requested and was supplied background documents that support the EFM in MFL development. The EFM is relatively new and not in wide use but because the US ACOEs was a participant in its development, and its use has been presented in peer reviewed documents, the panel did not take exception to its use in setting MFLs. However, we encourage including more information in the report on the application of EFM. We also suggest adding some detail on the HEC-RAS modeling but are generally impressed by the sophistication of the modeling effort.

Task 2. Scientific Deficiencies

a. Deficiencies

Some potential deficiencies are noted and suggested remedies were provided by the reviewers. However, in most cases, these were offered as suggestions, and clarification may be all that is needed. One reviewer pointed out that the 0.5 ft/sec velocity may not be consistent with the table referenced in the text. Also, there is some concern over the assumptions discussed in Task 1.b. as related to the protection of other WRVs. It is not clear by the data and analyses presented that protection of habitat is the most conservative WRV and that the other WRVs are protected as a result.

RESPONSE:

Also addressed in Comment No. 57 from K. Watson, PhD

The proposed MFL is the flow that corresponds to a 15% reduction in available habitat at a depth of 2.0 feet. The adoption of a 15% reduction in habitat is consistent with the peer reviewed approach used by the Southwest Florida and St. Johns River Water Management Districts to determine the limit of significant risk to the available habitat (Gore *et al.* 2002; Southwest Florida Water Management District 2002 and 2004); Lower Suwannee River MFL, WRA 2005. The depth of the water column (2.0 feet) is protective of the requirements of the taxa of concern for the Upper Santa Fe River (Table 5-1). The minimum velocity adopted for the MFL was 0.5 feet sec^{-1}. This velocity is protective of the macroinvertebrate taxonomic groups of concern (Table 5-1). For the brown darter, a minimum velocity of 1.0 feet sec^{-1} is required while for the crayfish, the 1.5 feet sec^{-1} velocity criterion was employed.

b. Remedy

The reviewers request a clear distinction between what is an assumption (or given) in the setting of MFLs and what is a conclusion based on scientific analyses. We also request more information supporting the assertion that the MFLs for habitat protection are the most conservative.

RESPONSE:

Also addressed in Comment No. 71 from K. Watson, PhD

The direction of the District to the MFL development team was to use their best professional judgment and experience to focus on the MFL criteria that would be the most pertinent to defining significant harm to the waterbody. The District direction was further defined to perform only a qualitative analyses on those items which in the professional opinion of the consulting team would not be the driving criteria to establish the MFL. It is the opinion of the consultant that although investigating the other MFL criteria, such as recreation and aesthetics would make the report more comprehensive, the time and cost could not be justified and would have an extremely low probability of affecting the recommended MFL.

It was the intention of the authors that assumptions were clearly stated in the report . As stated in the reviewers comments Task 2. Scientific Deficiencies, the narrative regarding the applicability if the environmental values for this waterbody were not assumptions but qualitative and/or quantitative evaluations rather based upon expertise of the authors and review of the information specific to the waterbody.

Further, Chapter 62-40.473 F.A.C. states "consideration" should be given to the environmental values and does not require that each value is protected from significant harm or even scientifically evaluated. The MFL development process for the SRWMD adheres to this rule by giving qualitative and/or quantitative consideration to all environmental values which are applicable to the water body being considered.

This approach is further supported by the fact that the consultant is not aware of any free flowing waterbody MFL established in Florida, that was based on any environmental or human use value other than estuarine resources or fish and wildlife habitats and the passage of fish. This was also the case for this waterbody.

CONCLUSIONS

The data used in the analyses appear to be the best available given that protection of "fish and wildlife habitats and the passage of fish" was selected as the most conservative WRV. The methodologies utilized in developing the MFL are technically sound with respect to the protecting the selected WRV from significant harm, including habitat protection and swimming at O'Leno Park.

Based on the information provided in the report, it has not been clearly shown that the protection of fish and wildlife habitat is the most conservative WRV and therefore protective of the other potentially important WRVs listed in the report.

APPENDIX A

RESUMES OF THE PEER REVIEW PANEL

SCOTT H. EMERY, Ph.D.
Senior Technical Consultant/Ecologist

CREDENTIALS/CERTIFICATION

Ph.D., Ecology, Biological Sciences, SUNY at Stony Brook, N.Y. 1984
M.S., Zoology, Clemson University, S.C. 1978
B.A., Biology, Williams College, MA. 1975

PROFESSIONAL AFFILIATIONS

IES Board of Directors, University of South Florida, 1993-present
Minimum Flows/Levels Committees/Sub-committees, 1996-present
Chairman, FDEP Groundwater Rule TAC, 1996-present
American Water Works Association
Ecological Society of America
Society of Wetland Scientists
Courtesy Associate Professor, University of South Florida 2003 – 08

FIELDS OF SPECIALIZATION

- Minimizing impacts from water supply development projects
- Assessing impacts from groundwater withdrawal on lakes/streams/wetlands
- Resource Management
- Water conservation and demand management
- Water supply development, treatment, and testing
- Ecological risk assessments

RELEVANT PROJECT EXPERIENCE:

Minimum Flows and Levels Rules. Dr. Emery has been one of Hillsborough County's primary technical representatives to the various committees developed by the SWFWMD to develop methodologies and actual flows and levels in various lotic and lentic water bodies. Dr. Emery spent years working with the District technical experts and others on the different methods for evaluating Category I, II, and III lakes, evaluating cypress wetlands, springs, and river/stream flows. This is an ongoing project, with emphasis on river and springs MFL development in 2003-04**. Among the rivers Dr. Emery has/is working on: Alafia River, Hillsborough River, Little Manatee River, Palm River, Brooker Creek, Rocky Creek.**

Minimum Flows and Levels for the Upper St. Johns River. Dr. Emery is the Project Manager for the project for the SJRWMD to determine whether the proposed MFLs for a major portion of the St. Johns River meet the water resource protection and human use values specified by Chapter 62-40 Florida Administrative Code.

Hillsborough River Greenways Task Force and Suncoast Greenways Projects: Dr. Emery was the Professional Facilitator and project manager for these award-winning, multi-year efforts sponsored by 1000 Friends of Florida. The projects identified numerous water quality, water quantity, land use, mining, transportation and habitat issues within the Hillsborough, Upper Peace, Alafia, Little Manatee, and Manatee River systems. These projects involved detailed discussions on the development of position statements regarding 5 large spring systems within the different rivers.

Development of hydrobiological monitoring programs for the Tampa Bay Estuary and major rivers in the area. Dr. Emery was one of two principal developers of Hillsborough County's Independent Monitoring Program, designed to detect impacts from water supply projects on the Tampa Bay Estuary and its major rivers and spring systems. Subsequently, Dr. Emery has assisted the local regulatory agency (EPC) in subsequent biological and water quality sampling, using his fully equipped sampling vessel. Dr. Emery was a member of the Technical Advisory Group that helped develop the Hydrobiological Monitoring Program for the Tampa Bay Estuary. Dr. Emery continues to examine data collected from these monitoring efforts on behalf of Hillsborough County.

Spring Flow Limitations on a Water Use Permit Issue. Dr. Emery was one of Hillsborough County's technical

experts in a legal matter between a major regional water supply authority and the County regarding impacts from a newly permitted wellfield on the flow from Lithia and Buckhorn Springs. Dr. Emery helped develop the methodology used to assign a minimum flow/level below which wellfield pumping would have to be reduced or eliminated.

Spring Flow Limitations on a Water Use Permit Issue. Dr. Emery was on of Hillsborough County's technical experts in deliberations on how much water was to be allowed to be diverted from Sulfur Springs to augment the base of the Hillsborough River Dam with a minimum flow. This was a highly controversial matter, in as much as the City of Tampa relies heavily upon the river for its potable water supplies, and given the importance of the springs to the ecology of the lower river.

Evaluation of multiple plans to develop new water supply sources in west-central Florida, with emphasis on potential impacts to wetlands, lakes, springs, streams and estuaries. Dr. Emery has evaluated multiple groundwater and surface water projects for their potential to impact natural systems within and around Tampa Bay. Dr. Emery continues to act in this capacity for Hillsborough County and Hillsborough County Environmental Protection Commission (EPC).

Ecological evaluations of hundreds of wetlands and lakes in west-central Florida, with emphasis on detecting impacts from water withdrawals. Dr. Emery provides on-going monitoring and analytical services to public sector local and regional governments in this regard. He maintains complete set of field sampling vehicles and equipment, including power boat with specially designed booms for benthic sampling.

Northern Tampa Bay Water Resource Assessment and Supply Development Project. Dr. Emery has acted as Hillsborough County's Technical Representative on this multi-year project since its inception. The project is designed to determine the sustainable limits to groundwater pumpage within a large area of north of Tampa Bay. The project has included years of wetland work, well tests, hydrologic monitoring, and modeling.

Feasibility analysis for proposed large reservoir. Dr. Emery was the principal author of a feasibility report concerning the proposed development of a large water supply reservoir to be located within Hillsborough County, Florida.

Water Use Caution Areas, Rule Developments. Dr. Emery has been involved in the Northern Tampa Bay Water Use Caution Area and the Southern Water Use Caution Area (including its predecessor areas, the Eastern Tampa Bay Water Use Caution Area and the Highlands Ridge Water Use Caution Area) since the initial meetings in the mid 1980's. Dr. Emery has served on advisory boards, and has assisted local governments on various ecological, water quality and hydrologic aspects of these efforts. He continues to be involved in the latest developments within the WUCAs. All these projects are intended to determine sustainable levels of withdrawals of water. Dr. Emery's focus has usually been on impacts to surficial features such as lakes, wetlands springs and streams, plus impacts to private well users.

Four Wellfields Administrative Hearing. Dr. Emery was a major participant in one of the largest Administrative Hearings ever held, involving over-pumping and adverse impacts to lakes, and wetlands. Multiple parties were involved on both sides. Dr. Emery represented one of the parties seeking to have wellfield pumpage reduced. Dr. Emery was deposed as an expert witness as part of this case. The resultant Findings of Fact clearly indicated that wellfield pumpage had caused impacts to lake and wetland systems, and that such impacts were adverse.

Governance Agreement and Partnership Plan. As a direct result of the Four Wellfields Administrative Hearing, the parties involved began intense, long-term negotiations for reducing pumpage within impacted areas. Dr. Emery acted as a technical advisor to the Hillsborough County Administrator and Board of County Commissioners for both the development of the new Governance Agreement (greatly re-structured the former WCRWSA) and the Partnership Plan between the local governments, the new Tampa Bay Water, and the SWFWMD. As a result of these agreements, permitted wellfield pumpage was to be reduced by more than 50%.

Ecological investigations and ecological risk assessments (ERA) associated with Work Plans and RCRA Facility Investigations for more approximately two dozen projects at various locations within Florida, including Kennedy Space Center, Cape Canaveral Air Station; Titusville, Pinellas Park, Sanford, Temple Terrace and Winter Haven. These projects involve evaluations of ecological habitats and animal/plant receptors, analyses of potential contamination in surface water, groundwater, soils and sediments, and modeling of potential toxicological impacts.

Preliminary risk report of mercury in a surface water body used as a public water supply for a regional government in southwest Florida. Dr. Emery developed a report/brochure for the Peace River /Manasota Regional Water Supply Authority on the issue of mercury in portions of the Peace River. Florida's Department of Environmental Protection provided compliments on the manner in which the report was developed so as to be easily understandable to non-technical individuals, and requested permission to utilize part or all of the report.

Evaluations of borrow pit use and phosphogypsum use in roads for University of South Florida. Dr. Emery was part of a multi-disciplinary evaluation of the use of borrow pits for road material compared with the use of phosphogypsum. The study identified multiple issues with either source of road bed material.

Analysis of land use and surface water/drainage changes in Hillsborough County. Dr. Emery authored a report on historical changes in land use and surface water drainage in an area of high groundwater pumpage.

Expert witness services to governmental and private interests dealing with wetlands and lakes, Water Use Permitting and water quality issues.

Director of Resource Management/Director of Environmental Services, West Coast Regional Water Supply Authority (1984 – 92). Developed/implemented innovative, state-of-the-art ecologic, hydrologic and water quality monitoring and analytical programs (>$3 million/year) for each wellfield/source of supply designed to identify potential impacts from groundwater production and developing mitigating methodologies (including well rotation and augmentation programs). Developed and directed all activities associated with the Authority's fully certified (DHRS, DER, EPA) analytical testing laboratory; directed all in-house and consultants in developing policies and programs for managing and protecting the resource. Directed all activities in management of Authority water supply facilities (serving 1 million people) with total asset value of $150 million. Authority's in-house expert on all issues pertaining to matters of ecology and wellfield impacts, water quality, water treatment, and public health considerations. One of the top five applicants to head the Florida Department of Natural Resources (1991).

TRAINING COURSES:

Toxicology for Chemists
National Wetlands Inventory and Wetlands Mapping
Pesticides in Groundwater
Gas Chromatography
Principles of Accounting
Essentials of Management/Management Principles
Radiation Safety/Nuclear Soil Gauge Certifications
Budgeting

COMMITTEES, BOARDS:

AWWA Water Resources Sub-committee, 1990-92
AWWA Water Quality Sub-committee, 1990-92
AWWA Yearbook Assistant Editor, 1992
IES Board of Directors, University of South Florida, 1993-present
Minimum Flows/Levels Committees/Sub-committees, 1996-present
Chairman, FDEP Groundwater Rule TAC, 1996-present

REPORTS, PAPERS, PUBLICATIONS:

Author/co-author of 8 peer-reviewed published scientific/technical articles.
Over 60 technical reports.
Oral presentations at symposia, conferences.

W. MICHAEL DENNIS, Ph.D.

Areas of Specialization:

Wetland delineation, permitting and mitigation; plant taxonomy and ecology; remote sensing and aerial photointerpretation; Threatened and Endangered (T&E) species; and wildlife evaluations.

Experience:

President, Breedlove, Dennis & Associates, Inc. (BDA), Winter Park, Florida. 1997 to present.

Principal, BDA, Winter Park, Florida. 1984 to present.

Vice President, BDA, Winter Park, Florida. 1983 to 1997.

Senior Scientist, Breedlove & Associates, Inc., Gainesville, Florida. 1981 to 1983.

Projects and responsibilities included development of technical data and management of projects in the following areas:

- Vegetation analysis and wetlands jurisdictional evaluations for land development activities in Orange, Osceola, Seminole, Lake, Polk, Wakulla, Martin, St. Lucie, Marion, Hamilton, Brevard, Hillsborough, Sarasota, Dade, Duval, Jackson, Gadsden, Leon, Liberty, Franklin, Citrus, Hernando, Pasco, Volusia, Hardee, Manatee, Palm Beach, Indian River, Flagler, Lee, Collier, Escambia, Walton, Alachua, Putnam, Sumter, Charlotte, Broward, Columbia, Baker, Nassau, Clay, St. Johns, Pinellas, Highlands, Hendry and Monroe counties, Florida.
- Vegetation mapping of plant communities in Florida, Georgia, South Carolina, Alabama, Tennessee, New Jersey, North Carolina.
- Wetlands evaluations for phosphate, sand, and limerock mining activities.
- Wetland evaluations, permitting for Disney Development Company, Universal Studios, and Sea World.
- Airport permitting.
- Wetland reclamation planning.
- Ordinary high water line determinations: Lake Saunders, Lake County; and Peace River Valley, Alafia River, Lake Kissimmee, Lake Hatchineha, Lake Tohopekaliga, Lake Poinsett.
- Power plant and right-of-way siting.
- Technical Advisor in administrative and legislative rule making process.
- Served on Technical Committee advising the Senate Natural Resources Committee on the 1984 Wetlands Legislation.

- Member of the Wildlife Advisory Group appointed by the Department of Community Affairs.
- Member of the Econlockhatchee River Task Force appointed by the St. Johns River Water Management District (SJRWMD).
- Participated in development of Florida Wetland Delineation and Environmental Permitting State Rules during the 1993/1994 Legislative Session.
- Member of the Environmental Constraints and Development Suitability Mapping Project Advisory Committee for Orange County.
- Member of the Technical Advisory Committee for the SJRWMD on the Cumulative Impacts Provision of the SJRWMD's Environmental Resource Permit rules.
- Expert witness testimony--qualified in wetlands evaluation, and jurisdictional determinations and permitting, botanical indicators of ordinary high water line determinations, terrestrial and wetlands ecology, T&E species surveys, and wildlife investigations.

Botanist, Tennessee Valley Authority (TVA). 1976-1981. Responsible for planning, implementing, and presenting studies on the environmental impact of proposed TVA facilities on aquatic macrophyte communities, and ecological and taxonomic studies of aquatic plant species.

Project experience includes:

- Studies of aquatic and wetland plants of the Tennessee Valley.
- Phipps Bend Nuclear Plant environmental report.
- Bellefonte Nuclear Plant environmental report.
- Yellow Creek Nuclear Plant environmental report.
- Future power plant siting studies, Courtland, Westmoreland, Town Creek sites.
- Pumped storage site evaluation report.
- Hydrilla contingency plan for the Tennessee River watershed.
- Aquatic weed control program.
- Study of the vegetation of naturally occurring ponds of the Cumberland Plateau.
- Ecology of mud flat vegetation of Tennessee Valley reservoirs.
- Preparation of a manual of the submersed and floating-leaved plants of the Tennessee Valley.

- Utilization and revegetation of reservoir shorelines.
- Acid rain studies program for assessing impact of acid precipitation on aquatic systems.
- Studies of heavy metals accumulation in aquatic plants, Holston River basin.
- Vegetation study of Towns and Rabun counties, Georgia.

Faculty Associate, University of Tennessee. 1980-present.

Adjunct Professor, University of North Alabama. 1980-1981.

Visiting Assistant Professor, University of Tennessee. 1979.

Graduate Teaching Assistant, University of Tennessee. 1973-1976.

Research Assistant, University of South Carolina. 1973.

Studied floristic composition and ecological parameters in ponds of the sandhill belt of South Carolina.

Research Assistant, University of South Carolina. 1972.

Studied the flora and ecology of the Santee Swamp.

Teaching Assistant, University of South Carolina. 1971-1973.

Medical Laboratory Technician, U.S. Army. 1969-1971.

Education:

Ph.D. University of Tennessee, Knoxville, Tennessee, 1976. Botany.

M.S. University of South Carolina, Columbia, South Carolina, 1973. Biology.

B.S. Emory University, Atlanta, Georgia, 1969. Biology.

Habitat Evaluation Procedure (HEP) 150 - Executive HEP Briefing Workshop, 1989.

HEP 400 - Advanced Recreation Economic Techniques Workshop, 1989.

EL 305 - Expert Witness Workshop, 1990

Civil Service Commission Workshop in Environmental Assessment, 1977.

National Aeronautics and Space Administration Technology Transfer Course, 1976. Basic concepts of remote sensing and data handling techniques as they apply to the analysis of digitally recorded LANDSAT multispectral scanner data and the Earth Resources Laboratory's data analysis system.

Associations:

Ecological Society of America
Association of Southeastern Biologists
Southern Appalachian Botanical Club
Society of Wetland Scientists

Honors:

Distinguished Alumni Award - Oxford College of Emory University, 1987.

Selected Publications and Presented Papers:

Bates A.L., **W.M. Dennis** and T.L. Goldsby. 1978. Experimental use of diquat in Guntersville Reservoir. Aquatic Plant Management Society.

Bates, A.L., T.L. Goldsby, and **W.M. Dennis**. 1978. A prevention and contingency control plan for *Hydrilla*. Aquatic Plant Management Society.

Bates A.L., **W.M. Dennis**, and T.L. Goldsby. 1978. The use of remote sensing for determining effectiveness and planning of aquatic plant control operations in the Tennessee Valley. Aquatic Plant Management Society.

Bates, A.L., **W.M. Dennis**, and T.L. Goldsby. 1980. Eurasian water-milfoil (*Myriophyllum spicatum L.*) identification, distribution, and life history. Proceeding of the Mississippi Aquatic Weed Workshop, 13 February 1980, Mississippi State University.

Bates A.L., **W.M. Dennis**, and T.L. Goldsby. 1980. Prevention and control of *Hydrilla*. Proceedings of the Mississippi Aquatic Weed Workshop, 13 February 1980, Mississippi State University.

Bates, A.L., E. Pickard, and **W.M. Dennis**. 1978. Tree plantings: a diversified management tool for reservoir shorelines. Proceedings of the National Symposium on Strategies for protection and Management of Floodplain Wetlands and other Riparian Ecosystems.

Batson, W.T. and **W.M. Dennis**. 1973. Record trees of South Carolina. South Carolina Wildlife 20(5):12-16.

Bierner, M.W., **W.M. Dennis**, and B.E. Wofford. 1977. Flavonoid chemistry, chromosome number and phylogenetic relationships of *Helenium chihuahuensis* (Asteraceae). Biochemical Systematics and Ecology 5:23-28.

Breedlove, B.W. and **W.M. Dennis**. 1984. The use of Small-format Assessment of Microphyton; collection, use, and meaning of the American Society for Testing and Materials STP 843.

Breedlove, B.W. and **W.M. Dennis**. 1987. Recent changes in and responses to U.S. Army Corps of Engineers 404 permitting. Environmental Land Use Law Section Reporter 10(1):22-23.

Carriker, N.E., **W.M. Dennis**, and R.C. Young. 1981. Quantification of allochthonous organic input to Cherokee Reservoir: Implications of hypolimnetic oxygen depletions. Proceedings of the International Symposium on Inland Waters and Lake Restoration, September 8-12, 1980, Portland, Maine.

Dennis, W.M. 1973. A new record water hickory for South Carolina. Castanea 38:205.

Dennis, W.M. 1974. A synecological study of the Santee Swamp, Sumter County, South Carolina. ASB Bulletin 21(2):51.

Dennis, W.M. 1976. Chromosome morphology of *Clematis*, subsection *Viornae*, (Ranunculaceae). Canadian Journal of Botany 54(10):1135-1139.

Dennis, W.M. 1977. Contributed *Clematis* (in part) to M.C. Johnston and J. Hendrickson, Chihuahuan Desert Flora.

Dennis, W.M. 1978. Contributed Macrophyte section for C.I. Weber (ed.), Office of Water Data Coordination Manual.

Dennis, W.M. 1978. The taxonomic status of *Clematis gattingeri* Small (Ranunculaceae). Brittonia 30:463-465.

Dennis, W.M. 1979. The new combination *Clematis pitcheri* T. & G. var. *dictyota* (Green) Dennis. Sida 8:194-195.

Dennis, W.M. 1980. *Sarracenia oreophila* (Kearny) Wherry in the Blue Ridge Province of northeastern Georgia. Castanea 45:101-103.

Dennis, W.M. 1982. Contributed *Jamesianthus alabamensis* and *Clematis* Subsection *Viornae* to the National List of Scientific Plant Names. United States Department of Agriculture Soil Conservation Service-TP-159.

Dennis, W.M. 1982. Ecological notes on *Jamesianthus alabamensis* Blake and Sherff (Asteraceae) and an hypothesis on its endemism. Sida 9(3):210-214.

Dennis, W.M. 1984. Aquatic Macrophyton Sampling: An overview. Ecological Assessment of Macrophyton: Collection, use and meaning of data, American Society for Testing and Materials STP 843.

Dennis, W.M. and W.T. Batson. 1974. The floating log and stump communities in the Santee Swamp of South Carolina. Castanea 39:166-170.

Dennis, W.M. and M.W. Bierner. 1980. Distribution of flavonoids and their systematic significance in *Clematis* subsection *Viornae*. Biochemical Systematics and Ecology 8:65-67.

Dennis, W.M. and B.W. Breedlove. 1983. "Wetlands Reclamation: A Drainage Basin Approach."

Dennis, W.M. and B.W. Breedlove. 1984. "The Assessment of Environmental Regulations on Agriculture Operations in Florida Through the Use of Small and Medium Format Color Infrared Aerial Photography." Abstract, p. 173. Color Aerial Photography in the Plant Sciences and Related Fields.

Dennis, W.M. and B.W. Breedlove, 1987. "Location of a Court Required Period Specific Ordinary High Water Using Detailed Survey, Tree Aging and Medium Format Color-Infrared Photography." Presentation at the ASPRS/ACSM 1987 Convention; Baltimore, Maryland.

Dennis, W.M., P.A. Collier, E.L. Morgan, and P. DePriest. 1981. Habitat notes on the aquatic lichen *Hydrotheria venosa* Russell in Tennessee. Bryologist 84:392-393.

Dennis, W.M., A.M. Evans, and B.E. Wofford. 1979. Disjunct populations of *Isoetes macrospora* in southeastern Tennessee. Amer. Fern J. 69:97-99.

Dennis, W.M. and B.G. Isom. 1984 (ed). Ecological Assessment of Macrophyton: Collection Use and Meaning of Data. A symposium sponsored by American Society for Testing and Materials Committee D-19 on Water, Ft. Lauderdale, Florida, 15-16 Jan. 1983. ASTM STP 843 122 p.

Dennis, W.M. and C.S. Keener. 1982. The subgeneric classification of *Clematis* (Ranunculaceae) in temperate North America north of Mexico. Taxon 31(1):37-44.

Dennis, W.M., J.M. Neil, and R.C. Young. 1983. Productivity of the Aquatic Macrophyte Community of the Holston River: Implications to Hypolimnetic Oxygen Depletion of Cherokee Reservoir TVA/ONR WR-83/12.

Dennis, W.M., T.S. Patrick, and D.H. Webb. 1981. Distribution and naturalization of *Cyperus brevifolioides* (Cyperaceae) in eastern United States. Sida 9(2):188-189.

Dennis, W.M. and D.H. Webb. 1981. Additions to the flora of Tennessee. Sida 9(2):184.

Dennis, W.M. and D.H. Webb. 1981. The distribution of *Pilularia americana* A. Br. in North America, north of Mexico. Sida 9:19-24.

Dennis, W.M., D.H. Webb, and A.L. Bates. 1988. An Analysis of the plant community of mudflats of TVA mainstream reservoirs. pp. 177-198. In: Snyder, D.H. (ed.). Proceedings of the first annual symposium on the natural history of lower Tennessee and Cumberland river valleys. The Center for Field Biology of Land Between the Lakes. Austin Peay State University, Clarksville, Tennessee.

Dennis, W.M., D.H. Webb, and B.E. Wofford. 1977. State records and other recent noteworthy collections of Tennessee plants. II. Castanea 42:190-193.

Dennis, W.M., D.H. Webb, B.E. Wofford, and R. Kral. 1980. State records and other recent noteworthy collections of Tennessee plants. III. Castanea 45:237-242.

Dennis, W.M. and B.E. Wofford. 1976. Evidence for the hybrid origin of *Proserpinaca intermedia* Mackenz (Haloragaceae). ASB Bulletin 23(2):54.

Dennis, W.M. and B.E. Wofford. 1976. State records and other recent noteworthy collections of Tennessee plants. Castanea 41:119-121.

Tucker, A.O., M.J. Maciarello, B.E. Wofford, and **W.M. Dennis**. 1997. Volatile leaf oils of *Persea borbonia* (L.) Spreng., *P. humilisnash*, and *P. palustris* (Raf.) Sarg. (Lauraceae) of North America. J. Essent, Oil Res. 9: 209-211.

Webb, D.H., H.R. DeSelm, and **W.M. Dennis**. 1997. Studies of prairie barrens of northwestern Alabama. Castanea 62(3):173-184.

KEN W. WATSON, Ph.D.
President/Principal Hydrologist

EDUCATION / CREDENTIALS

B.S. Soil Science, University of Florida, 1977
M.S. Soil Physics, University of Kentucky, 1979
Ph.D. Soil Physics, University of Kentucky, 1983

Continuing Education

University of South Florida

Hydrology of Islands/Coasts, 1988
Florida and Island Hydrology, 2000
Analytical and Semi-analytical Models, 1992
Mathematics of Flow Nets and Analytic Elements, 1994

Risk Assessment (American Petroleum Institute)
Risk Analysis
Stochastic Methods in Risk Analysis
Visual ModFlow
Basins

PROFESSIONAL AFFILIATIONS

Certified and registered Professional Hydrologist – Groundwater
American Institute of Hydrology
National Groundwater Association
American Water Resources Association

FIELDS OF SPECIALIZATION

- Hydrologic and solute transport modeling in porous and fractured media (analytical and numerical)
- Hydrologic, hydraulic and hydrodynamic modeling of surface waters
- Mixing zone modeling
- Surface water quality and permitting
- Total Maximum Daily Loads
- Statistics and stochastic modeling
- Investigation of groundwater, surface water, soil and sediment and contamination
- Investigation of remedial alternatives
- Human health and ecological risk assessments
- Groundwater and surface water hydrology
- Minimum Flows and Levels
- Water conservation
- Irrigation and drainage system design
- Saturated and unsaturated hydraulic conductivity determinations
- Wetland investigations
- Expert Witness

EXPERIENCE SUMMARY

As a Principal Hydrologist at HSW (1988 to present), Dr. Watson is the officer in charge of water resources investigations, surface water modeling studies, groundwater studies, hydrologic and solute transport modeling projects and human health risk assessments, contamination assessments/corrective actions of industrial facilities, and numerous underground storage tank projects. He is also involved in specific investigations dealing with establishing minimum flows and levels in water bodies in west-central Florida for the Southwest, St. Johns River and Suwannee River Water Management Districts. Dr. Watson is continually called upon to provide quantitative expertise with respect to groundwater, surface water and unsaturated zone hydrology, and the transport of contaminants in surface and-subsurface waters, and has qualified as an expert in administrative hearings in the fields of groundwater modeling and applied mathematics. As president of HSW, he is in charge of corporate technical development.

After receiving his Ph.D., Dr. Watson held a Research Associate position (1983 – 1986) with Oak Ridge National Laboratories (ORNL). Under sponsorship of the Office of Health and Environmental Research and the University of Tennessee, Dr. Watson participated in studies of the transport rates of trace contaminants from shallow land waste disposal sites, biodegradation of TCE, solidification techniques, geostatistics and various review committees dealing with hazardous waste disposal.

Dr. Watson also spent 16 months (1979 – 1980) at the U.S. Department of Agriculture research station in Beltsville, Maryland, where he investigated the transport of nitrogen in the vadose zone. Measurement techniques were developed for sampling in the vadose zone, and models to describe
transport in the vadose zone were investigated.

Before co-founding HSW Environmental Consultants, Inc. (HSW), Dr. Watson was a senior consultant with the firm of Geraghty & Miller, Inc. (G&M) in Tampa, Florida, where he was manager of numerous projects and assisted the professional staff in several G&M offices on numerical modeling studies (1986 – 1988). Projects involved the assessment and remediation of contaminated soil and groundwater, the implementation of complex numerical modeling codes to predict the transport and recovery rates of contaminants, and provision of expert testimony related to modeling efforts. As manager of the computer department at G&M's Tampa office, an in-depth knowledge of verified numerical modeling codes (e.g., MODFLOW, MOC, MT3D, ATD123) also was required.

Dr. Watson has compared various modeling strategies for determining solute travel times to water supply wells, and developed stochastic modeling techniques for water flow and solute transport problems. He has applied complex numerical transport models to hazardous waste areas; developed solution sampling techniques for unsaturated soil systems; developed field measurement techniques and instrumentation for unsaturated hydraulic conductivity determinations; investigated modeling techniques for biodegradation of TCE; and designed a spray irrigation system for the removal of VOCs.

From 1986-present, Dr. Watson has been involved in numerous projects where travel times, recovery rates, capture zones, mixing zones, and other quantitative analyses of dynamic processes are required. He investigated the transport of sulfate from a gypsum stack in central Florida; calculated the travel time of a solvent plume from an industrial landfill in central Florida to a nearby public water supply wellfield; performed a capture zone analysis for public supply wells in Hillsborough County, Florida; and conducted numerical and statistical modeling studies of public water supply wellfields, saltwater intrusion, and contaminant migration. He is well versed in the most recent versions of modeling codes (groundwater - MODFLOW, MODPATH, MT3DMS, WinFLOW, and WinTRAN; surface water BASINS, XP-SWMM, HEC-RAS, CE-QUAL, and CORMIX; and the statistical packages SPSS and SAS) and has written specialty codes for hydrologic and statistical evaluations. He has also performed numerous human health risk evaluations and reviewed ecological risk assessments. He currently manages very diverse projects that include contamination assessment and remediation of DNAPL sites at the Kennedy Space Center, underground storage tank sites, human health risk assessments, water conservation in agriculture, and groundwater and surface water modeling tasks.

Dr. Watson recently prepared a detailed drainage model for TECO's Big Bend Facility using XP-SWMM. This model was used because of its ability to model surface water conveyance and pumping systems, which was necessary because of the blending of process and surface waters at the facility. He currently manages and plays key technical roles in several water resource projects involving minimum flows and levels in surface water bodies located in the SWFWMD, SJRWMD, and SWRWMD. For SWFWMD, he is performing a variety of statistical analysis and modeling tasks to assist with establishing MFLs in estuarine systems. For the SRWMD, Dr. Watson is part of and manages a Peer review team for MFLs in rivers in that District. This includes peer review of the surface water models used for setting MFLs (e.g., hspf and HEC-RAS).

PROJECT EXPERIENCE

Modeling & Solute Transport

- Performed a detailed drainage and hydraulic conveyance model of Tampa Electric's Big Bend plant using SWMM.
- Evaluated MFLs set on the St. Johns River using extreme value frequency analysis techniques.

- Currently managing and on a peer review team evaluating MFLs in the SRWMD, including the appropriate use of hydrologic, hydraulic, and hydrodynamic models (e.g., hspf (BASINS), and HEC-RAS)

- Performed Residence time modeling for estuarine systems in support of minimum flows and levels on the Alafia River in west central Florida.

- Project officer and lead modeler for water resource evaluation of the Belleair Wellfield. Developed a pumping optimization model and performed trend analysis and water level and water quality data.

- Served as project officer and lead modeler for modeling of selected hydrogeologic settings in Pinellas County, Florida for siting of a reverse osmosis water treatment facility.

- Compared various modeling strategies for determining solute travel times to water supply wells.

- Developed stochastic modeling techniques for water flow and solute transport problems.

- Applied complex numerical transport models to hazardous waste areas.

- Investigated modeling techniques for biodegradation of TCE.

- Investigated potential salt-water encroachment in the Northwest Hillsborough County area and developed a conceptual model of the transition zone in that region of the county.

Contamination Assessment & Remediation

- Project manager and project officer for numerous contamination assessment and remediation investigations for solid waste management units at the Kennedy Space Center that include the contaminants: chlorinated VOCs including DNAPL, petroleum compounds, PCBs, PAHs, and metals.

- Serving as project officer for the preparation of annual reports for several wellfields operated by Tampa Bay Water. Work included statistical evaluation of groundwater level and water quality trends.

- Principal investigator for 1.5 million dollar cleanup of chlorinated solvent site at facility in Orlando, Florida

- Served as project manager on various contamination assessments for hydrocarbon and inorganic contamination at service stations, industrial complexes, and military bases.

- Served as project manager for an Alternative Concentration Level demonstration.

Risk Assessment

- Lead scientist for numerous human health risk assessments for sites at the Kennedy Space Center and other industrial clients.

Statistical Analysis

- Performed statistical evaluations of pumping and other stresses on water levels in and around the Cross Bar Ranch Wellfield.

- Performed a variety of descriptive, parametric, and non-parametric analyses procedures to evaluate water level and water quality trends as well as the relationships between water level changes and environmental stresses.

- Performed trend analysis and regression analysis of water flow and level data for several rivers in west central Florida in support of establishing minimum flows and levels for these water bodies.

- Performing frequency and duration analyses for flow and levels on the Saint Johns River in support of establishing minimum flows and levels on a section of that river.

- Provided peer review to the EPA for establishing statistical procedures for determining cleanup of RCRA facilities.

Expert Testimony

- Provided expert testimony on the G-I Aquifer Wellhead Protection Rule. Qualified as an expert in groundwater flow modeling and applied mathematics.

Water Resources, Wellfield Siting, Development & Management

- Project officer for water resource evaluation of the Belleair Wellfield. Developed a pumping optimization model and performed trend analysis and water level and water quality data.

- Served as project officer on a wellhead protection program for Hillsborough County, Florida.

- Evaluated potential water savings alternatives in agriculture for the SWFWMD.

- Project manager for hydrologic studies and annual wellfield reports for the Tampa Bay Water from 1990 – current.

- Manage peer review team and perform peer review related to the establishment of MFLs on surface rivers for the SRWMD.

- Evaluated proposed MFLs for the St Johns River against 10 water resource values foe SJRWMD.

Engineering Design

- Designed spray irrigation system for the removal of VOCs.

- Provided conceptual and quantitative design of various remediation systems including pump and treat, air sparge, soil vapor extraction, exfiltration galleries, and bioremediation.

Other Relevant Experience

- Developed a solution sampling technique for unsaturated soil systems.

- Developed field measurement techniques and instrumentation for unsaturated hydraulic conductivity determinations.

- Simulated the transport of sulfate from a gypsum stack cooling pond.

- Simulated the transport of VOCs from several landfill sites to a municipal wellfield.

- Served as project officer for the preparation of the annual Groundwater Quality Assessment Reports for the Department of Energy's Y-12 Plant in Oak Ridge, Tennessee.

- Involved with unsaturated zone studies of wetlands that involved the installation and use of piezometers.

SELECTED PUBLICATIONS AND PRESENTATIONS

Radcliff, D., T. Hayden, K.W. Watson, P. Cowley, and R.E. Phillips. 1980. Simulation of soil water within the root zone of a corn crop. Agronomy Journal 72: p. 19-24.

Southworth, G.R., K.W. Watson, and J.L. Keller. 1987. Comparison of models that describe the transport of organic compounds in macroporous soils. Env. Tox. and Cehm. Vol 6, p. 251-257.

Watson, K.W. 1979. In-situ unsaturated hydraulic conductivitiy measurements on two Kentucky soils. M.S. thesis, Agronomy Department, University of Kentucky.

Watson, K.W. 1982. Effect of conventual tillage and no-tillage on the infiltration and initial distribution of added water. Agronomy Abstracts p. 167 American Society of Agronomy, Madison, Wisconsin.

Watson, K.W. 1983. Stochastic modeling of the initial distribution of surface applied water and dissolved solutes. Ph.D. presentation, Agronomy Department, University of Kentucky.

Watson, K.W. and R.E. Phillips, in review. Estimating pore water velocity distribution parameters using solute tracer data. Soil Science Society of America Journal.

Watson, K.W. and R.E. Philips. 1984. Estimating pore water velocity p.d.f. parameters using solute tracer data. Transactions, AUG 65 (16), p. 206.

Watson, K.W. and R.J. Luxmoore. 1984. Estimating macropore distribution to total water flow in a forest watershed. Agronomy Abstracts, p. 177. American Society of Agronomy, Madison, Wisconsin.

Watson, K.W. and G.R. Southworth. 1985. Comparison of three transport codes for describing the movement of reactive organic compounds. Transactions, AUG 66 (8), p. 264.

Watson, K.W. and R.J. Luxmoore. 1986. Estimating macroporosity in a forest watershed by use of a tensoin infiltrometer. Soil Science Society of America volume 50: p. 578-582.

Watson, K.W., January 1997. What's New in Water Quality Permitting. Environmental Permitting Short Course. Florida Chamber of Commerce, Orlando, Florida.

Watson, K.W., June 1996. Wellhead Protection in Florida. Environmental Permitting Short Course. Florida Chamber of Commerce, Marco Island, Florida.

Watson, K.W., January and July 1998-2005. Water Quality Permitting, **including application of CORMIX and PLUMES mixing zone models**. Environmental Permitting Short Course. Florida Chamber of Commerce, Marco Island and Orlando, Florida.

Griffin, T.W. and Watson, K.W., 2002. A Comparison of Field Techniques for Confirming DNAPLs, Manuscript in Press for Ground Water Monitoring and Remediation. Spring 2002.

Griffin, T.W. and Watson, K.W., 2002. DNAPL Site Characterization – A Comparison of Field Techniques. In proceedings from Remediation of Chlorinated and Recalcitrant Compounds, Battelle Press, May 2002.

Griffin, T.W., Bardsley, D.S., and Watson, K.W., 2002. Confined Aquifer Horizontal Recovery Wells for Contaminant Source Reduction. in proceedings from Remediation of Chlorinated and Recalcitrant Compounds, Battelle Press, May 2002.

APPENDIX B

PEER REVIEW COMMENTS

PEER REVIEW FORM
SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Project or Report Name: Technical Report – MFL Establishment for the Upper Santa Fe River

Name and Affiliation of Reviewer: Scott H. Emery, Ph.D. Visiting Research Professor University of South Florida, Senior Technical Consultant to HSW Engineering

Discipline specialty covered by this review: Ecology, Hydrology, Water Quality

This document is for the use of project peer reviewers retained by the Suwannee River Water Management District (District) for the purpose of providing a technical peer review of a District report, including manuscripts prepared by District staff and consultants.

SCOPE OF REVIEW REQUIRED BY THE DISTRICT:

Task 1. Determine whether the method used for establishing the minimum flows is scientifically reasonable.

a. Supporting Data and Information: Review the data and information that supports the method and the proposed minimum flows, as appropriate. The panel shall assume the following:

1. The data and information used were properly collected;
2. Reasonable quality assurance assessments were performed on the data and information;

Note: The reviewers are not expected to provide independent review of standard procedures used as part of institutional programs that have been established for the purpose of collecting data, such as the USGS and District hydrologic monitoring networks.

b. Technical Assumptions: Review the technical assumptions inherent in the methodology and determine whether:

1. The assumptions are clearly stated, reasonable and consistent with the best information available; and
2. Assumptions were eliminated to the extent possible, based on available information.

Project or Report Name: Technical Report – MFL Establishment for the Upper Santa Fe River

c. Procedures and Analyses: Review the procedures and analyses used in developing quantitative measures and determine qualitatively whether:

1. The procedures and analyses were appropriate and reasonable, based on the best information available;
2. The procedures and analyses incorporate appropriate factors;
3. The procedures and analyses were correctly applied;
4. Limitations and imprecision in the information were reasonably handled;
5. The procedures and analyses are repeatable; and
6. Conclusions based on the procedures and analyses are supported by the data.

Task 2. If a proposed method is not scientifically reasonable, the CONTRACTOR shall:

a. Deficiencies: List and describe scientific deficiencies.
b. Remedies: Determine if the identified deficiencies can be remedied and provide suggested remedies.
c. If the identified deficiencies cannot be remedied, then, if possible, identify one or more alternative methods that are scientifically reasonable, based on published literature to the extent feasible.

REVIEW CONSTRAINTS

CONTRACTOR and the review panel shall acknowledge the statutory constraints and conditions (Sections 373.042 and 373.0421, Florida Statutes) affecting the District's development of MFLs. CONTRACTOR shall also acknowledge that review of certain assumptions, conditions, and established legal and policy interpretations of the Governing Board (hereinafter referred to as "givens") is not included in the Scope of Work. These givens include:

1. The selection of water bodies for which minimum flow and/or levels are to initially be set;
2. The determination of the baseline from which "significant harm" is to be determined; and
3. The definition of what constitutes "significant harm" to the water resources or ecology of the area.
4. The determination of the specific water-resource values considered in development of the MFL.

PEER REVIEW FORM
SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Project or Report Name: Technical Report – MFL Establishment for the Upper Santa Fe River

Instructions:

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2. By signing this form, the reviewer certifies that the peer review was conducted according to the guidelines listed above and that the opinions and recommendations included in the review constitute an independent review per Chapter 373.042(4)(b), in the discipline noted above.
3. The reviewer also certifies that the review was conducted according to the Scope and Conditions specified above.

Signature of Reviewer:	**Date of Peer Review:**

Responder's Certification: The comments and criticisms provided by the Peer Reviewer have been addressed as noted in column C in a separate response document, which is attached, and in the report.

Name and Affiliation of Responder to Peer Review Comments: Mark D. Farrell, P.E., Water Resource Associates, Inc. Anthony J. Janicki, Ph.D., Janicki Environmental, Inc. Patrick Tara, P.E., P.H., Intera, Inc. Sam B. Upchurch, Ph.D., P.G., SDII-Global, Inc.	
Signature of Responder:	**Date of Response:** February 23, 2007

PEER REVIEW FORM
SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Project or Report Name: Technical Report – MFL Establishment for the Upper Santa Fe River

Comment No.	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect Conclusions of Report? (Yes/No)	To be completed by Reviewer(s)		To be completed by report author(s)
			A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	C. Action to be Taken in Response to Comment
1	Page 1-2	No	Section 1.2, third sentence…"was" a well-developed, dendritic drainage….is it no longer in this condition?	Suggestion	Misprint. Should be has. Change was made
2	Pages1-4+1-7	No	Page 1-4, 4 lines from bottom, shouldn't that be "periods of LOW flow" rather than "HIGH" flow. "Sediment Loads" is indented on 1-7	Suggestion	Fixed.
3	Page 2-21	No	In contrast to most of the other figures, this one does not contain a reference.	Suggestion	Fixed
4	2-37 thru 2-41	No	Are all the benthic invertebrate summary statements based upon Bass and Cox (1985?)	Suggestion	No, also based on SRWMD data. Text has been added.
5	Chapter 2	No	Overall, an informative chapter	None	//
6	Page 3-6	No	Is there a page 3-6?	Suggestion	Yes. Page numbering has been corrected.
7	Page 4-1	No	3rd sentence of first paragraph, use of the term "structures" is unclear.	Suggestion	Changes made

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			1st sentence, second paragraph, "characterized" should be "characterizes"		
8	Page 4-5	No	Figure 4-6, x-axis, units(?)	Suggestion	Units added
9	Page 4-6	No	Figures, 4-7 and 4-8, units in cfs ?	Suggestion	Units added
10	Page 4-11	No	Believe it is *Magnolia virginiana*	Suggestion	Spelling corrected
11	Page 4-15 + 4-17	No	Interesting that periphyton species richness was greatest in 1990 (page 4-15) while benthic species richness was lowest that same year (4-17)	None needed	//
12	Page 4-38 to 4-42	No	2nd to last paragraph states there is "compelling" evidence that cumulative flow regimes affected community structure. It takes until page 4-42 to learn that this relationship is evident only at higher flows (last paragraph). Suggest the "higher flow" qualifier also be mentioned on page 4-38.	It would help the lay reader to state "why" the data used are considered "baseline" data Suggestion	Additional text added
13	Page 4-43	No	My copy appears to be missing the last page or two in the "References" section,		All references included

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			and does not have the various citations by Williams and Yeager.		
14	Page 4-49	No	2nd sentence, delete "that" in order to make the sentence correct.	Suggestion	Text clarified
15	Page 4-52	No	Is "Black Crappier" French for "Black Crappie"?	Suggestion	Name corrected
16	Page 4-53	No	Last sentence, who is the "we've" referring to?	Please clarify	Text clarified
17	Page 4-55	No	Last sentence of 1st paragraph…..may be too general…..suggest modifying to say they are not the best taxa for use in this particular riverine MFL (these could be applicable to lake MFLs)	Please clarify	Text clarified
18	Page 4-56	No	Citation for Figure 4-41 and 4-42?	Suggestion	Clarified
19	Page 5-1	No	1st sentence…why use "risk", rather than "harm"?	?	The Consultant is intentionally not using the term "Significant Harm", but rather significant risk in view of the fact that "Significant Harm" is a

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					policy decision to be determined by the Governing Board, based upon science and policy considerations.
20	Page 5-5	No	"Provisional data"……is that yours or simply USGS?	Please clarify	Removed the figure in question completely. It has little to no bearing on our discussion and appears to cause more trouble than it is worth.
21	Page 5-6	No	2nd to last bullet at bottom of page….last part of that paragraph does not make sense.	Please clarify	Correct text added
22	Page 5-12	No	1st paragraph…….it would be helpful to briefly explain why, out of ALL the transects, 42.54 and 45.48 were the only 2 that were actually used to obtain the 42 cfs?	Perhaps the other transect figures could be placed in an appendix and referenced.	Appendix 5-1 created
23	Page 6-2	No	Need a parenthesis before "Above Worthington Gardens"	Please correct	Done

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24	General	No	(1) A good description of the rationale for use of EFM vs PHSABSIM. (2) The EFM relies heavily on HEC-RAS (3) The Alabama shad is anadromous…..how did it get all the way up to Rte 441?.....did it have to navigate underground?....or is the sampling site downstream of the River Rise?	None needed	//

PEER REVIEW FORM
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Project or Report Name: Technical Report – MFL Establishment for the Upper Santa Fe River

Name and Affiliation of Reviewer: W. Michael Dennis, Ph.D., President and Senior Scientist, Breedlove, Dennis & Associates, Inc.

Discipline specialty covered by this review: Riverine Ecology

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3. The reviewer also certifies that the review was conducted according to the Scope and Conditions specified above.

Signature of Reviewer:	**Date of Peer Review:**
	**February 2, 2007**

Responder's Certification: The comments and criticisms provided by the Peer Reviewer have been addressed as noted in column C in a separate response document, which is attached, and in the report.

Name and Affiliation of Responder to Peer Review Comments: Mark D. Farrell, P.E., Water Resource Associates, Inc. Anthony J. Janicki, Ph.D., Janicki Environmental, Inc. Patrick Tara, P.E., P.H., Intera, Inc. Sam B. Upchurch, Ph.D., P.G., SDII-Global, Inc.	
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1	—	No	The draft reviewed had no table of contents (TOC).	Suggest adding TOC.	Table of Contents has been added.
2	Page 1-3, Figure 1-1	No	In general, the figures in my copy were washed out and all the information was not always readable.	Suggest better quality control on final report.	Originals will be used for final.
3	Page 1-4, Under 1.4(b)	No	Should the reference to "interact during periods of high discharge" be *low* discharge?	Correct or clarify so there is no confusion.	The potential for confusion is apparent. High was changed to low
4	Page 1-6	No	Agree with the analysis of screening criteria and the final list as identified here.	No action.	//
5	Page 1-7	No	Given the Outstanding Florida Water status of the river, should the legal factors for recreation in and on the water and aesthetic and scenic attributes be (3)?	Reevaluate.	Yes, it has been changed.

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6	Page 2-1	No	For clarity, expand the next to last paragraph on physiographic setting. The references are incomplete and to the unfamiliar, may be confusing. These are not all the physiographic provinces in Florida.	Reword.	1. References are complete and in the References Section. 2. The Figure citation (Fig. 2-2) directs the reader to their locations, which is sufficient for this introductory statement. All we are trying to do is point out that the main Suwannee System crosses two provinces. 3. There is a detailed discussion of the physiographic provinces relevant to the upper Santa

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					Fe in Section 2.3.3 and Figure 2-37.
7	Page 2-10	No	Good discussion of Geology.	No action.	//
8	Page 2-15	No	Good overview of Regional Aquifer Systems.	No action.	//
9	Page 2-20 2.1.4.2	No	Under water — Is there any data on how much of this is actually returned to the system?	Clarify is there is an answer.	Not really. Water budgets indicate how much is lost to ET, etc. and flow model has an effective recharge component that hint at the amounts, but no data.

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10	Page 2-23	No	In 2.2.1.1, the last two sentences, it states that "about 39 inches annually, is utilized either as ET or consumptive use, and that the ET estimate is 40.8 inches." Does this mean that consumptive use equates to 1.8 inches of rainfall?	Clarify.	No. The two numbers are different estimates of what is essentially the same quantity
11	Page 2-36 — 2-42	No	Generally good overview of Ecological setting. Under 2.2.2.2 — Why are fish not included in the overview paragraphs? Other species are described and fish are included in Table 2-7.	Add some discussion of fish.	Text has been added.

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12	Page 2-50	No	Reformat the text and drawings. It is confusing going back and forth in the columns.	Reformat.	Formatting of the photographs, etc. in the text will not allow us to accommodate the suggestion. There are too many figures for the volume of text, so figures and tables have to be spaced out. Comment is noted for future reports.
13	Page 2-52	No	Reformat to have Table 2-10 follow text where it is cited and on Page 2-53, put Figure 2-36 after land use section.	Reformat.	See above

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14	Page 2-53	No	In line three, it states the projected total use is 35.7 for 2000. What was the actual? Is this data available? How well did the projection match the actual?	Clarify.	Actual use data are not available.
15	Page 2-55	No	Reformat Figure 2-38. Again, figures should follow their citation in the text.	Reformat.	See response to Comment 12
16	Page 2-59	No	Fourth line from the bottom, change altitude to elevation.	Change.	Done

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17	Page 3-8	No	Suggest adding a bullet under the "significant shortcomings" ● Estimates of return flows or quantities from identified use.	Suggestion.	This was not added. It is unclear to what the suggested addition refers. If it refers to return of water to the system after consumptive use, the data do not exist, but this is not considered a significant shortcoming because it is accounted for by the actual water level and discharge values.
18	Page 3-48	No	Figure 3-51 should be Figure 3-52 and Figure 3-52 should be Figure 3-53, etc.	Change.	Done. Only applies to 52 and 53.

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19	Page 3-53	No	Can't see all the numbers on Figure 3-58.	Make figure legible.	Done
20	Page 3-54	No	Can't see all the numbers on Figure 3-59.	Make figure legible.	Done
21	Page 4-1	No	Adding a map of the major ecotypes and habitats in the basin in this section would be helpful.	Suggestion.	There is a map of general ecoregions in Section 2 – none added to Section 4.
22	Page 4-7	No	Is there any more recent landuse and vegetation analysis since 1994-1995? This is now 12 to 13 years old. If not, perhaps a statement or analysis to indicate whether this information is still relatively accurate with no major changes or changes?	Suggestion.	This is the most recent existing land use explained in text.

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23	Page 4-11 Table 4-1	No	I think the reference to *Persea borbonia* should be *Persea palustris*. I know some books lump these, but the most authoritative studies indicate two distinct species. Also, under Oak-Pine-Hickory Association, correct *Quercus falcate* to *Quercus falcata*.	Suggestion.	Name changes made.
24	Section 4	No	Overall appropriate level description of ecological setting for this analysis.	Comment.	//
25	Page 5-1	No	Bigham 2002 citation is not in the literature cited section.	Add to literature cited.	Citation added
26	Page 5-1	Understood	It is understood that the 15% increased risk is defined as a priori as signified harm and that any comment on this is outside the scope of this review. Therefore, this assumption is not addressed herein.	Comment.	This paragraph has been deleted.

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27	Page 5-1	No	This section is the key to this MFL analysis. The three approaches that were evaluated and to a degree used in the weight-of-evidence approach are generally appropriate methods to be used for this type evaluation. The EFM approach was developed by the Department of the Army, Corps of Engineers (ACOE) and has been applied to similar type evaluations in the Sacramento and San Joaquin Basins in California; the Savannah River in Georgia; and the Gila River by the Nature Conservancy.	Comment.	//
28	Page 5-1	No	Dividing the river into separate segments, given the characteristics of the segments is appropriate for setting these MFLs.	Comment.	//

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29	Page 5-2	No	The use of the wetland perimeter approved with actual survey and cross sections is an appropriate approach to determine the actual, physically limiting topographic river characteristics.	Comment.	//
30	Page 5-7	No	Under 2, the second paragraph — This is not a complete sentence.	Clarify.	Correct text added.
31	Page 5-9	No	Under 4 — Where are the graphs referenced.	Clarify.	Figure 5-5 added, which is an example plot of EFM output, and referenced in the text at this point.

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32	Page 5-10/5-11 5.2.1.1 and Figure 5-5	No	It was determined that at least a 2.3 cubic-feet-squared (cfs) flow and the Graham gage is protective of the biota based on the wetted perimeter approach. Inspection of the graphs in Figure 5.5 — It is unclear how the inflection points were picked. If by inspection, it appears other inflection points could have been picked e.g., ~.5, ~1. Since this is the critical analysis used to set this flow, this needs more explanation. Also, it would be helpful, if possible, to relate the wetland perimeter numbers to the type of habitat, i.e. swamp, riffle, etc.	Explain and clarify.	Referenced in text the appendix (Appendix 5-1) of all of the wetted perimeter plots by transect. Made more specific the reference to the methodology we used to determine the wetted perimeter-based MFL for the entire system by discussing our visual inspection techniques to estimate a transect's inflection point and the calculation of a simple mean thereof.

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33	Page 5-12 5.2.1.2	No	A 42cfs flow at the Worthington gage is determined to be protective of the biota in this segment. There is only a brief discussion of how this number was picked, i.e. median of inflection points.	Explain further and justify.	Explained with added text in the document.
34	Page 5-12 5.2.2.-1	No	There is little explanation. Support the conclusion under 5.2.2-1.	Explain further and justify.	Expanded in the text.
35	Page 5-12 5.2.2-2	No	There is little explanation. Support the conclusion under 5.2.2-2.	Explain further and justify.	Expanded in the text.
36	Page 5-12 5.2.3	No	It appears that the minimum fish passage uses the limiting cross sections and sets an appropriate depth.	Comment.	//

PEER REVIEW FORM
SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Project or Report Name: Technical Report – MFL Establishment for the Upper Santa Fe River

Comment No.	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect Conclusions of Report? (Yes/No)	To be completed by Reviewer(s)		To be completed by report author(s)
			A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	C. Action to be Taken in Response to Comment
37	Page 5-17 5.3	No	Even though the explanations need further clarification as suggested above, it appears, based on the data and site inspections by the peer review team and St. Johns River Water Management District personnel, that the flows suggested would be protective of the biological resources. It is suggested that this could be made more apparent by directly describing the elevation of stages resulting from these flows with the existing historical flow and stage data.	Comment and suggestion.	Thank you; assume reviewer intended to cite the Suwannee River Water Management District.
38	Page 5-17 5.4	No	Based on these data and analyses provided, it appears that the recommended MFLs are conservative and protective of the ecological values; and the approach using the flow duration curves is appropriate.	Comment.	//

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39	Master List of Literature Cited	No	If the authors want to include this as a master list, the actual cited references should be annotated on the list.	Comment.	Extraneous references have been eliminated.

NOTE: Insert additional lines as needed.

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Name and Affiliation of Reviewer: Kenneth W. Watson, Ph.D., President and Principal Hydrologist, HSW Engineering, Inc.

Discipline specialty covered by this review: Quantitative Hydrology, Statistics

This document is for the use of project peer reviewers retained by the Suwannee River Water Management District (District) for the purpose of providing a technical peer review of a District report, including manuscripts prepared by District staff and consultants.

SCOPE OF REVIEW REQUIRED BY THE DISTRICT:

Task 1. Determine whether the method used for establishing the minimum flows is scientifically reasonable.

a. Supporting Data and Information: Review the data and information that supports the method and the proposed minimum flows, as appropriate. The panel shall assume the following:

1. The data and information used were properly collected;
2. Reasonable quality assurance assessments were performed on the data and information;

Note: The reviewers are not expected to provide independent review of standard procedures used as part of institutional programs that have been established for the purpose of collecting data, such as the USGS and District hydrologic monitoring networks.

b. Technical Assumptions: Review the technical assumptions inherent in the methodology and determine whether:

1. The assumptions are clearly stated, reasonable and consistent with the best information available; and
2. Assumptions were eliminated to the extent possible, based on available information.

c. Procedures and Analyses: Review the procedures and analyses used in developing quantitative measures and determine qualitatively whether:

1. The procedures and analyses were appropriate and reasonable, based on the best information available;
2. The procedures and analyses incorporate appropriate factors;
3. The procedures and analyses were correctly applied;
4. Limitations and imprecision in the information were reasonably handled;
5. The procedures and analyses are repeatable; and
6. Conclusions based on the procedures and analyses are supported by the data.

Task 2. If a proposed method is not scientifically reasonable, the CONTRACTOR shall:

a. Deficiencies: List and describe scientific deficiencies.
b. Remedies: Determine if the identified deficiencies can be remedied and provide suggested remedies.
c. If the identified deficiencies cannot be remedied, then, if possible, identify one or more alternative methods that are scientifically reasonable, based on published literature to the extent feasible.

REVIEW CONSTRAINTS

CONTRACTOR and the review panel shall acknowledge the statutory constraints and conditions (Sections 373.042 and 373.0421, Florida Statutes) affecting the District's development of MFLs. CONTRACTOR shall also acknowledge that review of certain assumptions, conditions, and established legal and policy interpretations of the Governing Board (hereinafter referred to as "givens") is not included in the Scope of Work. These givens include:

1. The selection of water bodies for which minimum flow and/or levels are to initially be set;
2. The determination of the baseline from which "significant harm" is to be determined; and
3. The definition of what constitutes "significant harm" to the water resources or ecology of the area.
4. The determination of the specific water-resource values considered in development of the MFL.

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Instructions:

1. The results of this review are for the use of the District and they are not to be revealed to others without the express permission of the District.
2. By signing this form, the reviewer certifies that the peer review was conducted according to the guidelines listed above and that the opinions and recommendations included in the review constitute an independent review per Chapter 373.042(4)(b), in the discipline noted above.
3. The reviewer also certifies that the review was conducted according to the Scope and Conditions specified above.

Signature of Reviewer:	**Date of Peer Review:**

Responder's Certification: The comments and criticisms provided by the Peer Reviewer have been addressed as noted in column C in a separate response document, which is attached, and in the report.

Name and Affiliation of Responder to Peer Review Comments: Mark D. Farrell, P.E., Water Resource Associates, Inc. Anthony J. Janicki, Ph.D., Janicki Environmental, Inc. Patrick Tara, P.E., P.H., Intera, Inc. Sam B. Upchurch, Ph.D., P.G., SDII-Global, Inc.	
Signature of Responder:	**Date of Response:** February 23, 2007

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			A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	C. Action to be Taken in Response to Comment
1	Page 1-5 item C.	No	While estuarine resources are not important to this reach, this may be a place (or else where) to mention the cumulative affect of withdrawals as you move downstream or, conversely, the apportionment as you move upstream. This applies to all of the WRVs.	None needed.	//
2	Page 1-6	No	The selected WRVs seem appropriate	None needed	//
3	Page 2-23, last paragraph	No	Not sure what is meant by "the response to discharge lags four months behind rainfall.." Is this peak discharge or some measure of cumulative flow?	Explanation	The sentence was out of place. It refers to Fig. 2-15. It has been moved to 1st paragraph on page 2-26 and clarified.
4	Page 2-50, 3rd paragraph	No	Sentence beginning "Discharge was estimated to a discharge.." needs editing	Edit	Done
5	Page 2-53. Land use	No	Is there more recent LUC information for this part of the State?	None needed	No, this is the most recent.

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6	Section 2. General	No	This is a very good section on relevant "lay of the land" items. While much of the information is not absolutely necessary for this MFL report, it allows technical and non-technical readers (and reviewers) to picture the geographic area without searching out a lot of references. Because the information was primarily background in nature, I did not attempt to verify the data as presented.	None needed	
7	Page 3-11, last paragraph	No	The statement – "Therefore, discharge from the spring is related to both river and aquifer levels" is true regardless of whether or not the spring is an estavelle.	Clarify	Reviewer is correct. Wording has been changed by dropping therefore. And starting a new paragraph at discharge.
9	Figure 3-5	No	Perhaps the data could be color coded by decade to clarify.	Suggestion/none	This was attempted. It created an overly complicated figure that showed no trends or other important information

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10	Figure 3-6	No	Perhaps something like Sen's slope calculation or even a plot (and regression) of the stage difference between the gages might be helpful, although the graphs as presented are convincing.	Suggestion/none	The plot of stage differences was tried and we felt that the current Figure better dramatized our point.
11	Figure 3-14	No	Perhaps a piecewise function would be helpful and avoid the apparent down turn at high stage. It looks like the line extends beyond the data.	Suggestion	We utilized piecewise regression equations elsewhere. This polynomial provided similar results with a higher R^2 value. O'Leno is being dealt with in the Lower Santa Fe report and the piecewise regression will be further evaluated at that time. The regression line has been truncated to avoid the turn down. Changed in document.
12	Figure 3-19	No	Perhaps a piecewise function would work well in this case.	Suggestion	The Figure shows that a piecewise regression approach was utilized in this case. Both equations are depicted in the figure. The overlap has been removed, however. Changed in document.
13	Page 3-23	No	The straight line portion of the figure extends to	Clarify or	Yes. The graph has been adjusted

			about 1,100 cfs at HWY 441 gage but that portion of the relationship was only used above 3,000 cfs. Is this correct?	comment	accordinly. Changed in document.
14	Figure 3-38	No	Consider limiting the extent of graph to the data extents.	Suggestion	The extent of the graph is the extent of the data. Changed in document.
15	Page 3-44	No	This equation is an example of the problem of using highly correlated variables as independent variables. The stage at gage 1898 probably is not inversely related to flow at 61981 but rather it is acting as an adjustment to stage at 1500. No doubt the stages at 1500 and 1898 are highly correlated. It is understood and we agree that autocorrelation and multicollinearity do not inhibit the predictive ability of the model as long as the predictions are made within the bounds of the independent variable data values.	Observation/none	Agree
16	Figure 3-55	No	Perhaps a piecewise function would work better. It is not being suggested that spring flow begins to increase above a stage of 66 ft?	Suggestion	The regression is unimportant to the diagram. It was removed from the graph.
17	Page 3-56-60	No	HEC-RAS model development is described in general. Model input and output were not supplied and, therefore not reviewed. However, HEC-RAS is an appropriate tool for generating rating curves, velocity profiles, and wetted perimeter profiles. This section of the report would be strengthened by including a few more details on model development, but it appears	Observation	No changes have been made.

			some advanced skills were used in model development.		
18	Page 3-54	No	Should cite HEC-RAS manuals as part of your literature.		HEC-RAS Manuals will be cited
19	Page 3-55	No	A summary of HEC-RAS cross-sections in tabular format would be beneficial. This would allow clear distinction of the number of surveyed cross-sections vs. simulated cross-sections and the distance between cross-section.	Suggestion	Appendix 3-1 has been provided
20	Page 3-56	No	While the reviewer is not technically familiar with the Arnold & Allen method for smoothing lateral inflows, using a smoothing approach for incorporating lateral inflow is an excellent addition to model development. Many HEC-RAS models do not include this level of sophistication.	Observation	//
21	Page 3-56	No (maybe)	The calibration of the model is bothersome if correctly interpreted by this reviewer. It appears as if the same data used to establish the boundary conditions is also used to “calibrate” the model. If this is true, one would expect excellent correlation between the two. One option to test the calibrated model would be to use the first three years of record for calibration of Manning’s n and then run the last years to validate model performance. Given that the purpose of the model is for input into the EFM, this may not be necessary, but a correct calibration would test the ability of the HEC-RAS model to predict future events.	Suggestion	Modifications have been made to the text.

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22	Page 3-56	No	Good observation that models developed for flood mapping are not calibrated for low flow conditions.	Observation	//
23	Page 3-56	No	Last paragraph, change “mode calibration” to “model calibration”	Edit	Text corrected
24	Page 3-56	No (maybe)	More information on how cross-sections were developed for the HEC-RAS model would be very helpful in assessing the accuracy of the HEC-RAS model. It’s unclear how many transects were surveyed as “part of this investigation” and how additional data from close cross-section were transposed onto new cross-sections. For example, if a cross-section is just “cut and pasted” from one location to another 10,000 feet away, it might be better to use a GIS tool or elevation map to interpolate or at least confirm floodplain elevations.	Clarify	Modifications have been made to the text.
25	Page 3-57	No	Identify the spikes in Fig 3-61. Are those road crossings (culverts)?	Clarify	Modifications have been made to the text.
26	Page 3-56 and 3-57	No	Two shoals are labeled and discussed but the third circled feature is inverted so is this a pool or spring and not a shoal or is the elevation in the model wrong? Assuming this is a pool, it appears there is one survey point in over 10,000 linear feet of river. Is more resolution of this feature possible?	Observation & Suggestion	Modifications have been made to the text.
27	Page 3-58	No	“Large losses”? What losses are being referred to? Discharge, mass, frictional? Please clarify.	Clarify	Modifications have been made to the text.

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28	Page 3-58	No	Over what longitudinal range is Manning's n held consistent? It appears as if the Manning's n is held constant between gauging stations. While this may allow for easier calibration, it doesn't necessarily reflect reality well. A better discussion of why its appropriate and acceptable based on the physical nature of the river would help defend this approach.	Clarify & Suggestion	The adjustment of Manning's n (as with any physical model) should be made using a scientifically sound methodology. The adjustment of friction factors can only be justified if the data comparisons necessitate. To perform point calibration in any model would impede the predictability of the model. Point calibration can not be justified given the data observations.
29	Page 3-60	No	In first paragraph, change "should be increase due" to "should be increased due"	Edit	Changed to "increased"
30	Page 3-60	No	Scaling roughness coefficient based on flow conditions is appropriate.	Observation	//
31	Page 3-60	No	Question on definition of "critical". When you state "critical flow conditions", are you referring to actual hydraulic critical flow as in Froude =1 or are you using the term critical to refer to an important flow condition for a specific species?	Clarify	Modifications have been made to the text.
32	Page 3-60	No	Using HEC-RAS output to map habitat has been used effectively before and is appropriately	Observation.	//

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			used here.		
33	Pages 3-61 to end	No	Summary use of Discharge data for MFLs. • Worthington data used entirely. MFL established at this location will protect to upstream of Olustee Creek to Graham. • Some Graham data were synthesized (Fig 3-7) using Worthington data. MFL will protect upstream of Worthington gage to headwaters. • Some O'leno data based on Worthington (Q1500), River Rise (Q1910), and Olustee Creek (Q1800). River Rise data were extended by correlation to High Springs gage. MFL to protect swimming at the park. • A policy decision is suggested to set MFL downstream of River Rise (i.e., Lower Santa Fe) to protect flow at O'Leno.	Summary observations	//
33 A	Chapter 3	No	There are several record extensions that do not appear to be used in the development of data sets to be used for MFL development. This information might be placed in an appendix to avoid confusion by the reader.	Suggestion	Some of the extensions will be used in the Lower Santa Fe MFL report. The data syntheses, etc. that were developed were utilized for selection of the MFL gages, development of HEC-RAS data, and to

					understand the functionality of the Upper Santa Fe system. We feel that they should remain in the main text because of the need to understand the system function and data selections that were made.
34	Page 4-1 second paragraph	No	The last sentence appears to repeat the second sentence. Consider restructuring this sentence?	Suggestion	Text clarified
35	Page 4-3 second paragraph	No	In the third sentence, what is the full range of DO concentration mean quantitatively? Consider giving a numerical range commonly occurring in this river reach?	Suggestion	Text and DO concentrations reworded
36	Pages 4-4 through 406	No	Consider providing the titled units for the x-axes for all the plots in these pages? Also, it would be easier to compare the DO variations along the stream if the same scale was used for the y-axes.	Suggestion	Units added
37	Page 4-17 Figure 4-17	No	Is this chart made using the samples from both SFR020 and SFR040?	Suggestion	Yes, text clarified
38	Page 4-17 section 4.5	No	This section accounts for almost 50% of Chapter 4. Consider giving an explanation of the particular relevance of this information to MFL development	Suggestion	Text added

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39	Pages 4-17 first paragraph	No	In the second sentence, it is stated that benthic invertebrate data at three long-term stations were used. However, in Figures 4-21 and 4-23, it appears data at four stations were used.	Explain	Differences in number of stations is related to gear type, explanatory text added
40	Pages 4-17 second paragraph	No	The fifth sentence states that Emphemeroptera, Trichoptera and Oligochaeta contribute to overall composition in descending order. This seems to depend on the location/station. The sixth and seventh sentences are also confusing. The percentage of each species contribution appears to depend on location.	Explain	Clarifying text added
41	Pages 4-19 through 4-20	No	What do the HD and QL mean in the titles of Figures 4-20, 4-21, 4-22, and 4-23?	Explain	HD and QL refer to specific gear types and this is explained in the figure captions
42	Page 4-21 second paragraph	No	USF station 20, mentioned in the last sentence, was not shown in Figure 4-24.	Explain	The station name was written incorrectly and has been corrected to correspond to Figure 4-24
43	Page 4-23 third paragraph	No	According to Figure 4-25, mean numbers of taxa and Shannon diversity index and organisms are slightly higher at the Worthington Springs. The MDS plot shows a considerable overlap in community structure, whereas the observations from Table 4-2 concluded that the structure of the Brooker and Worthington differed. Is there a quantitative criteria available to make such a	Suggestion	Explanatory text added

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			conclusion? Also, what is the value of the average dissimilarity in the title of Table 4-2 for SIMPLER analysis indicate?		
44	Page 4-30 first paragraph	No	Consider providing an explanation of why 2002 vs. 2003 are similar. What criteria were used to pick the consecutive years that are similar or dissimilar. Was the dissimilarity between consecutive years related to flow conditions? In other words, is the annual flow condition the reason for the difference in community structure?	Explain	Explanatory text added
45	Page 4-37 first paragraph	No	What about the station 40 in the last sentence.	Explain	Station name corrected
46	Page 4-39	No	It is very difficult to see the labels of Figure 4-31.	Improve	Figure resolution improved
47	Pages 4-30 through 4-42	No	This section contains substantial information and related tables and figures but it is not clear if or how MFLs would impact the ecological community/structure presented in these sections by reducing the water flows/stages. .	Modify or supplement	Text modified
48	Figure 4-31	No	It is very difficult to see anything here.	Observation	Figure modified
49	Page 4-48 to 4-56	No	It appears that protection of habitat for freshwater mussels, including the putative host fish (page 4-49), and the crayfish (as a primary	Please explain.	Text added to explain

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			prey item of the Suwannee Bass (page 4-55)) are criteria for setting the MFL. What is not clear is the relationship between the extensive discussion that preceded these latter sections on benthos, variety of taxa and the various statistical procedures used to quantify species distributions, on the selected criteria for setting the MFLs. Is there a link between the analyses and the conclusion?		
50	Page 5-1, 2nd paragraph	No	It does not appear that sufficient evidence has been presented that water quality is not directly related to flow. Water quality is a WRV and in a variety of settings is related to flow.	Clarify assumption in text.	Removed "assumes". We did not assume, the figure referenced from Section 4 clearly demonstrates that WQ params are not directly affected by the stream flow in the USF.
51	Page 5-1, 3rd paragraph	No	A 15% increased risk of reduced habitat availability is defined a priori as significant harm. The definition of significant harm is not part of our review charge. The 15% value seems to come from work on the Upper Peace River by SWFWMD and reviewed by J.A. Gore and others. Perhaps some phrasing like "we assume" instead of define. There is way too much subjectivity in this value, it has not been subjected to rigorous testing, and is gaining undeserved momentum.	Suggestion	This paragraph has been deleted.
52	Page 5-2	No	A "critical inflection point" is identified – are the authors referring to bankfull stage such that the	Clarify	Clarified in the text.

			wetted perimeter increased because of flow in the floodplain or are they referring to in channel features?		
53	Page 5-3, Figure 5-2	No	Figure is not very clear in my copy	Suggestion	Enhanced metafile version of the figure was added.
54	Page 5-3, last paragraph,	No	Is this an annual one-day low flow event?	Explain	No, it is the bank full stage.
55	Page 5-7, last paragraph	NO	If flows of 0.5 to 10 cfs are considered in the model, is it assumed in EFM that these flows represent an annual one-day minimum?	Clarify	Changed to “0.5 cfs increments”. Also included a statement that makes clear that we never intended for the flow range used in the evaluation of the EFM to represent “an annual one-day minimum flow”. Rather, it is simply a range that covers the flows below the median, in order to evaluate a low flow MFL.
56	Page 5-9, item 4)	No	How is total available habitat defined? Also, how many transects were examined? Is it the number of HEC-RAS transects?	Explain or specify please	Explained with added text.
57	Page 5-9, Item 5	Yes	0.5 is below the preferred velocity range of Brown darter and Crayfish	Clarify how a velocity of 0.5 is protective	Explained with added text.
58	Page 5-9	No	HEC-RAS has several “depth” outputs including maximum channel depth and “hydraulic depth” which is the cross-sectional channel area divided	Explain	Clarified and explained the estimation of depths from HEC-RAS model

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			by top width which give a “mean” depth. Which is being used in this analysis?		output
59	Page 5-9	No	Velocity reported by HEC-RAS is actually “mean channel velocity” as calculated by discharge divided by cross-section area.	Explain	HEC-RAS does support a “Flow Distribution Locations” along with “Export GIS Data” for steady state simulations. These two options allow the user to define the location for detailed output and then output the detailed results to a GIS export file. This function of HEC-RAS reports up to 15 separate velocities across the channel.

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60	Page 5-10	Yes (maybe)	In the modeling section of the report it was discussed that an artificial pilot channel was added below the bed for low flow conditions because the bed occasionally goes dry. A pilot channel was added between RM 30.31 and RM 70.18. A discussion of the dimensions of the pilot channel and its impact on wetted perimeter results should be included just to reassure the reviewer that this pilot channel is indeed not impacting results.	Suggestion	HEC-RAS uses the pilot channel for numerical stability. The pilot channel is only active when the water level is below the bed. Therefore it does not impact the results when there is water in the channel.
61	Page 5-10, last paragraph		The statement that there is no appreciable gain in wetted perimeter is not correct, particularly for transect 51.87. It is recognized that the slope decreases. The same applies to the lower reach (Worthington) only more so.	Suggest rewording	Wording changed to reflect that wetted perimeter is still affected by flow at flows above the critical inflection point.
62	Page 5-14, Figure 5-7	Yes	Without further explanation or supplied model, this cannot be reviewed. The EFM is relatively new but developed in cooperation with the US COE so it has that implied level of review.	Provided additional information in text or appendix	Added Appendix 5-1.
63	Page 5-17, last sentence above section 5.4	No	Do you mean Figure 5-10?	explain	Yes. It has been fixed.
64	Page 5-17, 3rd paragraph from the bottom	No	Significant harm has already been defined a priori as a 15% increased risk of habitat reduction. Is that the meaning in this referenced sentence.	Explain	Yes.

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65	Page 5-18, last sentence	No	There is no evidence presented one way or the other that the flood hydroperiod would be protected.	Respond	The text has been changed so as to not imply that the flood hydroperiod was not factored into the creation of a low-flow MFL.
66	Page 5-7, bullet 2) second paragraph	No	Second sentence structure	Observation	Fixed.
67	Page 5-8, Figure 5-4	No	Should top graph match Figure 3-66? Seems to be off at .1 (10%) probability.	Respond.	Figure 3-66 was based on an earlier data set. Figure 3-66 and Table 3-5 were revised accordingly.
68	Page 5-12, section 5.2.2.1	yes	The reference to the 15% increased risk appears to be the only reference back to the stated definition of significant harm on page 5-1. In the lower graph in Figure 5-7, % of potential habitat is reduced from about 48% to 32%. Is this the crux of this analysis? This analysis seems very key to the MFL and needs further explanation.	Please provide additional explanation	Yes, this was the crux of the analysis, which was reinforced by the results of the wetted perimeter analysis. Additional explanatory text has been added to the report and note should be made that the figure referenced as 5-7 is now 5-8 in the revised draft.
69	Page 5-12, last paragraph	yes	Is there significance to the 69.22 and 69.45 cross sections? Would hydraulic control points be more appropriate sections to look at or are	Explain	Clarified with added text.

			these hydraulic control points?		
70	Page 5-12, 2nd to last paragraph	yes	The statement regarding 15% flow reduction above the control points appears to be the first time a flow reduction is discussed. It is not clear how this 15% value is conservative, protective of ecological values or human use.	Explain further	Addressed in response to comment #68.
71	Page 6-4, last sentence, and ref. table	Yes	It is not clear that the other WRVs are less conservative. For example, 0.6 feet is not sufficient for safe motorized boat passage. Other statements regarding aesthetic and scenic attributes, water quality, and other important WRVs while perhaps true are not supported.	Clarify	The direction of the District to the MFL development team was to use their best professional judgment and experience to focus on the MFL criteria that would be the most pertinent to defining significant harm to the waterbody. The direction was further defined as the performance of a qualitative analysis on those items which in the professional opinion of the consulting team would not be the driving criteria to establish the MFL. It is the opinion of the consultant that although investigating the other MFL criteria,

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					such as recreation and aesthetics would be interesting, the time and cost could not be justified and would have an extremely low probability of affecting the recommended MFL. This approach is further supported by the fact that the consultant is not aware of any flowing waterbody MFL established in Florida, based primarily on any environmental or human use value other than estuarine resources or fish and wildlife habitats and the passage of fish.

NOTE: Insert additional lines as needed.