

Water Quality Constrains Hydrologic Management Options for a Northern Everglades Peatland

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Changes in water sources have altered both the hydrology and chemistry of the Everglades

Predrainage Ecosystem:

- Hydrology controlled by rainfall
- Oligotrophic, P-limited conditions
- Low-TDS (soft-water) conditions in peat-forming areas



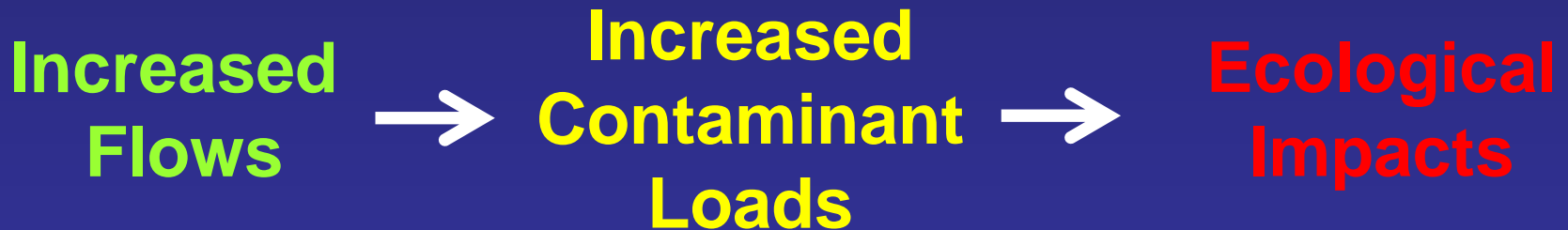
Managed Ecosystem:

- Hydrology influenced by canal discharges
- Phosphorus enrichment near discharge points
- Larger areas exposed to increased TDS loads (e.g., Ca^{2+} , HCO_3^- , SO_4^{2-} , K^+)

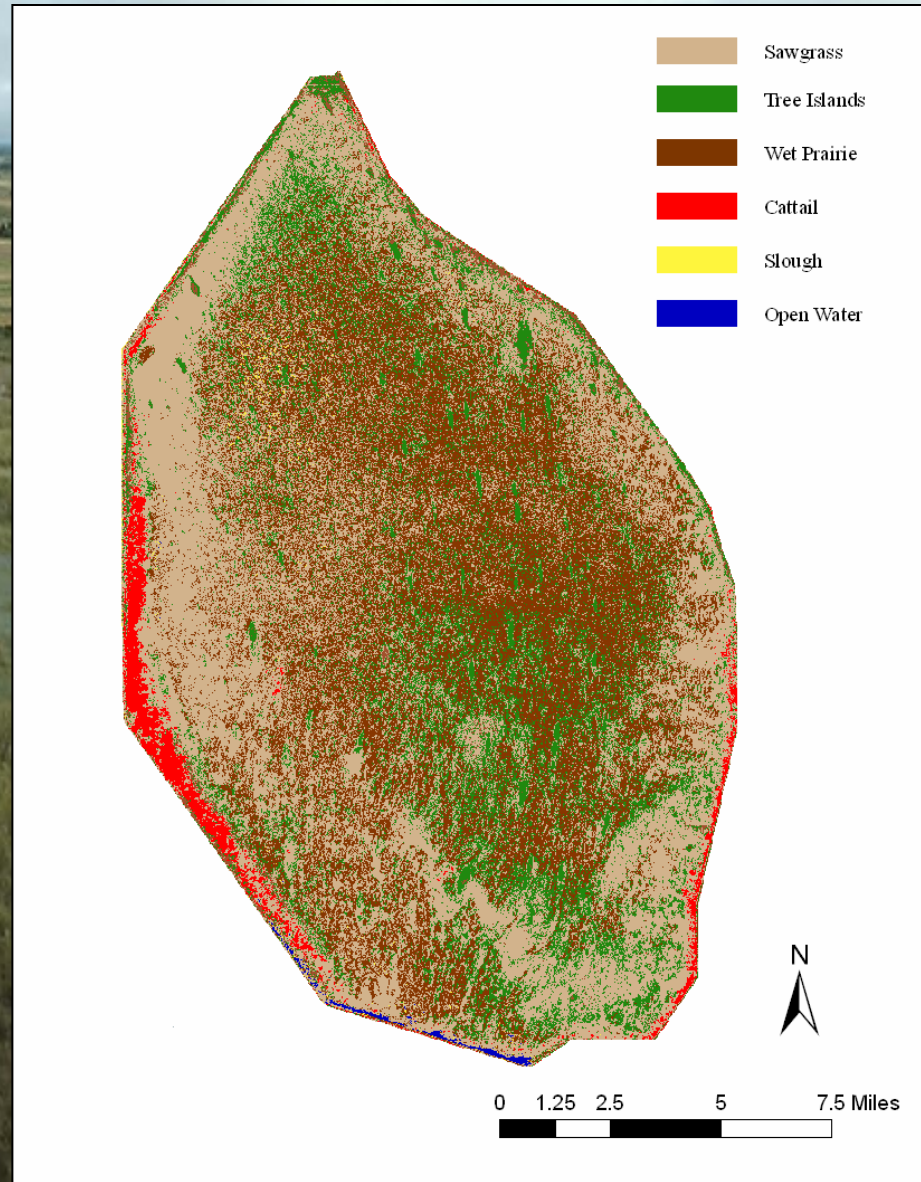
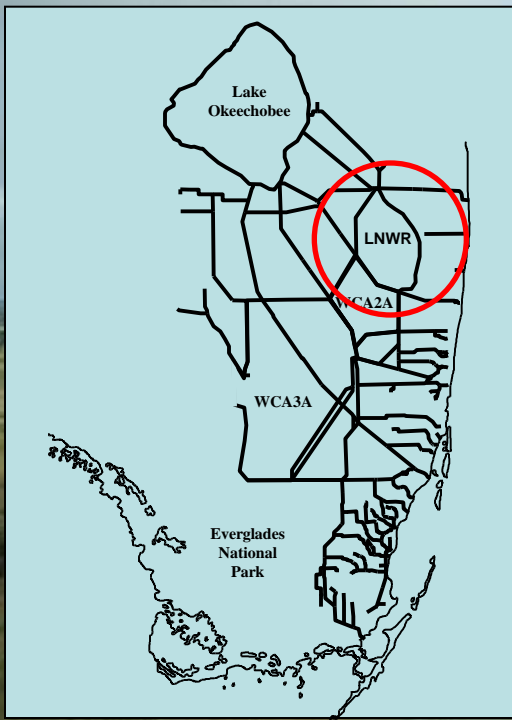


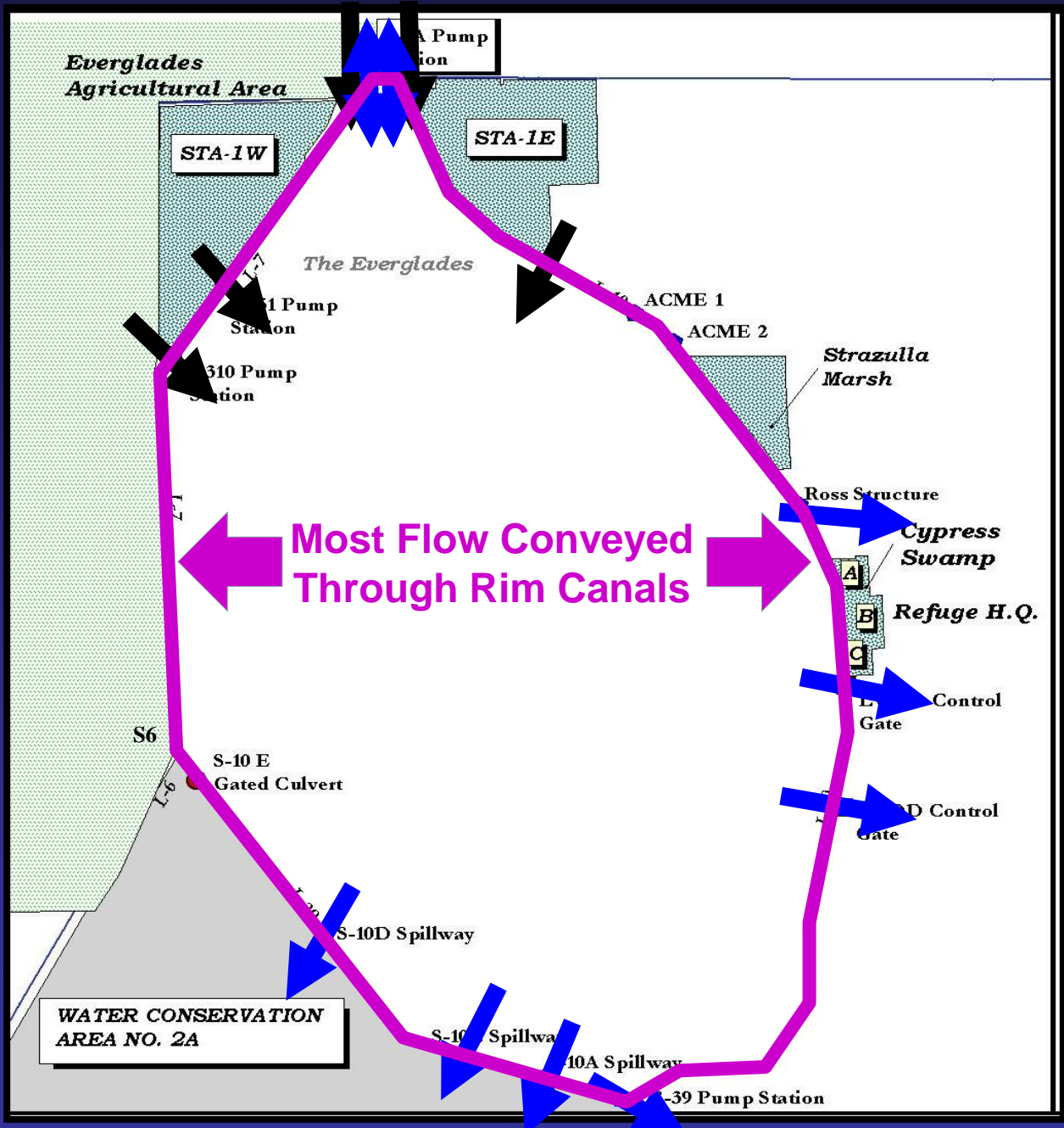
Conflicts between hydrologic and water quality needs of the natural system

- Poor quality of source waters
- Phosphorus reduction efforts (BMPs and STAs) have yet to meet environmental targets
- Other contaminant loads (e.g., sulfate, TDS) are not regulated



Loxahatchee National Wildlife Refuge (WCA1)





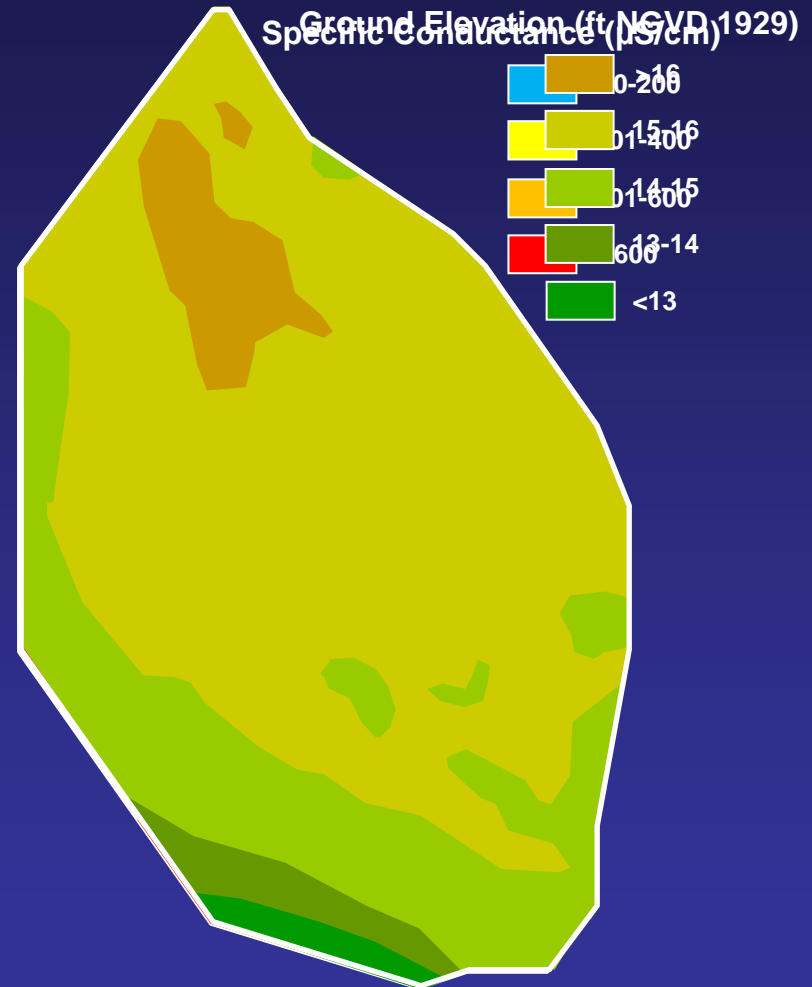
Major Environmental Gradients

- **Hydrology**

- North-South depth gradient

- **Water Quality**

- Phosphorus elevated near the perimeter
- Major ions (TDS) elevated across a large area



Hydrologic Management Options

Option 1: Flow Restoration

- **Ecological Benefits:**
 - Re-establish a major hydrologic driver
 - Reduce unnatural north-south depth gradient
- **Water-Quality Constraints:**
 - Forces P-rich, high-TDS canal water across the Refuge
 - STAs may achieve P targets but not designed to remove sulfate or other major ions
- **Engineering and Operational Constraints
(Insurmountable)**

Hydrologic Management Options

Option 2: Improve Impoundment Management

- **Ecological Benefits:**
 - Retard undesirable vegetation changes and soil oxidation
 - Support target fish & wildlife populations
- **Water-Quality Constraints:**
 - Can promote canal-water intrusion
 - STAs may achieve P targets but not designed to remove sulfate or other major ions
- **Engineering and Operational Constraints (Surmountable)**

Refuge Hydrologic Performance Measures

- **Seasonal High Stage**
 - Reach Full Pool for 3-4 weeks in most years
 - Maintain slough habitats and retard expansion of woody and invasive species
- **Spring Recession**
 - Gradual stage decline without significant reversals
 - Support breeding fish and wildlife

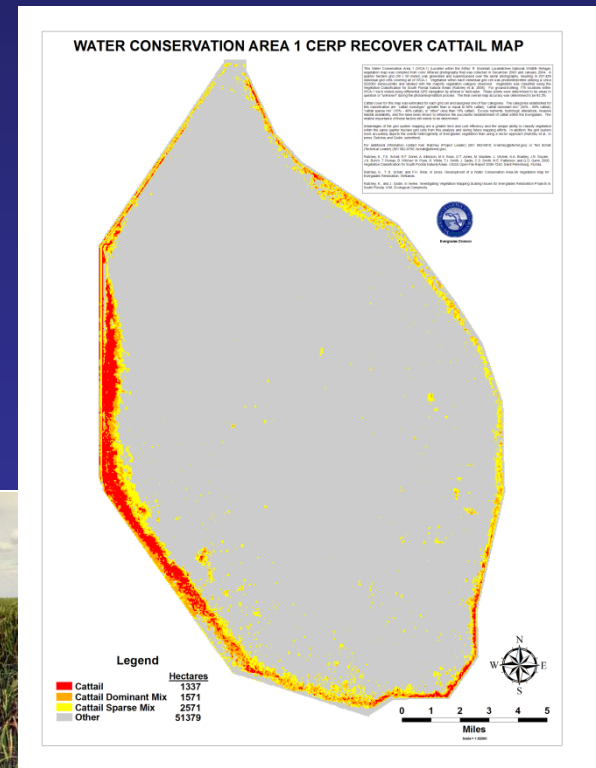


Refuge Water-Quality “Performance Measure”

- **Minimize Canal-Water Intrusion**
 - P, SO₄, TDS enrichment
 - Maintain desirable vegetation
 - Maintain habitat quality for fish and wildlife



P Enrichment



“Soft-Water” Refuge Vegetation.

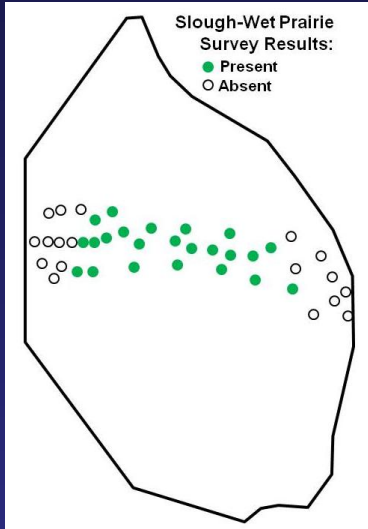
Xyris



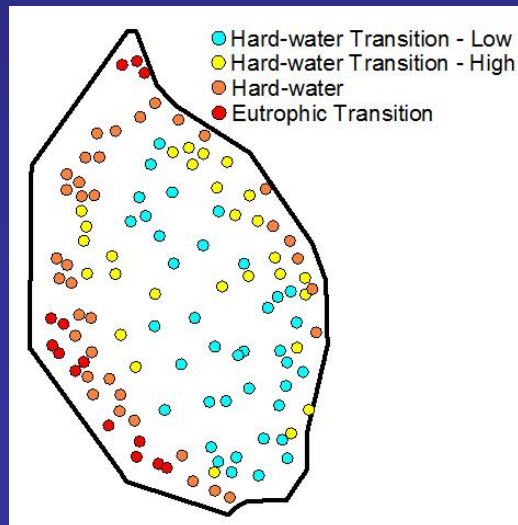
Nymphoides



Eriocaulon



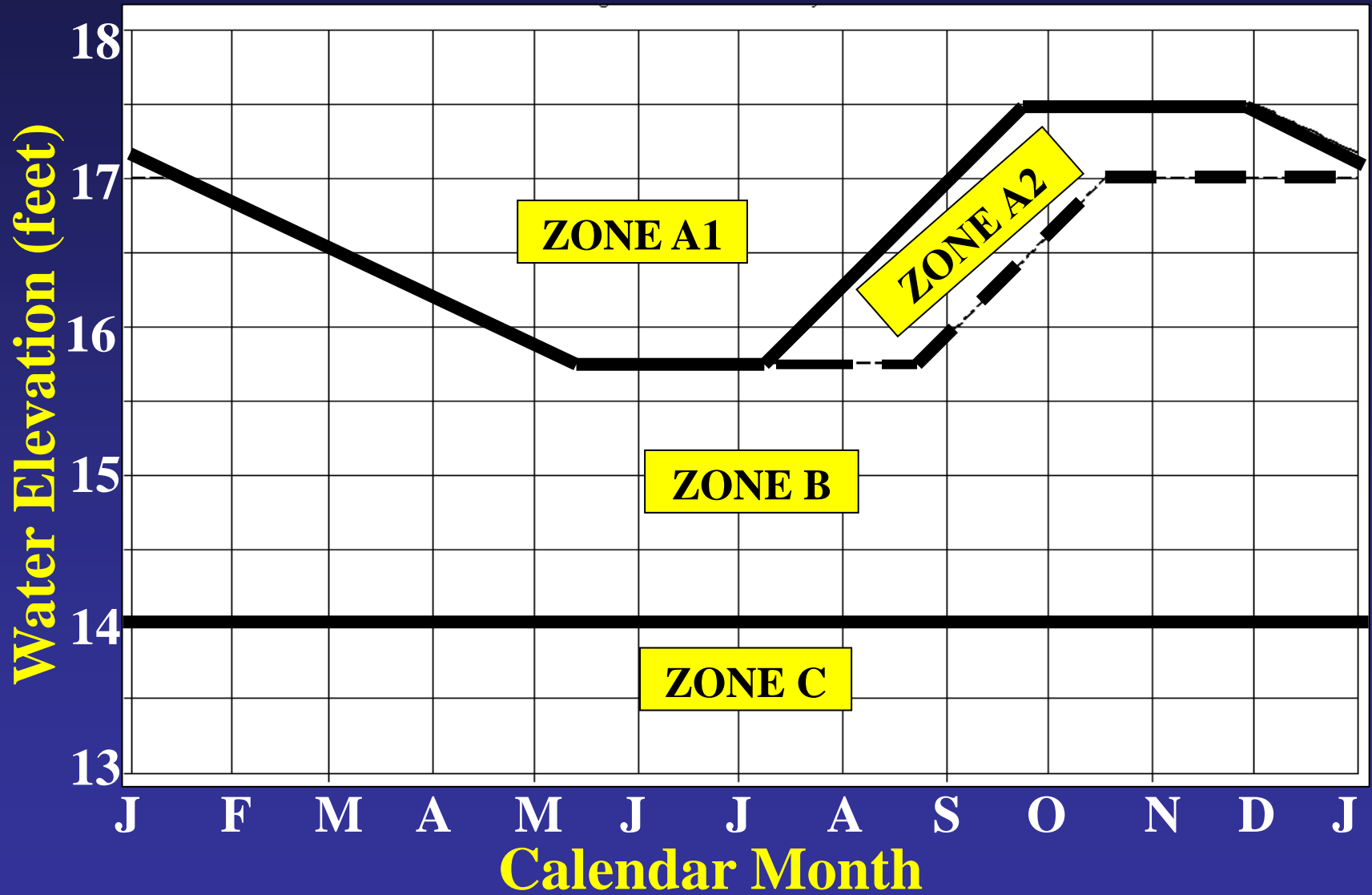
Periphyton



Refuge Hydrology vs. Water Quality: Compatibility and Potential Conflicts

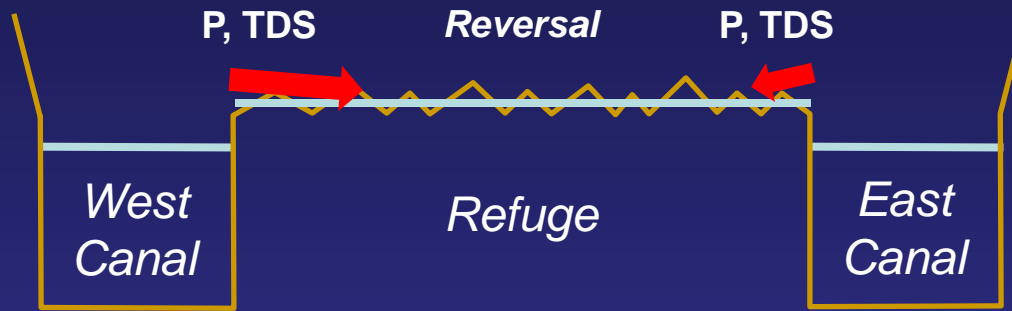
- **Spring Recession PM: Compatible**
 - Gradual stage recession without major reversals avoids intrusion
- **Seasonal High Stage PM: Potential Conflict**
 - Large inflows provide water but can cause intrusion if not properly managed

Refuge Regulation Schedule

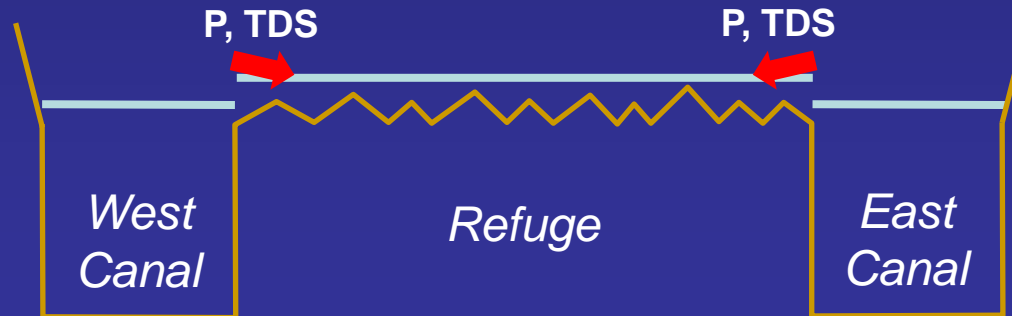


Canal-Water Intrusion

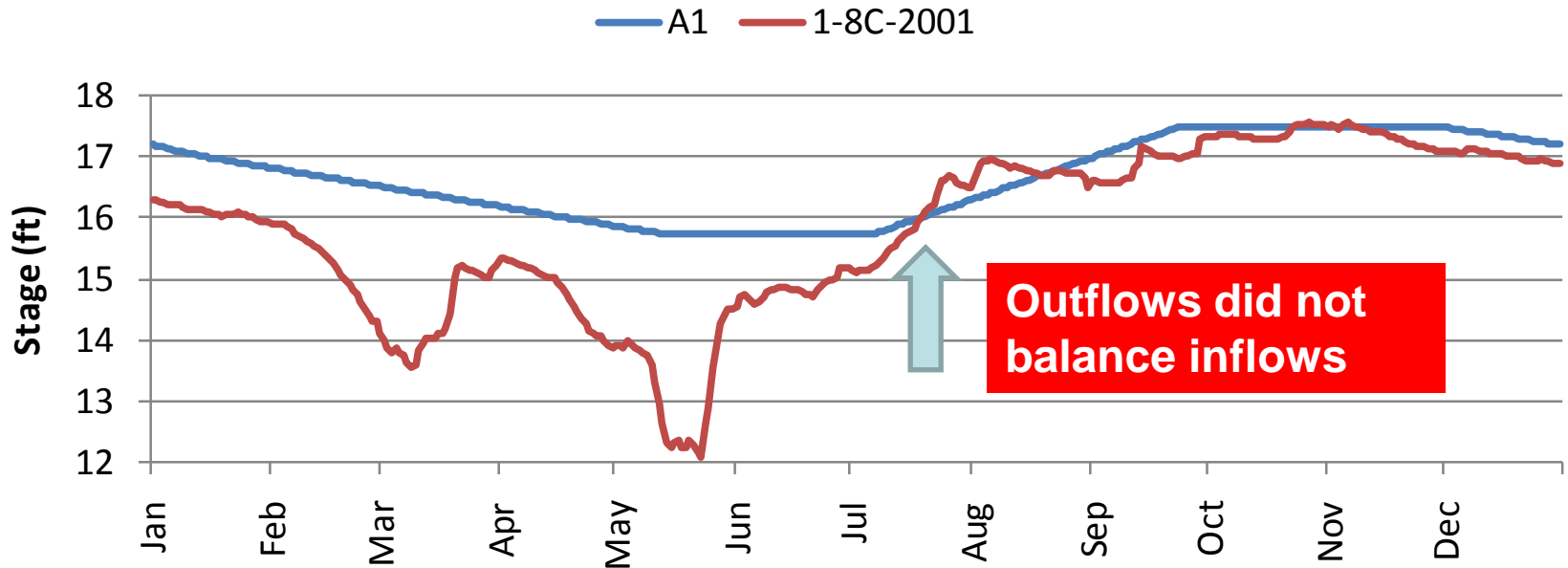
Dry Season (and “Dry” Wet Season)



Wet Season

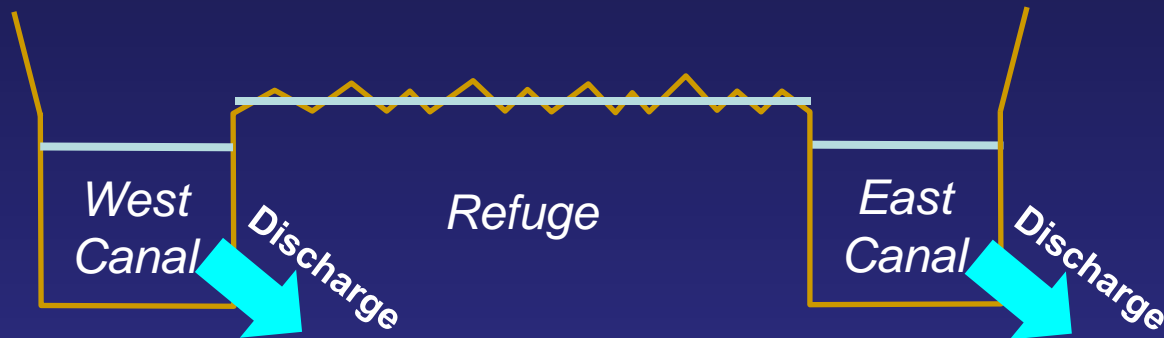


Refuge Outflow Structures (S10s)

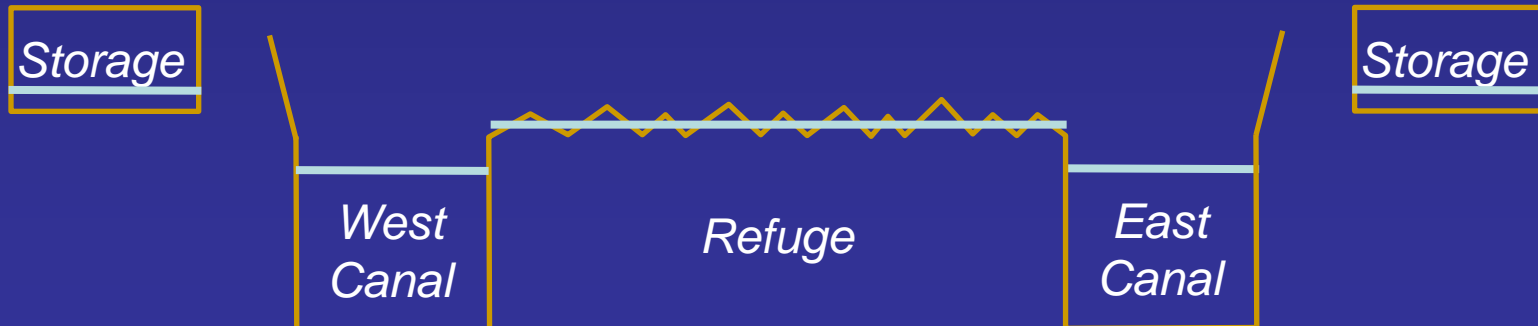


Intrusion (Reversal) Management

Synchronized Inflows and Outflows



Upstream Storage (Reduce Unwanted Inflows)



Conclusions and Recommendations

- **Conflicts between hydrologic and water-quality objectives are inevitable under current conditions:**
 - Refuge competes for poor quality water when conditions are dry
 - Refuge receives unwanted poor quality water as pulsed releases when conditions become wet
- **Near-term improvements:**
 - Synchronize inflows and outflows (structure automation)
 - Refine operational guidance for managing inflows and releases in Zone A1
- **Long-term improvements:**
 - Construct alternative water storage areas
 - Further reduce inflow P loads and concentrations

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**Findings and conclusions are those of the authors
and do not necessarily represent the views of the
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U.S. Geological Survey**