Predicting CERP Influences on Extreme High and Low Water Levels in Greater Everglades Wetlands

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Introduction

- This is a refinement to an approved RECOVER Performance Measure
- The key contributions of this performance measure refinement for Everglades restoration include:
  - Increased focus on events that might yield additional subsidence and the ability to account for both duration and intensity of dry events over an extended period of climate records
  - Application of regionally cohesive targets in a manner that is consistent with restoring the health of the entire ecosystem
  - Summary graphics that are intuitive and provide a mechanism to effectively communicate with both scientists and non-scientists

Scientific Basis

The pre-drainage Everglades was a single, hydrologically integrated system, with water depth and distribution determined by the seasonal and annual interplay of fairly high-contrast weather patterns, vegetation and the underlying topography. The intensity of drying events that occurred in a pre-drained system yielded a state of homeostatic equilibrium between the accretion and loss/compaction processes of Everglades' organic soils and Florida's hydrologic conditions (inundation and drying). The hydropattern exhibited by the historical system contributed directly to the development expansive areas of peat soils that supported a long, broad, shallow river of grass. The C&SF project made efficient drainage of the ecosystem possible, but the unintended result has been a reduction of the total amount of water stored in the system. Reducing total water quantity stored by the ecosystem has exaggerated the dry seasons and dry years that can follow, resulting in increased rates of organic soil loss (Stober et al. 1996, Sklar et al. 2000). While a general trend exhibited by the system is loss of peat soils, one immediate concern is that the managed system has resulted in an uneven pattern of soil loss (Figure 1) that may require decades of recovery and is likely to result in some short term losses and redistribution of landscape pattern and key habitats, like tree islands, as the system is being restored.

Extreme high depth events were likely rare events in the historical system, and designs of the system which result in chronic high water conditions should be avoided. The revision of this performance measure is intended to recognize the scientific basis for the current condition, and to identify locations in the restored areas where the extreme high and low water performance measures could potentially conflict. The methods described below for "relaxing" the application of extreme high events contains an implied stress on avoiding impacts to the physical system that would require a century or greater to recover from, over short-term impacts to vegetation (multi-year to decadal) that we are expecting to change/alter over a period decades back to a more natural/pre-drained state. In support of this perspective, whenever there is conflict between the two (in terms of extreme water depths), the proposed PM revision suggests placing greater emphasis on dry events since these would have a near-permanent impact on the landscape. RECOVER's GE sub-team continues to recognize that there are near-term impacts to vegetation and species from extreme high water events, and that these impacts need to be described, considered, and avoided when possible so long as their avoidance does not generally dry the system.

Methods

Application of Extreme High and Low Events in areas of significant subsidence

In areas that have subsided greater than two feet relative to NSM elevation, there can be no failing condition for the extreme high water metric, areas subsided between one half to two feet are graded for performance by adding 10 percentile to each grading increment for each half foot of subsidence. For example, if an area has subsided 1.5 feet, an A grade is assigned if the indicator region value for the alternative falls in the same 50 percentile category as predicted by the NSM (as opposed to the same 20 percentile category as proposed for the scoring method in soils that have not subsided). The Percentile categories are determined by the distribution of extreme high water metrics found among SFWMM cells present within an indicator region (see Figure 2 for example).

Indicator Region	Landscape Type	High and Low Targets
IR 100	Ridge and Slough	6-34 high events >2.5 feet of 0-5 weeks average duration and no more than one low event <-1.0 foot of no more than 2 weeks duration
IR 101	Ridge and Slough	6-34 high events >2.5 feet of 0-5 weeks average duration and no more than one low event <-1.0 foot of no more than 2 weeks duration
IR 102	Ridge and Slough	20-36 high events >2.5 feet of 10-25 weeks average duration and no more than one low event <-1.0 foot of no more than 2 weeks duration
IR 110, 111, 112, 113, 114,117, 118, 119, 120, 121-123, 124, 125, 126 and 128-133	Ridge and Slough	No more high events >2.5 feet than NSM 4.6.2. Minimize low events <-1.0 foot. Except: for IR 129, the NSM number of high events is considered too large[1]
IR 115, 116, 127, and 190	Sawgrass Plains	No more high events >2.0 feet than NSM 4.6.2. Minimize low events <-1.0 foot[1]
IR 143-145 and 148	Marl Marsh	No more than 7 high events >1.5 feet and >2 weeks duration. Minimize low events <-1.5 foot[1]
IR 140, 141, 146 and 147	Marl Marsh	No more than 7 high events >2.0 feet and >2 weeks duration. Minimize low events <-1.5 foot[1]
IR 150 and 151	Mixed	Not evaluated; targets remain under development
IR 160 and 170	Sawgrass Plains	No more high events >1.75 feet than NSM 4.6.2. Minimize low events <-1.0 foot[1]

Table 1
Indicator Regions (IRs identified in Figure 2), the landscape types they contain, and the explicit target for extreme high and low events in the IR. IRs colored red exhibit more than two feet of subsidence compared to NSM elevations and in these regions the extreme low water events metric determines the result of the evaluation. IRs colored green exhibit one half to two feet of subsidence compared to NSM, and evaluators will strengthen the low water events metric and relax the high water metric for evaluation.

[1] These targets are a high priority for alteration based on a comprehensive review of literature and experimental approaches that are designed to determine empirical agreement with the target. Current guidance to minimize the number of events, or consider a number of events to be too large should be made more specific.

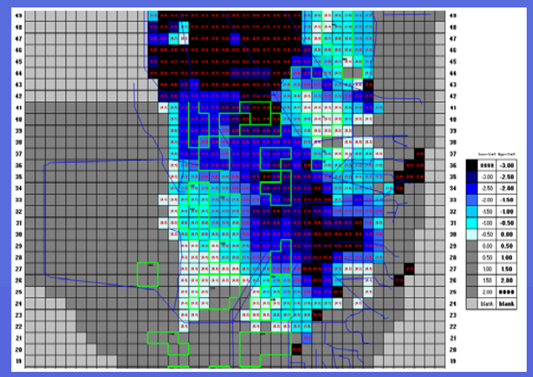

Figure 1
Map of Greater Everglades Wetland areas that have demonstrated significant subsidence compared to estimates of historical elevation contained in NSM. South Florida Water Management Model (SFWMM) 2X2 cells are color coded with respect to the degree of subsidence at 0.5 ft. intervals.

Methods
Cumulative drought intensity metric

1. For each day of the 36-year period of record every cell in the SFWMM 2X2 is queried for water depth. If water levels are below ground, the depth below ground is determined and scored in ft below ground units in an output spreadsheet. If water levels are at ground level or above ground, the cell is scored as a zero.

2. For each cell of the 2x2 covering the Greater Everglades areas, these scores are summed at monthly, annual, and total period of record intervals for reporting purposes.

3. Graphical displays of the annual and cumulative drought intensity index are created to show the actual scores of the Existing Conditions Baseline, the Natural Systems Model, the future without CERP, and alternative project configurations.

4. Comparison graphics demonstrate the differences between alternative project configurations according to the degree to which the alternatives put the system closer to or further away from the target condition (Figure 2).

Conclusions

1. Revisions to this PM will facilitate a more sustainable restoration program since subsidence issues will not negate the positive impacts of re-establishing sheet flow through to Florida Bay.
2. Setting NSM stage rather than depth targets allows for consistent application of evaluation tools across the ecosystem.
3. Peat protection component clarifies the consequences/risk associated with drydowns, and map allows evaluators to rapidly assess what portions of the landscape are at risk.

Citations

Sklar, F., L. Brandt, D. DeAngelis, C. Fitz, D. Gawlik, S. Krupa, C. Madden, F. Mazzotti, C. McVoy, S. Miao, D. Rudnick, K. Rutchney, K. Tarboton, L. Vilchek, and Y. Wu. 2000. Hydrological needs – effects of hydrology on the Everglades. In: SFWMD. Everglades Consolidated Report, South Florida Water Management District, West Palm Beach, pp. 2-1 to 2-62

Stober, J., D. Scheidt, R. Jones, K. Thornton, R. Ambrose, and D. France. 1996. South Florida Ecosystem Assessment Monitoring for Adaptive Management: Implications for Ecosystem Restoration. Interim report. EPA 904-R-96-008, Environmental Protection Agency, Athens, Georgia.

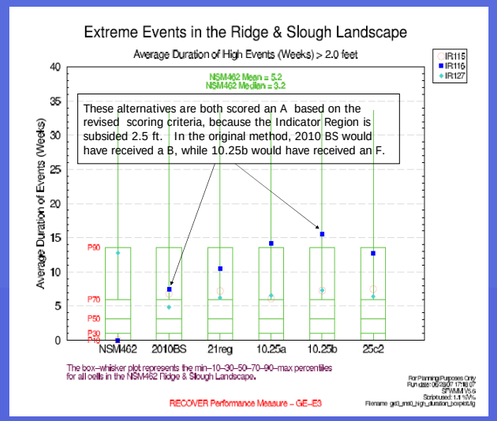

Figure 2
Example evaluation of extreme high events score in Indicator Region 115, the northern central boundary of WCA 3.

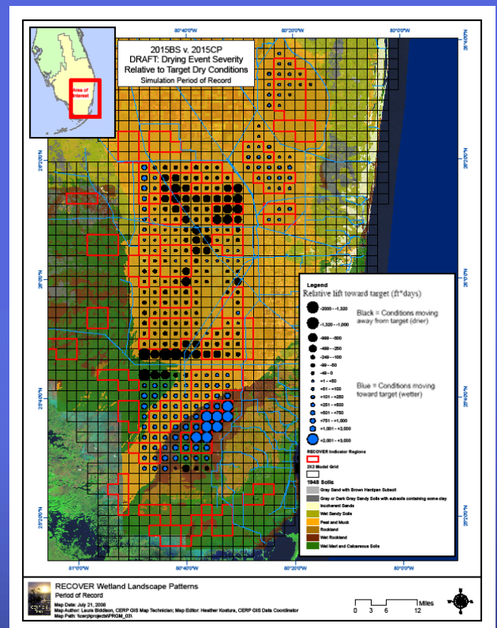

Figure 3
Cumulative drought intensity differences between project alternatives. Black circles indicate a condition that is drier than the alternative, blue circles indicate wetter conditions than the alternative. The size of the dot is proportional to the magnitude of difference between alternatives. The absence of a circle in a cell indicates that the cell is wetter than the NSM condition.

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