# Greater Everglades Performance Measure

## Surface Water Conductivity

**Last Date Revised: March 2, 2007**

**Acceptance Status: Accepted**

## 1.0 Desired Restoration Condition

Maintenance of a soft water, low conductivity surface water in the Arthur R. Marshall Loxahatchee National Wildlife Refuge and hard water, higher conductivity water in the remaining freshwater Everglades.

### 1.1 Predictive Metric and Target

Predictive metric and target are not available at this time.

### 1.2 Assessment Parameter and Target

No more than 25% increase above background for Greater Everglades marshes, while taking into consideration natural seasonal and annual variation. If conductivity significantly exceeds this performance measure, then a determination must be made whether CERP activities caused or contributed to the increased conductivity values.

## 2.0 Justification

Conductivity of a solution is a measure of its ability to carry an electrical current and varies with both the number and types of ions in the solution. Conductivity is useful for understanding the source of water and its flow path. Conductivity is also important in determining periphyton communities in the Everglades (Gleason and Spackman 1974, Gleason et al. 1975). Periphyton serves as the food web base in the Greater Everglades wetlands. Two distinct communities of periphyton inhabit the Everglades: soft water and hard water communities. The Arthur R. Marshall Loxahatchee National Wildlife Refuge has soft water with a lower pH. The rest of the Everglades has harder water with a higher pH.

The taxonomic composition of periphyton is affected by local water chemistry and hydrologic conditions. Large increases in ionic strength of water can shift the taxonomic composition of the periphyton community and change its quality as a food source (Browder et al. 1991). Without an understanding of how altered water flows have changed ionic concentration at monitoring stations, it is unlikely that causes of taxonomic shifts will be understood.

The source and quality of water supplied to the Everglades ecosystem have changed dramatically over the past half-century. Historically, except where salinity intrusion or groundwater interactions were significant, much of the Everglades was a low-conductivity system. Everglades' precipitation had very low conductance of about 10 umhos/cm. Conductivity for rainfall in South Florida is also about 10 umhos/cm or a bit higher.

From 1959 to 1979, as inflow into Shark River Slough changed from being dominated by unregulated marsh flow to canal discharge, wet season conductivity rose from 250 to 600 umhos/cm (Flora and Rosendahl 1982). Currently, water in the Everglades Agricultural Area drainage canals can exceed 1,000 umhos/cm and pronounced conductivity gradients occur throughout the Everglades canals into the marsh, indicating the extent the canal system and its operation impacts water quality (Scheidt et al. 2000). Conductivity in Water Conservation Area 2A is often greater than 800 micromhos per centimeter (umhos/cm) due to discharges of stormwater and groundwater from the Everglades Agricultural Area to the Everglades (Scheidt et al. 2000).

Currently, conductivity within the refuge interior marsh is often less than 100 umhos/cm, even during the dry season. Conductivity within the freshwater portion of Everglades National Park varies from approximately 300 to 800 umhos/cm, depending on the season. Values at the interior park stations are lower during the wet season and higher with dry down and values increase approaching canal delivery points. At the southern end of Shark Slough (station P-35), conductivity is 300 umhos/cm during the wet season, but can be 2,000 or 3,000 umhos/cm in the dry season due to estuarine/tidal influence. This high conductivity is rare, but it does happen and is a natural occurrence.

CERP implementation will change water flow and distribution, and is likely to affect conductance throughout the Everglades canals and marshes. Water recovered from aquifer storage and recovery (ASR) projects may have conductance greater than 1,275 umhos per cm; however, recoveries will be controlled to minimize conductivity excursions.

Everglades National Park and the Arthur R. Marshall Loxahatchee National Wildlife Refuge are Outstanding Florida Waters. No degradation of water quality other than that allowed in Chapter 62-4.242(2) and (3), Florida Administrative Code, is permitted in these waters.

## 3.0 Scientific Basis

### 3.1 Relationship to Conceptual Ecological Models

The indicator for this performance measure is an ecological effect (Surface Water Conductivity) in the following conceptual ecological models:

Regional Models (RECOVER 2004b)

Ecological Model for Hypothesis Clusters (RECOVER 2005)

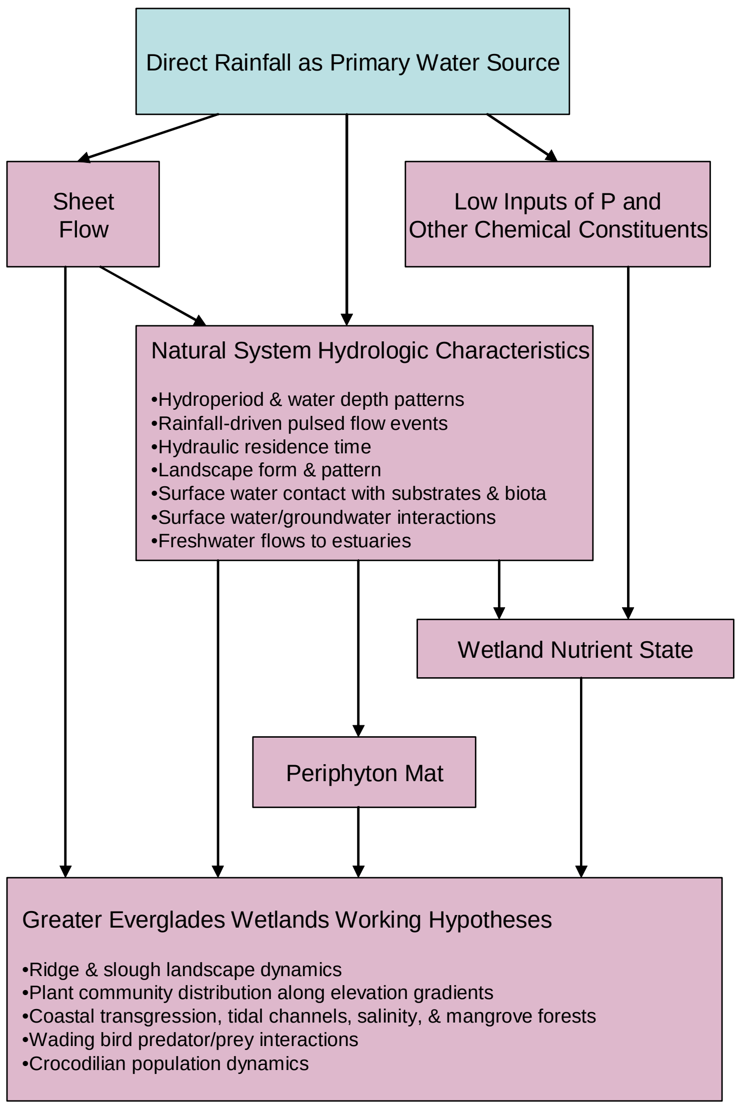
Integrated Hydrology and Water Quality Conceptual Ecological Model

### 3.2 Relationship to Adaptive Assessment Hypothesis Clusters

***Ecological Premise:*** The pre-drainage Greater Everglades wetlands system was characterized by hydrologic inputs (primarily from direct rainfall) and by extended hydroperiods. Natural conditions were characterized by oligotrophic conditions with low phosphorus and sulfur concentrations in surface waters having defined zones of low or high conductivity as compared to present conditions. An overriding expectation of CERP is that it will restore hydroperiods by providing freshwater inflows and restored hydropatterns to the Greater Everglades wetlands without increasing nutrient loads or subjecting more of the system (particularly the more pristine areas) either to elevated concentrations of surface water phosphorus, nitrogen, and sulfur or other constituents that alter the natural zones of conductivity in the freshwater regions, thereby improving overall water quality throughout the wetland system.

***CERP Hypothesis****:* The restoration of hydrology toward Natural Systems Model (NSM) conditions (a simulation of the pre-drainage Everglades) will result in maintenance of a soft water, low conductivity surface water in the Arthur R. Marshall Loxahatchee National Wildlife Refuge and hard water, higher conductivity water in the remaining freshwater Everglades.

**Integrated Hydrology and Water Quality Conceptual Ecological Model**




Above diagram is from the 2006 Assessment Strategy for the MAP (RECOVER 2006).

# 4.0 Evaluation Application

## 4.1 Evaluation Protocol

Predictive models to evaluate this performance measure are still under development and refinement. At this time, this performance measure should not be used to conduct evaluations.

## 4.2 Normalized Performance Output

## 4.3 Model Output

## 4.4 Uncertainty

Recognition of model uncertainty is needed when interpreting the ecological significance of model output. The Model Uncertainty Workshop Report provides guidance on the potential implications of uncertainty on model output interpretation (RECOVER 2002).

# 5.0 Monitoring and Assessment Approach

## 5.1 MAP Module and Section

See CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research - Greater Everglades Wetlands Module section 3.1.3.1 (RECOVER 2004a).

## 5.2 Assessment Approach

# 6.0 Future Tool Development Needed to Support Performance Measure

## 6.1 Evaluation Tools Needed

Predictive models to evaluate this performance measure are still under development and refinement.

## 6.2 Assessment Tools Needed

Accessibility to the various data sources through an integrated database is needed for the complete evaluation of these hypotheses and for parameter refinement.

# 7.0 Notes

This performance measure supersedes and addresses GE-11 Greater Everglades Wetlands Conductivity in Surface Water (Last Date Revised: September 20, 2005).

# 8.0 Working Group Members

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## 9.0 References

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