



Restoration Coordination and Verification (RECOVER)  
Evaluation Team, Regional Evaluation Report

**TRANSMITTAL LETTER**

July 1, 2005

Project Managers and Planning Technical Leads  
C-43 Basin Storage Reservoir Project  
Comprehensive Everglades Restoration Plan

Dear Project Team Managers and Planning Technical Leads,

RECOVER has completed its project-level performance measure consistency review of the C-43 Basin Storage Reservoir (BSR) and our final report is attached.

RECOVER's evaluation of project performance measures fulfills the following requirements as prescribed by the Programmatic Regulations:

1. Ensure project will be achieving consistency with the CERP's goals and objectives
2. Document consistency of the project performance measures with RECOVER's approved system-wide performance measures
3. Suggest improvements to the project performance measures with the intent of improving target or evaluations methods to better evaluate project alternative plans, that, if pursued, would contribute to selecting a tentative plan with the best performance by the project in achieving ecosystem restoration goals

During RECOVER performance measures consistency reviews, RECOVER focuses in the following general questions:

- Are project-level performance measures consistent with RECOVER's system-wide performance measures?
- Are project-level performance measures consistent with CERP goals and objectives?
- Are RECOVER system-wide performance measures included in the performance measure hierarchy? Additionally, is it clear who will be evaluating which effects of the project?

RECOVER finds that the project-level performance measures developed by the project team are generally compatible with the CERP system-wide evaluation performance measures developed by RECOVER. RECOVER is making suggestions regarding the content, target, and nomenclature for several of the performance measures. These suggestions can be found in Attachment A.

Best regards,

Evaluation Team Chairs  
(Orlando Ramos-Ginés, Kim Jacobs, Steve Gilbert)

*C-43 Basin Storage Reservoir (BSR)*  
*RECOVER EVALUATION OF PROJECT-LEVEL PERFORMANCE*  
*MEASURES (Final 070105)*

Prepared by the RECOVER Evaluation Team

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## 1.0 Introduction

The role of the Restoration Coordination and Verification (RECOVER) team is to organize and apply scientific and technical information in ways that are most effective in supporting the objectives of the Comprehensive Everglades Restoration Plan (CERP). RECOVER links science and the tools of science to a set of system-wide planning, evaluation and assessment tasks. These links provide RECOVER with the scientific basis for meeting its overall objectives of evaluating and assessing Comprehensive Plan performance and refining and improving the plan during the implementation period. RECOVER fulfills this role by working with the project delivery teams (PDTs) to help them meet CERP's system-wide goals and objectives. Specifically, RECOVER reviews the performance measures for project-level evaluation of alternatives for consistency with the system-wide evaluation performance measures developed by RECOVER.

The purpose of this performance measure consistency review is 1) to identify general compatibility of project-level performance measures with applicable system-wide performance measures, and 2) to provide information to project managers and others, as appropriate, regarding compatibility of project-level and system-wide performance measures of the C-43 BSR project as submitted to RECOVER in May 2005. RECOVER recognizes and appreciates the time and effort that went into developing these performance measures. The review comments below are intended to enhance the existing set of performance measures. Comments on the specific project-level performance measure are presented in the attached table (Attachment A).

## 2.0 General Document Comments

The C-43 BSR performance measures are generally well developed. However, RECOVER does offer suggestions to improve the performance measures' utility in conducting benefits evaluation, necessary linkages between biology and salinity, and the availability of the necessary biologic models needed to evaluate the project's benefits to the environment. Specific comments are included in Attachment A.

**Utility of Performance Measures in Evaluating Project Alternatives** - Several of the hydrologic performance measures do not have clear numeric targets to facilitate their use in an evaluation methodology, and may not be conducive to making decisions in distinguishing between alternatives nor in determining the performance of the alternative relative to an absolute numeric target. Such terms as "minimize", "maximize", "fewest", and "least" should be replaced by numeric targets where possible. Documenting the

linkage between the performance measure target and the evaluation methodology would clearly show how the performance measures could be used to make decisions. Setting targets and describing the linkage to project benefits will aid in justifying the size and benefits of the reservoir. As currently written, these performance measures may be more appropriate as performance indicators or constraints in screening alternatives.

**Linkages to Biology** – While the desired salinity ranges for submerged aquatic vegetation and oysters are described in the performance measure ecological performance targets, further documentation is needed to more closely link salinity to submerged aquatic vegetation and oyster abundance and quality. RECOVER suggests the project team include more references to Voltey et al. to better demonstrate the connection between salinity and biology. The use of a monthly time step for hydrological targets should be further discussed relative to its ability to provide protection for those attributes of concern (e.g., oysters).

**Modeling** – RECOVER recognizes a significant effort will be needed to complete the targets and tools necessary to support the C-43 BSR performance measures. RECOVER has some concerns that the ecological models for submerged aquatic vegetation and oysters in the estuary will not be available in time for the project's planning process and benefits evaluation. Once the performance measure targets are developed and the tools/models needed to evaluate them are completed, the C-43 BSR performance measures will be consistent with CERP system-wide performance measures.

### 3.0 Consistency with RECOVER System-Wide Evaluation Performance Measures

The project-level performance measures developed by the PDT for the C-43 BSR are generally compatible with the system-wide evaluation performance measures developed by RECOVER. However, RECOVER does offer suggestions regarding the content, target, and nomenclature for several of the performance measures. General comments of significance are noted below, while comments on each specific project-level performance measure are presented in the attached table (Attachment A).

**Water Quality** – RECOVER recognizes that the project team has recently added a suite of water quality performance measures in response to RECOVER comments made during a briefing meeting held March 2, 2005. Since the project has designated water quality improvement as one of its objectives, RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, RECOVER does suggest that further discussion be included in performance measure documentation to address how the 20% reductions in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to estuarine restoration.

**Hydrologic Targets** – The hydrologic flow targets for the C-43 BSR performance measures are consistent with RECOVER system-wide performance measure NE-E3 for the Caloosahatchee Estuary. In fact, the project's low flow limit of 450 cubic feet per

second (cfs) is more conservative than the 300-cfs low-flow limit specified in NE-E3. The projects proposed use of time series EST05 to create a flow distribution curve for inflows to the Caloosahatchee is a step forward in evaluating flows to the estuary. While there are still questions as to how extreme flow events will be characterized to maintain biologic diversity and health (discussed below), RECOVER will further investigate the incorporation of EST05 into system-wide performance measure NE-E3.

**Hydrologic Targets Using Mean Monthly Averages** – The current use of a mean monthly time step to evaluate hydrologic targets for the Caloosahatchee Estuary is consistent with RECOVER performance measure NE-E3; however, the mean monthly time step may not ensure the desired salinity ranges for the biological indicator species of oysters and submerged aquatic vegetation. While the performance measure is evaluated based on mean monthly flow, the indicator species are reacting at a much shorter time scale and are sensitive to short-term extreme flow conditions, which could occur within an acceptable mean monthly flow. For example, a 300-cfs mean monthly flow could be derived from 30 days of flow at 300 cfs, or 29 days of no flow with one day of flow at 9,000 cfs or any combination in between. RECOVER will be refining its system-wide performance measure to address this issue in the near future and suggests the C-43 BSR also consider how extreme flow conditions could be factored in the determination of monthly mean flows and an appropriate time step for the protection of attributes of concern.

**Lake Okeechobee** – The C-43 BSR project may provide benefit to Lake Okeechobee, as the lake will be relieved of making some water supply deliveries due to the presence of the C-43 Reservoir. RECOVER suggests the project consider including a performance measure, such as the system-wide performance measure LO-E10, Lake Okeechobee Stage Envelope, to quantify the project's effects on the lake.

**Dry Season** – While the targets for the C-43 hydrologic performance measures appear to be consistent with RECOVER system-wide performance measures, the nomenclature used may be inconsistent with terms used in similar RECOVER performance measures. For instance RECOVER performance measure NE-E3 defines the dry season as November-May rather than October-July.

#### 4.0 Conclusions

The project-level performance measures developed for the C-43 BSR project are generally compatible with the system-wide performance measures. The project incorporated EST05 time series appears to be an improvement over the current RECOVER performance measure and may be incorporated into the system-wide performance measure. Some revisions are suggested to increase the degree of consistency between project and system-wide performance measures. RECOVER suggests that the PDT reexamine some performance measure targets to address their utility in differentiating between alternatives and determine the performance of a specific alternative relative to an absolute numeric target. RECOVER also suggests the project consider strengthening the linkages between hydrology and biology to relate salinity to submerged aquatic vegetation and oyster quality and abundance. Additionally,

## RECOVER Performance Measure Consistency Review

RECOVER suggests that the project team document the protective scope of the monthly average time step for attributes of concern and investigate means of incorporating extreme flow events into hydrologic targets.

### 5.0 References

Volety, A.K., S.G. Tolley, and J.T. Winstead. 2003. Effects of seasonal and water quality parameters on oysters (*Crassostrea virginica*) and associated fish populations in the Caloosahatchee River: Final contract report (C-12412) to the South Florida Water Management District. Florida Gulf Coast University, Ft. Myers, Florida.

**C-43 Basin Storage Reservoir**  
**Performance Measure Consistency Review Recover Comment Table**

Hydrologic – (Water Levels, Flow Volumes)

**The following ecological performance target and evaluation method are common to all the hydrologic targets (1a through 5):**

Allowing for natural variation, reduce the high variability in freshwater inflow to the Caloosahatchee Estuary, thereby providing the full range of salinity along its longitudinal axis required to support the naturally occurring conditions and estuarine biota.

**Ecological Performance Targets (within the limits of natural variation)**

1. (a) Maintain a 30-day moving average salinity  $\leq 10$  ppt during the dry season at the Fort Myers continuous salinity sensor (near the surface at the Fort Myers Yacht Basin), such that *Vallisneria americana* (tape grass) in the Beautiful Island area does not decrease below 20% coverage and blade length is  $\geq 10$  cm (values are provisional and may be adjusted after current research (MML 2004 and 2007 reports) are evaluated); (b) Daily average salinity shall not exceed 20 ppt at Fort Myers more than once every two years, and neither shall the 30-day moving average salinity of 10 ppt (MFL Rule: SFWMD 2000); (c) Limit the occurrence of average monthly salinity  $< 15$  ppt at the Cape Coral Bridge sensor, so salinity  $\geq 20$  ppt is promoted in Iona Cove (Bierman 1993), which is supportive of minimum seagrass density (coverage  $\geq 30\%$  at 1-m water depth and average blade length  $\geq 10$  cm - values are provisional and may be adjusted upon further research); and (d) maintain daily salinity at Piney Point  $> 5$  ppt, so that minimum conditions are provided for the recruitment, survival, and growth of juvenile oysters upstream of Shell Point during March – October (juvenile oyster growth  $\geq 2.5$  mm a month; recruitment  $\geq 3$  spats per substrate shell a month; and mortality  $< 20\%$  per month - values are based on information interpreted from Volety et al. 2003).

2. Maintain an average monthly salinity  $\geq 25$  ppt, as measured at the Sanibel Causeway Bridge near surface continuous sensor, so that historical seagrass density and coverage in the San Carlos Bay area (as determined from previous surveys, hydroacoustic monitoring, and aerial photography) is protected and restored to a previous condition (at least circa Harris et al. 1983) that includes reestablishment of continuous coverage at deeper depths in the San Carlos Bay area between Shell Point and the Sanibel Causeway.

**Evaluation Method:**

Regional and subregional models will be used to simulate historical (base) and predicted flows to the estuary with and without CERP project features for each alternative considered. Natural system flows to the Caloosahatchee Estuary from its watershed and tidal basins may also be considered in order to compare flows associated with the developed basins. Output (flows) from the above model runs will be used to evaluate the level that hydrologic targets are achieved for each alternative and base condition. Model output will be used as input for the estuarine salinity model to further assess changes in salinity. To help evaluate if ecological goals will be met, the estimated salinity will be used to assess the impact on key biota by employing habitat suitability indices related to salinity.

**1a) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

Hydrologic performance targets to achieve the ecological targets

1a). For each alternative, compare the number of times that mean monthly inflows from the Caloosahatchee watershed fall below a low-flow limit of **450 cfs**, measured at S-79, during October to July . The alternative with the fewest number of times that monthly average flows fall below **450 cfs** will be considered better for protecting aquatic vegetation, oysters, and fish communities

**Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for submerged aquatic vegetation (SAV) and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term “fewest”. By providing specific ecologically-based targets for this and other performance measures, for example “less than 70 months with mean monthly flows below 450 cfs,” the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure’s evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

The current use of a mean monthly time step to evaluate hydrologic targets for the Caloosahatchee Estuary is consistent with RECOVER performance measure NE-E3; however, the mean monthly time step may not ensure the desired salinity ranges for the biological indicator species of oysters and SAV. While the performance measure is evaluated based on mean monthly flow, the indicator species are reacting at a much shorter time scales and are sensitive to short-term extreme flow conditions. RECOVER will be refining its system-wide performance measure to address this issue in the near future and suggests the C-43 BSR also consider how extreme flow conditions could be factored in the determination of monthly mean flows. If there has been an analysis or thought process of how this time step is protective of attributes of concern, such documentation should be included.

**1b) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

Hydrologic performance targets to achieve the ecological targets

1b). For each alternative, compare the frequency that the mean monthly low-flow limit of **450 cfs** through S-79 from the watershed was not met for just one month (not followed by another month below the this low-flow limit), as well as the frequency for 2, 3, 4... etc. consecutive months. The water management alternative with the fewest number of consecutive months below the **450 cfs** will be considered better for protecting estuarine aquatic resources.

**Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term “fewest”. By providing specific

ecologically-based targets for this and other performance measures, for example “no consecutive months with mean monthly flows below 450 cfs,” the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure’s evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

The hydrologic target statement is not clear regarding the meaning of “just one month”. RECOVER suggests the PDT address the following within the Evaluation Method section of the performance measure: (a) Does this refer to non-consecutive months during a one-year period? and (b) Will the project compare the number of flow limit exceedences for 2 consecutive, 3 consecutive, or 4 consecutive months, etc.?

### **1c) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

Hydrologic performance targets to achieve the ecological targets

1c). For each alternative, compare the frequency that the mean monthly low-flow limit of **450 cfs through S-79** from the watershed was not met for just one year (not followed by another year with months below **450 cfs**), as well as the frequency for 2, 3, 4...etc. consecutive years. The water management alternative with the fewest number of years and consecutive years with average monthly flow occurrences below **450 cfs** will be considered better for protecting estuarine aquatic resources.

#### **Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedances rather than the term “fewest”. By providing specific ecologically-based targets for this and other performance measures, for example “no years with mean monthly flows below 450 cfs,” the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure’s evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

RECOVER does have questions regarding whether any of the submerged aquatic vegetation models include the effect of nutrient inputs. RECOVER recommends the PDT address within the performance measure, how nutrient information is going to be used in determining the best scenario for *Vallisneria*?

**2a) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

Hydrologic performance targets to achieve the ecological targets

2a). For each management alternative, compare the number of times that mean monthly inflow from the watershed exceeds 2,800 cfs at S-79. The alternative with the fewest number of times that this criterion is exceeded at any time of year will be considered better for protecting both SAV and juvenile oysters at Shell Point and upstream. Additionally, a better ranking will be given to the alternative with the least number of discharges above these limits during March through October, in order to limit critically low salinity conditions from occurring both upstream and downstream of Shell Point, which threatens estuarine resources, including SAV and juvenile oyster recruitment and survival.

**Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term “fewest”. By providing specific ecologically-based targets for this and other performance measures, for example “no mean monthly flows exceeding 2,800 cfs,” the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure’s evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

**2b) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

Hydrologic performance targets to achieve the Ecological targets

2b). For each alternative, compare the frequency that the mean monthly inflow from the watershed, measured at S-79, exceeds 2,800 cfs for just one month (not followed by another month above this limit), as well as the frequency for 2, 3, 4... etc. consecutive months. The alternative with the fewest consecutive months that violate this criterion throughout the year will be considered better for protecting estuarine resources, including juvenile oyster recruitment and survival. Additionally, a better ranking will be given to the alternative with the least number of discharges above these limits during March through October, in order to limit critically low salinity conditions from occurring both upstream and downstream of Shell Point, which threatens estuarine resources, including SAV and juvenile oyster recruitment and survival.

**Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term “fewest”. By providing specific ecologically-based targets for this and other performance measures, for example “no consecutive months with mean monthly flows exceeding 2,800 cfs”, the project will be able to not only rank alternatives with respect to one another, but also quantify how close each

alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure's evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

### **3a) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

#### Hydrologic performance targets to achieve the ecological targets

3a). For each alternative, compare the number of times that mean monthly and mean weekly inflows from the watershed exceed 4,500 cfs at S-79 (weekly is important for protecting oyster recruitment and survival). The alternative with the least number of times flows exceed these limits will be considered better for protecting the estuarine resources, including those downstream in the San Carlos Bay region. Additionally, a better ranking will be given to the alternative with the least number of discharges above these limits during March through October, in order to limit critically low salinity conditions from occurring both upstream and downstream of Shell Point, which threatens estuarine resources, including SAV and juvenile oyster recruitment and survival.

#### **Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term "least". By providing specific ecologically-based targets for this and other performance measures, for example "no months or weeks with mean flows exceeding 4500 cfs", the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure's evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

### **3b) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

#### Hydrologic performance targets to achieve the ecological targets

3b). For each alternative, compare the frequency that mean monthly and mean weekly inflows from the watershed, measured at S-79, exceeds 4,500 cfs for just one month and 1 week (not followed by another month or week above this limit), as well as the frequency for 2, 3, 4...etc. consecutive months and weeks. The alternative with the fewest number of consecutive months and weeks that violate this criterion will be considered better for protecting aquatic resources, including juvenile oysters. Additionally, a better ranking will be given to the alternative with the least number of consecutive discharge periods above these limits during March through October, in order to limit critically low salinity conditions from occurring both upstream and downstream of Shell Point, which threatens estuarine resources, including SAV and juvenile oyster recruitment and survival.

#### **Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term “fewest”. By providing specific ecologically-based targets for this and other performance measures, for example “no consecutive mean monthly or weekly inflows exceeding 4,500 cfs”, the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure’s evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

#### **4) S-79, Shell Point and San Carlos Bay Freshwater Inflow**

Hydrologic performance targets to achieve the ecological targets

4). For each alternative, compare the frequency distribution of monthly average freshwater inflows through S-79 for the entire period of record being evaluated. The alternative with the frequency distribution of inflows that best approaches the range (EST05) defined in the main Performance Measures Document will be considered better for protecting estuarine resources, while further promoting biotic diversity. Specifically, the alternative that maximizes up to 75% of flows from S-79 in the **450 to 800 cfs** and almost all the remaining flows in the 800-2,800 cfs range will be considered the most desirable.

The preferred flow distribution (EST05) may change as more information is provided regarding predevelopment flow and salinity conditions; natural variation; what salinity conditions were naturally (historically) associated with droughts and flood events; and what flows are needed to protect and restore the biotic features in the current and future developed system.

#### **Is this performance measure consistent with RECOVER performance measures?**

This performance measure is consistent with RECOVER system-wide performance measures in that salinity is an important hydrological parameter. While the desired salinity ranges for SAV and oysters described in the ecological performance targets are consistent with the preferred range for adult oysters (10 to 30 ppt), further documentation is needed to more closely link salinity to SAV and oyster abundance and quality.

RECOVER suggests the PDT make the target for this performance measure more specific in terms of the frequency of exceedences rather than the term “maximize”. By providing specific ecologically-based targets for this and other performance measures, for example “75% of flows in the 450 to 800 cfs range”, the project will be able to not only rank alternatives with respect to one another, but also quantify how close each alternative comes to meeting the restoration target. Some kind of natural system model, as mentioned in this performance measure’s evaluation method, could provide such a target value, and some exceedences should be allowed for natural variability.

## Water Quality – Seasonal and Annual Nutrient Loads

**The following description and evaluation method are common to all the water quality targets (S-79 Structure 1a through 3c, and Feature Outfalls 1a through 2b):**

Reduce the annual and seasonal nutrient loads (total nitrogen and total phosphorus) delivered to the estuary at S-79. A reduction in nutrient loading should result in fewer and less severe occurrences of harmful algal blooms that are known to have occurred over the last 40 years. Reduction in nitrogen and phosphorus loading at S-79 can be accomplished by (1) attenuation of nutrient loads through storage and release of water from project reservoirs; (2) minimizing regulatory discharges from Lake Okeechobee to the Caloosahatchee Estuary; and (3) implementation of best management practices (BMPs) within the basin to control nutrient losses. Of these three means of nutrient load reduction, the first method (storage and release of water from reservoirs) is the only one that will directly result from the C-43 BSR project. Minimizing discharges from Lake Okeechobee will result from the implementation of other programs as well as other CERP elements. Implementation of BMPs is likely to result from Florida Department of Environmental Protection (FDEP) and United States Environmental Protection Agency (USEPA) actions to establish and meet nutrient total maximum daily loads (TMDLs) within the Caloosahatchee basin. These evaluation criteria require the comparison of future with project conditions to future without project conditions as well as an evaluation of project effects on nutrient loading at the time of project implementation. The latter comparison is required to assure FDEP that the project will not contribute to water quality degradation in the short-term (first 0 to 10 years after construction).

### **Evaluation Method:**

Regional and subregional models will be used to simulate historical, current, and predicted flows to the estuary with and without C-43 BSR and CERP features for each alternative considered. Output (flows) from the above model runs in conjunction with water quality analyses will be used to assess the extent that water quality targets are achieved.

### **1a) Nutrient Targets at S-79 for Average Annual Total Phosphorus Load**

1a). The estimated average annual load of total phosphorus delivered at S-79 for with project conditions should be reduced by at least 10% from existing conditions. The estimated average annual load of total phosphorus delivered under with project conditions should be reduced by at least 20% when compared to future without project conditions. Under existing conditions, approximately 300 tons of total phosphorus are discharged at S-79 on an annual basis.

### **Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the 20% reduction in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**1b) Nutrient Targets at S-79 for Average Annual Total Nitrogen Load**

1b). The estimated average annual load of total nitrogen delivered at S-79 for with project conditions should be reduced by at least 10% from existing conditions. The estimated average annual load of total nitrogen delivered under with project conditions should be reduced by at least 20% when compared to future without project conditions. Under existing conditions, approximately 2,700 tons of total nitrogen are discharged at S-79 on an annual basis.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the 20% reduction in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**2a) Nutrient Targets at S-79 for Average Dry Season Total Nitrogen Load**

2a). The estimated average dry season (December through April) total nitrogen load for with project conditions should be reduced by 10% relative to 2050 without project conditions. The estimated average dry season nitrogen load for with project conditions should be no greater than existing (without project) conditions.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the 20% reduction in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**2b) Nutrient Targets at S-79 for Average Wet Season Total Nitrogen Load**

2b). The estimated average wet season (May through November) total nitrogen load for with project conditions should be reduced by 20% relative to 2050 without project conditions. The estimated average wet season nitrogen load for with project conditions should be reduced by 10% relative to existing (without project) conditions.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the 20% reduction in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**3a) Nutrient Targets at S-79 for Monthly Average Dry Season Total Nitrogen Load**

3a). Reduce to zero the estimated number of occurrences of dry season monthly average total nitrogen load exceeding 190 metric tons relative to future without project conditions and existing conditions. Under existing conditions, the dry-season maximum desirable total nitrogen load is exceeded 45 times over a 36-year simulation period.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the restoration targets for the estuary were chosen. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**3b) Nutrient Targets at S-79 for Monthly Average Wet Season Total Nitrogen Load**

3b). Reduce to zero the estimated number of occurrences of wet season monthly average total nitrogen load exceeding 350 metric tons relative to 2050 without project conditions and existing conditions. Under existing conditions, the dry season maximum desirable total nitrogen load is exceeded 60 times over a 36-year simulation period.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the restoration targets for the estuary were chosen. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**3c) Nutrient Targets at S-79 for average annual TN load**

3c). Reduce to zero the estimated number of occurrences of average annual total nitrogen load exceeding 3,000 metric tons relative to 2050 without project conditions and existing conditions. Under existing conditions, the average annual desirable maximum total nitrogen load is exceeded 10 times over a 36-year simulation period.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the restoration targets for the estuary were chosen. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**1a) Nutrient Targets at Feature Outfalls for Annual Average Total Nitrogen Load**

1a). For each project reservoir, the estimated annual average total nitrogen load delivered at the outfall should be reduced by 20% relative to the estimated annual average total nitrogen load pumped into the reservoir.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the 20% reduction in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**1b) Nutrient Targets at Feature Outfalls for annual average TP load**

1b). For each project reservoir, the estimated annual average total phosphorus load delivered at the outfall should be reduced by 20% relative to the estimated annual average total phosphorus load pumped into the reservoir.

**Is this performance measure consistent with RECOVER performance measures?**

RECOVER endorses the creation of a set of water quality performance measures to quantify the project's expected benefits; however, further discussion should be included in performance measure documentation to address how the 20% reduction in nutrient loads from the 2050 without project condition were chosen as restoration targets for the estuary. It is unclear in the current documentation whether the proposed nutrient reductions will result in nutrient levels that correspond to restoration targets for the estuary.

**2a) Nutrient Targets at Feature Outfalls for Annual Average Total Nitrogen Concentration**

2a). For each project reservoir, the estimated annual average total nitrogen concentration of water delivered at the outfall should be no greater than the estimated annual flow-weighted average total nitrogen concentration of water pumped into the reservoir.

**Is this performance measure consistent with RECOVER performance measures?**

**2b) Nutrient Targets at Feature Outfalls for Annual Average Total Phosphorus Concentration**

2b). For each project reservoir, the estimated annual average total phosphorus concentration of water delivered at the outfall should be no greater than the estimated annual flow-weighted average total phosphorus concentration of water pumped into the reservoir.

**Is this performance measure consistent with RECOVER performance measures?**

**GENERAL COMMENTS**

This project may also benefit Lake Okeechobee, as the lake will be relieved of making some water supply deliveries due to the presence of this reservoir. The project could consider including a performance measure, such as the system-wide performance measure LO-E10, Lake Okeechobee Stage Envelope, to quantify the project's effects on Lake Okeechobee.

Completion, including calibration and verification of an SAV and oyster model for the estuary, will facilitate refinement of targets.

In general, RECOVER recommends setting the most definitive targets towards achieving estuarine restoration. We recommend that targets with modifiers such as "fewest", "maximum", etc. be replaced with definitive numeric targets (incorporating natural variability if possible) that will still enable comparison of alternatives but also indicate the differential between alternative performance relative to an overarching target.