Appendix 1-2: Peer Review Panel Comments on Draft Volume I

During September–November 2015, comments from the peer review panel were provided on the 2016 South Florida Environmental Report (SFER) Web Board (www.sfwmd.gov/webboards); no public comments were received during the review period. Panel comments were prepared under separate purchase orders with the South Florida Water Management District. This content was not edited by the SFER production staff and appears verbatim as posted on the web board.

Note: Comments and recommendations from the panel were sought on, but not limited to, the following general questions targets for two levels of review:

1. ***Accountability Review.*** *Does the draft document present a defensible account of data and findings for the areas being addressed that is complete and appropriate? Is the synthesis of this information presented in a logical manner, consistent with earlier versions of the report? Are findings linked to management goals and objectives? The panel may also provide constructive guidance for the District's large-scale programs, particularly as related to water quality assessment and source control across the agency programs.*
2. ***Technical Review.*** *Are the findings and conclusions supported by "best available information," or are there gaps or flaws in the information presented in the document? Are there other interpretations of the data or other available information that should be considered by the authors and presented to decision makers? If so, the panel shall identify specific studies that should be addressed or available data to support alternative findings.*

2016 Draft South Florida Environmental Report (SFER)

Chapter 3A – Water Quality in the Everglades Protection Area

"AA" Review Prepared by Vladimir Novotny

Accountability Review. This level of review targets progress and achievements of expectations in District programs and projects that are generally descriptive or standardized in nature, and may deal with cross-cutting themes or content. This review addresses, among others, the following questions of concern to the South Florida Water management District (SFWMD):

> *Does the draft document present a defensible account of data and findings for the areas being addressed that is complete and appropriate? Is the synthesis of this information presented in a logical manner, consistent with earlier versions of the report? Are findings linked to management goals and objectives? The panel may also provide constructive guidance for the District's large-scale programs, particularly as related to water quality assessment and source control across the agency programs.*

General Comments

This chapter was written to (1) provide an assessment of water quality within the Everglades Protection Area (EPA) during Water Year 2015 (WY2015) (May 1, 2014–April 30, 2015), (2) fulfill numerous reporting requirements of the Everglades Forever Act (EFA), (3) provide a preliminary assessment of total phosphorus (TP) criterion achievement, and (4) provide an annual update of the comprehensive overview of nitrogen and phosphorus concentrations and loads throughout the Everglades Protection Area (EPA). The information provided in this chapter is an update to Chapter 3A of the *2015 South Florida Environmental Report* (SFER) – *Volume I*. Because this reviewer has also reviewed Chapter 3A of the 2015 Report, some references to the previous reviews and findings will also be made herein.

The entire Everglades Protection Area (EPA) encompasses 10,020 km^2 (3,877 sq miles or 2.5 million acres) of the original Everglades marsh which is currently divided into several large separate distinct shallow impoundments. The most important is the Everglades National Park (ENP). In addition to rainfall input, which is significant when compared to surface sources, the surface water inflows from agricultural tributaries, such as the Everglades Agricultural Area (EAA) to the north and the C-139 basin to the west, feed the EPA. The EPA also receives surface water inflows originating from Lake Okeechobee to the north and from predominantly urbanized areas to the east. Today, surface runoff from the Everglades Agricultural Area and some Lake Okeechobee outflow pass through several large Stormwater Treatment Areas (STAs) providing treatment and removal of phosphorus from the flow (see Chapters 4 and 5B) . The STAs are shallow marshes covered by submerged and emerged aquatic vegetation.

As in the previous 2015 SFER Chapter 3A, the team of authors over the years developed a good writing format and protocol along with graphical presentations which make the chapter very

understandable and easy to compare to previous years. They are consistent with units, using mostly the SI unit system, and provide SI conversion to the US systems when needed. However, in the previous 2015 SFER (Chapter 3A) this reviewer pointed out the inappropriate use of the odd unit for volume (kacre -ft = 1000 acre-ft = 1.233 x 10^6 m^3). Checking Google, this unit is nowhere used or defined. The closest term found is *Nacre,* which is a shiny mineral excreted by shellfish. The authors and the agency should reconsider using this odd unit. The pitfalls and unreasonableness of this odd unit were pointed out in the last year review of the 3A Chapter in the 2015 SFER. The same comment on inappropriateness of using made-up, not accepted units extends to other chapters of the SFER (e.g., Chapter 2). Generally, agencies should abandon trying to invent their own units and, in today's world, use and provide conversion factors if both unit systems are intermixed or only US units are used.

The analyses and summaries were intended to provide a synoptic view of water quality conditions in the Everglades Protection Area (EPA) on a regional scale. For parameters with water quality criteria, regional analyses were conducted based on the frequency of exceedances of the applicable criteria, which is the correct methodology and has been used in the previous reports. This simple statistical methodology is based on and is similar to the US Environmental Protection Agency (US EPA) guidelines for Section 305(b) of the Clean Water Act of Water Quality Reports by the states to the US EPA and Congress. In the 2016 SFER the authors of the chapter included ranking of water quality concerns as follows: (1) **concern** (C) – any parameter with a criterion exceedance frequency statistically greater than 10 %, (2) **potential concern** (PC) – any parameter with an exceedance frequency statistically greater than 5 % but less than 10 %, and (3) **minimal concern** (MC)– any parameter with an exceedance frequency less than 5 % but greater than zero. Parameters without exceedances were characterized as **no concern** (NC)**.** Pesticides were categorized based on whether the parameter was detected at concentrations above the maximum detectable limit MDL (potential concern) or at concentrations exceeding Class III (Florida) criteria or chronic toxicity values (concerns).

In his previous reviews this reviewer pointed out the fact that the 1972 Clean Water Act Section 305(b) water quality reporting classifies water quality into "good", "fair", and "poor" categories, which may not be fully protective and should be used only as a tool for reporting. The US EPA guidelines suggested so called 10% rule[1] for conventional pollutants such as TSS, pH, BOD as guidance for assessing compliance with water quality standards; however, USEPA guidance has not encouraged use of the "10% rule" with other pollutants, including toxics and it should not be used for dissolved oxygen. The current US EPA water quality criteria[2] that were issued, for example, for dissolved oxygen or ammonia may override the 10% rule. Loosely, according to the USEPA 10% rule, the 10 % exceedances (frequency of violation of the water quality criterion/standard) would lead to "poor" classification whereas in the SFER assessment the classification would be "concern". Accordingly, "potential concern" could be interpreted as

[1] http://www.epa.gov/owow/tmdl/2006IRG/report/2006irg-report.pdf
[2] http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/index.cfm

“fair”. Appropriateness of the 10% rule will be discussed further in this review in reference with each individual pollutant. In contrast, the 2016 SFER Chapter 3A used zero frequency of exceedance (all measurements yielded zero value) for classifying toxics which is more stringent than that included in the USEPA water quality criteria. For toxics US EPA criteria for priority pollutants allows a very small probabilistic percentage (less than 0.1% or once in three years on average), depending whether the criterion applies to aquatic life or human health, to exceed the standard and still be in compliance.

Achievement of the TP criterion was assessed by a four-part test for each WCA using two networks of stations; impacted and unimpacted (page 3A-12) . The parts of the achievement test are:

1. The five-year geometric mean averaged across all stations is less than or equal to 10 µg/L.
2. The annual geometric mean averaged across all stations is less than or equal to 10 µg/L for three of five water years.
3. The annual geometric mean averaged across all stations is less than or equal to 11 µg/L; and
4. The annual geometric mean at all individual stations is less than or equal to 15 µg/L.

This criterion is stringent and reflects the great ecological importance of the EPA and its ENP. It is protective, better than that in the US EPA draft nutrient guidelines, and characteristic of water bodies thatwith such relatively low concentrations of nutrients would generally fall into oligotrophic (oligo = few, trofik = nutrients, nourishment) category .

The chapter fulfills the Everglades Forever Act (EFA) requirement for an annual report to “identify water quality parameters, in addition to phosphorus, which exceed state water quality standards or are causing or contributing to adverse impacts in the Everglades Protection Area.” In addition, this chapter provides an annual update of the comprehensive overview of nitrogen and phosphorus concentrations and loads throughout the EPA, along with an assessment of total phosphorus (TP) criterion achievement. In an overall assessment it can be stated that the chapter, as presented, fulfilled the above accountability goals.

In order to characterize the trends in water quality, this chapter separated the WY 2015 and other historic data into following four periods: (1) the historical WY1979–WY1993 period (Baseline), which corresponds to the timeframe prior to implementation of the Everglades Agricultural Areas (EAA) Best Management Practices (BMPs) Program and the Everglades Construction Project (i.e., Everglades Nutrient Removal Project/Everglades Stormwater Treatment Areas, or STAs); (2) the intermediate WY1994–WY2004 period (Phase I); (3) the Phase II BMP/STA implementation period after WY2004 (i.e., WY2005–WY2014), and (4) the current 2015 water year, WY2015.

Page 3A-11 contains the list of 22 constituents and 62 pesticides that should be investigated. Of the 22 listed herein this report evaluated eleven:

Alkalinity	Turbidity	Dissolved Oxygen (in situ)
Unionized ammonia	Specific conductance (in situ)	Sulfate
pH (in situ)	Total nitrogen	Total iron
Total phosphorus	Ortho-phosphate	

The remaining 11 constituents that were not evaluated are toxic metals that in the previous annual evaluations were found as not threatening (no concern). However, it is not clear whether any metal measurements were made in the WY 2015 and the *no concern* judgement was made based on several zero or no detects measurements during the WY 2015 or measurements were not made and the evaluation was simply postponed to some future SFER. Since metal evaluation was not included in the preceding 2015 and 2014 SFERs, the reason for not evaluating metals in at least two consecutive reports should be explained. Due to the fact that some very busy transportation corridors transect the EPA and traffic is a significant source of toxic metal emissions (e.g., copper), the metals may warrant an evaluation. On the other hand, previous funding by the reviewer noted that the traffic metal pollution is mostly restricted to about 30 to 100 meters (100 to 300 ft) distance from the traffic corridor[3].

On Page 3A-15 the SFWMD revealed the number of sampling days which throughout the EPA ranged from 340 in WCA-3 (abutting the ENP) to 160 in the Refuge area. ENP had 363 sampling days. About 1.7 % of the collected data were rejected. This is a great monitoring effort that certainly provides a very rich data base for statistics. Comparison with Florida Class III water quality standards revealed numeric statistical excursions (C, and PC ranking) of four water quality parameters: dissolved oxygen, pH, alkalinity, and specific conductance (Table 3A-1). Whether these numeric excursions represent a quality problem or the problem is due to natural or anthropogenic causes will be subsequently discussed. It should be pointed out that one should differentiate between the water quality problem that is predominantly a consequence of natural/background conditions or the problem is anthropogenic. Section 502-19 of the Clean Water Act defines "pollution" as caused by humans or human activities and not by nature.

Dissolved Oxygen (pages 3A-18-19) appears to be the most serious water quality problem. Marshes (wetlands) are generally naturally dystrophic, i.e., exhibiting low dissolved oxygen concentrations. Because of that SFWMD established (and US EPA approved) a site-specific alternative criterion (SSAC) which is a binomial model for all periods that for the time of the year and day estimates DO concentrations that would represent natural conditions. In the previous review this reviewer pointed out that on some days SSAC calculates DO concentrations that in most other water bodies may be harmful to fish and are below the federal DO standards. Starting with the last year (SFER 2015), Florida Class III DO standards, which are more stringent than SSAC and are based on the federal criteria, were applied to the inflow, outflow and rim area, while the SSAC criteria were applied to the interiors. In evaluating the DO criteria

[3]Novotny, V. *et al., Urban and Highway Snowmelt: Minimizing the Impact on Water Quality*, (Novotny V. et al.) Water Environment Research Foundation, Alexandria, VA, 1999 (Nationwide Manual)

compliance the 10% rule was not recommended by the US EPA. The DO standards are linked and based on the time of fish survival during less than optimal (lethal) concentrations which is limited to few sequential days (1 to 5 days) days not to 10% of the time. Nevertheless, if DO concentrations are violated by more than 10% of samples then, obviously, the situation is very serious (poor-concern).

In the previous years (baseline, Phases II and III) the DO situation was serious and violations of the SSAC in the interiors and Class III in canals and rim area were ubiquitous and very serious, classified as "C" (concern). The WY 2015; however, shows improvements in all areas to better than C, except in the ENP which stayed as C in the inflow and worsened in the interior (from MC to C). However, the seriousness of the situation in the ENP can be illustrated on the measured DO minima (App.3A-3) that in 2015 in four out of nine monitoring stations were 1.0 mg/L or less and DOs expressed in % saturation were ranging in these stations from 2.8 to 10.8%, which clearly are lethal to fish and would be classified so by the US water quality criteria[4]. The EPA 1986 criteria document reported that the larvae of largemouth bass will die after 3 hour of exposure to DO concentrations of less than 1 mg/L.

The ENP interior DO situation is puzzling because this section of EPA has the lowest Total P concentrations that are commensurate to oligotrophic water quality yet the DO concentrations would indicate highly eutrophic to hypertrophic conditions. In the same year, the high DO concentrations (max 4.3 to 9.0 mg/L) do not indicate any excessive photosynthesis and most of Total P input is from difficult to control but steady atmospheric deposition. This worsening and the entire low DO situation in the ENP warrants a closer look because of the general success with abatement of Total P inputs into the system. Could it be caused by some unidentified factor that is increasing the sediment oxygen demand, e.g., elevated sediment temperature due to global warming or stirring the sediments by some meteorological event? Sediments in the EPA are rich with TP and organic decomposing matter deposited naturally by the vegetation of the Everglades.

An editorial comment: When describing the DO excursion the wording "exceeding the standard" (line 394) may not be appropriate because the excursions imply that DO concentration is below the criterion, not exceeding.

Alkalinity and pH

For alkalinity and pH the 10% rule is appropriate. Until recently (Baseline and Phases I and II) both alkalinity and pH "problems" were classified as a moderate concern in the Refuge and WCA-3 areas and also, in the past, in the interior of the ENP. In the previous reviews and discussions with the SFWMD scientists it was pointed out that natural pH of precipitation is an equilibrium with the natural atmospheric content of CO_2 which, before ongoing climatic changes were reported, was 5.6, The EPA systems receive a large portion of water inputs from precipitation. One additional cause of lower pH (increased H^+ ion) may also be sulfate

[4] US EPA (1986) Ambient Water Quality Criteria for Dissolved Oxygen, EPA 440/5-86-002,Wahington, DC http://nepis.epa.gov/Exe/ZyPDF.cgi/00001MSS.PDF?Dockey=00001MSS.PDF

discharges ($SO_4^{=}$) from agricultural areas that are more endemic in the upper reaches and most likely were causes of the pH problems in the Refuge and WCA-3 areas. However, one of the consequences of the ongoing significant global, mostly anthropogenic, increases of the atmospheric CO_2 content is the decrease of pH (increase of the H^+ ion) in the precipitation and subsequent acidification of the oceans and all of water bodies that have a low natural buffering capacity (alkalinity) and receive large portion of water input from the atmosphere. Increase of H^+ (reduction of pH) in precipitation reduces alkalinity because of its reaction with the OH^- ion. The problems with atmospheric CO_2 from anthropogenic and pseudo natural causes (forest fires) are increasing. Decreasing pH means increasing H^+ ion in precipitation and subsequent reduction of alkalinity. While it is not expected that severe acidification (acid rain) that by sulfur oxide emissions from power plants that devastated forty years ago lakes in Scandinavia and forests in Europe and Northeast US (White Mountains in New Hampshire or Adirondacks) may occur in Florida, the agency should add acidification as a potential concern even though the situation in the WY 2015 appeared to be better than in the previous baseline and Phase I and II water years.. From these reasons and because the ENP receives large water inputs from precipitation, this reviewer cannot rank the pH and alkalinity as **no concern** and recommends that SFWMD scientists look into the problem of potential acidification and its buffering in the EPA system. It is also possible that the pH problems may also still be aggravated in the upper reaches (Refuge, WCA 2) by sulfate ($SO_4^{=}$) inputs from the agricultural areas.

Editorial comment line (lines 453-454). Alkalinity is an equivalent sum of the contents of HCO_3^-, $CO_3^{=}$, OH^- ions sometimes also including some metallic divalent ions (Strontium) if present in larger concentrations. It is expressed as an equivalent $CaCO_3$ content of these cations.

Specific conductance (pages 3A20-21) which is a measure of the ionic content of water/salinity is elevated in canals by inputs of sea water intrusion. Excursions were calculated using the 1,275 µS/cm criterion. For WY2015, specific conductance was categorized as a potential concern for Refuge inflows 9 and minimal concern for Refuge rim, WCA-2 inflow, and interior regions and for the interior of ENP. Due to improved water management the specific conductance concentrations have improved in the impacted e Refuge and WCA-2 basins to moderate concern and improved in WY 2015 to no concern in ENP and WCA-3.

Unionized ammonia (NH_3-N) the toxic fraction of the Total Nitrogen is no concern in the EPA mainly because of relatively low pH.

Pesticides. The current EPA monitoring program consists of 19 sites and is conducted on a biannual basis. In the WY 2015 monitoring 11 pesticides were detected but none above the limits. Even though the pesticide monitoring was initiated in 1976, the WY 2015 was the third consecutive year in which pesticide or pesticide breakdown products were detected at concentrations above their MDLs (Method Detection Limit – please define the acronym) but did not exceed state water quality criteria. However, it could be a warning.

Phosphorus . **T**he Florida Department of Environmental Protection established a relatively stringent numeric criterion of 10 µg/L for Total phosphorus (TP) applied to a long term geometric average of the concentrations. Annual geometric mean limit for individual stations is 15µg/. In addition to TP, the District study also measured orthophosphate. The study presents also spatial and temporal trends which are satisfactorily shown in tables, charts and maps and in the Appendix. The annual geometric mean TP concentrations measured during WY2015 exhibited a general north-south-concentration gradient with Refuge inflow concentrations achieving 19.0 µg/L TP (when flowing) and ENP inflows achieving 9.0 µg/L TP.

The TP concentrations during the Baseline Phase (1979 - 1993) were relatively high and threatened the high ecological values of the EPA and ENP. The system was overloaded by unabated agricultural nonpoint pollution and urban development. Starting with the late 1990s, the agricultural BMPs and STA programs were initiated during Phases I and II and became operational, which gradually started to reduce the loads of nutrients, predominantly phosphorus. TP concentrations during the early and mid-portions of the Phase II period were dramatically influenced by climatic extremes, including active hurricane seasons with intense rainfall and periods of extended drought with little or no rainfall and subsequent marsh dryout.

Annual geometric mean TP concentrations in WY 2014 and 2015 were markedly reduced and became less variable compared to levels observed during the Baseline period and in WY 2014 and for the first time in history, the geometric mean in all interior areas (Refuge, WCA2, WCA3, and ENP) were below the long term standard of 10 µg/L and mild improvement continued in the WY 2015. The geometric mean and median of TP concentrations in the interior of the ENP in WY 2015 were 4.2 and 4 µg/L, respectively, which is a remarkable success; however, these low TP concentrations make the above mentioned low DO problem in the ENP puzzling. The last year report contained a study of the effectiveness of the BMPs to remove very low concentrations of phosphorus and concluded that the efficiency of conventional BMPs to remove TP at the concentrations below 10 µg/L is nil. Considering that the inflow geometric mean concentration of TP into ENP in WY 2015 was 9 µg/L, in the interior it was 4 µg/L and a great portion of water input difference between the inflow and interior concentration is due to dilution by precipitation, it can be conceivably assumed that the limit of TP reductions in the ENP might have been reached. Of note is also the measured WY 2015 maximum TP concentration in the interior of ENP of 21 µg/L, which is much smaller than that in the preceding Phases. But this is not to say that the load reduction programs should not continue. There may be some improvement of TP loads from watershed outside the EPA that discharge directly into the ENP where abatement is still planned but implemented, for example, territories of two Native American Tribes.

The authors attribute higher percentage of interior monitoring stations meeting the 10 and 15 µg/L limits observed for WY2015 to the continued recovery from recent climatic extremes, improved treatment of the inflows, and overall improvement in phosphorus conditions within the interior marsh due to ongoing restoration activities.

For the total phosphorus load (pages 3A35-42) the chapter presents calculations and mass flow graphs of the TP inputs to each individual basis and north to south flow of TP. The graphs are illustrative but are lacking description of individual sources. It appears that atmospheric deposition seems to be underestimated or not included. The only comprehensive and informative data on atmospheric deposition, both wet and dry, the reviewer was able to find was the article by Ahn and James[5] which contains data that are about 18 years old. In thus paper the total TP deposition was estimated for the ENP as 33 mg/m^2-yr which is consistent with the information in Garfield (2002) referenced in the 2016 SFER. If the total atmospheric deposition over the entire EPA is calculated the result is

$$2.5\text{x}10^6 \text{ (acres) x } 4045(m^2/\text{acre}) \text{ x } 33(mg/m^2) \text{ x } 10^{-9} \text{ (t/mg)} = 333 \text{ tons (metric)}$$

which is more than twice that estimated in the report and is 72% greater than the total inputs from the terrestrial sources (193 tons). There is also a puzzling inconsistency between the total TP loads presented in this section. On page 3A-35 the total P load from external sources to EPA would be 193 tons, in Table 3A5 the total load is 65 tons, and on line 904 the total load is 47 tons. The authors should reconcile these inconsistencies.

The fact that the atmospheric, difficult to control deposition is much greater than the total sum of the external loads poses a new dilemma. This would be especially true for the ENP which is receiving the TP load of only 9 tons input from the WC-3 and non EPA basins, which may be inconsequential when compared to the atmospheric deposition over the ENP basin which may be hundreds of percent greater.

The mean orthophosphate concentrations in the interiors of all basins were listed as 1 μg/L, which apparently was less than the detection limit.

Total nitrogen (pages 3A45-52). The nitrogen statistics in WY 2015 are very similar to the previous WY 2014 so the wording herein is similar to that of the last year assessment. The data on N statistics in Table 3A-9 and Figure 3A7 show significant improvement since the Baseline period. Further improvement can be expected by improving the performance of agricultural BMP, STAs, by improving mileage of automobiles and in the near future even by switching to hybrid and electric cars. Automobile traffic is a significant source of NO_x emissions. However, Figure 3A-17 shows that most nitrogen in the EPA system is organic N. Unlike nitrates or ammonium organic nitrogen is not readily available for algal growth,

Concluding Assessment

Chapter 3A of the WY 2015 is very similar to the same chapter of the WY 2014 report. It documents marginal improvement or no improvement in water quality from the last year. This is not to say that the progress is not being made. Water quality improvements are noticeable in the upper basins (Refuge and WC-2) but generally good but stable water quality has been reached in

[5] Ahn. H., T. James (2001) Water. Air and Soil Pollution 126:37-51

the ENP with the exception of DO. Issues that have not been addressed in the previous reports focusing mainly on reduction of phosphorus now include the DO problem in the ENP and other basins that will be difficult to remedy by reducing the terrestrial sources of P. It appears that the major P input into the ENP and to a lesser degree to the other basins is by atmospheric deposition over the EPA area from the sources that at this time have not been fully identified; some of them are far field (phosphate mining in Central Florida?).

This chapter is well written and organized and provides a wealth of information. Accordingly, based on the information, it can be concluded that the status of the EPA has significantly improved from the Baseline and Phase I periods owing to the implementation of STAs, agricultural and some urban BMPs, flow management and also due to more favorable meteorological conditions with less catastrophic disruptions. Since the major STAs have been operated only few years after finishing and optimization and expansion of BMPs is ongoing, further improvements can be expected for the terrestrial loads.

The chapter has again pointed out obvious long lasting problems and controversies with the DO concentrations in the Everglades caused most likely in the ENP by the sediment oxygen demand. It was not addressed by the authors who tried to report water quality in the frame of the current standards and did not comment extensively on the seriousness of the DO problem. The District and the US EPA established a Site Specific Alternate Criterion (SSAC) hoping that the DO problem would be assessed by a temporarily variable function calculating DO concentrations resembling natural conditions typical if Everglades. But the DO excursions even of this more lenient criterion are still serious. In the opinion of this reviewer, SFWMD with all federal and local agencies are doing utmost in reducing the phosphorus input with remarkable results. This effort in reducing external terrestrial TP inputs must continue but may not have much future significant impact on ENP (it is already oligotrophic with respect to TP concentrations) and its DO problem. The DO problem therein may now be more natural than anthropogenic but still it is serious so the society may have to decide whether to let the system heal naturally after a natural (?) disruption or help the system somehow to get over the aquatic life threatening situations. The problem is that the DO deficiencies are frequent and they look widespread (4 out of 9 stations) in the ENP

The authors have accomplished the goals they identified for this chapter.

REVIEW CLOSURE AND BULLETS OF THE 2016 SFER – CHAPTER 3A WATER QUALITY IN THE EVERGLADES PROTECTION AREA BY VLADIMIR NOVOTNY (AA)

General Comment

This chapter provides (1) an assessment of water quality within the Everglades Protection Area (EPA) during Water Year 2015, (2) a preliminary assessment of total phosphorus (TP) criterion achievement, and (3) an annual update of the comprehensive overview of nitrogen and phosphorus concentrations and loads throughout the EPA. It fulfills reporting requirements of the Everglades Forever Act (EFA).

The authors in their responses focused on key issues of the ongoing discourse on the goals (criteria) and presented well written summaries of the current water quality, trends and progress in improving water quality of several key water quality parameters. Over the years they developed a very good reporting format and used up to date statistical methods to arrive at their conclusions. The analyses and summaries provide a synoptic view of water quality conditions in the Everglades Protection Area (EPA) on a regional scale. For parameters with water quality criteria, regional analyses were conducted based on the frequency of exceedances of the applicable criteria, which is the correct methodology and has been used in previous reports.

Of note are the annual geometric mean TP concentrations which in WY 2014 and 2015 were markedly reduced and became less variable compared to levels observed during the Baseline period. For the first time in history, the geometric mean in all interior areas (Refuge, WCA2, WCA3, and ENP) were below the long term standard of 10 µg/L and mild improvement continued in WY 2015. The geometric mean and median of TP concentrations in the interior of the ENP in WY 2015 were 4.2 and 4 µg/L, respectively, which is a remarkable success.

In general there are no major disagreements between the reviewer and the authors. The reviewer's mission has been to provide an independent impartial assessment and appreciates the authors balanced responses and willingness to seriously consider and even accept the comments.

Specific Comments

Comments #1 – Units. As stated in the review, the authors were consistent with units, using often the SI unit system and provided SI conversion when the US systems was used. The agency provided its own view on the use of units posted on Novemebr 2, 2015 which is trying to develop a compromise wherein some traditional units (acre, cfs) will continue to be primary units used in the reports, hopefully with the SI conversions. In reference to this chapter, the reviewer objected to the use of the made-up unit "kacre" which is unknown outside SFWMD. It

is gratifying to learn from the authors response that use of this unit will be reconsidered. The authors also introduced in Response 10 more proper unit of mas "ton (metric)" which is better than previously used "mt" that could be interpreted by outsiders, following the "kacre" template example, as "milliton" which is one thousandth of a ton (one kilogram?) .

Comments and Responses 2-3, 5-9, 11 are inquires and suggestions that were satisfactorily addressed by the authors and do not require additional deliberation.

Comment 4 – Dissolved Oxygen Issues. The authors provided in their response a defense of the Everglades Dissolved Oxygen Site-Specific Alternative Criteria (DO SSAC). This defense is appreciated but it is not the major issue. The reviewer would like to point out that he is very familiar with developing alternative water quality site specific criteria. He led a team that prepared for the Water Environment Research Foundation a nationwide manual on Use Attainability Analysis[1] which extensively dealt with methodologies for developing site specific and alternate criteria and also included an appendix with a pilot UAA to St. Johns River (FL) developed in cooperation with the St. Johns River Water Management District. Following the Clean Water Act and US EPA Water Quality Criteria Guidelines, the manual developed, advocated and, hopefully, improved methodologies for UAAs and SSACs, including those for dystrophic wetland type water bodies which, by the way, do not differ from those used by SFWMD and FSEP. He was also a member, along with an expert from the FDEP, of the National Research Council Committee for TMDL[2] and expert for the US GAO[3] for evaluation of TMDLs. There is no need to educate the reviewer about the diel cycles of DO in water bodies affected excessively by algae (not the case of the EPA which is not eutrophic). Here are the facts that have been and must be pointed out:

1. The reviewer has no fundamental objections to the Everglades DO SSAC nor does he insinuate that DO SSAC is a wrong criterion. It apparently realistically describes and statistically synthetizes annual and diel DO variations at the least impacted sites that have been select for the criterion development. Because of the potentially dystrophic nature of the system, the lowest "natural" DO concentrations calculated by the DO SSAC are substantially lower than the lowest DO concentrations mentioned (and allowed) in the US EPA Water Quality Criteria (Guidelines)[4] for DO in fresh water bodies. But that is why the

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[1] V. Novotny, V. *et al,. Use Attainability Analysis: A Comprehensive UAA Technical Reference*, , Water Environment Research Foundation, Alexandria, VA, 1997 (Nationwide Manual, republished in 2005)

[2] Panel member for National Research Council (2001) *Assessing the TMDL Approach to Water Quality Management,* Committee to Assess the Scientific basis of the Total Maximum Daily Load Approach to Water Pollution Reduction, National Academy Press, Washington, DC

[3] Expert for US GAO report CLEAN WATER ACT: Changes Needed If Key EPA Program Is to Help Fulfill the Nation's Water Quality Goals; GAO-14-80: Published: Dec 5, 2013. Released: Jan 13, 2014.

[4] US EPA (1986) Ambient Water Quality Criteria for Dissolved Oxygen, EPA 440/5-86-002,Washington, DC http://nepis.epa.gov/Exe/ZyPDF.cgi/00001MSS.PDF?Dockey=00001MSS.PDF

DO SSAC in a document mentioned in the authors' reply (Weawer, 2004) was implemented.

2. The seriousness of the situation in the ENP was illustrated on the measured DO minima violating the DO SSAC (App.3A-3) that in 2015 in four out of nine monitoring stations were 1.0 mg/L or less and DOs expressed in % saturation were ranging in these stations from 2.8 to 10.8% of DO saturation, which clearly are lethal to juvenile fish indigenous to the EPA and would be classified so by the US water quality criteria. The SFER classified DO problem as "concern". This issue should have been addressed. Low DO concentration minima (below 3 mg/L) are endemic throughout the EPA.

3. The reviewer hypothesized that, in the absence of eutrophic conditions in the ENP and elsewhere throughout the EPA, these waters could be more dystrophic than oligotrophic. Oligotrophic waters have very low TP content (≤ 10 µg/L), high transparency and the DO concentrations greater than 80% saturation but no oversaturation typical for eutrophic waters. Dystrophic water bodies are shallow stagnant or slow moving waters with very low, sometimes zero, DO concentration minima caused by excessive mostly natural sediment and dissolved organic oxygen demand; they have lush aquatic vegetation but not excessive algae growth, low pH and have also very low total nutrient content (TP≤ 10 µg/L). Consequently, further reductions of the TP concentrations in the ENP, e.g., to less than 5 µg/L averages, may not improve the DO and other (e.g., pH) water quality problems. Any further significant reduction of already relatively low TP concentrations (less than 5 to 10 µg/L) may be difficult to achieve based on results of SFWMD studies. Furthermore, most of the TP input into lower parts of the EPA is from uncontrollable atmospheric deposition. It was most likely beyond the authors writing protocol objectives to address this issue and the reviewer does not have enough information to provide a better qualified judgment.

Comment #6 – Causes of lower pH. So far, in the discussions about the low pH and low alkalinity in the EPA system, the focus was on atmospheric deposition that is naturally acidic and may become more acidic in the future because of the increasing content of the atmospheric CO_2 caused by excessive emissions of greenhouse gases (GHGs) from fossil fuel burning and natural sources such as more intensive and extensive forest fires (global climatic changes). The discussion above also identified that low pH (and alkalinity) is characteristic of dystrophic water bodies. In contrast, eutrophic water bodies have higher pH and alkalinity. The reviewer also hypothesized that the Sulphur addition in the EAAs could acidify the runoff contributing to the EPA, which was indirectly confirmed by the authors in their response by presenting the chemical equation. Consequently, the statement by the reviewer "that pH problem was aggravated in the upper reaches by sulfate inputs" was incorrect and a typographic error. It should have been "sulfur inputs".

Comment # 10 and Response – Atmospheric depositions of Total Phosphorus was not included in the TP mass balance flow charts. The authors greatly expanded the discussion on the atmospheric deposition of phosphorus that currently and in the future may be larger than the terrestrial sources. They extensively updated the mass balance calculations.

Suggestion of Highlights and Recommendations - Bullets

- Annual geometric mean TP concentrations in WY 2014 and 2015 were markedly reduced and became less variable compared to levels observed during the Baseline period and in WY 2014 and for the first time in history, the geometric mean in all interior areas (Refuge, WCA2, WCA3, and ENP) were below the long term standard of 10 µg/L and mild improvement continued in WY 2015. The geometric mean and median of TP concentrations in the interior of the ENP in WY 2015 were 4.2 and 4 µg/L, respectively, which is a remarkable success of the Everglades Forever Act programs.
- The TP and TN reduction program should continue to improve water quality and trophic status in the EPA fringe areas and in watersheds outside of the EPA, especially those that discharge directly into the ENP where abatement is still planned but not implemented; for example, territories of two Native American Tribes or watersheds in the Northern Everglades.
- Judging from the TP concentrations in the EPA and especially in the ENP, which are very low, the trophic status could be classified as oligotrophic. However, oligotrophic waters have also high dissolved oxygen content, above 80% of saturation, normal pH, and high transparency, which is not the case in the lower Everglades that are consistently exhibiting low dissolved oxygen concentration minima that sometimes drop below 10% saturation. Low pH and alkalinity have also been measured. Low nutrient levels, low DO concentrations, alkalinity and pH, along with lush vegetation but not algae, organic sediments and dissolved organic solids are characteristic of dystrophic waters wherein additional reduction of Total P concentrations would not solve the low DO and other problems. The DO problem therein may be far more natural than anthropogenic but still it is serious so society may have to decide whether to let the system heal naturally after a natural disruption or help the system somehow to get over the aquatic life threatening situations.

2016 South Florida Environmental Report

Chapter 3B – Mercury and Sulfur Environmental Assessment for the Everglades

"AA" Review Prepared by Vladimir Novotny
"A" Review Prepared by Michael A. Mallin

Technical Review –is a more traditional peer review aimed primarily at projects and associated methodology and findings. It is expected to provide detailed input on science and engineering and will draw more heavily on the experts' time to complete the review. The questions to be answered in the review are:

> *Are the findings and conclusions supported by the "best available information", or are there gaps or flaws in the information presented in the document? Are there other interpretations of the data and other available information that should be considered by the authors and presented to decision makers? If so, the review shall identify specific studies that should be addressed or available data to support alternative findings.*

General Comments

This chapter provides an assessment of sulfur (S) and mercury (Hg) status within the Everglades Protection Area (EPA) during the Water Year 2015 (WY2015) (May 1, 2014–April 30, 2015) reporting period. The analysis and summaries provide a synoptic view of Hg and S in the EPA and surrounding 13 areas on a regional scale. EPA includes the Arthur R. Marshall Loxahatchee National Wildlife Refuge [Refuge, or Water Conservation Area 1 (WCA-1)], Water Conservation Areas 2 and 3 (WCA-2 and WCA-3, respectively), and Everglades National Park (ENP).

Mercury contamination of fish and other aquatic biota (e.g., fish eating fowl, alligators, turtles, etc.) is serious and it is highest in the Everglades National Park which otherwise has the lowest inputs of pollutants. It has been discovered in the 1970s period of worldwide concerns with mercury contamination following serious episodes of deadly epidemics of Minamata disease in Japan in late 1950s. The Minamata disease was caused by industrial discharges of methyl mercury while in South Florida near field industrial mercury discharges may not present. MeHg (methyl mercury) is a bio cumulative pollutant that biomagnifies throughout the food chain.

The reason why sulfur and mercury were linked together in one chapter was because of the finding several years ago by the scientists retained by the SFWMD and extensively reported in the 2013 SFER that sulfate may promote mercury methylation in the sediment. These earlier findings led to the efforts to establish a unimodal sulfate standard (1 mg of SO_4^{2-}) for sulfate concentrations throughout the EPA. Later other factors were added and it was found that implementing the unimodal standard would be counterproductive and actually lead to worsening of the problem. These issues were extensively discussed in the past reports and reviews. The

formation of methyl mercury (MeHg) is related to the biological activity of sulfur reducing bacteria (SRB), the same bacteria that by reducing sulphate to sulfide release immobile iron and aluminum bound phosphorus into pore water as phosphate. This process may also be driven by eutrophication increasing dissolved organic matter, which was found in the 2013 report as one of the factors affecting formation of MeHg. Chapter 3B in the 2016 SFER has introduced other possible factors that will also be discussed herein. It should be prefaced that methyl mercury formation in aquatic systems has been researched for decades, yet, satisfactory models that could be used to develop a scientifically well-founded standard are still not available.

This chapter updates the status of Hg and S monitoring in the Everglades region and summarizes Hg concentrations in biota; Hg atmospheric deposition; and surface water sulfate ($SO_4^{2-)}$ concentrations, loads, and atmospheric deposition to the EPA. It also includes Sections on mercury and sulfate sources to the Everglades Protection Area, and trends in atmospheric deposition of mercury. The latter was found as the current most dominant source of Hg to the EPA system.

This chapter is focusing extensively on describing the spatial distribution and temporal trends of methyl mercury in fish and aquatic biota and also on sources of sulfur and mercury. It does not present extensively new scientific models, its emphasis is on reporting and interpreting the data collected during WY2015 which has been done satisfactorily. Nevertheless, the extensive investigations led to new important finding of the vegetation and of dissolved iron effects on methyl mercury formation and fish MeHg contamination.

Temporal trends and spatial distribution mercury in fish (pages 3B-4 -21). SFWMD scientists have been collecting samples of fish tissues from largemouth bass, sunfish, and mosquito fish. These three species have different life spans; hence, they represent three time spans of accumulation of mercury corresponding to different trophic levels and life spans for absorption of MeHg. The average life span of mosquito fish is several months, that of sunfish up to 5 years but 1-3- year old fish were collected for the analysis, average lifespan of largemouth bass is about 16 years. Water samples for analyses of SO_4^{2-} concentrations were also collected . Through the years of surveying the scientist established defensible sampling protocols and methodologies and quality assurances. Fatal data qualifiers are used both by laboratories for sample analyses and data users for reporting to indicate the quality or accuracy or to exclude data that may not be suitable for water quality evaluations.

For the *mosquitofish* THg concentrations in WY2015 exceeded the federal US EPA criterion of 0.077 mg/kg MeHg for trophic level 3 (TL3) fish at two of the 13 active monitoring sites; sunfish THg concentrations exceeded the USEPA protection of wildlife criterion at nine stations, and for largemouth bass six locations exceeded the USEPA recommended criterion for the protection of human health (0.350 mg/kg).

Figure 3B-3 shows that there is no distinct trend in the mosquitofish tissue concentrations of mercury; however, there are differences between the wet and dry years, not in magnitude (mean concentrations are statistically similar) but in variability. The chapter authors could not explain

the large intra-site temporal variations in mosquitofish THg concentrations (page 3B-9) although it was hypothesized that changes in inter-annual precipitation (i.e., wet years versus dry years) and site specific biogeochemistry including SO_4^{2-}, available Hg^{2+}, dissolved organic carbon (DOC), and reduction-oxidation (redox) have the ability to influence mercury concentrations. This intuitive hypothesis combined with the results of the previous years could lead to a better definition of decision variables that affect the THg fish tissue concentrations and potentially to an acceptable multivariate (multimodal) nonlinear model.

Page 3B-13 – line 305 – the trend of the THg in the mosquito fish concentration increase from north to south is mentioned and documented. It would be beneficial to the readers of this report unfamiliar with the previous SFERs to explain the consistency of this trend over the years.

The marked variability differences of Figures 3B -4 and 3B-5 between the wet and dry years and the fact that most mercury input (95%) is in wet deposition (Figure 3B-4) warrants more attention. The variability is larger in marshes than in canals (Figure 3B-5). This high degree of variation in marsh habitats was attributed by the authors to relatively dynamic hydrology (i.e. dry-down, dry-out, water level changes, etc.), the dynamics of marsh trophic structure and biogeochemistry associated with dynamic hydrology.

The statistical boxes and limits of the variability on these figures should be identified in the caption (% variance).

The overall average *sunfish* whole-body concentration of THg for data pooled from all sites and years was 0.185 ± 0.003 mg/kg (n=2600). This exceeded the USEPA MeHg criterion of 0.077 mg/kg for trophic level 3 fish for protection of wildlife. The THg concentration in sunfish tended to increase from north to south (Figure 3B-6). Only two monitoring stations showed a significant increasing temporal trend in mean sunfish THg concentration throughout the period of record (POR), while all other stations had no significant temporal trend (Table 3B-2; Figure 3B-7).

As expected because of longer life span, the levels of THg fish tissue contamination and its variability was greater among the stations (Figure 3B-5) and it was the highest in the ENP station L67F1. The fish tissue concentrations on average decreased with time. These differences could be due to feeding preferences among these three species. Depending on size class and hydrologic conditions, bluegill prefer omnivorous invertebrates, redear sunfish prefer herbivorous invertebrates and spotted sunfish prefer decapods and omnivorous invertebrates (lines 332-334). Reviewers find this as a reasonable hypothesis.

For *largemouth bass* during WY2015, mean THg concentrations in LMB ranged from 0.141 mg/kg at site CA3F2 (WCA-3A) to 1.660 mg/kg at site L67F1 (ENP), with an overall WY2015 median value of 0.433 mg/kg, which is a 13 percent decrease in the reported median value from WY2014 (0.494 mg/kg). This indicates a great variability between the stations and also between the level and time length of exposure to the SO_4^{2-} (actually to the level of sulphate to sulfide transformation in the sediment by SRBs).

Lines 352 to 354 lists several key factors that could influence THg conditions, including water quality conditions (pH, alkalinity, 353 nutrient availability, etc.), trophic position, and habitat structure (Julian and Gu, 2015). This sentence sort of presents a broad array of factors without stating how or why they might impact concentrations. They could be listed in the reference but it would help to the reader of the chapter to have a more specific explanation; hence, some additional material here to clarify it for the reader should be included.

Figure 3B-9 presents the box plot statistics of the THg contamination of the largemouth bass fish tissue at all stations for the POR from WY1999 toWY2015. It is important to note that the WY 2015 means for 5 stations are much greater than those for the POR, the largest increase being recorded for Station L67F1 in the middle of the ENP which exhibits the smallest SO_4^{2-} water column concentrations. Throughout the POR, no statistically significant temporal trends in largemouth bass THg tissue concentration were evident (Table 3B-3). This increase is contradicted by generally decreasing atmospheric inputs of Hg over the last10 years presented at the end of the chapter on Figure 3B-23. Probably the longer life span of the largemouth bass causes the delay in the response. Please, provide your explanation.

Page 3B-17 – line 361 –states that in some years half of the stations approximately exceeded the recommend criterion" Not really – it appears to be 60% at best or mor, so please correct and be precise.

The authors concluded that bioaccumulation of THg in fish tissues throughout the EPA continues to be a significant water quality problem within the EPA and Greater Everglades. THg concentrations in higher trophic level fish (i.e. Sunfish and LMB) were found to be highly variable across the landscape and continue to exceed criteria concentrations for the protection of piscivorous wildlife and humans at many locations.

This section was well written and presented the information in a logical manner. The authors focused on presenting the data and mostly refrained from discussing possible causes and causative factors. Nevertheless, it is hoped that the efforts to find explanations and solutions are continuing. It is the reviewers' opinion that the EPA and surrounding systems are the only place which provides wealth of variability and has extensive data base to unlock the relationships between high Hg fish and biota contamination and causative factors.

Perspectives On The Spatial Variability Of Mercury In Mosquitofish (pages 3B-22 to 29). This section/article is focusing on the variability of the Hg contamination of one specific fish species- mosquito fish. The contribution by Dierberg et al, is well written and high level scientific analysis that contributes to the enhancement of knowledge on this difficult topic. It is worth to note that the preceding section has documented spatial variability of the contamination of this specific species which is not as distinct as that for gold fish and largemouth bass so that the statement that "persistent spatial variability in Eastern mosquitofish tissue Hg concentrations across the Everglades has been recognized since at least 1996". The authors of the two sections should reconcile these contradicting findings.

The second possible statement in the first paragraph "there is unexplained variability in the fish Hg/surface water SO_4^{2-} relationship which must be explained if an effective MeHg mitigation policy is to be devised" is not exactly correct. Several literature sources, e.g., Gabriel et al,[1] and the 2014 SFER introduced a possible and credible explanation of the Hg fish tissue contamination. It can be explained by a relatively simple concept of Hg contamination increasing at low SO_4^{2-} concentrations, reaching maximum at concentrations somewhere between 1 to 5 mg/L of SO_4^{2-} and then decreasing and leveling off thereafter, perhaps due to increasing sulfide toxicity effects. This lead to a classic bell shape relation known, for example, from toxicity of metals and other pollutants on biota which at low concentrations stimulate growth and are toxic in high concentrations. Obviously, even in the 2014 SFER other variables plus randomness play a role; hence, the relationship is highly statistical. However, as pointed out in the preceding section the relationship for mosquito fish is as not as pronounced as for the other two species.

In the long paragraph on page 3B-24 the authors elaborate the difficulties using the unimodal fish THg contamination vs. SO_4^{2-} water column concentration. For example, on page 3B-25, lines 494-500, they reported a puzzle at a sampling site DB-15 that since 2011 had SO_4^{2-} concentrations below detection limit (0.2 mg/L), yet, the mosquito fish had moderate THg tissue contamination. This indicates that other factors, perhaps iron may play a role. But it has been established several years ago that the relationship is not unimodal but even Figure 3B-12 has an indication that the bell shaped relationship may be present hidden under what at first look appears to be a lot of noise but in addition to randomness an effect of the other constituents present in water (e.g, DOC, dissolved Fe^{2+}) and/or sediment composition may also have an effect. Hence, the efforts should be focused on identifying the other variables and separation of the random component (white noise) that would correlate in a multi regression nonlinear model. This could be characterized as "nonlinear principle component analysis and neural net modeling" and not just linear unimodal straight line regression (see Bedoya et al.[2]). As shown on Figure 3B-13, the correlation between the water column sulphate and pore water sulfide is fuzzy which introduces a new uncertainty and need to identify other variables that affect the sulfide formation in the sediment (perhaps organic content, temperature).

Figure 2B – 14 is confusing and the selected data from only a few stations cannot be extrapolated to the entire picture. For one, it lacks points from sites where the SO_4^{2-} concentrations are between 1 to 5 mg/L which on other similar plots contained the highest THg fish tissue contamination values. On the other hand, when the same data were replotted on Figure 3B-15 very interesting (exciting) relatively new information was revealed, i.e., (1) in the absence of sulfur at Site DB-15 dissolved iron was present and most likely driving the MeHg absorption while sulfur did the same at Sites F2 and U3, (2) in oligotrophic parts of EPA both iron and

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[1] Gabriel, MC., N. Howard, and TZ.Osborne (2014) *Environmental Management* **53**(3):683-93

[2] Bedoya, D., E.S. Manolakos, and V. Novotny (2011) Prediction of biological integrity based on environmental similarity – Revealing the scale-dependent link between study area and top environmental predictors, *Water Research* **45:**2359-2374

sulfur can trigger MeHg formation and cause THg mosquitofish contamination and reducing bacteria are capable to form MeHg, (3) aquatic vegetation can play an important role.

On pages 3B-28 to 29 the authors expand their finding to suggesting alternative method a of management. On line 335 to 338 they hypothesized that "the physical or ecological structure imposed by different vegetation types (P-enriched monotypic cattail (*Typha*) versus P-enriched open water with submerged macrophyte *Chara* versus typical oligotrophic open-water Everglades slough with submerged and sparse emergent macrophytes) was an important factor mediating the uptake of Hg by mosquitofish (and other biota)". This is a reasonable hypothesis but is should be clarified exactly how and why; i.e., what are the reasons the uptake by mosquitofish would be affected – either increased or decreased. Very broad statement as it stands.

However, before more critique is presented herein let us look at Figure 3B-16 which contains hundreds of data of mosquitofish THg contamination plotted vs SO_4^{2-} water column concentration. What is exciting about this plot is that it clearly confirms the bell shaped "Goldilocks" model wherein the highest THg contamination occurs between 1-5 mg SO_4^{2-} /L and decrease on both sides of this range. It also shows that other factors and randomness are present and affect the mosquitofish tissue contamination. It also shows that presence of cattail vegetation may reduce THg fish tissue contamination. Even though this discussion goes somewhat beyond the (AA) reviewer's expertize, it is known that some emerging wetland vegetation (cattails) can create oxic environment near their roots and rhizomes that may interfere with the redox potential and prevent or reduce the sulfate and iron reducing processes in the sediment (Amstrong et al. [3], Mitsch and Goseling[4]). The authors themselves concluded (lines 555 to 557)"that it appears very likely that the vegetation community is an ecological driver of Hg bioaccumulation, perhaps disrupting the expected unimodal relationship between fish Hg and surface water SO_4^{2-} ".

It is hoped that by now all of us realize that a unimodal straight line relationship (i.e., absorption of THg in aquatic organisms increases correlates linearly to the increase of the SO_4^{2-} concentration in the water column) does not exist.

The reviewers suggest it is possible to go beyond this finding and identify other drivers already mentioned in this section (iron) and previous reports (dissolved organic carbon). Hence, because it has now been clearly established that the MeHg formation and absorption into fish tissue may indeed follow the bell shape relationship and this relationship is not unimodal and contains a random component and there is plenty of data now available, time has finally come for developing a statistical multimodal nonlinear model. Ten years ago the reviewer's team working on the EPA STAR project was facing a problem how to find a relationship of the multi-parameter (multimodal) Index of Biotic Integrity to environmental variables (physical –habitat,

[3] Amstrog, J.,R.E. Jones, and W. Armstrong (2006) Rhizome phyllosphere oxydation in Phragmites and other species in relation to redox potential, convective gas flow, submergence and aeration pathways, *New Phytologist* **172:**719-731

[4] Mitsch, W.J., and J.G. Goselink (2007) *Wetlands,* Wiley, New York

land use and chemical). "Data mining experts" were a part of the team and the effort was successful and in this particular outcome led to quantitative recognition of the importance of physical parameters[5] . Because the number of driving parameters may be more than one there is a need in the analysis to eliminate cross-correlations. For example, both dissolved iron and sulfide concentrations may be correlated to the dissolved organic carbon.

Editorial comment on Figure 3B-16: the line identifying the cattails went beyond the point on the right side, there are no cattail points (crosses) beyond 70 mg/L.

Mercury sources to EPA are presented on pages 3B-30 – 34. In the lead paragraph, please, list the most important sources of Hg to the atmosphere (i.e. coal-fired power plants, cement plants, etc.). It is important to note here that the State of Florida is one of the largest consumers of coal in the U.S. for power production purposes. Even though the U.S. inputs in general have decreased, Florida situation should be specified.

Atmospheric source represents between 95 to 98 % of mercury inputs to the system. Due to the data release schedules, this assessment only spans WY1996–WY2014. Only 5 monitoring sites were active, only one in ENP. During WY2014, atmospheric loading in the EPA was highest within ENP followed by WCA-3, WCA-1, and WCA-2 . However, the differences were very small and it appears that if Student statistic similarity test was performed then, statistically, there would be no difference between the basins. For these reasons no statistical conclusions can be made on the relationship between the magnitude of the Hg deposition and fish tissue mercury contamination. However, if a numeric (pseudo) deterministic model is developed by a consultant, at some university or federal government research center, the magnitude of the mercury input will have to be considered; hence, the current research provides valuable information.

Page 3B-32 – Table 3B-4 – please add period of record in years to the table caption.

The statement on lines 671-672 in page 3B-34 "qualitatively there is a small potential correlation between fish tissue Hg and deposition….limited data and small regional differences limit investment in more detailed data collection and analysis" may be a little misleading. It is recommended that on line 671 the term "correlation" is changed to "relationship" at this point, until the proper statistics can be run. A statement should be included that in addition to the development of a nonlinear multivariate (multimodal) model by advanced "data mining" , development of a quantitative deterministic model of the Hg cycle from the deposition to the fish and aquatic biota contamination should be also encouraged as a follow up. This model will be useful for predicting quantitatively the effects of the expected reductions of emissions from

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[5] Novotny, V., D. Bedoya, H. Virani and E. Manolakos (2009) Linking Indices of Biotic Integrity to Environmental and Land Use Variables - Multimetric Clustering and Predictive Models, *Water Sci. & Technol.,* **59**(1):1-8

Bedoya, D., V. Novotny, and E. Manolakos (2009) Instream and off-stream environmental conditions and stream biotic integrity. Importance of scale and site similarities for learning and prediction purposes. *Ecological Modeling* **220:**2393-2406

power plants and changing from coal or dirty oil to green energy and natural gas. For this Hg cycle model and quantitative Hg mass balance between the subsystem the knowledge of external inputs and their past and predicted trends is needed.

Sulfur sources and Effects are covered on pages 3B35-46. Sulfur inputs to the Everglades, both anthropogenic and natural, include: (1) inputs from atmospheric deposition, (2) inputs of connate seawater (connate water= water entrapped in sedimentary rocks during the time of their formation) into canals, (3) export of sulfate from the Everglades Agricultural Area (EAA), and (4) oxidation of peat soils.

The District has established a network of monitoring stations throughout the EPA (Figure 3B-20). The stations were situated near or on inflows and outflows and interiors of the fours basins (Refuge, WCA 2 and 3, and ENP) and EPA; these are the same points as for monitoring water quality parameters presented in Chapter 3A. Similarly to the water quality chapter, this section summarizes SO_4^{2-} concentrations within the EPA during WY2015 and describes trends or changes in these concentrations over four periods: (1) Baseline period including WY1979–WY1993, (2) intermediate period, or Phase I, including WY1994–WY2004, (3) Phase II Best Management Practices (BMP)/STA implementation period after WY2004 (WY2005–WY2014), and (4) the current water year (WY2015). The presentations of the data and statistics are also identical to those in Chapter 3A. The methodologies, monitoring protocols and Quality Assurance have been tested over the years and are good.

Bottom paragraph – on page 3B-36, line 774 states that data were collected on flow events only. Does that mean rain events? It may by unclear to the readers what "flow events" are.

Similarly to other water quality parameters within the EPA presented in Chapter 3A, sulfate concentrations are high in the north Refuge basin (mean 60.1 mg/L) and decrease markedly southward to ENP where they are very low (median in WY 2015 of 0.7 mg/L) (Figure 3B-20, Table 3B-6). Highest sulfate concentrations were observed in the Refuge peripheral canals. Regarding the trends, in WY 2015 there were substantial increases in the SO_4^{2-} concentrations in the outflows from Refuge and WCA-2 otherwise the concentrations fluctuate among the phases without trend but decreased significantly in the ENP.

Table 3B-6 contains the statistical summaries of the data. At first look there are questionable very high concentration maxima at some sections, especially in ENP, which unrealistically distorts the probability distribution. Typically, monitoring data follow the log – normal probability distribution which is exhibited on a log of data vs. probability of exceedance plot as a straight line. Such plot should be included. At this time, the maximum measured values in ENP and some other sections look like unexplainable outliers because of a great difference between the means and medians. The differences between the arithmetic mean (4.4 mg/L) and geometric mean (0.7 mg/L) seem to be excessively large. Other data mentioned in this chapter indicate that the measured sulfate concentrations in twelve out of fourteen monitored points within ENP had sulfate concentrations less than 1 mg/L. The presence of very high sulfate concentrations at the northern boundary of ENP should be explained. Was it a dryout?

This section on pages 3B-42 and 43 discusses the feasibility of sulphate criterion for controlling Hg contamination of fish tissue and other aquatic fauna species. This study has documented that relatively low SO_4^{2-} additions (i.e., 0.5 to 1.0 mg/L) "in areas with very low sulfate concentrations significantly increases water column MeHg concentrations, indicating that non-abatable sources of sulfate could support meaningful MeHg production in the presence of bioavailable inorganic Hg".

On page 3B-42 line 863-864 the authors state "the very low SO_4^{2-} concentrations observed for the interior portion of the Refuge indicate that either assimilation of sulfate is occurring and potentially could be limiting". Limiting to what? Plant growth in general? Any particular species?

Page 3B-43 – first sentence – change …"anions have *become* widely recognized" to "anions have *been* widely recognized".

The reviewers agrees again with the statement on lines 908-911that "empirical evaluation of Hg and SO_4^{2-} data (**using a simple unimodal linear model–** added by the AA reviewer) provides little predictive power to link water column concentrations or loads to environmental Hg levels". Other factors and parameters have already been identified; therefore, the relationship as well as the character of the relationship (bell shape) has been proven to affect the model. Even the SO_4^{2-} effect is not imply linear, it is increasing (stimulating methylation) at very low concentrations and exhibiting interference with methylation because of increasing sulfide toxicity at higher concentrations, which results in the bell shape relationship with a maximum somewhere between 1 to 5 mg/L. Other factors already identified include dissolved iron, dissolved organic carbon, and emerging aquatic vegetation creating oxidizing pockets in the sediments. Suspected but not yet quantitatively identified factors may include temperature, magnitude of the inputs, redox potential in the sediment, presence or absence of DO in the interstitial water-sediment layer, etc. There is no support by science for implementing the 1 mg SO_4^{2-}/L criterion. It cannot be defended, so it would be best to pull it and work on accumulating data until sufficient data are accumulated followed by a multi-parameter nonlinear statistics to produce a reasonable remedial measure.

There is a chance that a "performance" based criterion such as vegetation management, in addition to further reduction of sulfate loads from external sources (atmospheric linked to acid rainfall controls and terrestrial reducing the sulfate loses from agricultural lands) and Hg loads may be developed and adopted. Annual SO_4^{2-} wet deposition and Hg deposition representing about 95 to 98 % of the total atmospheric input, have already significantly declined throughout the POR (page 3B-44, line 965 and Figures3B-20 and 3B-23) in the last ten years perhaps because of the controls of power plant emissions.

Question: Page 3B-44 – lines 975-976 – why is 10 years the sufficient lag time? Is there a reason for this specific period, or a reference one can provide?

Line 981 - "Error! Reference source not found" – explain or remove statement.

Figure 3B-23 is excellent and gives encouragement to hope that the near and far field deposition of Hg may be reduced so that the system may begin to recover. Is the decrease in the overall atmospheric deposition of Hg in the last ten years unique to Florida, EPA or is it nationwide?

Concluding comment

This chapter presented by a team of authors who are leading experts in the field is well written. It brings new scientific evidence on the complex effects and relationships explaining high Hg fish tissue contamination in otherwise pristine oligotrophic (with exception of DO) environment of the ENP and the transitions in the Water Conservation Areas 1to 3. It also documents the progress in reducing sulfate loads both from terrestrial and atmospheric sources and the decrease of atmospheric Hg deposition over the last 10 years. In this and last year water year reports the authors refrained from scientific argumentations on the type of models or even its structure. However, they presented a wealth of precise scientific knowledge to let others, including the reviewers, speculate on the type of the relationship and model and its decision variables. But there is no doubt that a milestone towards a full understanding of the problem is now being reached and the EPA system is the only place in the world where this could happen. This chapter satisfied all requirements outlined in the review assignment.

REVIEW CLOSURE AND BULLETS OF THE 2016 SFER – CHAPTER 3B BY VLADIMIR NOVOTNY (AA) WITH A CONTRIBUTION OF MICHAEL MALLIN (A)

General Comment

This difficult topic of methyl mercury formation and aquatic fauna contamination has been described and reported by the District scientists for several years and reviewing the chapters led to enlightening discussions between the authors (who changed to some degree over the years) and the reviewers. There is also a parallel ongoing investigation by scientists elsewhere; however, there is no doubt the monitoring and research by the South Florida Water Management District (SFWMD) is the largest effort currently advancing the understanding of the serious methyl mercury problem, its complexity and paradoxes.

The SFWMD effort has documented that a simple relationship of the level of fish tissue mercury contamination to the sulphate concentrations apparently does not exist. Hence, implementing a simple low sulfate standard might even be counterproductive because of paradoxes of the highly statistical multiparameter unimodal relationship which exhibits the highest TMg fish tissue contamination in the Everglades National Park (ENP) where the SO_4^{2-} concentrations are less than 5 mg/L. Furthermore, the overall water quality – eutrophication expressed by the interior TP concentrations (less than 5 μg /L in WY 2015) in the ENP is the best (oligotrophic and/or naturally dystrophic – see Closure to Chapter 3A). It is gratifying that the work by the district scientist and, originally also by scientists from national laboratories and academia who contributed to previous reports, is apparently leading now to deciphering the puzzle and paradoxes of the relationship of the fish methyl mercury contamination, mercury deposition and environmental factors that also include sulphate concentrations.

The original hypothesis of methyl mercury formation and fish tissue THg contamination tied it to the activities of sulfur reducing bacteria in the sediment, hence, the MeHg formation and fish and higher trophic level fauna tissue contamination was related to SO_4^{2-} . The most important findings presented in Chapter 3B of the 2016 South Florida Environmental Report include discoveries, confirmed also by other literature sources, that other microbial guilds and several other factors, including type of wetland vegetation, also cause mercury methylation. The research over the last several years (reported in SFERs since 2013) produced also a large data base that can be now or in the near future "mined" by using advanced computer data mining methods to identify key factors and key determinants affecting Hg methylation in the EPA system (and elsewhere), quantify the key nonlinear multivariate relations between MeHg in sediments and MeHg tissue contamination of organisms at several trophic levels and also determine the random components needed to quantify a margin of safety for possible development of criteria and management alternatives. Subsequently a deterministic model can be

developed that, after calibration and verification, can be used to propose realistic abatement and management of the system to reduce MeHg contamination to acceptable levels.

Specific Comments

The overall assessment of reviewers' comments and authors' responses is that in most cases both authors and reviewers are in full agreement on the key issues.

Comments 2-6, 13-16, 18-22. These comments contained inquiries and suggestions by the reviewers that were accepted (noted) and satisfactorily addressed by the authors. The reviewers are looking forward to the improved version of the chapter.

Comment 7 pertains to the Section in the report dealing with the variability of the MeHg response and contamination in Eastern Mosquitofish and differences between Largemouth bass. The terms "unimodal" (one peak in the data) and "bell shaped "are indeed synonymous.

The discussion on the somewhat different interpretation between the authors of the chapter and work by Gabriel is between these authors. The reviewers pointed out that there is some similarity between the authors finding and Gabriel (2014). The explanation of the decreasing fish tissue contamination with increasing SO_4^{2-} concentrations beyond the 5 mg/L peak was presented and discussed in the previous 2013 and 2014 reports but this report has documented that after the peak the relation, while still decreasing, is fuzzy. The reviewers agree that other factors are significant, including randomness.

Comments 9 and 10 highlight the role of other microorganisms, iron and trophic structure of vegetation having effects on methylation. This is an important contribution in the 2016 SFER Chapter 3B. The authors and reviewers are in agreement. The question regarding aquatic vegetation effects addressed in the Comment and Response #10 hypothesizing that plant structure can mediate Hg uptake from various biota (including mosquitofish) is a complex one, and we look forward to the author's final revised text regarding this hypothesis.

Comment 11 – Next step – Identify other key factors besides sulfur. The authors "100%" agree with the reviewers' suggestion that the key next steps should be identification and quantification of other factors that affect the MeHG formation and absorption by aquatic organisms at several trophic levels.

Comment 12 – Alleged level of coal utilization (source of mercury) by Florida. The discussion on which state has the highest coal use by power companies is irrelevant and should have been avoided in the review. Reviewer A was apparently given faulty information by another source. The reviewers agree that a substantial portion of the atmospheric sources of Hg does not originate from Florida. The future of coal use by power plants will change dramatically in the near future by switching to natural gas and green energy. The latter source of new energy (solar, wind and tide) is abundant in Florida.

Comment 17 – Statistical possibility of outliers in maximal concentrations of sulfur in ENP. The authors' explanation is noted as well as their willingness to include log-normal distribution (log C vs. [p+1]/N where C is the concentration, p is percentile of being less or equal on the probabilistic scale and N is the total number of samples). Ideally, the concentration points would lie on a straight line.

Suggestion of Highlights and Recommendations - Bullets

- Mercury contamination of fish and other aquatic biota (e.g., fish eating fowl, alligators, turtles, etc.) is serious and it is highest in the Everglades National Park which otherwise has the lowest inputs of pollutants.
- The authors of Chapter 3B successfully continued the quest for decrypting the puzzle and paradoxes of high methyl mercury levels and contamination of aquatic fauna exhibited by the highest MeHg contamination in the Everglades National Park which is the most pristine but possibly dystrophic (see Closure to Chapter 3A) part of the Everglades Protection Area.
- The original focus on the hypothesis that the MeHg formation and contamination is tied only to the activities of sulfur reducing bacteria that led to a proposal for implementing a sulphate criterion has been proven incomplete to the point of being false.
- The research presented in the 2016 SFER Chapter 3B investigated other factors and microorganism guilds that can produce methyl mercury, hence, sulfate is only one of the MeHg forming factors. As a result of these monitoring and research efforts, this complex and originally puzzling relationship is becoming more clear and the research can now focus on quantification of the processes and impacts of the key factors.
- In the multiyear (and most likely multimillion $s) effort the SFWMD team now has developed a large data base that, along with similar data gathered by other teams investigating the MeHg problem in other water bodies, can be now "mined for knowledge". The "data mining" process is a sophisticated computerized methodology wherein nonlinear multivariate stochastic models (e.g., neural nets) are used to retrieve statistical relationships between the multivariable outputs (e.g., MeHg content of organisms at different trophic levels) to multivariate inputs and impact factors (e.g., Hg deposition, sulfur and iron in water and sediments, vegetation, dissolved organic content, possibly dissolved oxygen). Randomness inherent in these processes and relationships can also be quantitatively identified. Note also that there could be also biomagnification between the organisms from the lowest (plankton?) to the highest (birds and fish eating mammals) levels.
- Collecting the data pertinent to MeHg contamination, key factors and related special studies should continue. It is clear that the EPA is the best and ideal large laboratory with high quality ENP to moderately polluted basins and water bodies (EAA and Lake Okeechobee) and gradients of decision factors and MeHg formation and contamination.

- Once these relationships are discovered and quantitatively identified by data mining, developing a complex deterministic model of mercury methylation, absorption and biomagnification by the organisms, similar in concept to the toxic effect model developed by the US EPA researchers in the last century, would become possible and their development should be suggested to funding agencies. Such models have been in the past successfully used by the US EPA for development and implementation of criteria for priority toxic and carcinogenic chemicals. Most likely, developing such criterion would not be a responsibility of the SFWMD.
- Once the criterion is instituted and margin of safety defined, the model can be used to propose and develop strategies and abatement for MeHg contamination reduction and abatement..

2016 South Florida Environmental Report (WY 2015)

Chapter 4 – Nutrient Source Control Programs

Review (AA) by Vladimir Novotny

Accountability Review *(for chapters that are of a more routine nature).* This level of review targets progress and achievements of expectations in District programs and projects that are generally descriptive or standardized in nature, and may deal with cross-cutting themes or content. This review addresses, among others, the following questions of concern to the South Florida Water management District (SFWMD):

> *Does the draft document present a defensible account of data and findings for the areas being addressed that is complete and appropriate? Is the synthesis of this information presented in a logical manner, consistent with earlier versions of the report? Are findings linked to management goals and objectives? The panel may also provide constructive guidance for the District's large-scale programs, particularly as related to water quality assessment and source control across the agency programs.*

General Comments

This chapter and related appendices (Appendices 4-1 through 4-3 of this volume) provide the update on the District regulatory source control programs for Water Year 2015 (WY2015; May 1, 2014–April 30, 2015). It describes the source controls –Best Management Practices in the large watersheds and update on the nonpoint source control programs mandated by the Everglades Forever Act (EFA) and Northern Everglades and Estuarine Protection Program (NEEPP). The chapter outlines the programs in Lake Okeechobee, the St. Lucie River, the Caloosahatchee River, C-139, C-111, Everglades Agricultural Area (EAA), and some smaller watersheds, some of them discharging directly into the Everglades Protection Area in the southern part of the Everglades. The key component of the NP source control program carried out by the South Florida Water Management District and other agencies (Florida Department of Agriculture and Consumer Services, Department of Environmental Protection) are permitting programs that differentiate this program from a majority of NP pollution programs in other states that rely on voluntary participation. The programs also include monitoring, adaptive management and education of land owner/dischargers. Therefore, it can be stated right at the beginning of this review that the regulatory component and the entire process already is successful in the EPA basins and can make successful the entire South Florida NP control program.

The watersheds of the Kissimmee River, Lake Okeechobee, the St. Lucie River and Estuary, the Caloosahatchee River and Estuary, and the Southern Everglades are an interconnected system.

Lake Okeechobee is the focal point which releases its outflow in a managed way to both rivers and by five canals to the downstream Water Conservation areas of the EPA system. In the past, flow releases from Lake Okeechobee into two estuaries were intermittent to protect their brackish/salt water ecology. Lake discharges and releases are also a significant source of nutrients.

Figure 4-2 on page 4-3 is a nice illustrative representation of the program and how it fits into the overall effort to reduce nutrient inputs into the EPA. Most of the surface pollution to the Everglades originates from nonpoint sources but it was realized that source control programs dealing with a very large number of sources and source controls may not be enough. Furthermore, as this reviewer pointed out in the review of Chapter 3A a large portion of the TP, sulfate and mercury loads come from atmospheric deposition, including from far field sources outside of the Everglades watershed. Therefore the plan is hierarchical wherein local source controls are followed by regional control of runoff in Stormwater Treatment Areas and self-purification in the EPA basins.

The main goal of the entire Everglades Forever program has been to achieve at least a 25 % reduction of phosphorus loads to EPA and especially to the ENP. Phosphorus is a limiting nutrient stimulating eutrophication process exhibited by excessive algal growths and other symptoms like clarity, lowering dissolved oxygen concentrations, change of quality of fish population and aquatic life. The same problems have affected Lake Okeechobee and estuaries of the St. Lucie River and Caloosahatchee River. In the estuaries, both phosphorus and nitrogen are harmful nutrients.

Pages 4-4 to 4-9 present Highlights of Achievements in WY 2015 of the collaborative efforts by several lead agencies (SFWMD, FDEP, FDACP). The detailed summaries of the load are presented in Tables 4-1 (Total Phosphorus) and 4-2 (Total Nitrogen). TN loads were presented only for the St. Lucie and Caloosahatchee Rivers because their estuaries may be both phosphorus and nitrogen limited. Both estuaries have serious eutrophication problems.

Of note is the 79% reduction of the TP loads from the Everglades Agricultural Areas, which is the largest source. This reduction is greater than the goal of 25% TP reduction. However, it is evident that in the other watersheds, C-139 Basin, Non – ECP Basins, and Lake Okeechobee, St. Lucie River, Caloosahatchee River , implementing the source and regional NP pollution programs are still in progress and results may be noticed after the year 2020. Table 4-1 shows some basins in the Lake Okeechobee and St. Lucie watersheds have very high unit and total loads of TP (e.g., Indian Prairie) and also contribute high loads to these water bodies. *Please, include a note whether or not these loads impact the EPA basins (most likely they are not).*

The problems with noncompliance with the TP reduction goals are most visible for the Non-ECP basins (lines 181-187). These basins, although smaller in size, discharge directly into the EPA basins and may have adverse local impact on the quality within the EPA. For example, the

Long-Term Plan describes a phosphorus concentration requirement of 50 µg/L in discharges from the North Feeder Canal Sub-basin, yet, the WY2015 TP flow-weighted mean concentration (FWMC) in discharges from the Canal Sub-basin was 228 µg/L. *This situation should be addressed more forcefully. Also the discharges from unabated discharges from the Native American Territories (Reservations) should be addressed in more detail.*

In reference to Tables 4-1 and 4-2 and other follow up information of results throughout the chapter it is evident the authors are reporting the results mixing US and metric units. They provide conversion factors between the unit systems in the tables. Ideally, SI (metric) unit system with conversions to the old US unit system in parentheses should be used. Concentration is defined and measured as mass/volume. *Ppb which means one part of something divided by billion of parts of the same something, is the same as µg/L only if water has a temperature of 4^oC.* The same is true for ppm and mg/L. In any other temperature there is a difference between the two which is pertinent to the Everglades where water temperature may exceed 30^oC . *Hence they are only **approximately** equal. Provide also conversion in the text, for example, from acres to km^2 and possibly, square miles and use these larger units when describing large watersheds* (line 231 and throughout the chapter). In general, acres and hectares should be used for smaller watersheds, i.e., use proper units appropriate to the site. None one would use pounds (kg) to describe loads from the Mississippi River.

Pages 4-11 to 4-23 describe source control programs and update in the ECP and EAA Basins.

The chapter highlights the source control program's mandated implementation of BMPs in the EAA and C-139 basins. This program is the primary regulator of TP loads in discharges from the basins prior to inflow to the Stormwater Treatment Areas (STA) which provide the final (and effective as pointed in Chapter 5B) TP removals prior entering the EPA. As pointed out the EAA Basin is required to achieve a 25% percent reduction of the TP loads discharged when compared to the pre-BMP baseline period while the C-139 Basin is not to exceed the historical loads observed during the baseline period, as defined in the EFA (lines 337-339). *This goal for C-139 is confusing. Normally it would be expected that source controls would result in a reduction of the load not keeping status quo. Please, explain*. Furthermore, it appears that C-139 just barely keeps the loads below the historic loads. It also seems that some permittees are reluctant to cooperate (lines 355-359). *Is this caused by a lack of effective enforcement? Is there a way to obtain full cooperation?*

The foundation of the success **in the EAA areas** is the permitting program. The permit-required BMP plans are comprehensive; they address both nutrient input to the system and transport from the system and generally consist of nutrient management, water management, and particulate matter and sediment controls. The authors reported that the EAA Basin has been in compliance each year since the program's inception (line 448 and lines 463-465). The results for the WY 2015 are then presented in Table 4-4 and for each year from1980 in Table 4-5. **The goal of 25% reduction of the TP load have been met consistently since 1992**. This downward trend of TP

load reduction is also graphically presented on Figure 4-5. This is interesting. *On one side, meeting the goal so early when hardly any BMPs were implemented is great but it leads to an impression that the goal might have been set too low. Please, comment.* Historical water quality data show that the 25% load reduction goal would not result in attaining the water quality goal of 10 and 15 μg of TP/L in the ENP and other EPA basins.

Figure 4-6 shows corresponding reduction of unit loads. In the caption provide a conversion from lbs/acre to kg/ha.

As far as financing the program, the Everglades Forever Act imposes a tax of $10 to $25/acre (there is not a need to include a conversion, the tax is a legal instrument and not a technical or geographical variable) to finance the program (lines 363-373). *What is the level of compliance of landowners and how is the tax collected?* This is an interesting instrument not used in other states for NP control.

Pages 4-21 to 4-24 discuss the EAA source control activities. The existing regulatory program focuses on BMPs at the source, minimizing pollution leaving the permittee site. The program consists of (1) Permits, (2) Research, (3) Demonstrations, (4) Outreach, and (5) Restoration Strategies. *This section, while being descriptive of existing and future programs, is full of acronyms which leave the reviewer and readers to jumping all over the chapter to decipher what they are. This may be also true for some other sections. The authors should edit their writing* and if a large number of acronyms and references to various section and paragraphs are needed they should be redefined at the beginning of the section where they first appear. Going back ten or so pages to find a reference for an acronym is difficult.

Nevertheless the fundamentals of the program description and their logic are interesting and should be noted. For example, the fast dissemination of the ongoing research to the stakeholders and landowners so that they can take an adaptive management approach to making improvements to their operations from a water quality perspective could serve as an example to plans in other states and is worth to mention. The master permit for BMP research, testing, and implementation is the mechanism through which the District 634 implements research and outreach requirements.

Page 4-24 to 30 present the C-139 Basin update. It appears (Figure 4-7) that this basin discharges into STA 5/6 to receive further treatment before the flow enters EPA. The introduction (lines 746 p 751) to this section claim the District (SFWMD) implemented (1) cost-shared implementation of higher cost technologies, (2) improved the water quality monitoring network, (3) conducted integrated regulatory approaches with consumptive water use and stormwater management system permitting groups within the agency, (4) enhanced stakeholder interaction and outreach, and (5) utilized the Watershed Assessment Model (WAM) to evaluate the feasibility and TP reduction potential of BMPs and source control infrastructure projects.

Table 4-7 on page 4-26 is supposed to summarize the actions implemented in the Basin. It appears that about 50% of planned actions have not been implemented and the rest is in the planning stages. *From the table and the text, it is not clear what the "points" are for and what they represent; hence this table is very confusing*. Also permittees in the C-139 Basin are not required to collect water quality and quantity data to characterize permit-level discharges so it is up to District to step in and establish the water quality and quantity monitoring network and collect the necessary data for the Basin.

This ambiguity of the C-139 program is reflected in the results. Table 4-8 shows results for WY 2015 which indicate the annual load from the basin was about 10 % better than the target predicted load. This "good" (actually "marginal") result for WY 2015 is contradicted in Table 4-9 and Figure 4-8 in which 6 out of the last years (including WY 2014) had TP loads greater than the target value. Luckily, the TP load removal performance of STA 5/6 (Chapter 5B) is very good, about 85%, but this does not give an excuse for low outcome of the source control in the C-139 Basin. *Please comment*.

In the footnotes to Table 4-9 note that ppb only approximately equals µg/L. *Include conversion from lbs/acre to kg/ha in the caption of Figure 4-8.*

C-51 Basin located on the east side of EPA. Only a portion of the storm runoff flows into STA 1-treatment basin, the rest is apparently released into the tide of the Atlantic Ocean. The District monitors water quality in the C-51 West Basin to ensure phosphorus loads generated within this basin do not affect the performance of STA-1W and STA-1E.

Pages 4-31 to 4-39 deal with the Non-ECP basins. Non - ECP apparently implies that no construction programs are being implemented therein. These basins are abutting the EPA and some even directly discharge into the ENP. The total TP load of 18 tons (mt) was discharged to the EPA from the non-ECP basins during WY2015 (lines 931-932). In the overall picture this may appear small but it has to be realized the total terrestrial input into ENP after all source control, treatment in STAs and by self -purification in the WAC 1,2,3 is about the same (Chapter 3A).

Figure 4-10 shows that the Feeder canal and L-28 basin bring most of the TP load from the Non-ECP basins directly into EPA. C-111 Basin discharge goes directly into the ENP. The programs in the Non-ECP struggle to meet the 50µg/L outflow concentration goals, as a matter of fact the current concentrations are far above this goal (page 4-35) in the Feeder Canal The District is working with the landowners and two Native American Tribal territories . Apparently, work on tribal lands is stalled (page 4-37). As stated in the chapter, the 2003 Long-Term Plan recommended modification of the plan to convert WRA-7 (little abatement-reviewer's comment) to an STA by 2010 as of August 2015, had not been authorized.

Please, provide the reasons for the delay or an update if there is a change. Also, replace word "Indian" by "Native American" and "Reservation" by 'Territory" or "Land" in this Chapter and, hopefully, in the entire SFER).

Northern Everglades Programs. Overview of the Northern Everglades Source Control Programs is presented on **pages 4-39 to4-45**. Northern Everglades include watersheds of Lake Okeechobee, Caloosahatchee River, and St. Lucie River. These water bodies and watersheds were in the past heavily modified. The NEEPP includes a phased, comprehensive, and innovative protection program composed of integrated approaches such as source control programs, construction projects, and research and water quality monitoring programs. Hydrological modifications have caused diversions of significant portions of the flow from Lake Okeechobee into the two rivers and, hence, to the Golf of Mexico and Atlantic Ocean. The pollutants of concern in the Northern Everglades are phosphorus in the Lake Okeechobee watersheds and both phosphorus and nitrogen in the river watersheds and in the flow into the Water conservation Areas of EPA. Lake Okeechobee was suffering years ago from cyanobacteria growth, today this important lake still may be eutrophic. One reason may be (*please comment*) that the NP Source controls in the Lake Okeechobee watershed have not yet been fully implemented. Table 4-10 lists the nutrient control plans and actions in the Northern Everglades. Besides the listing the table could also include the status of the programs (planned, ongoing, complete).

On lines 1191 and 1192 the District reported the maximum cost of the action to remove TP as $5/lbs. *How was this limiting cost determined, in the plan or by monitoring the performance*? *Does it mean that if the cost is greater than the limit there would be no removal or cost can be shifted between less expensive and more costly programs?* The 1989 rules require that each agricultural and non-agricultural discharger meet water quality criteria at the point of discharge from their property. This requires monitoring but conceivably not every source BMP can be monitored.

Figures 4-12 to 4-14 show the source control implementation areas. *The scale of the maps does not allow to read, identify and locate the projects.*

Pages 4-46 to 4 - 52 contain narratives describing the status of the programs followed by charts presenting (a) plot of annual TP load, five-year rolling average TP load, and annual FWMC; (b) basin timeline; and (c) land use distribution in the individual monitoring stations.

At the beginning of this section (page 4-46) the authors stated the objective of the Regulatory Nutrient Source Control Program which is to establish permitting criteria for approval of a BMP plan for new and existing activities to ensure that water quality in stormwater discharges to Works of the District (WOD) is compatible with the District's ability to implement statutory mandates and meet regulatory requirements posed on the District by the FDEP. It was stated that the regulatory WOD program is unique to South Florida, apparently to the Everglades System, including also the watersheds that discharge to Gulf of Mexico and Atlantic Ocean. The reviewer

who is familiar with the nationwide BMP control efforts confirms the uniqueness of the Everglades restoration and NP pollution control programs. In other states, the programs on the discharger side are voluntary and the impetus is subsidies which in some states are meager or none. The reviewer also recently (2013) assessed the successes and failures of the TMDL programs in many states. The failures commonly were caused by insufficient abatement of NP sources due to lack of enforcement and, indirectly, lack of subsidies. In other failures, physical anthropogenic modification of the receiving water bodies not covered by TMDL were the cause of the TMDL deficiencies. The latter cause of nonattainment of the Clean Water Act goals is also pertinent to some rivers, the Kissimmee River above all, that were heavily modified in the past.

Understandingly, the authors of this chapter focused on the NP source controls but the effects of physical modifications may play also an important role in increasing or attenuating the nutrient loads to Lake Okeechobee, the Caloosahatchee River, and St. Lucie River, and potentially to the Everglades. Ideally, *one page information dealing with physical restoration of the rivers and reclamation of floodplains that can attenuate nutrient loads would be nice to complete the entire picture on nutrient abatement in the Northern Everglades.*

The District currently implements a Regulatory Source Control Program for phosphorus within the majority of the Lake Okeechobee Watershed. Approximately 86 percent is permitted (individual, general, and no notice permits). During this transition period of rule development efforts, the District has relied upon the voluntary agricultural BMP program. The WOD rule currently also does not address the Upper Kissimmee and Lake Istokpoga basins (page 4-47). The 86 percent participation is progress over previous years but it also indicates the programs are still in the initial phases of implementation and the results may not be fully noticeable for some time.

The more detailed information about the ongoing and planned programs in each watershed is presented on page 4-47 to 4-51. Figures 4-12 through 4-14 in the rest of the chapter contain water quality trends for individual hydrologic basins and individual tributaries and upstream sites where water quality and flow are monitored. Additionally, Appendix 4-3 of this volume provides a timeline of major source control activities, flow schematics depicting hydrologic basin boundaries, flow transfers between basins, water control structures associated with the water quality and flow data used for nutrient load calculations, and the water quality tributary stations (quoted from the report).

The figures contain histograms of Total P loads, ongoing projects and land use distribution. Land use distribution represents a historical dataset and the most recent period for which District land use data are available.

For all figures in the caption provide conversions for lbs/acre to kg/ha (not verbatim pounds/acre, everybody knows what lbs/acre is). Remove if possible ppb and replace it by µg/L.

The authors did not comment nor attempted to analyze the variability of the histograms on Figures 4-15 to 4-38. One could assume that because no source controls have been implemented and actually working in the watersheds the plots could be more or less steady reflecting variation of meteorological and hydrological factors. Nevertheless in some watersheds land uses changes have occurred over the last twenty years and also one or two (or more) hurricanes could have an impact. Land use changes can generate temporary heavy pollution or even permanent (e.g., change from natural land to agriculture) heavy NP loads. Some distinct characteristics of the histograms can identified and arranged into three groups:

Group I – Steady state – no distinct trend no to moderate land use change.

Figure	Watershed	UAL (lbs/acre)	Comment
4-17	Lower Kissimmee R.	0.36	Mostly natural land and pasture
4-22	S-133 Basin	0.71	Natural land, pasture, no change in urban use (28%)
4-24	S-154 Basin	2.66	99% natural land and pasture
4-25	S-191 Basin	0.95	75% natural land and pasture, no change in urban
4-27	L-8 Basin	0.11	60% natural, no change in urban, loss of citrus
		Note typo UAL cannot be negative	
4-26	S-135 Basin	0.34	Mostly natural, pasture and others
4-28	S-4 Industrial	0.65	Sugar cane and other agriculture 80%
4-29	East Caloosahatchee R	0.24	Sugar cane and citrus 35%
4-30	West Caloosahatchee R	0.62	Mixed land use
4-38	St. Lucie Tributaries		53% urban and transportation

Group 2 - Loading peaked around 2005 and decreased thereafter, most likely a hurricane effect

4-15	Boggy Creek	0.12	46% urban, urbanization
4-16	Shingle Creek	0.45	49% urban, urbanization
4-18	Fisheating Creek	0.20	Natural and pasture 76%, tree plantation
4-19	Arbuckle Creek	0.42	77% Natural, pasture, and others, 10% land conversion
4-21	Indian Prairie Basin	0.56	70% natural and pasture
4-23	S-154	0.85	80% natural and pasture
4-31	Tidal Caloosahatchee R.		35% urban, rest natural, woodland, and pasture
4-32	Coastal Caloosahatchee R.		Mixed land use
4-34	C-34 Basin	1.11	73% natural, woods, pasture, 12% land use change
4-36	C-25 Basin	0.7	20% land converted to agriculture
4-37	Ten Mile Creek	1.16	land use change

Group 3 - Increasing trend

4-20	Josephine Creek	0.12	37% natural, pasture, 8% land use change
4-33	C-23 Basin	1.14	62% natural,woods, 16% land used change to agriculture
4-35	C-44 basin	0.64	Almost 50% agriculture land use change

Concluding Summary

1. Similarly to the last year chapter in the 2015 SFER (WY 2014), the outline of the programs described in this year report was impressive and contained a lot of good ideas. It is an integrated plan and the strategy includes (1) mandatory implementation of BMPs for phosphorus reduction, (2) regulatory programs, mostly for stormwater discharges, (3) voluntary programs, (4) educational programs, and (5) integration with local and regional water quality projects.
2. Implementation of NP source controls in the Northern Everglades watersheds is in the permitting phases of implementation and at this time do not have an impact on the TP (or TN) loads.
3. The largest land uses are in the Northern Everglades watershed are natural land and pasture that will not be affected by implementation of NP pollution controls.
4. Meteorological extreme events affect the loadings, followed by several years of recovery (decrease).
5. Land use changes from natural and pasture to agricultural and urban lands may have significant impact on loadings wherein BMPs must be applied and subjected to permitting.
6. A reader of the chapter is overwhelmed by acronyms and section and paragraph numbers of the regulation to the point of being lost and spending a lot of time looking for the definitions. Some reediting may be necessary.
7. There is still a need to reedit the definition and use of units as advised in the review.
8. The chapter satisfactorily fulfilled and answered the questions to be considered for the Accountability type of document.

REVIEW CLOSURE AND BULLETS OF THE 2016 SFER – CHAPTER 4 BY VLADIMIR NOVOTNY (AA)

General Comment

The problems of eutrophication in the Everglades Protection Area (EPAhave been known for decades and the efforts to reduce the phosphorus load have been ongoing for at least twenty five-years. The Entire Everglades waters and the nutrient load abatement also include Lake Okeechobee and its tributaries and the St. Lucie and Caloosahatchee Rivers. The watersheds of the Kissimmee River, Lake Okeechobee, the St. Lucie River and Estuary, the Caloosahatchee River and Estuary, and the Southern Everglades are an interconnected system. The rivers receive intermittently releases from Lake Okeechobee and discharge them, with the runoff contributions from their own watersheds, into Gulf of Mexico and Atlantic Ocean.

Significant reductions in the TP loads have been achieved primarily by implementation of the Storm Water Treatment Areas (STA) providing a buffer between the Everglades Agricultural Area (EAA) and other land sources. STA programs were discussed in Chapter 5B. The nutrient control programs described in Chapter 4 focus on individual dischargers and also include two Native American Tribes. Their goal is to reduce unit loads of phosphorus in the entire Everglades watershed and also nitrogen in the watersheds of the two rivers which discharges into saline water bodies. Many of the programs described in Chapter 4 are still in the planning stages; hence, the improvements in TP loads are not marked as they have been those by STAs. The problem with participation in the nutrient reduction program described extensively in Chapter 4 is the fact that the programs are not fully enforceable and rely, to some degree, on voluntary participation. However, landowners pay a tax which pays partially for the programs.

Specific Comments

Comments and responses 1-4, 7-9. 12- 20 are inquiries or suggestions by the reviewers that were noted and satisfactorily addressed by the author.

Comments 4, 7, 17, 21, 22 are reviewer's notes on using improper units and the authors' referred them to the Distric response posted on November 2, 2015. The District response only addressed the units of volume (acre-ft) and flow (cfs) and not the improper units used in Chapter 4 (e.g., ppb instead of μg/L).

Comment 5 – Problems with Basin C-139. Herein, the Everglades Forever Act (EFA) mandated land owners to collectively not exceed annual average loadings measured in the period of 1978 to 1988, adjusted for the rainfall. This ambiguous goal, not addressing the individual landowners, resulted actually in increasing loads untill 2009. Furthermore, it has given landowners an option

not to participate in monitoring, which apparently left the agency partially blind, relying only on regional monitoring. However, monitoring individual sources especially when done by dischargers is almost impossible, the discharges are intermittent and landowners generally cannot operate expensive automatic monitoring equipment and analyses.

Comment 6 - the goal of the 25% reduction of the TP load. The 25% reduction goal was selected early in the 1990s in the EFA and was easily met with minimum implementation of BMPs. The authors agreed that after 20 years of the successful program, in hindsight, the goal of reducing loads to EPA could have been more stringent. It is the reviewer's opinion that a new goal for BMPs should be established because the efficiency of (well-functioning) STAs is already reaching its limits.

Comments 10 and 11– Clarification of BMP programs in C139 basin. The authors agreed to include clarification and explanation of the programs and "points" for BMP performance evaluation in the chapter.

Comment 12 – Loads from Feeder Canal – on Figure 4-10. These loads seemed to be significant but the concentration of TP is relatively low (8 µg/L). A note accompanying Figure 4-10 about the low concentrations in the canal could be added.

Suggestion of Highlights and Recommendations - Bullets

- The chapter highlights the source control program's mandated implementation of BMPs in the EAA and C-139 basins. The chapter satisfactorily fulfilled and answered the questions to be considered for the Accountability type of document.
- The EFA plan is hierarchical wherein local source controls are followed by regional control of runoff in Stormwater Treatment Areas and self- purification in the EPA basins. The authors reported that the EAA basin has been in compliance each year since the program's inception, similarly to EAA areas that border STAs. These programs are a core of the success of the total phosphorus controls in the EPA. The authors reported that the EAA basin has been in compliance each year since the program's inception.
- C-139 watershed seems to be a continuing problem where the goals have not been fully achieved. As a matter of fact, until five years ago, the water quality was getting worse and in six out of the ten years (including WY 2014) had TP loads greater than the target value. It appears about 50% of planned actions has not yet been implemented, the rest is in planning stages and land owner have an option not to collect water quality and quantity data to characterize permit-level discharges.
- The negotiations with the Native American Tribes should be concluded and their land included in the efforts.
- The participation of the landowners in the watersheds of the Lake Okeechobee and St. Lucie and Caloosahatchee Rivers Regulatory Source Control Program for phosphorus has been improving and exceeding now 80 percent. However, it has been taking a long time to plan and implement the BMP programs, especially in the watershed of the Norther Everglades and St. Lucie and Caloosahatchee Rivers. The full beneficial effects of BMP implementation in these watersheds will be materialized after 2020.
- Using an adaptive management approach, the agencies should reassess the original EFA BMP of 25% TP reduction goal that was achieved in the EPA 20 years ago without implementation of major BMP and stormwater runoff treatment abatement measures. In other words, the true potential goal of the past and current BMP planning and realization efforts should be quantified (e.g. by modeling) and the efforts adjusted accordingly.

016 South Florida Environmental Report

Chapter 5A – Performance and Operations of the Everglades Stormwater Treatment Areas
"AA" Review by Siobhan Fennessy

Overall this is a clear and useful overview and synthesis of the status of the WY2015 projects designed to improve water quality and meet the water quality standards necessary for the restoration projects in the SFQMD. Table 5A-1 is particularly helpful in outlining how projects relate to management goals. It would be beneficial to expand this table to include all the Consent Orders to demonstrate where the district is in the over scope of the projects (if possible). The expansion of STA-1 and establishing the FEBs should provide valuable returns in meeting water storage and water quality goals. A few specific comments are offered below to help improve clarity of the projects described in this section of the report.

Page 5A-2 (line 28) mentions that the Consent Orders recognize that the WQBEL won't be met until all the Consent Order activities are complete – when is that deadline?

Figure 5A – this map clearly shows the bounds of the L-8 FEB, but it isn't clear what the L-8 basin (shown in yellow) is, or how the two areas are related. Is this a catchment area? An explanation in the legend indicating what the different points are about would also be helpful, for example, points that start with "S" mean something, and points that start with "G" mean something else (I assume). There are a lot of these types of named structures in the reports overall and they can be difficult to track for those of us not working on the projects day to day,

Page 5A-11 – the bottom photo, labeled 5A-4, is out of order in the report; should be 5A-9, and on the following page 5A-10 (instead of 5A-5).

A-1 FEB - For the FEBs that are shallow and meant to hold stormwater, did the hydrological planning account for water losses due to evapotranspiration? This may be detailed elsewhere, and not appropriate for this chapter, but it seems that evaporative losses could be quite high.

Line 234, Additional Components – it is not clear what is meant by "conceptual projects" and where they might be found on Figure 5A-1 (as indicated). Conceptual seems very different than 'planned.' Perhaps the terminology should be changed, and the map modified accordingly?

Final comments in response to author revision and bullets for Chapter 5A of the Draft 2016 SFER
by Siobhan Fennessy (AA)

Please note: Any comments not specifically addressed below contained questions and suggestions that were satisfactorily addressed by the authors.

Response to comment #1

While I understand from the response that FDEP has requested that the District only report on milestones that were completed for the SFER in a given reporting year, it remains that expanding table 5A-1 to include all the Consent Orders to demonstrate where the district is in terms of the whole project would be beneficial.

Response to comment #2

This clarification should be added to the text.

Response to comment #5

If it hasn't been, this information on the hydrologic planning to include losses due to evapotranspiration should be incorporated into the text.

Response to comment #6

The altered text to eliminate mention of "conceptual projects" is helpful.

Suggestion of Highlights and Recommendations - Bullets

- This is a clear and useful overview of the status of the WY2015 projects designed to improve water quality and meet the water quality standards necessary for restoration projects in the SFQMD.

- Expanding table 5A-1 to include the status of all the Consent Orders would clearly demonstrate where the district is in terms of progress on the overall restoration project.

- Suggest that the information specifying that hydrologic planning included evaporative losses be incorporated into the text.

2016 South Florida Environmental Report

Chapter 5B – Performance and Operations of the Everglades Stormwater Treatment Areas
"A" Review by Vladimir Novotny
"AA" Review by Siobhan Fennessy

General comments

The Everglades Stormwater Treatment Areas (STAs) are freshwater wetlands located south of Lake Okeechobee and constitute a buffer between the Everglades Agricultural Area (EAA) and the Everglades Protection Area. Hence they are a critical component in the restoration of the Everglades with the goal to remove total phosphorus (TP) from surface water flow. The STAs abut the Water Conservation Areas 1(Refuge), 2 and 3, which themselves provide a buffer to the Everglades National Park (ENP). In addition to treating runoff water from EAA, about 80% of 721.6×10^6 m^3 (or 0.722 km^3 = 585,000 ac-ft) of Lake Okeechobee flow releases were directed to the STAs in the WY 2015. Overall, the STAs provide about 80% TP removal, which is very good in comparison to traditional stormwater settling ponds (and wetlands) that typically have TP removal efficiencies around 50 to 60 percent. Average inflow weighted TP concentration of 99 μ/L was reduced to 17 μg/L, a remarkable achievement. (Please note that on lines 44 and 45 ppb was used with conversion to μ/L and not to μg/L; ppb is an archaic improper US unit that cannot be used in scientific report).

The purpose of this chapter was to document the performance of the Everglades STAs for WY2015, analyze short-term and long-term trends in STA performance, describe the status of the STAs, and summarize operational challenges, repairs, and management activities. Over the period of record (POR), the STAs have been subjected to high hydraulic loading (HLR) events associated with large storm events - hurricanes and regional drought periods. The good performance of the Everglades STAs in WY2015, except for STA-5/6, can, in part, be attributed to a moderate water year, with no significant storm events or dry-outs.

Table 5B-1 presents the summary of performance of all STAs in WY 2015. While providing lots of useful information, the table uses a mix of SI (mt, g/m^2/year, cm/year) and old US (acre-ft and ppb) units without conversion factors for US units. Readers unfamiliar with the SFWMD reporting and using SI system would read mt as milli – ton (one thousandth of a ton). The same problem with the inconsistent use of units is apparent in Figures 5B-2 and 5B-3 where the flow units are acre-ft (without a conversion) which is a unit of volume. Concentration unit ppb for TP must be replaced by μg/L as parts per billion is not a unit of concentration (mass/volume) but a fuzzy unit of parts of something divided by billion parts of the same something. These unit inconsistencies and improperness are ubiquitous throughout the chapter. There is no need in the captions to explain what cm/day (centimeters per day) and g/m^2/yr (grams per square meter per year) are, every high school student should know that. The preferable format of the unit phosphorus load is $g/(m^2$ - day) or better, g m^{-2} day^{-1}. If giving an explanation is deemed

necessary perhaps a glossary could be constructed for the report. If the district is compelled to use units such as acre-ft, without conversion to SI units, perhaps the rationale for this could be explained in the text.

This inconsistence and mishmash of units characterize almost every figure in the chapter. For example ppm in Figure 5B-8 should be replaced by mg/L.

Figure 5B-3 – The hydraulic loading reported of approximately 2 cm/day is similar to natural or free surface wetlands used for stormwater treatment[1]. TP loading is very low when compared to design parameters for free surface wetlands (WPCF 1990 [1]). The WPCF manual recommends TP loading in kg/ha-day that, after conversion to g/m^2-year would be order of magnitude greater that those listed in presented on the Figure and throughout the chapter. However, it should be pointed out that typical constructed storm and waste treatment wetlands do not provide degree of treatment that would be as good as P removal in STAs.

Line 186 –It is not clear what is mean by vegetation condition; does this refer to community composition and cover data? An assessment of condition connotes things that aren't presented here. This term is also used in subsequent headings, such as at line 378. Please change to reflect what was actually measured. In contrast, the section starting at line 1399 does present information on vegetation condition (in this case, the result of stressors that affect the 'health' of a given plant).

Line 225 - This paragraph has text that is identical to text in the paragraph at line 217.

Page 5B-12- STA-1 The hydraulic shortcutting, loss of emerging aquatic vegetation (EAV), and catastrophic loss of submerged aquatic vegetation (SAV) was apparently anticipated in this area. Most likely the loss of vegetation created free flowing, higher velocity channels. In spite of these deficiencies, STA-1 removed in last years over 90% of incoming TP load (Figure 5B-6). On line 385-386 SAV coverage in Cells 4N and 4S was reported as poor, with 20 and 10 percent of the area, respectively. There was also a brief period of 7 days from January 30 to February 5 in which one cell appeared dry. After the dry period, internal water levels in the cell rapidly increased (lines 408-409).

Figure 5B–This figure is lacking the legend for the colors used (this is found in other figures, for example at line 500). Figure 5B-9 shows that the depths in STA 1- Cell 2 ranged from 0.2 to 0.4 meters (0.6 to 1.3 ft), which is a very shallow flow. In 5B-9b it is not clear why net inflows are described as negative; this figure is meant to show inflow and outflow volumes as separate lines.

Line 584 – It is reported here that turbidity at S5-A was 20 ppm. It would be helpful to explain what S5-A is and where it can be found? On Figure 5B-1 it looks that it might be an inlet from

[1] WPCF. 1990. Natural Systems for Wastewater Treatment; Manual of Practice FD-16. Water Pollution Control Federation, Alexandria, VA

an unidentified canal. Also turbidity is not measured in ppm (mg/L) which must be a typo. The unit of turbidity is NTU, which has no mass value.

Figure 5A-20 is another representation of SAV coverage of a cell which shows shortcutting channel along the side though which shortcutting may occur. If these areas support EAV or other vegetation types please clarify.

STA –2 has performed relatively well, with an annual TP flow weighted mean average concentration of 21 μg/L at the outflow and TP load retention of 77 percent. Apparently, two cells within STA-2 were never farmed and it was suspected that this reduced the flow of P from the soils forming the bottom of the cells.

Figure 5B-24 – The text states that starting in WY2009, the southern end of Cell 2 was converted from cattail to SAV to improve treatment performance, however Figure 24 doesn't indicate improvement in the STA's performance overall. Is there an explanation for this?

Figure 5B-25 is missing legend on vertical axes A, B, and D. Are they the same as those on C?

Figure 5B-26 - PLR (phosphorus loading rate?) should be defined in the caption. It might have been defined pages before in the text but a reader might have a hard time to find it. On subsequent figures replace ppm by mg/L.

Line 787 – It was surprising to see such a lengthy discussion of calcium here since it was not mentioned above. Why is it a focus for STA 2 and not the other STAs? Some rationale for its inclusion here would be useful. Most readers at this point in the report are expecting a parallel structure to be used for the findings on each STA and their flow ways. As it is presented this seems like an outlier. It is also introduced very abruptly. The first sentence in the section states that calcium decreased by approximately 38 percent at the STA-2 inflow; 38% of what? Obviously the chemistry of calcium and phosphate are intertwined (as influenced by pH), but this section needs to be introduced properly and set in context.

Line 817 –This paragraph doesn't synthesize the Ca and SRP data, which we were expecting. The flow of logic would also benefit by re-ordering the paragraphs in this section to more clearly explain the goals and results. As an example, the paragraph starting at line 827, which gives the objectives of the study, could be presented first.

Line 836, - Why was Ca measured only in 2 months? Is this enough data to make sound conclusions?

Line 845 - Results and discussion – this goes back to a discussion of P only with maps of the spatial distribution of P. What happened to the Ca profiles (line 827)? Why not plot P and Ca? The discussion of the links between Ca and P are not clear. This is an interesting topic and, if it is retained, should be presented in a clear and logical manner. As it stands, this section is very

disorganized and extremely difficult to follow. It almost reads as if parts of a draft manuscript was copied and pasted into the report.

Line 927-8 - What insights have been provided? This is vague.

Line 1336 and 1337 and Figure 5B-44. As a note, the TP unit load of 0.7 g/m^2-year is an order of magnitude smaller than that typical for stormwater treating wetlands[1].

Figure 5B-44 - It would be helpful to identify what the abbreviations WFW, CEW, and EFW stand for (as in Figure 5B-46).

Line 1362 – Here the same general points as above apply for the Ca- P discussion. In addition, Ca is presented in units of mg/L (as it should be) while above the units were ppm.

Figures 5B-45 and 5B-46. PWM and FWM (respectively) should be identified in the captions.

Line 1400 – Why is this a question of interest here and not in the other STAs? What were the findings?

Page 5B-68 - The authors report that herbicides were used to eliminate cattail vegetation. Why? Cattail herbicide treatment was also mentioned for other STAs. This contradicts with the finding in Chapter 3B dealing with excessive mercury contamination of fish tissue in the EPA which observed that cattail vegetation cover has had significantly more beneficial effect on reducing THg fish tissue contamination than SAV or absence of vegetation.

STA 5/6. The overall efficiency for TP retention (67%) was less than that for the other STAs but still relatively good. Can the cause of differences in performance be discussed?

Line 1677 – There are no maps of vegetation for this last section as there were for the other STAs. The maps were quite well designed, conveyed a lot of information and few well into the discussion. Overall the chapter ends quite abruptly. The authors might address the overall conclusions, issues, and possible lessons learned from all of the above data on the STAs that can feed into adaptive management decisions.

Table 5B-8 presents the vegetation controls. It mentions repeated herbicide controls of hyacinths. While hyacinths are invasive species there are known to be highly effective for removing nutrients and other pollutants and can be harvested for producing biofuel. Has this been considered? Does the state prohibit them for this use?

Concluding comments on the main deficiency of the chapter.

Overall, the work presented in this chapter is scientifically sound. It is hampered by the misuse of units and some organizational issues. In the last years the reviewers were repeatedly reminding the authors about inconsistent units used in their chapters. The SFER is read and used not only by the employees of the SFWMD but it is put on web, sent to wide audience and interest

in this report is worldwide. Consequently, the primary unit system used in report writing ideally should be SI system with conversions to the old US system in parentheses. Authors of some chapters realized this fact and are using generally proper units and if some US units are used (e.g., archaic acre-ft) conversion factors to SI units (1 acre-ft = 1 233 m^3) or equivalent values in US units should be provided in parentheses. However, authors of some chapters in this (and last) year SFER even mixed SI prefix with the archaic acre-ft to come up with "kacre ft" (meaning kilo-acre ft) which is nowhere defined on web or scientific conversion tables. The closest found on Google was "nacre" which means a shiny mineral excreted by shellfish. SI units are now used by 100% of scientific reports, books and journals, most government reports, in all US EPA reports and taught now by all major universities as the primary unit system.

We are now fifteen years in the new millennium but Chapter 5b brought the quality of writing back by twenty five years. The chapter is one of the worst mishmashes of units in the SFER whereby archaic US units (ppb, ppm, acre-ft. cfs) are used in the same paragraph of even sentence with SI or (pseudo) SI units (mt for metric ton, g/m^2/year,. The authors must completely revise the units in reporting, replace all "ppm" by mg/L (as they done on some pages of the chapter) and "ppb" by µg/L. Ppb and ppm are not proper measures of concentration defined as mass/volume. They have not been used for years and are unacceptable. Concentration in all scientific report has been defined as mass/volume (mg/L or gram/m^3) while ppm means parts (of something) per million of parts (of something). Concentration of 5 mg/L of a pollutants expressed as 5 lbs of the pollutant per one million lbs of water would be the same as mg/L only if water is very pure and has temperature of 4ºC (39.2 deg F). In any other temperature or salinity ppm would not be the same which is the case of the EPA. TP unit load in g/m^2/year should be reported as g/(m^2-year) or more properly g m^{-2} $year^{-1}$.

As this is an on-going issue, perhaps the District could craft a "style manual" for these reports that authors could use in the years to come. This might alleviate some of the issues discussed above and lead to a more consistent product that needs less editing. These reports are a huge undertaking that require the contributions of many people, which we understand can be challenging. A style guide might help the authors and the consistency of the final report.

Final comments in response to author revision and bullets for Chapter 5B 6 of the Draft 2016 SFER
by Vladimir Novotny (A) and Siobhan Fennessy (AA)

Comment 1. Problem with units and writing

This is a repeating problem appearing throughout the chapter year after year. The inconsistency with the units and the use of archaic and incorrect units has not improved from previous years. In this chapter inappropriate units are used and different units are used for the same variables in different places (e.g., mg/L and ppm), which undermines the scientific credibility of the report. In this respect, this chapter appears to be among the worst of the chapters reviewed. The reviewers pointed out that without correcting these inconsistencies the chapter should not be published. The chapter was apparently written by more than a dozen of authors who did not coordinate; the chapter was not edited for inconsistencies or to make it cohesive. This year, the authors avoided addressing the issue of units and pointed to an agency response. While reviewers appreciate that the problem with inappropriate use of units has attracted the agency's attention, the authors should acknowledge the inconsistencies and willingness to address them.

We recommend the District create "style manual" for these reports for use by all authors. This could alleviate the issues discussed above and lead to a more consistent product that needs less editing. These reports are a huge undertaking that require the contributions of many people, which we understand can be challenging. A style guide might help the authors and the consistency of the final report.

Comments 2-8, 10-11, 13, 16-21, 23, 25.

These comments contained inquiries and suggestions by the reviewers that were satisfactorily addressed by the authors.

Comment 9 – Lack of improvement in Cell 2 after eliminating cattails.

The authors attributed the lack of improvement of cell -2 of STA-2 to "multiple factors". The text of the chapter should contain a list of the factors and a plan on how the problem of the lack of improvement will be remedied.

Comment 12 – No rationale given for calcium (Ca) investigations and text is disorganized.

We appreciate the information provided on t he rationale for this part of the study. However, it is not clear in the authors' response whether the text will be edited for clarity. For example, there is a parallel structure to the other sections of the report that is not found here, with no introduction for the reader.

Comment 14 – Calcium (Ca) investigations lasting only two month

The information provided in the authors' response could be included in the chapter. As the response is written it isn't clear whether this is intended.

Comment 15 – Disorganized section on Ca – P relationship

The response to comment 15 is not complete. If this section is not a subsection under the preceding calcium section, then why does it appear without introduction? Why place a section called 'Results and Discussion' without saying what the results are for? If this section comes at the end of the section on calcium, then why is calcium data presented below at line 930? As it stands now, the authors did not address the fact that the section is disorganized and difficult to follow.

Comment 22 – The effect of cattail removal in methyl mercury contamination

While the reviewer(s) agree that the problem of low methyl mercury contamination in some STAs may be related to higher sulfate levels, the statement that "the selective removal of cattails is not anticipated to create elevated mercury in fish inhabiting in STAs" is conflicting with the finding in Chapter 3B which reported significant "beneficial" effect of cattail vegetation on reducing methyl mercury contamination in some fish species.

Comment 24 – Lack of vegetation maps

The information provided in the authors' response could be included in the chapter. As the response is written it isn't clear whether this is intended.

Comment 26 – Efficiency of FAV and their potential for harvesting and lack of market for byproducts

As pointed out in the last year review of the chapter, killing FAV by herbicides and leaving the dead biomass in the lagoon/wetland will accelerate the eutrophication process of change of eutrophic shallow water bodies (STAs) to a marsh filled with organic muck and loss of efficiency. The harvested FAV are a resource but their harvesting and deposition without resource recovery, for example, in landfills would not make sense and would be uneconomic. Nevertheless, the potential of the harvested biomass for energy products is real and will improve in the future. If the dead biomass is left in place, the muck will have to be removed in fifteen or so years by dredging with the problems and economics that may be far more serious

Suggestion of Highlights and Recommendations - Bullets

- This chapter was written by thirteen authors with different writing styles and methods of organizing text, making it difficult to follow the science that is presented. In addition, the chapter was not edited for the use of inappropriate units and consistency. The chapter is also lacking conclusions.

- We recommend the District create a "style manual" for the SFER for use by all authors. This could alleviate issues with units and writing and lead to a more consistent product that requires less editing. These reports require a lot of effort and the contributions of many people. A style manual will help the authors and the consistency of the final report.

- The main work on implementing STAs appears to be finished and the current phase is focusing on observation and fine-tuning, especially on control of vegetation. The performance of STAs exhibiting 80 to 95% Total P removal is **very good**, particularly when compared to artificial and natural wetlands treating urban stormwater and wastewater effluents.

- The study of the relationship of TP to calcium should be better explained and clarified, and the text reorganized.

- The district might consider initiating studies on the resource recovery (energy, agricultural soil conditioning and fertilizing biomass) from harvested FAVs, which are very efficient in removing nutrients from water. Using herbicides to kill FAV and leaving the dead biomass in place shortens the lifetime of STAs which is not limitless.

Comments on Chapter 5C: Update for the Restoration Strategies Science Plan
AA reviewer – P. Dillon
Accountability Review

General

a. Does the draft document present a defensible account of data and findings for the areas being addressed that is complete and appropriate?
This sub-chapter presents a brief overview and update of eight studies that are in progress and that form the core of the Science Plan for the Everglades Stormwater Treatment Areas. It provides a well-written overview of this topic that is easy to read (with one exception) and understand. The Science Plan and the studies all focus on methods to reduce the output of phosphorus from the STAs. All 8 of the studies are in an early phase; thus, many understandably have few findings to present at this time while some others that started earlier have more results. All of the projects appear to be on schedule. The study schedules for future work are realistic and the proposed future activities are consistent with the detailed study plans. One minor point – the number of acronyms and capitalized phrases makes the introduction hard to read.

The first project, on the use of soil amendments to control P flux project is just finishing phase 1 with a draft report prepared but no results included in this chapter.

The second project, on development of operational guidance for FEB and STA regional operation plans, is in its third year and demonstrating good progress. It is nice to see some of the high quality research that is being undertaken appear in the peer-reviewed literature rather than just the grey literature. Again, it is good to see the modeling making significant progress. One criticism – I have no idea what the first point under progress (l. 126-128) means.

The third project on evaluation of P sources, forms, flux and transformations is going well. Fig.5C-4 is very helpful. It indicates that work on P speciation should have begun about a year ago. I would be interested to hear more about the results of this task but there is no mention of this in the results section. Also, I remain dubious about the use of auto-analyzer technology for P sample collection, although the relatively high concentrations here make it less likely to fail.

The fourth project which focuses on periphyton-based stormwater treatment shows marked success in reducing P concentrations although this is a site where TP concentration of the inflow is relatively low to begin with. I am not clear on why the volume of water out is much greater than that coming in (Table 5C-1) – is this unmeasured leakage in that is included in the outflow? is it rainfall? Is the drop in TP a dilution effect?

The project on the influence of canal conveyance features on inflow and outflow P concentrations seems designed to tie up the loose end addressing whether the inflow and outflow canals themselves contribute or remove P. This is still in its early phase and few results are discussed. The report that one canal acted as a P source certainly requires further investigation.

The evaluation of inundation depth and duration for cattail sustainability began this year and already much progress has been made in terms of setting up the study site plots.

The seventh project focusing on improvements in estimating the water and P budgets has made substantial progress as well. Improvements in water budget estimates will translate directly into better P budget estimates.

The final project on evaluation of sampling methods for P is critically important. The project's results are only as good as the data collected. My experience with autosamplers is opposite to that reported here. I expected and saw lower TP values, largely because a portion of the P ends up in bacteria and phytoplankton attached to the sample bottle walls. My solution has been to use containers in the autosamplers that the sample can be digested in with no transfer to another vessel.

b. Is the synthesis of this information presented in a logical manner, consistent with earlier versions of the report?
The material is presented in a very clear and logical manner and is totally consistent with earlier versions. I like the charts provided with the third and fourth projects that show the timelines for the different activities very clearly.

Are findings linked to management goals and objectives?
All of the studies contribute very directly to the management goals and objectives in that they all focus on ways of reducing P output from the STAs.

Is there any constructive criticism and guidance to offer for the District's large-scale programs?
I suggest careful evaluation of the autoanalyzer sampling methodology is warranted. The question of P speciation hasn't been addressed in any detail in this or previous reports but needs to be.

2016 SFER
Chapter 5C Update for the Restoration Strategies Science Plan
Reviewer Dillon (AA) – Accountability Review

Closing Comments

This sub-chapter presents a brief overview and update of eight studies that are in progress and that form the core of the Science Plan for the Everglades Stormwater Treatment Areas. The Science Plan in general and these studies in particular focus on methods to reduce the output of phosphorus from the STAs. All 8 of the studies are in an early phase; several have limited or no findings to report at present while some others that started earlier have more results. All of the projects are on schedule and have realistic schedules for future work.

The chapter does a very good job of fulfilling its intended purpose of providing an overview of the studies that are the core of the Science Plan for the Stormwater Treatment Areas. The replies to the comments made by the reviewer address all issues raised in the review. Additional results that have been gathered since the draft report was circulated will be added to the final version of the chapter; it is good to see that timely updates can and will be added.

Key Findings and Recommendations

1. All of the studies can contribute directly to the management goal of reducing TP loading. The potential reduction in TP load will make a significant contribution to the goal of reducing TP load to 140 mt/yr.

2. Proposed future activities for the coming year are consistent with the long-term plan and the goals of the District, and should proceed.

3. Phosphorus (loads, concentrations) is a central focus for the SFER. It is critical that analyses be accurate and precise. Detailed studies (as planned) about the use of autoanalyzer technology in collecting water samples for P analysis and about P speciation (organic P) are very important and should be priority work. Similar investigations of dissolved vs. particulate P should be planned in future.

Comments on Chapter 6 of the 2016 South Florida Environmental Report
Dr. Michael A. Mallin, 'A' reviewer
Dr. Siobhan Fennessy, 'AA' reviewer.

General Comments

Overall this chapter is quite strong, with most sections stating clearly articulated goals with clear links to restoration management objectives. The chapter is well organized, with most sections having an introduction, methods, results, and discussion, then a conclusion on the relevance of that topic to water management. This makes the text clear and easy to follow, and allows the science to take center stage. Some of the research presented is quite strong and will benefit our basic ecological understanding of the Everglades ecosystem, and its application will strengthen, and make more efficient, the various restoration activities. It is encouraging to see the positive direction that many of these projects are moving in.

Table 1 is very useful in summarizing the Everglades studies and demonstrating the links between mandates and the results of monitoring and research to support those mandates. However, comments such as projects are "providing interesting information", for example with the Cape Sable Seaside Sparrow, are vague and should be revised.

Hydrologic Patterns for Water Year 2015

I found the discussion on page 6-9 regarding the relationship between the wading bird abundance and habitat very interesting. Line 195 makes the statement that nesting close to the ground in cattail is rarely successful due to mammal predation, yet there were 9,000 ibises nesting within. I have read (Dorcas et al. 2012) that there have been severe declines in everglades mammal populations from Burmese python predation – could this be a factor in improved nesting success?

Dorcas, M.E., J.D. Willson, R.N. Reed, R.W. Snow, M.R. Rochford, M.A. Miller, W.E. Meshaka, Jr., P.T. Andreadis, F.J. Mazotti, C.M. Romagosa and K.M. Hart. 2012. Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. *Proceedings of the National Academy of Sciences* 109(7): 2418-2422.

Regarding the fires – I would think that burning would reduce the amount of overlying cover the prey items would normally have protecting them, and the wading birds were simply taking advantage of this. I would further speculate that after a burn, new growth would be nitrogen-rich, and invertebrate grazers as well as herbivorous fish would avidly feed on it, thus increasing their exposure to avian predators.

Wildlife Ecology

Page 6-19 – line 325 – please state (briefly) the tenets of the Trophic Hypothesis here.

Page 6-20 lists the performance measures, and they are ordered beginning with nesting bird numbers. However, the discussion on restoration targets is back on page 6-24, along with a nice

table (6-3) that should be the lead for the section following the listing of performance measures. State what occurred, then follow that with the various explanations that are on pages 6-21 to 6-23.

Fish Distribution

This is an excellent study based on an effective experimental design with well-designed figures. The data show quite clearly the rapid response of fish to hydropatterns. Specific comments include:

Page 6-25 – line 550 – please state enclosure dimensions here.

Page 6-31
– line 636 – please remove the word "hopefully". Also, making the text more active is encouraged. For instance, this sentence might read "Next year we hope to experimentally examine the relative roles of recession rate and …. "
lines 637-644 – the rapid use of newly flooded habitat is proscribed to habitat profitability. I assume that means the availability of terrestrial insects in the newly flooded habitats? This can be easily tested by sampling for prey items of newly flooded habitat compared with habitat that has been flooded for weeks. Something to add into next year's study perhaps.

Cape Sable Seaside Sparrows

Page 6-34, top – The text states that two organizations monitor the sparrows, but only the NPS staff is mentioned.

Page 6-35, bottom – please explain what "degradation of two roads" means (removal? destruction?). Are there results of the vegetation removal efforts to present?

Tree Islands

Page 6-41-line 885-9 – monitoring the "health" of the islands in order to determine how the structure and function relate to restoration is a lofty but vague goal. How is ecosystem health defined? Using the term 'ecological condition' seems more appropriate and relates more directly to the goal of restoring ecological integrity. In light of that, what are the goals for the three measurements presented here? The data for ET is not presented, so this should be removed from the specific objectives presented here, or an explanation offered as to why it isn't included.

– The last few lines on this page discuss the variations in ^{13}C values – please explain what high or low ^{13}C means, physiologically to plants. What is the target for determining 'health'? What insight do these data give?

A figure, perhaps a drawing, of a healthy tree island vs a "ghost' island would be a great help here for the reader to visualize the difference, as would a description of what a ghost island is. Label the key areas on the drawing. I am sure there are such figures available within the SFWMD.

Page 6-42, Figure 6-23- this is not an easy figure to interpret. Please clarify. A key to the different colors would be helpful.

Page 6-44 – line 916 - The stable isotope data are not mentioned here, is it meant to be the basis for a metric?
Table 6-6 – It seems that a single reference site (one intact tree island) is the basis for defining the target for metric performance. Relying on a single site (n=1) to set expectations is risky as natural variability is not accounted for. If this is the case the performance targets will be difficult to defend. If the targets were drawn from earlier data sets then citations should be included.

Ecosystem Ecology

The discussion of the results of the cattail herbicide and burning attack was very interesting. Wading birds came in rapidly and their use persisted for many weeks. It is interesting that on Page 6-49, line 1060, the authors note that "As expected, this management approach produced habitat highly attractive to foraging wading birds'. This seems to contrast with page 6-10, where on line 201 the feeding in the burned areas is described as 'unusual behavior". So it is unusual or expected?

Page 6-46 – line 1010 - There is an extra word here.

Page 6-47 – The east-west difference in spatial patterning is not described, yet is cited as an important factor in the results. Please add where appropriate.

Overall, the active marsh improvement projects seem to be generating a lot of excellent and practical data that can be applied.

Florida Bay Water Quality

This on-going study builds on a comprehensive and extensive data set that is invaluable in monitoring restoration success. Only one comment on this section is on the Figures (6-28-30), which have different ranges of data on the y-axes. It would make comparisons easier if the y-axes covered the same range of values, or if the differences were noted in the legends to alert the reader.

Coastal Lakes

Please add some information about these coastal lakes, such as size, average depth, trophic state (if available). These systems are rarely mentioned as part of the everglades to those not intimately involved in local research.

Benthic Vegetation

Page 6-60, Methods – It appears that each group involved in the monitoring is using a different method for the vegetation monitoring. The reference to earlier studies is appreciated, but adding a sentence or two here justifying why these data are comparable is warranted.
Paragraph line 1249 – the frequency of *H. wrightii* in 2015 looks to be within the range of variability for Twin Key and Rabbit Key. Can these be tested for significance?

SAV Projects

Please reconcile the two Florida Bay SAV chapters. On page 6-60, bottom, it is stated that in WY2015 the overall benthic vegetation community is stressed. On page 6-62, the combined indicator score for 2014 is largely rated "good". The two chapters share one of the co-authors, so please come up with some sort of compromise (I realize the two may be referring to two adjoining years, but it is still conflicting as written).

Page 6-62, first paragraph – Please include citations or a short explanation of the metrics used.

Peat Collapse

This section discusses the potential impacts of sea level rise on the chemical and physical breakdown of the peat soils in the shoreline marshes. It is all bad news, but it is important that the SFWMD continue to support such efforts for planning purposes.

Page 6-65, first paragraph – If CO_2 and CH_4 emissions were measured as a function of salinity, we expect that methane emission rates will decrease as sulfate increases. See for example:

Poffenbarger, H.J., B. A. Needleman, and J. P. Megonigal. 2011. Salinity influence on methane emissions from tidal marshes. *Wetlands*. 31:831-842.

Given that, it isn't clear why the marshes were bigger C sources with increased salinity. The means by which these two C fluxes were combined into an overall C flux isn't provided. Please explain.

Decomp Physical Model

First – change the name of this chapter. It is an atrocious title and tells the reader absolutely nothing. Change it to "Experimental restoration of sheet low to improve habitat" or something like that. It contains important restoration information so make it something someone who is not a modeler will want to read.

Page 6-76 – last line of the report – it says this process could potentially alter P cycling in the canal. You need to be less vague. How would it be altered? What are the implications?

Final comments in response to author revision and bullets for Chapter 6 of the Draft 2016 SFER
by Michael Mallin (A) and Siobhan Fennessy (AA)

Please note: Any comments not specifically addressed below contained questions and suggestions that were satisfactorily addressed by the authors.

Response to comment #1- An overall statement on the chapter

We reiterate that this is a strong chapter, with most sections having clearly articulated goals with clear links to restoration management objectives. It is well organized and easy to follow, allowing the science to take center stage. Some of the research presented is excellent and will benefit our basic ecological understanding of the Everglades ecosystem, and its application will strengthen, and make more efficient, the various restoration activities. We are encouraged to see the progress made on many of these projects.

Response to comment #3 – The potential of pythons impacting mammal nest predation in cattails

With python predation lower in the N. Everglades, the authors make a solid case for local alligators keeping mammal nest predation low.

Response to comment #4 – Impact of fires

We appreciate the fuller explanation regarding water depth, as well as the reference.

Response to comment #5 – What is the trophic hypothesis

It is still unclear exactly what the trophic hypothesis states – this should be described (however briefly) in the report rather than directing the reader to a hyperlink. Saying they are tightly interrelated is not helpful.

Response to comment #8 – enclosure dimentions

We appreciate the clarity on the enclosure dimensions.

Response to comment #10 – prey availability in newly flooded habitats

The authors are in the process of analyzing the insect abundance and this should provide some intriguing data for the next report.

Response to comment #12 – clarify degradation of two roads

We thank the authors for the clarification regarding the road cuts – it seems to indeed be improvement rather than degradation!

Response to comment #15 – Meaning of ^{13}C values

We thank the authors for the fuller explanation added to the chapter, and look forward to the final results of this project.

Response to comment #16 – Add a 'ghost' island figure

We appreciate that the authors are developing a generalized figure for a tree island, and are including a photo of the island in question for this report.

Response to to comment #17 – Clarify Figure 6-23.

We appreciate that the authors have added text to clarify this figure.

Response to comment #18 – Stable isotope metrics

We appreciate that the authors have added text to clarify this work, and are looking forward to seeing how it performs in future studies.

Response to comment #19 – Number of reference sites

We appreciate the explanation provided, and the constraints of resource availability. If they haven't already, we encourage the authors to add this explanation to the text of the report.

Response to comment #20 – Bird use of burned habitats

We appreciate the fuller explanation of bird use of the burned area.

Response to comment #24 – Use consistent range of data on y-axis of graphs

We appreciate that the authors have altered the figures and made the data easier to interpret.

Response to comment #25 – Coastal lakes

We appreciate the fuller explanation regarding these coastal lakes. They may be "sentinel systems" for freshwater increases. These aquatic systems should provide a number of excellent graduate student projects.

Response to comment #28 – Florida Bay SAV

The authors have taken pains in the revision to more fully explain the indicator process and the results – thank you!

Response to comment #33 – Model name

A much better and informative title, thank you!

Response to comment #34 – P cycling in the canal

The authors have changed the last paragraph to provide much more detail than before, and have improved clarity. It appears the future flow events will be providing excellent information on nutrient vs flow dynamics in the canals and surrounding environs.

We appreciate the clarifications and chapter edits from the authors!

Suggestion of Highlights and Recommendations - Bullets

- This is an excellent chapter; most sections have clearly articulated goals and clear links to restoration management objectives. It is well organized allowing the science to take center stage. The research presented will benefit our basic ecological understanding of the Everglades ecosystem, and its application will strengthen the various restoration activities. It is encouraging to see the positive direction that many of these projects are moving in.

- A description of the trophic hypothesis is needed (however briefly) in the report rather than directing the reader to a hyperlink. The statement that wading bird reproduction, foraging, prey availability, and hydrology are interrelated and form the basis for the hypothesis is not clear.

- The use of only one tree island reference site as the basis for defining performance targets for metrics is problematic. Relying on a single site (n=1) to set expectations is risky as it cannot account for natural variability between sites. This will make the performance targets difficult to defend.

Comments on Chapter 7: Status of Non-indigenous Species
AA reviewer – P. Dillon
Accountability Review

a. Does the draft document present a defensible account of data and findings for the areas being addressed that is complete and appropriate?
This chapter provides a very thorough account of the current status of non-indigenous plant and animal species and of management activities related to eliminating or at least reducing their effects on the environment of South Florida. Although eradication is always the preferred solution, this is often impractical or impossible, and controlling the spread of invasive species may be the most that can be achieved. The report acknowledges that there are many non-indigenous species for which there are no data, but it is clear that attention is given to those with the greatest potential to damage the ecosystem. The 3-level scoring (red/yellow/green) approach is an effective way of presenting the level of risk for each species.

The chapter is very thorough in its approach, and I appreciated particularly the species by species discussion on pages 13-42. The authors are open about the challenges, indicating clearly species for which they expect to have trouble implementing a successful control programme. One small addition would be helpful for the reader – in a few cases the year of introduction of the species is reported but usually it is not given. This would give the reader an idea of how fast new species are spreading.

There are some notable successes to date. The melaleuca story is an excellent example of what can be accomplished with adequate funding and a co-ordinated approach with buy-in from all partners. It appears that the programmes in place have reduced the extent and impacts of several key invaders, although the region is clearly under great pressure from a continuous influx of new species.

b. Is the synthesis of this information presented in a logical manner, consistent with earlier versions of the report?
This chapter is very well-written and organized and very informative. The current status of the most important non-indigenous species is outlined and any control activities that are in place are updated. I would like to see a little more detail on control methods, specifically which herbicide is being used with which species.
Note that in my copy Table 7-1 is blank.

Are findings linked to management goals and objectives?
The linkages between the control programmes, the monitoring results and management objectives are very clear. The amount spent on control programmes is substantial but it is clear that increases are needed make headway against the increasing number of potential serious threats. Prioritizing based on risk, as is being done, is essential.

Is there any constructive criticism and guidance to offer for the District's large-scale programs?
Biological controls for melaleuca, water hyacinth and old world climbing fern have been introduced and others are being considered and worked on. As mentioned last year, the scientific literature is full of examples where biological controls have had unexpected adverse effects. It is critical that extensive studies be carried out before any biological control agent is introduced.

Specific comments

l. 218 – “a new insect was developed” – what do you mean, not created, surely

l. 318 – it is good to see the CISMAs developed but it is not clear whether or not different CISMAs overlap spatially, e.g. is there more than one CISMA concerned with the Kissimmee watershed? the Everglades? A figure like 7-6 for each CISMA mentioned would be useful, or a single figure with the different CISMAs showing.

l. 1190 – a good example where regulatory tools are inadequate but should be easily fixed

2016 SFER
Chapter 7 Status of Non-indigenous Species
Reviewer Dillon (AA) – Accountability Review

Closing Comments

This chapter provides a very thorough account of the current status of the large number of non-indigenous plant and animal species threatening the South Florida natural environment. Details of the management activities related to eliminating or reducing their effects on the environment are outlined. There have been some notable successes but this is likely a never-ending battle. Eradication is the preferred solution, but is often impractical or impossible; however, controlling the spread of many invasive species can be achieved with adequate resources. Given that resources are limited, it is critical that attention be given to those species with the greatest potential to damage the ecosystem, and this has in fact been done. The authors are open about the challenges, indicating clearly species for which they expect to have trouble implementing a successful control programme.

The authors have addressed the reviewer's comments effectively. The reassurances given about managing the potential risks of introducing biological control agents provide confidence that this will not lead to further problems.

Key Findings and Recommendations

1. Non-indigenous species, both plant and animal, present a very serious threat to the south Florida environment. New introductions occur annually and this will likely continue.

2. The control programmes and the monitoring studies are directly linked to management objectives. The amount spent on control programmes is substantial but it is clear that increases will be needed make headway against the increasing number of potential serious threats.

3. Rapid response to contain and potentially eradicate newly discovered non-native species should be emphasized across state and federal jurisdictions, and should be built into standard operating procedures.

4. It is critical that a risk management approach continue to be used so that attention is given to those species with the greatest potential to damage the ecosystem.

5. Active management approaches involving control of the most damaging species are having some success. The melaleuca story is an example of how effective control can be given adequate resources.

6. The District should continue to use extreme caution when employing biological controls involving the introduction of new species.

Subject: Review comments on Chapter 8 of the 2016 South Florida Environmental Report
Date: October 2, 2015
AA Reviewer: Dr. Michael A. Mallin
A Reviewer Dr. Peter Dillon

General

This chapter includes detailed information about, and analysis of the measures implemented in the past year under the Lake Okeechobee Watershed Protection Plan to reduce phosphorus and nitrogen loading to the lake, about the nutrient status of the lake including external loads and in-lake chemistry, and about the ecology of the lake with respect to submerged and emergent aquatic vegetation, phytoplankton including algal bloom formation, exotic species control, fish, and wading birds.

The writers have produced an excellent summary of the ongoing work on Lake Okeechobee and its watershed, and have provided a very clear picture of the status of the lake. They have demonstrated more progress towards environmental targets than in other years, although some targets remain elusive. There still has to be great concern regarding achieving the TP target value of 140 metric tons/year. Although the total phosphorus load decreased in WY2015 compared with the previous year, the in-lake TP concentration did not improve, and the frequency of cyanobacteria blooms increased.

This chapter is well-written, concise and easy to follow. The conclusions are supported by the data presented. That having been said, some of the sections left the reviewers hanging, and need more explanatory material needed. Some re-arrangement of data presentation could help as well.

SUMMARY

Well-written and informative.

WATERSHED UPDATE

Regarding the lakeside ranch and the pilot-scale stormwater treatment areas – please add the N removal results as well as the P removal results in these brief summaries.

ECOLOGY UPDATE

Page 8-4, line 158 – please add the names of the other exotic invasive species to this paragraph.

Page 8-4, lines 165-170 – It would be useful to add a bit more material here on microcystin levels in the lake, and what they mean.

Page 8-5, top – it would be worth mentioning is there were or were not any fish kills in the lake during this period.

INTRODUCTION

The Introduction sets the stage very well, and clearly brings out the importance of this vast lake/marsh ecosystem. Well-written.

OVERVIEW OF THE LAKE OKEECHOBEE WATERSHED PROTECTION PROGRAM

WATERSHED CONSTRUCTION PROJECT UPDATE AND RELATED ACTIVITIES

This section presents a very impressive array of best management practices that are currently in use or in some phase of construction. Information on the various construction projects including the Stormwater Treatment Area (STA) projects is for the most part summarized effectively in Table 8-1. Most of these projects are proceeding well and are contributing significantly to reducing the P load. Implementation should lead to significant further reductions in P leading to the lake. However, some of the project summaries could use a bit more information.

Page 8-12 – line 384 – this is a significant decrease in TP load and gives cause for optimism with respect to reaching the 140 mt target eventually

Table 8-1 – Lakeside Ranch Stormwater Treatment Area – under estimated water quality benefits, it says an average annual load reduction of 19 mt/yr, but it does not say of what. Probably TP, so please add.
For WY2015 status update, please add the realized TN reduction as well.

Taylor Creek STA – under 2015 status update – again please add TN removal.

Regarding p removal - the Lakeside Ranch STA is working well based on better than expected P removal, while the Taylor Creek STA is not as effective – any comments on why the difference in P retention?

Regarding the Hybrid Wetland treatment technology – please expand on the general description in reference to what chemicals are added – is it to precipitate P?

Regarding the KRRP; please note that it is important as much for re-establishing ecological integrity through habitat modification as for reducing P loads

The FAVT project makes more sense than burning dead biomass (cattails), as burning will effectively release the P while burial hopefully will remove some and maybe most P from circulation

Figure 8-4 is very impressive in regards to all the efforts underway to reduce nutrient loading!

Page 8-22 – good to see some innovative economically-based treatment projects underway. The buy-in on private land program seems like a very good partial solution to the water fluctuation issues.

Regarding the West Waterhole Project, on line 468 it says the marsh filters the nutrients out. Of course filtration is a physical process, and this statement is oversimplified. Please state in a couple sentences how P is removed in the wetlands (plant uptake? Soil sequestration?). Is the N removal via denitrification? Plant uptake?

Line 485 – what is the estimated P removal by the 8 funded projects? There is some concern that nutrient retention in the marsh(es) could be short-term unless the biomass is harvested; decomposition of the biomass made release a large portion of the nutrients back into the water eventually.

The Payment of Environmental Services program is innovative, and other areas of the country may wish to adapt such a program. Please state where the funds come from; i.e. state government, federal government, private donations, etc.

Additionally, please state the going rate(s) that are paid to ranchers – is it based on the amount of N or P removed? By acre of ranchland converted to wetland? This puts a monetary value on wetlands that is sorely lacking in economic discussions of wetlands protection elsewhere in the country.

WATERSHED MONITORING AND ASSESSMENT

Page 8-23, line 516 – the watershed (and lake) monitoring programs have been very effective in scope and implementation. Past overlap in effort is now removed and some gaps have been filled.

Page 8-25, line 538 – the data, as in previous years, show how dependent variations in loads are on changes in hydrology. The TP load declined by 159 mt despite a small increase in flow. This is promising since it indicates that the average concentration of the inputs dropped. Again, this has a lot to do with hydrology because it seems that the flow increased in the inflows with lower TP and not in those that typically have higher TP. This another example why volume-weighted inflow concentration is generally better than loading when assessing progress as it factors out hydrologic effects reasonably well.

Page 8-27, line 585 – although the 5-year moving average TP load decreased, this is not going to continue over the next few years. The extremely low load of 2011 (177 mt) will drop out of the moving average next year, which will likely lead to a jump in the 5-yr figure.

Page 8-28, line 614 – the N/P load ratio looks to be a little over 12, indicating P limitation, which is no surprise but is probably worth mentioning.

Page 8-29, line 629 – the volume-weighted TP concentration of all inflows declined, is now lower than the lake concentration, but the lake concentration increased; this deserves more explanation. It may be partly due to the residence time of the lake being >1 year, partly due to internal loads?

Page 8-30 – Table 8-5 – These drainages are ordered by subwatershed, which themselves do not seem to have any particular logic in their placement in the table. If P loading is the critical factor in this table, why not have the table rank the drainages (or even subwatersheds) in descending order from highest to lowest in terms of unit area load, or even TP load. That way the reader can focus on the most problematic areas (as noted in the discussion) more easily. The ranking comment goes for the following tables (Tables 8-5 to 8-8) as well.

What this report section needs is more description of <u>what landscape factors within these troublesome subwatersheds and drainages</u> account for the highest loading of P and N. As the section reads now, it merely reports data with no analysis of the meaning. This is a critical point.

Page 8-35, line 744 – good to see that improved N measurements have been initiated.

MODELING, RESEARCH, DEMONSTRATION AND ASSESSMENT PROJECTS

Table 8-11 - Overall, an impressive collection of projects

Good to see the WAM sensitivity and uncertainty analysis – badly needed

LAKE STATUS

The water quality monitoring and the biological monitoring are well-conceived and appear to be well-executed.

Lake Okeechobee has some impressive performance standards to shoot for.

Page 8-39, line 808 – please state how the diatom to cyanobacterial ratio is computed. Is this by biovolume?

Page 8-39, line 810 – any explanation for the increased frequency of cyanobacteria blooms? Perhaps a combination of temperature, hydrology? Possibly related to burning of cattail? There is considerable evidence that blooms are linked to the Fe cycle in at least some locations; I presume that there are no iron data available?

Page 8-40, table 8-12 – Please clarify that the N/P ratios are by weight (if so). Readers will compare your values to the Redfield ratios, which are molar not weight ratios.

NUTRIENT BUDGETS

Page 8-42, line 877 – until the last few years there is a fairly consistent increase in TP in the lake despite, if anything, a slight decrease in volume-weighted inflow concentration. Does this suggest that other processes, e.g. internal load, have an increasing role?

Page 8-43, line 885 – says a low sedimentation coefficient indicates that the lake adsorbed less excess TP load from the watershed; does this mean it sequestered less P in the sediments? Or is this uptake by phytoplankton? Please clarify. It has ranged from 0.16 to 1.10 over the years. Is there a target sedimentation coefficient for the lake that would be desirable to exceed?

LAKE OKEECHOBEE MONITORING RESULTS

SUBMERGED VEGETATION

Overall – very impressive data collection on SAV. Some of the signs (e.g. *Potamogeton* data) are encouraging, however.....

Page 8-49 – *Hydrilla* is one of the most problematic invasive macrophytes nationwide. Please present some data on its increase or decrease in this lake over a several year time period.

The loss of *Vallisneria* coverage is troubling. Are there any hypotheses as to what is causing this decrease?

Page 8-57, line 1104-1106 – any speculation as to why cattail is aggressively expanding?

EMERGENT VEGETATION

Excellent photograph (Figure 8-20) of an alligator sunning itself among herbicide-sprayed cattail. Are the herbicides known to have any adverse effects to wildlife? Please address this question.

Line 1112-1115 – Clearly burning the dead cattail is done to reduce BOD and SOD but it will release all the P in highly available form. It would be ideal, but probably impossible, to remove the dead biomass from the system.

EXOTIC SPECIES CONTROL PROGRAM

Please make a list of the exotic plant species threatening the lake environment (species and common name) in order of most problematic.

Line 1140 – it is encouraging to see the control program for torpedo grass working well.

Figure 8-26 – please add a second bar next to each species bar that shows the estimated total acreage covered by each species, so the reader can compare acres treated with total acres covered.

ALGAL BLOOM MONITORING

It is good to see the microcystin sampling taking place. A couple of points – the levels are not extremely high but may be of concern. Dr. Dillon notes that the Canadian drinking water standard is 1 ug/L – what is the Florida and US EPA drinking water standard? Also, a colleague of Dr. Dillon's who works on microcystin told me that there is good evidence that fish reproduction is affected at 0.5 µg/L. Finally, there is now evidence that microcystin bioaccumulates in fish (in tropical lakes in Africa), sometimes to dangerous levels with respect to human consumption. It would be worth measuring levels in some sport and commercial fish species.

STATUS OF THE LAKE OKEECHOBEE FISHERY

Several biological indicators including fish seem to be showing improvement which is very positive.

It would be instructive to note whether or not there were any fish kills in the lake environs during the water year.

AVIAN MONITORING

Page 8-77, line 1547 – it is good to see bird species other than wading birds included; gives a much more well-rounded ecosystem view..

Draft 2016 SFER – Volume I, Chapter 8
Final Comments: Technical
'AA' Reviewer: Dr. Michael A. Mallin, 'A' Reviewer Dr. Peter Dillon

Overall
The reviewers reiterate that the authors have produced a solid scientific document that is orderly and clear to follow. The authors have taken pains to address the earlier concerns of the reviewers and we appreciate that. For some of the query responses it was unclear as to whether the authors were including the explanations in the revised document as well as in the replies to the reviewers; so we have noted those below.

Summary
Response #2 – We are pleased the authors will include TN load results as well in the final report- this will provide a fuller picture.

Response #3 – We are happy the authors will include the names of the exotic invasive species of concern in the Ecology Update.

Response #4 – Thank you for including more information on microcystin levels; the authors may want to note there are no USEPA or FDEP drinking water standards.

Response #5 (and 37) – we understand there are no complete data sets on fish kills in the lake.

Watershed Construction Update and Related Activities

Response #6 and 7 – Table 8.1 – we appreciate the revision regarding Lakeside Ranch and Taylor Creek Treatment Areas!

Response #8 – We thank the authors for the fuller explanation regarding treatment efficiencies – please be sure to bring this out in the text too.

Response #9 – The hybrid treatment technology looks very exciting – we look forward to its results down the road.

Payment for Environmental Services

Response #10 – filtration issue – thank you for the attention to this matter.

Response #11 – we do hope that nutrient removal will be tracked in the future, if funds become available.

Response #12 – thank you for the explanation of the Payments Program – please be sure to add in at least a reduced explanation (who pays and cost range) to the final report.

Watershed Monitoring and Assessment

Response #17 – we understand that the alphabetical ordering is done to facilitate year-to-year comparisons.

Response #18 – please do update the trend analysis in the next three-year update of the plan – this is a key metric for sure.

Lake Status

Response #22 – please include the brief description of the diatom to cyanobacterial ratio computation in the final report.

Response #24 – and elsewhere – we appreciate the clarification of the N/P ratio issue.

Response #26 – We understand that the sedimentation coefficient issue will be clarified in the final report, thank you.

Response #28 – the teaser regarding the relationship between *Hydrilla* and the invasive apple snail and the endangered snail kite looks like a fascinating ecological story – we hope SFWMD is researching this!

Response #29 – *Vallisneria* coverage – we look forward to the results of the next aerial mapping survey.

Response #30 – cattail expansion – we appreciate that the authors will be including expanded information in the final report.

Response #31 – We understand that the use of herbicide provides a net positive to the ecosystem, and usage is reported in the final report indexes, thank you.

Response #32 – We understand the huge cost difference in removing rather than burning dead cattail (ouch!).

Response #33 – thank you for the list of species – please be sure it is in the chapter as well.

Response #35 – thank you for the explanation.

Response #37 – Please note in the chapter the lack of EPA or FDEP drinking water standards, but please provide the recreational standards within.

Again, we are very pleased with the author responses to our queries, and think the final product will be a useful and informative document that professionals and laypeople alike can appreciate.

Bullets for Chapter 8, Lake Okeechobee Watershed Protection Program Annual Update

- The SFWMD and associated entities are making significant progress in the fight to reduce nutrient loading to Lake Okeechobee. There are a number of promising storage and retention projects on public and private land, and the payment for environmental services programs are innovative and could serve as national models.

- There is excellent information on TP load reductions from sub-watersheds. A critical need is to track overall progress by more in-depth assessing of land use factors and their contributions. This will provide needed guidance on where to apply future financial and scientific resources.

- Recognizing funding constraints, the SFWMD and collaborators are doing an excellent job monitoring water quality, flora and fauna in and around the lake.

- A challenge is to make more progress on determining causes of the cyanobacteria blooms that continue to occur within the lake, and are apparently on the increase. Such blooms are a primary nutrient response variable and can be publicly visible.

Comments on Chapter 9: Kissimmee River Restoration and Basin Initiatives
of the 2016 South Florida Environmental Report
AA reviewer – P. Dillon
A reviewer – S. Fennessy
Technical Review

General

This chapter provides a good summary of restoration activities in the Kissimmee River watershed in HY2015. This is a very ambitious collection of projects whose overall goal is to restore the ecological integrity of the system (as stated on line 244 - a brief definition of ecological integrity here would be helpful). There are several new activities included in this year's report, all of which contribute to the aims of the program. While there is still much work to be done, there is now a strong record of success leading to substantial ecological gains, and it is clear that recovery of at least some components of the ecosystem is accelerating in response.

The field and lab work seem to have been very well done as was the case in past years. The data analysis and interpretation are sound and some of the methods employed are, in fact, significant improvements over past years.

The chapter is generally well-written and concise enough, although there are some sections that could use substantial editing (noted below).

Summary and Introduction

The summary is clear and succinct enough and captures the key findings effectively. The introduction is straightforward.

Kissimmee Basic Restoration Project

The section on the engineering aspects of the KRRP is very detailed but gives useful perspective and highlight the very large scope of this effort.

Hydrologic Conditions and Water Management

This section includes a great deal of data with much detailed discussion. This section could be improved in terms of readability. The writing is dense with long sentences and passive voice, making it difficult to follow in some sections, e.g. the sentences on lines 359-362, and 488-491. Editing for clarity and directness will help readers follow the discussion more readily.

l. 427 - 429 – as is the case in other chapters and other years' reports, a mix of English and metric units is employed throughout which can be confusing to the reader who continually has to do conversions. It is good to at least have an explanation for why the authors use non-SI units in the report. However, it would be even more useful if the conversions were done. Even the USACE must use metric units for parameters such as concentration (i.e. mg/L) so it should not be an impossible jump.

l. 468 – the number of significant figures used in several places in the chapter is unwarranted. It is unlikely that rainfall measurements can or were made to the hundredth of an inch.

l. 510 – are these recommendations from the district for management in the year that has just passed? Not clear how these fit.

l. 530 - the suggestion here about alternating years in which the lake or river objectives are met is a good one, particularly given that the hydro-period targets have not been met for the Kissimmee since 2001 (line 508). Alternating management priorities could provide data, and perhaps more insight, into the trade–offs that are made by these management decisions. This could help with the tension that exists between conflicting management goals and perhaps improve the hydrological conditions for the river-floodplain.

l. 604, 657 – were any fish kills noted as a result of this hypoxia?

This entire section on hydrology provides very detailed information and rational explanations for the observed data. The question of how climate change will affect the hydrology of this basin in the long term is critical to future planning but is not addressed in this chapter. Is there information/discussion of this in other documentation? At present, the approach seems to be based on short-term considerations only, I think with the implicit hope that these will be valid in the long term. A lot of money could be spent on system alterations that may not be the right ones in 10 or 20 years. Hopefully, there is considerable thought being given to this broader picture.

KKREP

l. 884 – adding data on temporal trends for a few key variables or indicators would provide useful information on the restoration progress being made, as many other sections of the report do. For example, Table 9-4 could be altered to present data for each of the years shown, instead of listing the beginning page numbers where these data can be found in earlier reports. Clearly this couldn't be done for all the variables presented here, but presenting time-series data for a few would help give a sense of progress.

Hydrology

The proposed changes to several of the hydrology metrics, which are described starting on page 9-31, are an important modification and the rationale for the change needs to be should be explained more clearly. As it is now, the paragraph starting on line 928 implies that the current criteria and metrics were not stated in operational terms (line 934), which is not really the case. Instead, the ecological and management basis for the changes should be the focus (such as the information given on page 9-32), making clear that the metrics were revised based on the increase in available data and (perhaps) a refinement of the district's understanding of the dynamics of the system. That said, the new BLM hydro-period metric seems relaxed; in several of the reference years the floodplain was inundated for over 210 days total, and was just a few days shy of 210 days in the August –February window. If these are counted (and ecologically they would be very similar in their characteristics) that would give a total of 41% of water years.

l. 1044 - isn't clear, do increases in depth indicate new recession events? In other places the text says that recession is counted as days where water levels are dropping.

Overall this section presents a sound analysis of the challenges facing floodplain restoration with lots of relevant data and recommendations for improvements.

Oxygen

l. 1346 – very good to see the rigorous interpretation of the oxygen data with appropriate statistics

l. 1353 – these results are promising. I expected poorer oxygen after Phase I for a few years because of the disturbance of the soil/sediment and increased oxygen demand.

l. 1404 – it is good to have multiple stations but the virtually identical measurements at 3 sites suggest that if any project cuts are necessary, it would be better to reduce the number of sites that are so similar than other cuts.

Phosphorus

l. 1423 - 1428 - there are errors in the punctuation of this (very long) sentence.

l. 1439 – the potential P load reduction of 17.75 mt would make a strong contribution to the needed decrease; can you put any error estimates on that figure?

Wading Bird Abundance

As predicted, there has been a strong positive response of the avian community to the Kissimmee River restoration. The trends in the data shown in Figures 9-24 and 9-25 are helpful in gauging the success, and would benefit from an explanation of the low numbers seen in 2007-2009 (also in figures 9-26 and 27). The comments on line 1509 state that water depths greater than 1.3 feet are too deep for foraging. With the hydrologic criterion for inundation depths greater that 1 foot, this is a narrow target for water depths. Is the goal to maintain depths between 1.0 and 1.3' for wading birds, with deeper areas for other species of waterfowl? Have floodplain zones that differ in depths been established to hit these targets?

Figure 9-26 shows the expectation line of $\geq$ 3.9 ducks/km^2 but the line is drawn at a value of about 9.

Invasive Plants

Is there any concern about or documentation of the spread of (for example) Limpograss as a result of the test plots that were established (line 1701). Control of all four species might be tested for responsiveness to herbicide treatments; as it stands now only Limpograss and Peruvian Primrose-willow are subject to tests. This may be a funding issue, but should be clarified.

Key Restoration Project Notes

The news on the first meander breakthrough is quite exciting, as is the work on backfilling the MacArthur Ditch. The district is to be congratulated.

KCOL and KUB Monitoring and Assessment

The presence of cyanobacteria in the KCOL is not surprising given the degree of eutrophication of the system, but the authors should be clear that while cyanobacteria are common in water bodies, significant levels of the toxins that some species can produce are less common (e.g., microcystin). It would help to distinguish the presence of cyanobacteria from the toxin they produce, particularly if this will be the basis for decisions to control hydrilla.

l. 2028 – please provide some details on the monitoring stations that will be established such as the size of the plots and what aspects of the vegetation will be monitored. Also, line 2046 refers to 'vegetation conditions - what does this mean?

l. 2059 – are all CPUE data collected by electro-fishing or are there any creel data measured? If there are, how do they compare?

l. 2097-2122 – are there more specific causes of the decreases in the proportion of snail kite nests in the KCOL that can be added to this discussion?

l. 2137 – alligator data are interesting; don't remember seeing them in earlier reports. These are estimates and definitely should not be reported to 5 significant figures; 2 is probably valid, possibly 3.

l. 2348 - P is expressed in units of mg/L (very appropriate) while much of the rest of the report (other chapters) uses ppb (less good). Consistency in the choice of units is important.

l. 2237 mentions requirements set forth in the rules. Which rules?

Page 9-85 through the end of the report – page numbers here say 8-85 etc.

Closing Comments and Recommendations
Chapter 9: Kissimmee River Restoration and Basin Initiatives
of the 2016 South Florida Environmental Report
AA reviewer – P. Dillon
A reviewer – S. Fennessy

Closing Comments

Restoration activities in the Kissimmee River watershed include an ambitious collection of projects requiring very substantial resources. New work has been added in the past year to augment these efforts. Although there is still a great deal of work ahead, there have been some notable successes leading to substantial ecological gains. There are now clear indications that recovery of some components of the ecosystem is occurring in response, which is very heartening given the effort that has been expended.

This chapter provides a thorough summary of these restoration activities over the past year. In general, the field and lab work are well done, the data analyses and interpretation are sound as was the case in past years.

Most of the reviewers' comments and suggestions on the report have been addressed effectively by the authors in their reply. Many of the reviewers' comments involved clarification needed in the chapter, which has been provided and will be included in the final version of the report. We understand that oft-repeated comments about units of measurements and the number of significant figures will be addressed on a broad basis in the near future.

Key Findings and Recommendations

1. All issues related to completing the next phase of the KRRP have been resolved and this phase is scheduled for completion in 2019.

2. Despite receiving significantly higher than average rainfall is WY2014, particularly during the dry season, maintenance of lake stage levels in the three groups of lakes near their desired levels resulted in frequent rapid stage reversals in the floodplain. As a result, there were only brief intermittent periods of floodplain inundation; thus, the expectation of 210 days with 1 foot of water in the broadleaf marsh was not met, as was also the case in all previous years. Expectations concerning frequency of recession events were also not met, largely because they occurred too rapidly. However, the means of achieving expectations related to both hydro-period and recession events in future have been identified and should be implemented.

3. The targets for two of four metrics related to oxygen levels were met in WY2015 while the other two were close. Overall, oxygen levels showed significant improvements relative to pre-restoration levels and the potential for achieving the targets in future years seems realistic.

4. The Kissimmee River remains a major source of TP to Lake Okeechobee. Studies to address the potential for P retention in the floodplain, estimated as 18 metric tons, were not complete.

This should be a high priority since a reduction of this scale would contribute significantly to achieving the target TP load to Lake Okeechobee.

5. The expectations for long-legged wading bird abundance and for waterfowl abundance were met while waterfowl species richness remains slightly below the target. These are positive signs of recovery.

Accountability Review of 2016 South Florida Environmental Report
Chapter 10, St. Lucie and Caloosahatchee River Watershed Plan Annual Update

AA Reviewer Dr. Michael A. Mallin

The Accountability Review differs from the larger technical review and is based on the following questions: *Does the draft document present a defensible account of data and findings for the areas being addressed that is complete and appropriate? Is the synthesis of this information presented in a logical manner, consistent with earlier versions of the report? Are findings linked to management goals and objectives? The panel may also provide constructive guidance for the District's large-scale programs, particularly as related to water quality assessment and source control across the agency programs.*

Overall Impression:
Chapter 10 is information-rich and contains detailed background information on the watersheds in question, as well as the TMDL processes that are ongoing. The information is presented in a logical manner. It is very readable and generally clear information is presented on the many efforts that are either ongoing or planned to reduce nutrient loads to these two important estuaries. The water quality overviews, however, could use some enhanced explanations and presentations of results, and linking to some of the TMDL goals could be improved.

SUMMARY

Many readers will only read the Summary. Thus, looking at the Summary from an outsider perspective – a few things require a bit more explanation:

There are generally positive results in the Summary regarding lowered nutrient inputs for the water year. This should translate into responses from the biota, as such, regarding Page 10-3 – line 107-109 – would be good to mention if there were any large algal blooms, or any fish kills.

Page 10-4, line 124 – mentions the positive news that larval spat supply continues to support natural recovery of eastern oyster……please mention what they are recovering from.

Page 10-4 - Lines 141-146 – this paragraph discusses meeting the average salinity goal being met. Please re-iterate here that salinity is controlled, at least in part, by agency releases of freshwater from Okeechobee.

Page 10-4, lines 157-159 – generally low chlorophyll levels – mention that there were no problematic algal blooms.

Page 10-4 –lines 164-165 – mention what the term reference concentration means.

Lines 166-167 – excellent news about re-appearance of *Vallisneria*.

INTRODUCTION

Concise and well-written

BACKGROUND

Well-written, excellent information is presented on the history of these systems. I had no idea that serious human re-engineering of the natural water systems had begun as far back as the 1880's.

Nicely presented maps as well.

Page 10-11 – top paragraph – it is noted that in the SL watershed there is 54% agriculture land coverage and in the CA watershed 35% agriculture coverage. Please discuss what types of agriculture dominates each, because it makes a difference in term of N or P runoff amounts. Also regarding livestock, I assume cattle dominates, but is there significant poultry production here as well? Both of those sources will produce manure with an N:P ration of around 3, whereas for crop agriculture the N:P in fertilizer is much higher.

WATERSHED EFFORTS

Table 10-2 presents an exciting array of projects that are ongoing or planned. I am impressed with the breadth of the projects and see that the state is taking rehabilitation of the north Everglades area and improvement of the estuaries seriously.

Unfortunately the 10 Mile Creek project did not perform as planned. Please add the reasons why the state feels this project did not work. Such information would be instructive to outside researchers as well as project stakeholders.

The FAVT project seems to be exciting and innovative research. I hope water column nutrients are being sampled directly at the project site(s) so the amount of N and P that may be escaping from the buried material into the WC can be ascertained.

WATERSHED RESEARCH AND WATER QUALITY MONITORING

Overall an impressive amount of hydrological and water quality monitoring is taking place in both of these watersheds. The rainfall, discharge, and TN and TP loading are well presented in the series of figures and tables.

SLE HYDROLOGY, WATER QUALITY AND AQUATIC HABITAT

Page 10-12 – lines 766-768 - please indicate that these are molar N:P ratios (if they are).

I believe that we can safely round the Okeechobee watershed TN:TP ratio from 9.79 up to 9.8, and the SLE watershed TN:TP ratio from 4.98 to 5.0.

Page 10-34 – first paragraph – I found this lead paragraph to be quite vague and unhelpful.

Page 10-34 – second paragraph, also Table 10-6. The authors need to put the chlorophyll *a* data into some kind of perspective. According to the standards, if I am reading them correctly, the chlorophyll *a* standard for the SLE tribs ranges from 5.0 – 7.4, and for the Caloosahatchee system it ranges from 4.2 – 5.6 ppb. So the reader can get some kind of perspective on what the recent levels mean, please add discussion of how the data stack up against the standards.

Figure 10-14 presents a near 20-year perspective on WQ data. There are several large peaks in chlorophyll *a* that jump out. I know the 2004-2005 blooms were related to the hurricanes and Lake Okeechobee releases. It would be instructive to add in the narrative (in a sentence or three) what caused the large blooms in the past.

Page 10-34 – lower two paragraphs. There is much mention of TN and TP in relation to freshwater inflow. Is there a statistical correlation between discharge and nutrient loads for the tributaries?

Figure 10-14. Need to designate in the caption which lines/colors designate inflow and which designate nutrient and chlorophyll concentrations.

There are red lines designating the annual TMDL TN and TP reference levels. Please add red lines for chlorophyll standards (or a band) as well, so the reader has a reference for this response variable.

Page 10-37 – excellent news regarding seagrass coverage!

Page 10-40 – Significant Findings – again the chlorophyll bullet essentially says nothing – please place in perspective of standards exceedences (if any) so the reader has some benchmark.

CRE HYDROLOGY, WATER QUALITY AND AQUATIC HABITAT

Page 10-42 top – there is truly impressive coverage of this watershed in terms of water quality monitoring!

Page 10-42 – line 11-83 – states "water column properties were determined…" besides nutrients and chlorophyll, what other WQ parameters are monitored? DO? Turbidity? Others?

Again – much interesting hydrological and loading data is presented within this section.

Page 10-49 – lines 1442 – 1449 – notes that over the past 3 years the FWM TN concentration shave shown a decreasing trend. That is excellent news for sure. Please explain (or even speculate) on the reasons for this decrease. It it just flow-driven or are nutrient controls having a positive impact?

Page 10-51 – middle paragraph – as with the SLE, please give some perspective on chlorophyll levels in relation to standards here.

Page 10-52 – Figure 10-25. As with Figure 10-14, need to clarify in the caption what lines represent what parameter; also please add chlorophyll standard designations.

Page 10-53 – first line – notes that TN concentration of the CRE is proportional to variations in freshwater inputs. Are these relationships statistically significant?

Page 10-54 – top paragraph regarding shifting of species dominance of seagrass. It might be useful to note in a concluding sentence if coverage here is sufficient in relation to targets.

Page 10-54 – lines 1580-1586 – seems to be excellent news on oyster density returning!

Page 10-54 – lines 1587 – 1599 – are there any targets for oyster recruitment in the estuary? If so, it would be worth discussing the present results in relation to desired targets.

Page 10-58 – Significant findings for the CRE:

Lines 1744 – 1750 – please place the chlorophyll results in perspective of the estuary-specific standards so the reader has a perspective from which to understand this response variable.

Lines 1757 – 1763 – it would be worth mentioning the amount of total seagrass coverage in the estuary, and how that relates to any target coverage levels.

In general, a well-written, helpful document that the authors have compiled. Many of my review comments are designed to improve the reader's understanding of the linkage between findings and goals, and between nutrient loading and chlorophyll *a* responses.

Lastly, are there any dissolved oxygen issues in either estuary? Since it was mentioned within that DO conditions can impact oyster survival, this might be a proper topic to explore in future versions of this chapter.

Draft 2016 SFER – Volume I, Chapter 10
Final Comments: Accountability
AA Reviewer: Dr. Michael A. Mallin

Summary – the authors have either provided satisfactory explanations for comments (i.e. fish kills) or have revised the text for the final report to provide further clarity in regard to comments on oysters, freshwater impacts to salinity, chlorophyll levels and reference concentrations.

Background – I am pleased that the authors will provide more details on the dominant agricultural land use in the final chapter; there are a lot of implications to water quality.

Watershed Efforts - While the 10-Mile Creek Project did not perform as planned, the facility will at least have utility for low level water storage. Regarding the FAVT Project, the authors note that they will forward my suggestions on further analysis to the FDACS, thank you.

SLE Hydrology, Water Quality and Aquatic Habitats – The authors are clarifying the TN/TP ratios as asked, rounding the ratios as suggested, and rewrote a paragraph to provide more clarity as asked. In the final chapter the authors note that standards will be included as asked.

I do hope that in next year's report the research team will attempt to tackle the analyses of what causes the large algal blooms. This is of course a key issue that nutrient reductions are based on (at least in part).

Page 10-34 comments – the authors have produced strong statistical regressions linking TP and TN to freshwater flow. Please note (in the final version) that these significant relationships occur.

The authors are revising the figures as suggested to make them more informative and clear. They are also revising the chlorophyll bullet to place in perspective of standards.

CRE Hydrology, Water Quality and Aquatic Habitats – Regarding the other water quality parameters being collected, the authors note that DO analyses will be considered in future versions, which will be useful in providing a broader picture.

Regarding the 3- year TN decrease – let us hope it continues, and if so, efforts need to be made to assess why.

The comments on the figures have been taken seriously and clarifications made, thank you.

I am pleased that the statistical relationships between freshwater flow and TN as determined by Drs. Buzzelli, Doering and Chamberlain will be added to the final chapter.

The oyster habitat index model under development looks to be an interesting and exciting addition for the future.

As with the SLE, placing chlorophyll in perspective with standards will be included in the final chapter, which will improve understanding by the readers.

Regarding seagrass coverage, it appears that a map is under development that should prove useful in assessing progress.

Overall, I am very happy with the author's responses to my review comments, and think the final product will be a useful and informative document that professionals and laypeople alike can appreciate.

Bullets for Chapter 10, St. Luci and Caloosahatchee River Watershed Protection Plan Annual Update

- The SFWMD and associated entities have put together an exciting array of projects aimed at reducing nitrogen loading to both of these estuaries.

- An impressive amount of hydrological and water quality monitoring data are taking place in both watersheds. These data are well-presented in the report figures and tables.

- It would be useful for the authors to pay special attention to putting the monitoring results in term of water quality standards, and on-ground project results in term of nutrient reduction goals; likewise seagrass coverage in terms of goals.

- A helpful future goal would be to present data and analysis on dissolved oxygen conditions in these estuaries. DO is a major ecosystem health variable and primary eutrophication response variable to loading of both N and P, so perspective on such conditions would be informative in a number of ways.