MEETING PURPOSE

- Introduce Lake Okeechobee System Operations Manual
- Algae Bloom Risk Metric
- Request Blue Green Algae Task Force Review
OUTLINE OF PRESENTATION

• Opening Remarks and Public Engagement
• Overview of Lake Okeechobee System Operating Manual
• USACE Request to Blue Green Algae Task Force
• Introduction of Draft Algal Bloom Risk Metric
• Discussion
OPENING REMARKS AND PUBLIC ENGAGEMENT

Colonel Andrew Kelly, Commander, USACE, Jacksonville District
OPENING REMARKS: WHAT ARE WE DOING AND WHY?

What are we doing?
- Conducting a study to evaluate Lake Okeechobee operations
- Study will result in a new operational manual
- No new infrastructure will result from the study

Why are we doing it now?
- Herbert Hoover Dike Rehabilitation will be complete in 2022
- Section 1106 of Water Resources Development Act (WRDA) of 2018:

"The Secretary shall expedite completion of the Lake Okeechobee regulation schedule to coincide with completion of the Herbert Hoover Dike project and may include all relevant aspects of the Comprehensive Everglades Restoration Plan described in section 601 of the Water Resources Development Act of 2000 (114 Stat. 2680)".
Goal: Incorporate flexibility in Lake Okeechobee operations while balancing congressionally authorized project purposes.

- **Objective 1.** Manage risk to public health and safety, life and property
- **Objective 2.** Continue to meet authorized purposes for navigation, recreation and flood control
- **Objective 3.** Improve water supply performance
- **Objective 4.** Enhance ecology in Lake Okeechobee, northern estuaries and across the south Florida ecosystem.
OPENING REMARKS - GOALS AND OBJECTIVES: WHAT ABOUT WATER QUALITY?

**Goal:** Incorporate flexibility in Lake Okeechobee operations while balancing congressionally authorized project purposes.

- **Objective 1.** Manage risk to public health and safety, life and property
- **Objective 2.** Continue to meet authorized purposes for navigation, recreation and flood control
- **Objective 3.** Improve water supply performance
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LOSOM Public Engagement Opportunities

Public Comment Period (Fall 2022)

Final NEPA* Document

Public Comment Period (Spring 2022)

Draft NEPA* Document

Start:
- Scoping Period
- Educational Webinars

Completion:
- Decision/Approval

Processes:
- Develop Purpose & Need, Study Objectives, Constraints and Considerations
- Develop Performance Metrics & High-Level Scenarios
- Evaluate and Compare Alternatives
- Select Operational Alternatives
- Develop Operational Alternatives

*NEPA, National Environmental Policy Act
+: PDT, Project Delivery Team

910 Public Meetings (Feb - Mar 2019)
> 8,000 comments received

Public Comment Period (Spring 2022)

PDT+ Meetings & Public Workshops (2020 – 2021)

Public Comment Period (Fall 2022)

lakeocomments@usace.army.mil
www.saj.usace.army.mil/LOSOM
OVERVIEW OF LAKE OKEECHOBEES SYSTEM OPERATING MANUAL

Tim Gysan, Project Manager, USACE, Jacksonville District
OVERVIEW OF LOSOM: LAKE OKEECHOBEE IS A PART OF THE SYSTEM

• The Central and Southern Florida (C&SF) Project (Authorized 1948 – House Document No. 643)

• Includes an interconnected system of 1,000 miles of canals, 720 miles of levees, and several hundred water control structures

• U.S. Army Corps of Engineers operates and maintains Lake Okeechobee as well as other parts of the C&SF Project

• Lake Okeechobee operations are governed by a manual developed through a public process
Operating manuals describe how to operate project components to ensure that the goals and purposes of the projects are achieved.

The C&SF System Operating Manual (SOM) consists of 7 volumes organized according to geographical regions, that collectively ensure that projects function in a coordinated, systematic way.

Volume 3 – Lake Okeechobee and the Everglades Agricultural Area, is the volume being updated in parallel with LOSOM development of Lake Okeechobee regulation schedule.
1. Identify water management tools to combine to form conceptual lake regulation schedules

PUBLIC OPPORTUNITY
Provide water management tools

2. Conceptual plan evaluation using Pareto analysis (JUL 20 to DEC 20)

PUBLIC OPPORTUNITY
Review and compare initial array, provide a schedule for analysis

3. Iteration 1 Initial Array (9+ Schedules) (DEC 20 to FEB 21)

4. Iteration 2 Balanced Array (3 Schedules) (MAR 20 to MAY 21)

PUBLIC OPPORTUNITY
Review and compare balanced array

PUBLIC OPPORTUNITY
Feedback on optimizations

5. Iteration 3 Optimize Recommended Schedule (1 schedule) (JUN 21 to JUL 21)

RECOMMENDED LAKE OKEECHOBEE REGULATION SCHEDULE JUL 21

PUBLIC OPPORTUNITY
Provide water management tools

TENTATIVELY SELECTED LAKE SCHEDULE

OVERVIEW OF LOSOM: PLAN FORMULATION STRATEGY

WE ARE HERE
OVERVIEW OF LOSOM: MODELING

Regional Hydrologic Models (RSM)
• Primary modeling tools for LOSOM assessment. The models provide daily, detailed estimates of hydrology across the planning domain.
• RSMBN & RSMGL

Sub-regional & Detailed Models
• Smaller scale, more detailed models to help analyze specific areas of interest
• DMSTA (water-quality)

Screening Tools and Techniques
• Simplified models and data processing techniques to analyze a broad range of options and to screen ideas for further in-depth analysis
OVERVIEW OF LOSOM: HOW WILL THE METRIC BE USED?

Conceptual Plan Evaluation

Iteration 1

Iteration 2

NATIONAL ENVIRONMENTAL POLICY ACT DOCUMENT
# LOSOM Overall Schedule

**Milestone**

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoping Meetings (complete)</td>
<td>February - March 2019</td>
</tr>
<tr>
<td>Plan Formulation &amp; Performance Evaluation Finalized</td>
<td>June 2020</td>
</tr>
<tr>
<td>Evaluation of Alternative Lake Schedules</td>
<td>July 2020 – July 2021</td>
</tr>
<tr>
<td>Draft Report Release</td>
<td>January 2022</td>
</tr>
<tr>
<td>Final Report Release</td>
<td>July 2022</td>
</tr>
<tr>
<td>Record of Decision (ROD)</td>
<td>October 2022</td>
</tr>
</tbody>
</table>

**90 Day Look Ahead**

**November 2020**
- Conceptual Plan Evaluation using Pareto Sorting
- Algal Bloom Risk Metric Reviews
- PDT Meeting (20NOV20)

**December 2020**
- PDT Meeting (TBD)
- Conceptual Plan Review with PDT
- Selection of Initial Alternative Array

**January 2020**
- Iteration 1 Modeling
- Existing and FWO condition Review
USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE

Colonel Andrew Kelly, Commander, USACE, Jacksonville District
USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE

Does Our Approach Makes Sense?

• Is the metric technically sound relative to its design objectives?

• Any comments on the underlying theory, concept, or computational aspects of the model?

• Do you see any potential issues that may affect the model’s usability, reliability, or use in comparing potential alternatives?

• Can you suggest additional tools that we could use to predict the potential for algal bloom risk given limitation of output from RSMBN (e.g. flow, stage)?
USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE

USACE REQUESTS THE BLUE GREEN ALGAE TASK FORCE TO PROVIDE COMMENTS TO USACE BY:

10 DECEMBER 2020

USING THE COMMENT RESPONSE MATRIX PROVIDED
USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE: LOSOM ALGAL BLOOM RISK PERFORMANCE METRIC DOCUMENTATION

USACE Documents Provided:
• PowerPoint Presentation Overview
• Initial Draft Algal Bloom Risk Performance Metric Documentation Sheet
• Initial Draft Regression Analyses Spreadsheet
• Model Support Literature and Conceptual Ecological Model
• Comment Response Matrix
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

Jim Riley, Water Quality Lead
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC: SCOPING MEETING SUMMARY

COMMUNITIES AROUND LAKE O
- Time = Take time; sound science; not politics, drive schedule
- Lake Level = Higher
- Focus = Water quality; agriculture; water supply; recreation; Lake health

WEST COAST COMMUNITIES
- Time = Accelerate LOSOM
- Lake Level = Lower; move water south
- Focus = Human health; ecosystem health; algae

SOUTH FLORIDA
- Time = Take time; sound science, not politics, drive schedule
- Lake Level = Higher
- Focus = Improve flow to Everglades & Florida Bay; water supply; water quality

EAST COAST COMMUNITIES
- Time = Accelerate LOSOM
- Lake Level = Higher & lower
- Focus = Human health; water supply; water quality; algae; economy
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

2020 REPORT TO CONGRESS:

LAKE OKEECHOBEE | NORTHERN ESTUARIES
HARMFUL ALGAL BLOOMS

Algal Blooms in Caloosahatchee Estuary*

PRECEDING CONDITIONS

- High Rainfall
- Nutrient Run-off from Watersheds Surrounding Lake and Estuary
- Warm Temperatures
- Long Hours of Daylight
- Stagnant Conditions
- Lake Releases to Estuaries for Flood Risk Management

*Image courtesy of Cavin Brothers

Lake Okeechobee and the Northern Estuaries experienced algal blooms in 2015-2020

- Although algal blooms occurred during each year of this reporting period, the summer of 2016 provides an example of the conditions that can spawn these events. June 2016 data indicated high levels of chlorophyll and detection of cyanobacteria in the Lake (June 14, 2016 NOAA cyanobacteria imagery overlaid on the map above).
- Prevailing winds and releases from Lake Okeechobee for Flood Risk Management sent algal blooms and nutrients into the estuaries. Coupled with nutrients from their watersheds, extensive algal blooms formed in the estuaries.

Image courtesy of NOAA 2020
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

Performance Metric Development

• LOSOM Water Quality Sub-Team: Multi-agency, multi-disciplinary team (Scientists and Engineers, State, Federal, Local Governmental Agencies and Tribes)

• The LOSOM Water Quality Sub-Team reviewed available tools that could use RSMBN model output (stage and flows are the only output) to evaluate algal bloom risk

• Two concepts considered to evaluate algal bloom risk: 1) Dr Walker’s chl a predictive equations; and 2) Dr. Welch’s concept to use the Lake Okeechobee environmental stage envelope.

• LOSOM Water Quality Sub-Team determined to use the chl a predictive equations. Metric documentation was only developed for that approach.

• Primary Authors of metric documentation for the chl a predictive equations:
  • Dr. Donatto Surratt, Department of the Interior, Everglades National Park
  • James Riley, USACE, Jacksonville District
  • Dr. Bill Walker, Department of the Interior Consultant (Regression Analyses)
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

• Recognizing that the science and predictive modeling tools for algal blooms/algal bloom risk are under development, this metric is our path forward to evaluate algal bloom risk for the development of LOSOM alternatives until better tools are available. This tool is not intended to guide daily or weekly operational decisions.

• The proposed metric uses chlorophyll a (chl a) concentration as a proxy/surrogate for estimating phytoplankton abundance and biomass in the water. There is a very large database of chl a values and Lake Okeechobee stage data. Preliminary analysis indicates that chl a conditions are correlated to lake stages.

• Chl a concentrations in Lake Okeechobee were simulated by separate regression equations developed for the lake’s littoral and pelagic regions based on the correlation of chl a with Lake Okeechobee stage.

• Two chl a thresholds are used to assess algal bloom risk:
  - 20 ppb(µg/l) chl a - The concentration standard for colored lakes in Florida
  - 40 ppb (µg/l) chl a - Development of TMDL target for Lake O used 40 ppb (µg/l) chl a as representative of a moderate bloom condition (normally visible to the unaided human eye). Concentrations of chl a above 40 ppb(µg/l) is considered indication of excessive nutrient concentrations.
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

Figure 1. Lake Okeechobee water quality stations monitored and used for algal bloom metric formulation.

ZONES:

- Littoral West: Assess risk of algal blooms in lake and at the S-77 structure
- Littoral South
- Pelagic: Assess risk of algal blooms in the lake and at the S-308 structure
Summer months (May through August) chlorophyll-a projections will be based on simple regression models of the form,

$$\log(chlaz) = stage_i \ast m + b,$$

where $chlaz$ is the predicted mean summer chlorophyll-a concentration by $z$ (zone) for each year, $stage_i$ is the summer average stage per year ($i$), $m$ represents the slope, and $b$ the intercept. Specific formulations for the three zones are presented in Table 1.

Table 1. Predictive equations for annual summer mean chlorophyll-a concentrations and performance statistics.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Equation</th>
<th>$R^2$</th>
<th>Standard Error</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelagic</td>
<td>$\log(chlapeLAGic) = stage_i \ast 0.122 + 2.956$</td>
<td>0.31</td>
<td>0.23</td>
<td>16</td>
</tr>
<tr>
<td>Littoral West</td>
<td>$\log(chlaweLlIt) = stage_i \ast 0.716 + 1.761$</td>
<td>0.73</td>
<td>0.56</td>
<td>16</td>
</tr>
<tr>
<td>Littoral South</td>
<td>$\log(chlasouThLit) = stage_i \ast 0.570 + 1.708$</td>
<td>0.73</td>
<td>0.44</td>
<td>15</td>
</tr>
</tbody>
</table>
INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

Algal Bloom Risk Metric Model Output
- Frequency of exceeding the thresholds,
- Mean chlorophyll-a concentrations, and
- Percent of releases from Lake Okeechobee towards each individual estuary during high-risk windows.

Performance Evaluation
- Percent of time of each zone above the chl a thresholds of 20 and 40 ppb relative to baseline conditions
- Frequency and magnitude of exceeding either threshold within the lake will be used to assess each scenario through conceptual planning and alternatives evaluations in the LOSOM process.
- The volumes delivered west (S-77) and east (S-308) from the lake with chlorophyll-a concentration above the thresholds will be used to evaluate risk of algal blooms for the Caloosahatchee and St. Lucie estuaries.
Limitations:

• The Algal Bloom Risk Metric is not a predictive tool intended to guide daily or weekly water management operational decisions.
• The Algal Bloom Risk Metric cannot predict the presence of toxins
• USACE recognizes the need for a holistic predictive model that relies upon nutrient concentrations, temperature, wind/weather conditions and predictions, circulation model information, etc.
• Jacksonville District in collaboration with NOAA, FDEP, and UF are seeking funding opportunities to develop these sort of tools. No immediate funding plan has been identified.
Parallel Corps ECO-PCX Review

Step 1: Conceptual Level Review

• Determine the degree to which the subject metric can be described as technically sound relative to its design objectives.
• Comment on the underlying theory, conceptualization, and computational aspects of the model.
• Comment on aspects of the model that potentially affect its usability and reliability as a potential producer of information to be used to influence planning decisions.
• Suggestion for additional tools that Jacksonville District could employ to ascertain the potential for algal bloom risk.

Step 2: Model Approval (February 2021)
QUESTIONS?