

State of Florida/SFWMD ROG Science Workshop  
West Palm Beach, FL  
January 27, 2010

The Miccosukee Tribe of Indians of Florida  
Perspective on  
***THE CONSTRAINTS***  
to Restoring Flows Through the Everglades

Terry L. Rice  
Colonel (Ret'd), PhD, PE

CONSTRAINT #1:

IRREVERSIBLE DAMAGE

## It Is Imperative that the Irreversible Damage Must Be Stopped Now

*“Every day that water does not flow from north to south as it did before man modified the Everglades system, is a day during which the Everglades will experience irreversible damage, and one day, not too far in the future, we will reach a point where restoration will simply not be possible.”*

T.L. Rice, CISRERP Brief, Miami, FL,  
September 2007

## CISRERP 2008 Everglades Report

*“If ecological resilience is not restored, the possibility exists that environmental changes could precipitate rapid and deleterious state changes that might be very difficult or impossible to reverse. Unless near-term progress is achieved on major restoration initiatives, including CERP and non-CERP efforts, opportunities for restoration may close with further loss of species numbers and habitat deterioration, and the Everglades ecosystem may experience irreversible losses to its character and function.”* Progress Toward Restoring the Everglades, The Second Biennial Review, p. 69, CISRERP, 2008

The Miccosukee Tribe could not agree more ... and this conclusion is the basis of why the Tribe does not support the ROG Acquisition and Associated Planning ...

Because the  
ROG Proposed Acquisition  
Serves to Perpetuate  
Irreversible Damage  
to the  
Everglades and Tribal Land

## Irreversible Damage – Soil P

EPA REMA-P 1995-96 Study  
Percent of Everglades Soil Above  
CERP Goal of 400 mg/kg

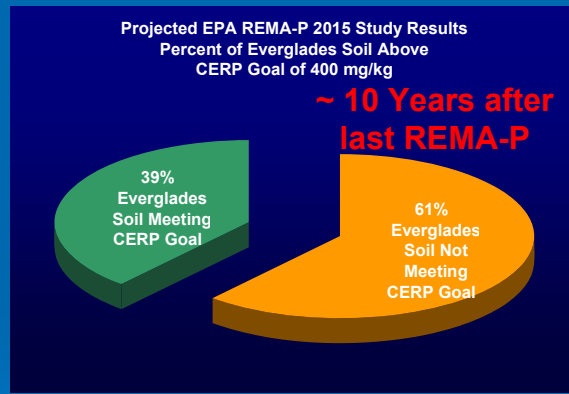
→  
~ 10 Years

EPA REMA-P 2005 Study  
Percent of Everglades Soil Above  
CERP Goal of 400 mg/kg



In approximately 10 years the percentage of Everglades impacted by soil P above the Comprehensive Everglades Restoration Plan goal of 400 mg/ml increased from ~34% to ~49% ... approximately a 46% increase in Everglades irreversibly damaged ... and this during a period of time when most believed that Everglades restoration was being accomplished

## Irreversible Damage – Soil P



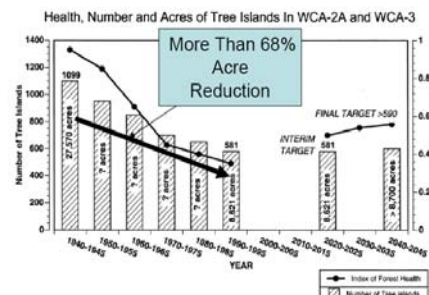
Given the current rate of P accumulation in the soil of the Everglades, in 10 years after the last REMA-P Study (~5 years from now), well over 50% of the Everglades will be impacted above CERP goals

THE MICCOSUKEE TRIBE CANNOT SUPPORT ANYTHING THAT EXACERBATES THIS IRREVERSIBLE DESTRUCTION ... AND THE ROG ACQUISITION DOES JUST THAT

## Irreversible Damage – Tree Islands



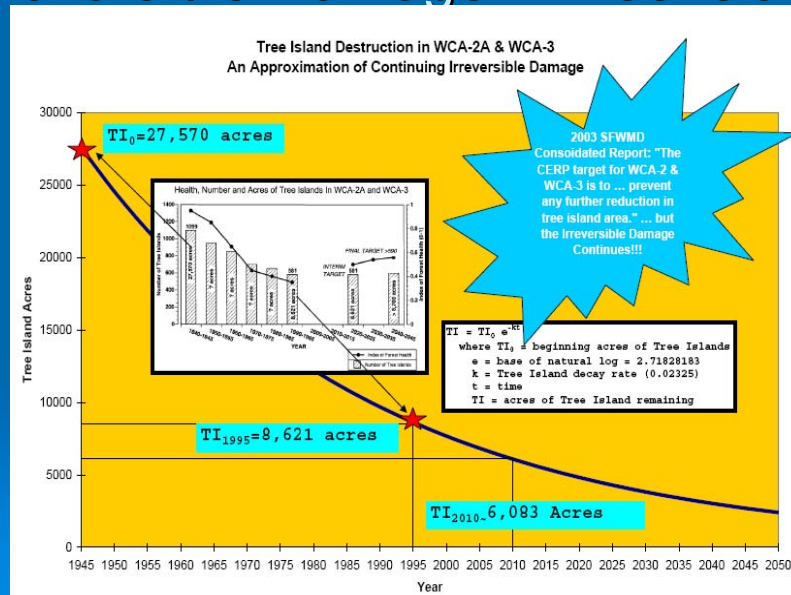
### Tree Island Destruction 1940 to 1995



US Army Corps of Engineers–8.5 SMA GRR/EIS July 2000–  
cost of delay in implementing Mod Waters project:

- “loss of tree islands has an impact on the critical habitats and cultural resources”
- “it is estimated as loss of 8.4 islands and 246 acres per year”
- “estimated values for full restoration of tree islands may range from \$50,000 to \$500,000 per acre”

# Irreversible Damage – Tree Islands

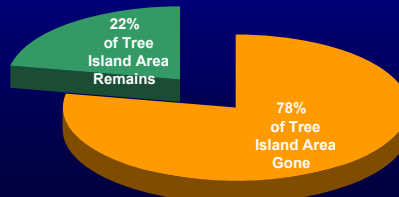
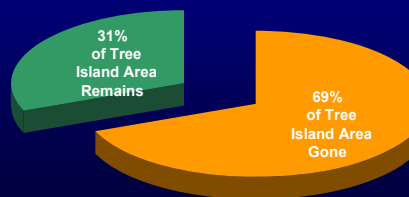


# Irreversible Damage – Tree Islands

Tree Island Destruction  
in WCA-2A & WCA 3  
by 1995

~ 15 Years

Projected Tree Island Destruction  
in WCA-2A & WCA 3  
by 2010

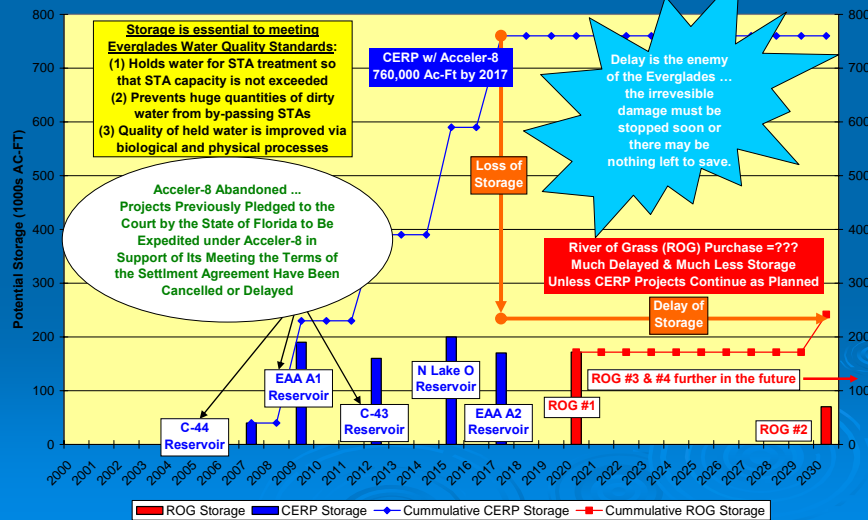


In approximately 15 years the percentage of Tree Islands destroyed in WCA-2A & WCA-3 of the Everglades has increased an approximation is from ~69% to ~78% ... approximately a 29% increase in Everglades irreversibly damaged ... and this during a period of time when most believed that Everglades restoration was being accomplished

THE MICCOSUKEE TRIBE CANNOT SUPPORT ANYTHING THAT EXACERBATES THIS IRREVERSIBLE DESTRUCTION ... AND THE ROG ACQUISITION DOES JUST THAT

# Irreversible Damage Exacerbated

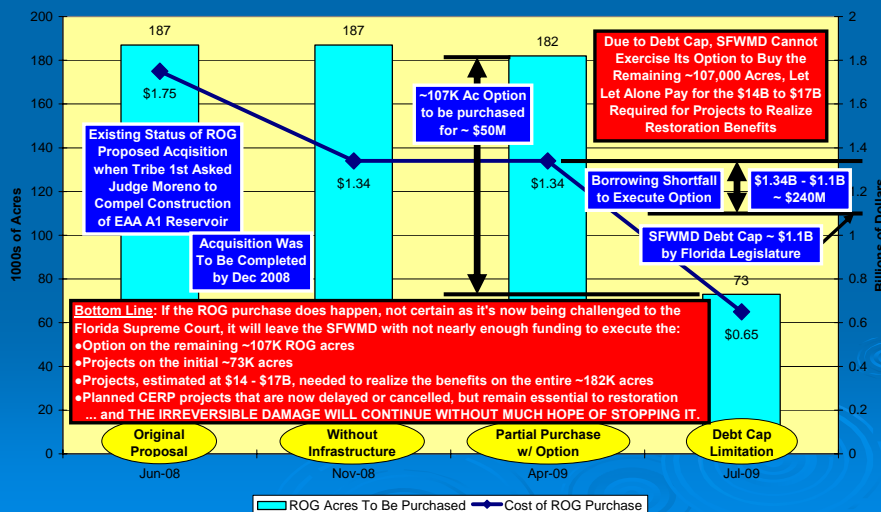
ROG Cancels or Delays CERP Planned Everglades Restoration Storage  
Thus, Unacceptable, Irreversible Damage Is Allowed to Continue



# Irreversible Damage Exacerbated

Proposed "RIVER OF GRASS" Acquisition

THE CONTINUOUS DEGENERATION FROM WHAT BEGAN AS A BAD IDEA ...  
A PERFECT EXAMPLE OF "GOING FROM BAD TO WORSE" WITH NO BOTTOM IN SIGHT



Irreversible Damage

Constraint: The Tribe Will Not  
Support Anything That  
Exacerbates Irreversible  
Damage to the Everglades ...  
i.e., the Bleeding Must Be  
Stopped at the Soonest, or  
the Patient Will Die

CONSTRAINT #2:

INCONGRUOUS LOSS OF  
EVERGLADES

## Everglades Restoration – Flow

CERP Yellow Book – The Effects of Decompartmentalization and the C&SF Restudy, Sue Perry, ENP; Cheryl Buckingham, FWS; Bill Loftus; BRD, USGS

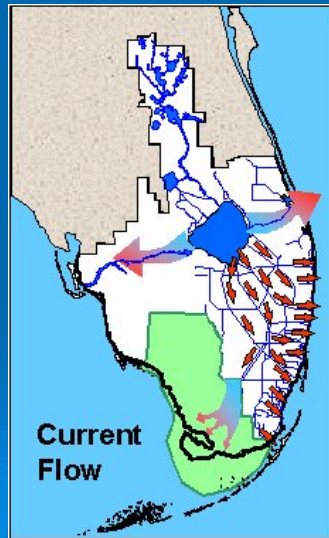
*“[1] The natural system has been reduced to approximately half of its historic spatial extent. [2] It can no longer handle the tremendous volumes of water necessary to maintain hydroperiods in Shark River Slough and proper salinities in Florida Bay without increasing the severity of damaging extreme depths and hydroperiods in the Water Conservation Areas. [3] Canals are capable of conveying water to the south quickly and efficiently, substituting for the missing part of the Everglades.”*

## Anthropogenic Modifications

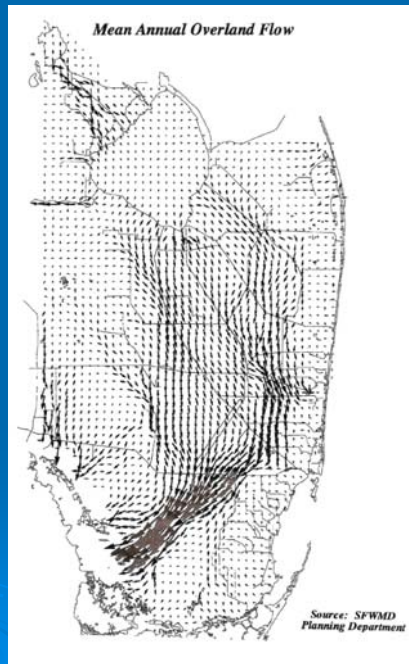
*“[1] The natural system has been reduced to approximately half of its historic spatial extent.”*



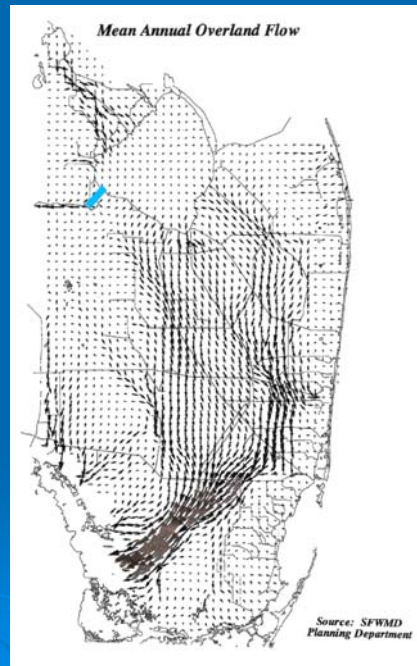
## Before & After



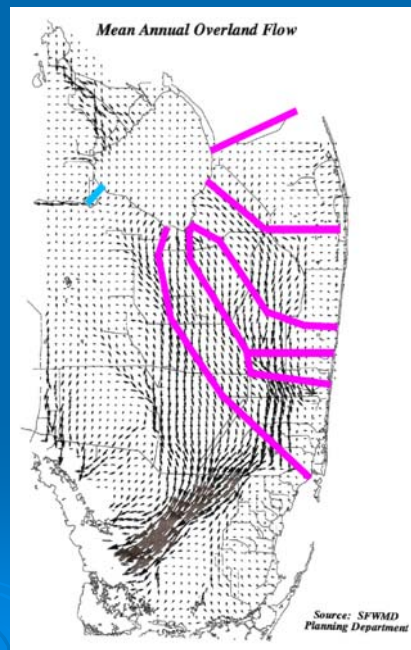
## Natural System Model (NSM)



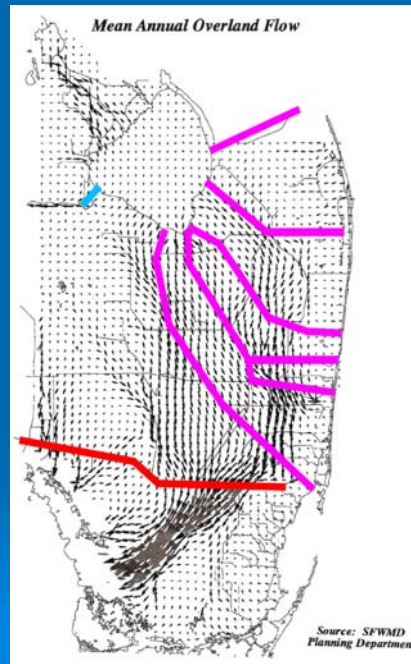
Hamilton  
Disston  
1881 – 1994



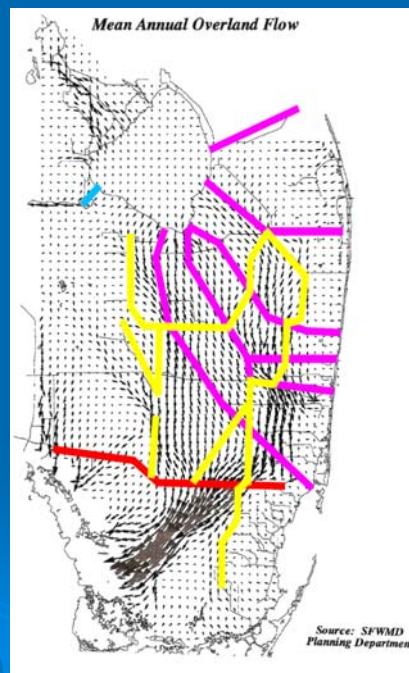
Napoleon  
Bonaparte  
Broward  
1907 – 1917  
(1931)



Tamiami  
Trail  
1915 – 1928



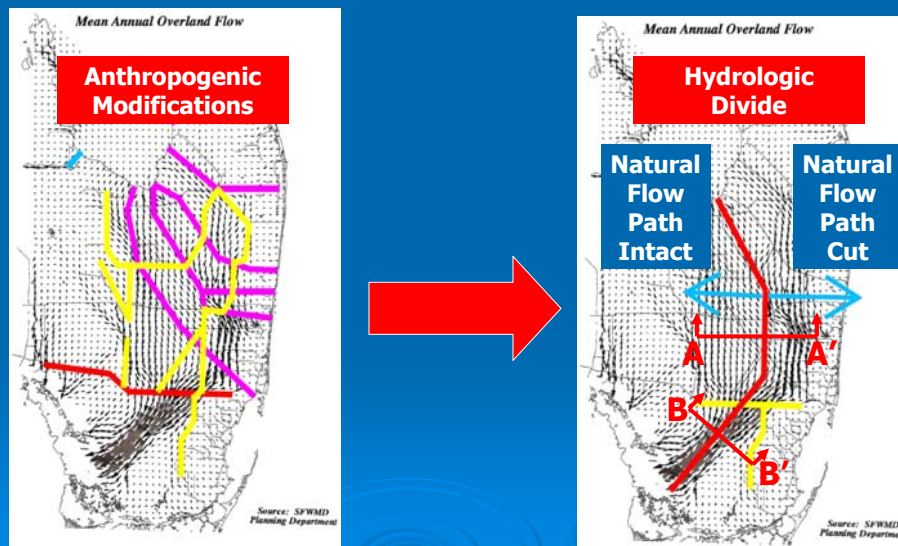
The Central &  
Southern  
Florida Project  
(C&SF)  
1947 – Present



## Hydrologic Result of Anthropogenic Modifications

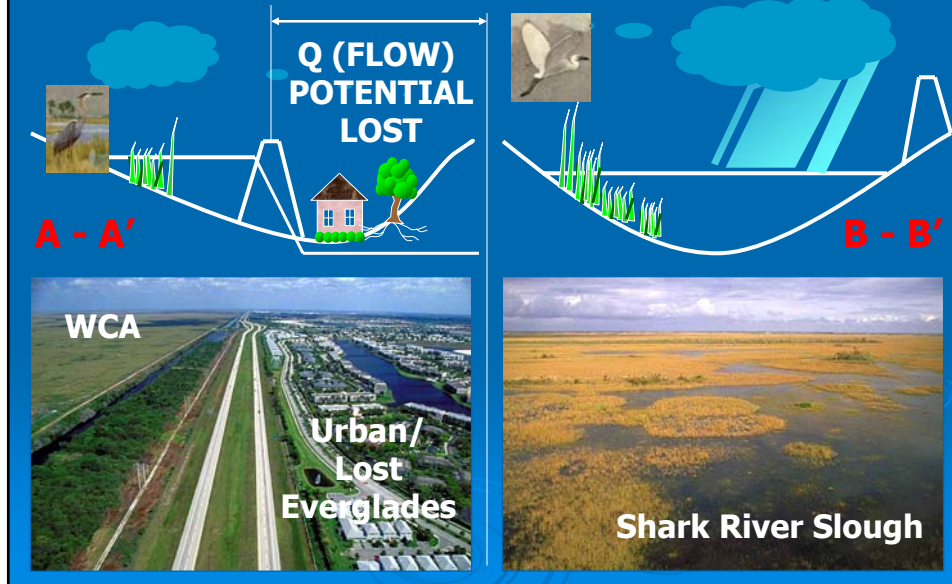
*"[2]It can no longer handle the tremendous volumes of water necessary to maintain hydroperiods in Shark River Slough and proper salinities in Florida Bay without increasing the severity of damaging extreme depths and hydroperiods in the Water Conservation Areas."*

## The Hydrologic Divide



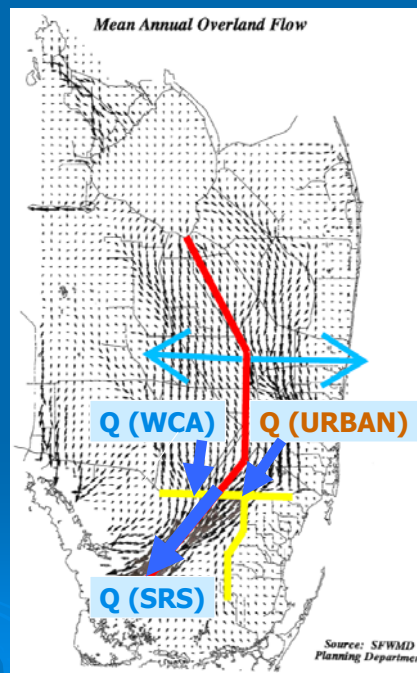


## Impact of Hydrologic Divide WCAs versus Shark River Slough

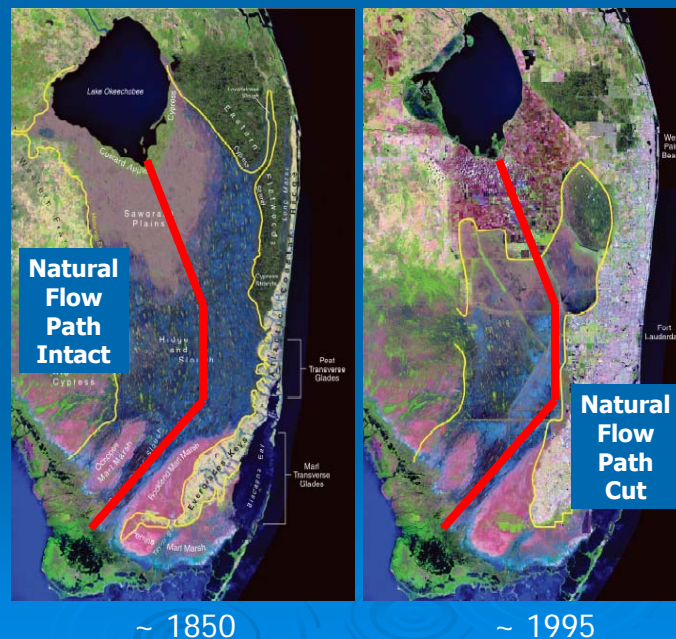


Therefore, restoration flows for Shark River Slough include two components, i.e.

$$Q(\text{SRS}) = Q(\text{WCA}) + Q(\text{URBAN})$$



Pre- &  
Post-  
Change  
Aerial  
Views ...  
Same  
Result



## Summary of Hydrologic Changes Due To Anthropogenic Modifications

Result is  $Q(SRS) = Q(WCA) + \cancel{Q(URBAN)}$

And  $Q(WCA) = \text{Velocity} \times \text{Area}$

or,  $Q(WCA) \sim \text{Velocity}(WCA) \times \text{Depth}(WCA) \times \text{Width}(WCA)$

Post changes, if  $Q(WCA)$  is forced =  $Q(SRS)$

Then  $\text{Velocity}(WCA)$  and/or  $\text{Depth}(WCA)$   
must increase ... both are destructive to WCAs

THUS, TO RESTORE WCAs & SRS,

**$Q(URBAN)$  MUST BE RESTORED**

## Dealing Effectively with the Hydrologic Consequences of Anthropogenic Modifications

*“[3]Canals are capable of conveying water to the south quickly and efficiently, substituting for the missing part of the Everglades.”*

... and CERP included plans/projects to provide for Q(URBAN) ... examples follow ...

## CERP Plan for Providing Q(URBAN)

CERP Yellow Book 9.1.8.16 Diverting Water Conservation Area 2 and 3 flows to Central Lake Belt Storage Area (YY and ZZ) ... *“The purpose of this feature is to attenuate high stages in Water Conservation Areas 2 and 3 and transport this excess water to the Central lake Belt Storage Area where it will be stored to meet downstream demands in Shark River Slough ...”*

## CERP Plan for Providing Q(URBAN)

CERP Yellow Book 9.1.8.20 Bird Drive Recharge Area (U) ... *"The purpose of the feature is to recharge groundwater and reduce seepage from the Everglades National Park buffer areas by increasing water table elevations east of Krome Avenue. The facility will also provide C-4 flood peak attenuation and water supply deliveries to the South Dad Conveyance System and Northeast Shark River Slough."*

## CERP Plan for Providing Q(URBAN)

CERP Yellow Book 9.1.8.21 L-31N Improvements for Seepage Management and S-356 Structures (V and FF) ... *"The purpose of this feature is to improve water deliveries to Northeast Shark River Slough and restore wetland hydropatterns in Everglades National Park by reducing levee and groundwater seepage and increasing sheetflow."*



## CERP Plan for Providing Q(URBAN)

CERP Yellow Book 9.1.8.22 West Miami-Dade County Reuse (HHH) ... *"The purpose of the feature is to meet the demands for: (1) the Bird Drive Recharge Area; (2) the South Dade Conveyance System; and (3) the Northeast Shark River Slough. ... (1) Finding a way to reduce the number of damaging high water events in Water Conservation Area 2A and 3B and the Pennsuco Wetlands to a level at or below the level predicted for D-13R."*

## Why do some eschew Q(URBAN) as agreed to in CERP?

- Q(URBAN) is primarily "active control" ... "active control" is anathema to some
- Q(URBAN) prevents use of WCAs as STAs ... more important now that State failed to meet its December 1, 2006 deadline for meeting the 10 ppb P Water Quality Criteria under the provisions of the Clean Water Act and the Consent Decree ... & there is no certainty that it ever will

## What is the Tribe's position on restoration flows? Summary ...

- CERP got it right ... restore as much natural flow thru the Everglades as possible, but recognize and plan for additional flows for Shark River Slough ... must have both Q(WCA) and Q(URBAN) components
- Quality ... achieving Flows and Levels with Dirty Water produces IRREVERSIBLE DAMAGE
- Levels ... achieving Flows with destructive Levels produces IRREVERSIBLE DAMAGE
- Flows ... achieving Levels with less than optimum Flows is UNDESIRABLE
- Therefore, Flow should never be considered independently of Quality and Levels ... a balance among all 3 must be forged, implemented, and maintained

## Incongruous Loss of Everglades

Constraint: The Tribe Will Not Support Any Plan That Drowns the WCAs in Order to Deliver Flows to the Park

## CONSTRAINT #3:

### SEEPAGE

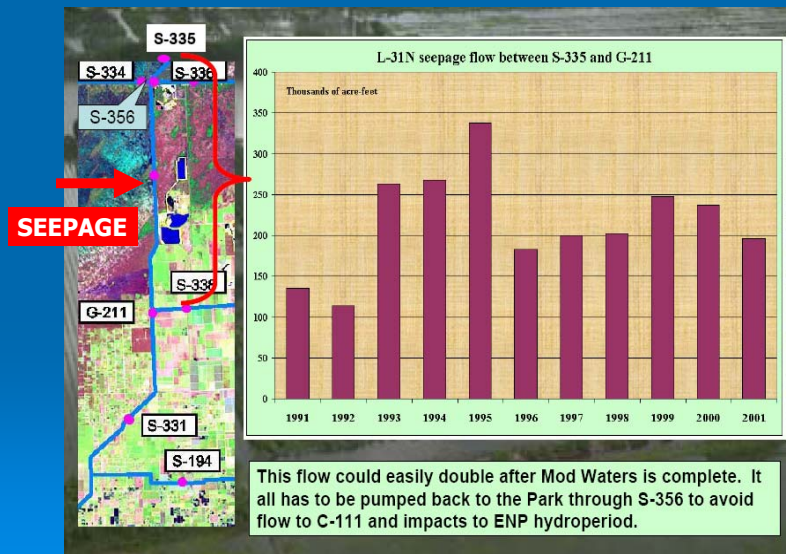
### SEEPAGE!!!

CERP, Section 6,

6.4.5.3 Everglades National Park

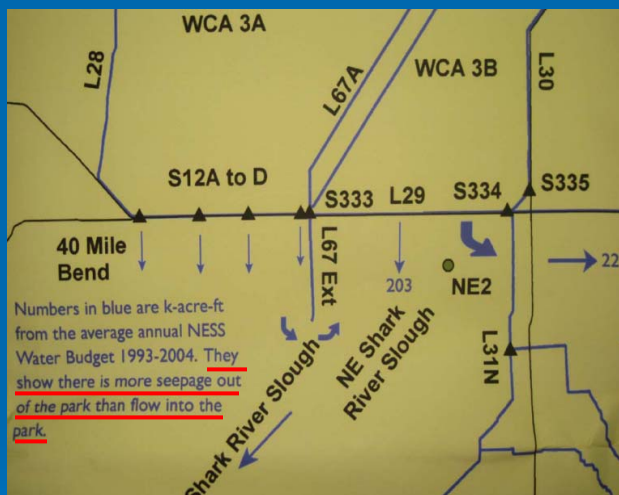
*“Groundwater seepage loss is the main impediment to any kind of restoration within Everglades National Park. Its impact is far reaching, affecting every water management decision along Tamiami Trail.”*

## The Seepage Challenge (MacVicar-3/8/04 CSOP Meeting)



NPS Poster  
for GEER  
Science  
Conf 2008

Confirms  
Seepage is  
a Major  
Issue

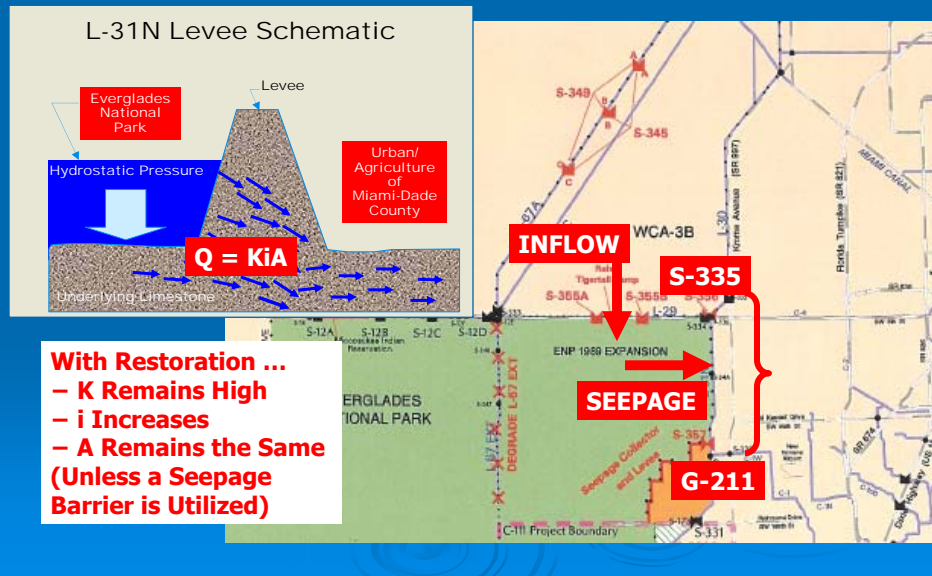


For additional information:

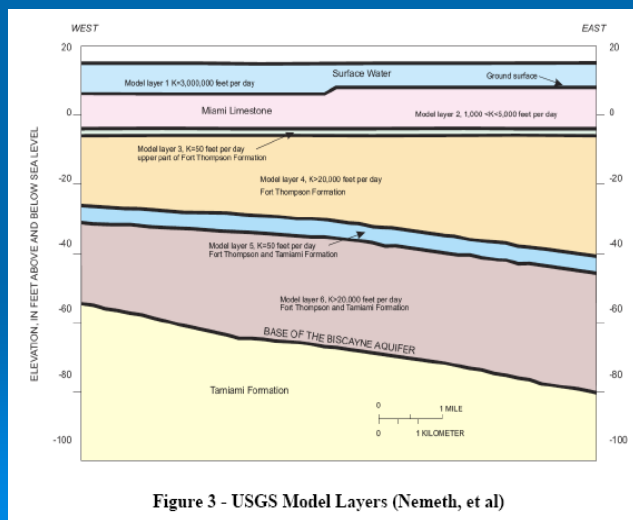
Roy Sonenshein (roy\_sonenshein@nps.gov)

Vin DiFrenna (vincent\_difrenna@nps.gov)

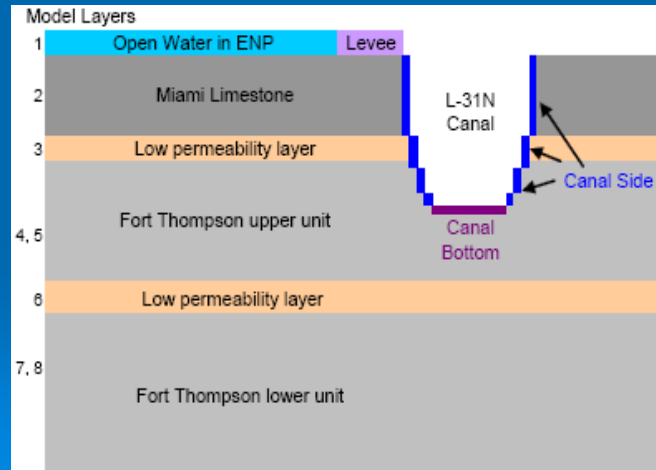
## Another Elephant in the Room ... SEEPAGE!!!



## Biscayne Aquifer Actual Layers



## Aquifer Layers Vis-à-Vis L-31N Canal



## Aquifer Permeability by Layer

Aquifer Parameters for the Cross-Section Model

Model Layer	Nemeth Layer	K (ft/d)	Thickness (ft)	Bottom Elev (ft)	Material
1	1	3,000,000		5.0	Surface water in the ENP
2	2	3000-12,500	13.0	-8.0	Miami Limestone
3	3	50	2.0	-10.0	Low permeability layer
4	4	25,000	7.5	-17.5	Fort Thompson upper unit
5	4	25,000	7.5	-25.0	Fort Thompson upper unit
6	5	50	5.0	-30.0	Low permeability layer
7	6	25,000	10.0	-40.0	Fort Thompson lower unit
8	6	25,000	10.0	-50.0	Fort Thompson lower unit

\* Nemeth, et al., 2000. USGS Water Resource Investigation Report 00-4066.

Very High Permeability



# The "Big Red Arrow" (MacVicar-3/8/04)

- 
- 
-

## Seepage

Constraint: Increased Flows  
Through the Everglades  
Cannot Be Achieved Until  
the Seepage Challenge Is  
Adequately Addressed

CONSTRAINT #4:

WATER QUALITY



## Water Quality Judge Gold 2008 Order

- 10 ppb Phosphorus confirmed as the Criteria for the Everglades
- December 31, 2006 Settlement Agreement deadline for the discharge of clean water to the Everglades was not met, i.e. "... the deadline for compliance was not met. Instead the Florida Legislature simply changed the deadline for compliance." (p32) ... and there is no certainty under the State's Rule that the deadline will ever be met

## Water Quality

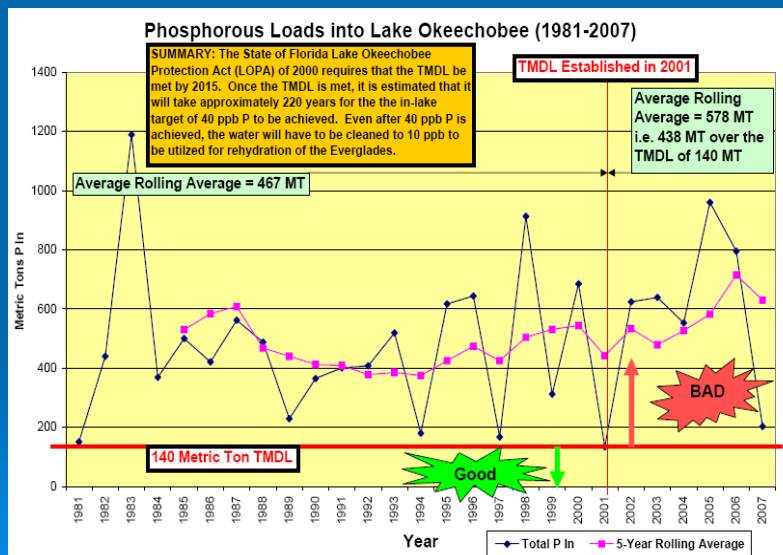
- All STAs consistently discharging above 10ppb ... as high as 93ppb for STA 6 in Water Year 2009 ... and this does not include Bypass Flows
- Rehydration with Dirty Water causes Irreversible Damage

## Water Quality

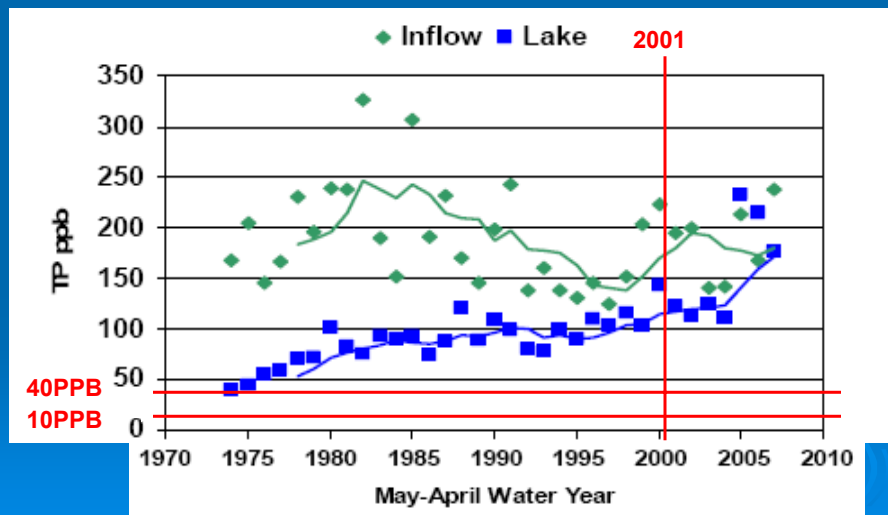
Constraint 4A: The Tribe  
Will Never Support the  
WCAs Being Utilized As  
STAs ... Discharges Into  
the Everglades Must Meet  
the P Criterion of 10 ppb

## Water Quality

### The Elephant in the Room ... Lake O



## Water Quality Lake O Phosphorous Concentrations



## Water Quality Lake Okeechobee

*Recent water quality restoration initiatives in the Northern Everglades are not likely to achieve the stated water quality goals (40 ppb total phosphorous in the lake and 140 metric tons per year phosphorous input load) by the year 2015, and it might take decades for these goals to be met with current strategies.*

From CISRERP (NAS) 2008 Report - Lake Okeechobee Conclusions & Recommendations (summary statements pp 186-188)

Water Quality  
Lake Okeechobee

Constraint 4B: Restoration Can  
Never Be Effective Without a  
Clean Lake O ... the Current  
Strategy Is Totally Inadequate  
and the ROG Acquisition Only  
Exacerbates a Bad Situation By  
Diverting Focus & Resources

Water Quality  
Dealing with All the Water

*An integrated, system-wide view of water  
quality management is essential to the  
achievement of restoration goals for the South  
Florida ecosystem.*

*From CISRERP (NAS) 2008 Report - Lake  
Okeechobee Conclusions & Recommendations  
(summary statements pp 186-188)*

Water Quality  
Dealing with All the Water

Constraint 4C: There is no  
*“integrated, system-wide view of  
water quality management”*  
which *“is essential to the  
achievement of restoration goals  
for the South Florida  
ecosystem.”*

Water Quality

Constraint: The Tribe Will Not  
Support Any Plan That  
Rehydrates the Everglades  
With Dirty Water ... the  
WCAs Will Not Be Utilized  
As STAs

## CONSTRAINT #5:

### ENDANGERED SPECIES

#### Endangered Species Challenges

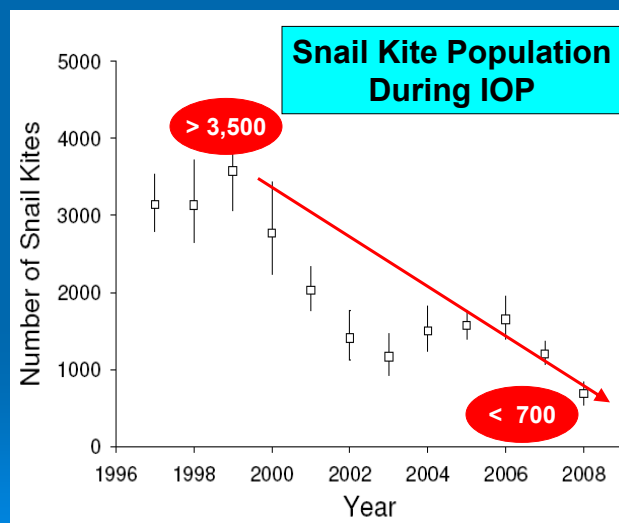
- Competing “Endangered” Species
- Single-Species Management
- “Critical Habitat” Designations
- “Jeopardy” Determinations
- Major Changes in Hydrology
- Habitat Shifts

## Endangered Species

*“Emergency water management for the Cape Sable seaside sparrows under the interim operational plan (IOP) illustrates the failure of species-by-species management. The resulting water regimes have led to unwanted flooding of tribal lands and probably have contributed to declines of snail kites and tree islands in WCA 3A.”*

*Progress Toward Restoring the Everglades,  
The Second Biennial Review, CISRERP, 2008*

## Endangered Species



## Endangered Species

Constraint: Multi-Species  
Recovery Requires That a  
Multi-Species Transition  
Plan Be Overlaid on the  
Restoration Flow Plan

CONSTRAINT #6:

BLOCKAGE OF FLOW



# Clearing Downstream of the Culverts



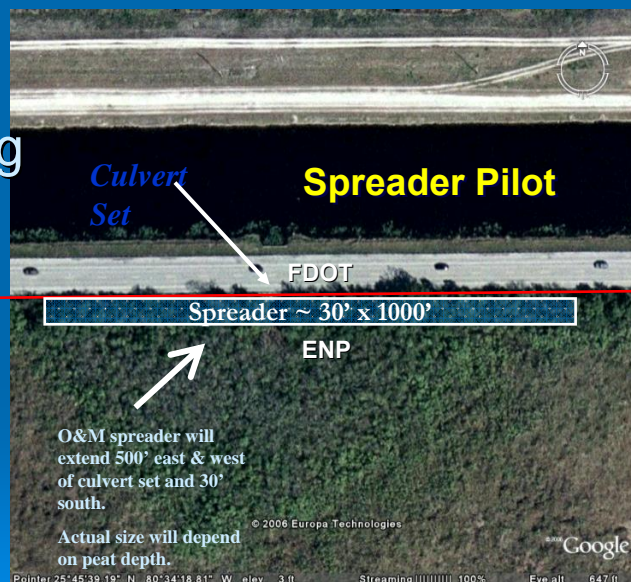
## Corps 2005 Final RGRR/2<sup>nd</sup> SEIS for Tamiami Trails Modifications Engineering Appendix D

TW EL (FT- NGVD)	ALL CULVERTS BETWEEN S-333 AND S-334															
	HW EL (FT-NGVD)															
	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
7.0	0	1,172	1,705	2,145	2,537	2,901	3,239	3,563	3,870	4,164	4,444	4,715	4,980	5,234	5,483	5,724
7.1		0	1,205	1,751	2,197	2,581	2,956	3,298	3,626	3,940	4,218	4,496	4,768	5,029	5,283	5,530
7.2			0	1,238	1,794	2,247	2,644	3,011	3,352	3,672	3,975	4,265	4,546	4,815	5,076	5,329
7.3				0	1,269	1,462	1,819	2,132	2,415	2,674	2,915	3,143	3,363	3,573	3,776	3,971
7.4					0	1,297	1,870	2,332	2,737	3,104	3,442	3,762	4,066	4,355	4,634	4,902
7.5						0	1,322	1,904	2,370	2,776	3,142	3,483	3,803	4,106	4,396	4,673
7.6							0	1,347	1,935	2,404	2,810	3,179	3,521	3,841	4,144	4,434
7.7								0	1,368	1,963	2,434	2,843	3,215	3,556	3,877	4,180
7.8									0	1,388	1,987	2,463	2,875	3,246	3,586	3,910
7.9										0	1,405	2,011	2,490	2,903	3,277	3,620
8.0											0	1,422	2,033	2,514	2,931	3,305
8.1												0	1,438	2,053	2,538	2,956
8.2													0	1,452	2,072	2,560
8.3														0	1,465	2,090
8.4															0	1,478
8.5																0
8.6																0
8.7																0
8.8																0
8.9																0
9.0																0
9.1																0
9.2																0

## Culvert/Swale Option New & Independent Information

- ENP Contracted Dr. David A. Chin (PhD, PE), University of Miami, Water Resources Engineering, to evaluate the "swale" option at 2 of the 51 culvert sets
- Report: "*The Effectiveness of Spreader Canals in Delivering Water to Everglades National Park*," completed January 2010

### Constructing Spreader Canals



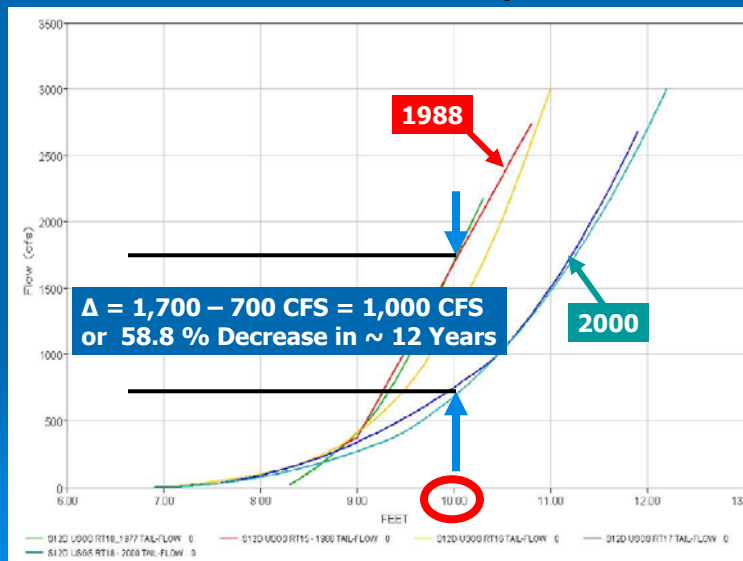
## Summary of Results

- Even the most modest swale considered, i.e., 500' by 30', at a constant L-29 stage of only 6.0 feet NAVD, will likely increase flows by 60% at one culvert set and 250% at the other ... the most robust swale considered, i.e., 1500' by 30', will provide for a 200% and 560% increase at the same culvert sets, respectively.
- Even a worst case scenario for both culvert sets during sensitivity analysis provided for a 48% and 200% increase in flows with the 1500' by 30' swale option, while an equally plausible, but more favorable, marsh resistance increased flows by 520% and 830% for the same swale option.
- Adding another culvert set at the swale locations provided only a little improvement in increased flows.
- **Replacing the culverts by bridges at the swale provided improvements, but not nearly as great as the increased flows predicted for simply building the swale.**
- When a bridge is simulated to replace the existing culvert set: "... it should be noted that, for a given spreader-canal configuration, water deliveries are independent of the bridge span as long as stage differences across the bridge opening are relatively small [which is the normal condition]."

## The S-12D ... Looking South into Everglades National Park



## Rating Curve Variation with Time S-12D Example



## Summary of Flow Reductions for the S-12 Structures Between ~ 1988 and 2003

Flows through the S12 Structures in cubic feet per second (cfs) @ 10 feet HW -- 1988 versus 2003

	S-12A	S-12B	S-12C	S-12D	Total
1988	630	550	850	1700	3730
2003	400	300	700	700	2100
Reduction	230	250	150	1000	1630
% Reduction	36.51%	45.45%	17.65%	58.82%	43.70%

**Another clear indication of the significant impact of sediment, vegetation, detritus, and garbage accumulation on flows**

## Blockage

Constraint: Increased Flows  
Through the Everglades  
Cannot Be Achieved Until the  
Tamiami Trail Blockages Are  
Adequately Addressed ...  
Great Improvements Can Be  
Made Now By Clearing the  
Culverts and S-12s

CONSTRAINT #7:

STORAGE



## Storage

Storage Alternatives Include:

- Shallow Surface Storage ... STAs (1-2 ft)
- Shallow Storage ... Flow-Way (1-3 ft)
- Shallow Surface Storage (4-10 ft)
- Deep Storage (11-18 ft)
- ASR

## Storage Challenge

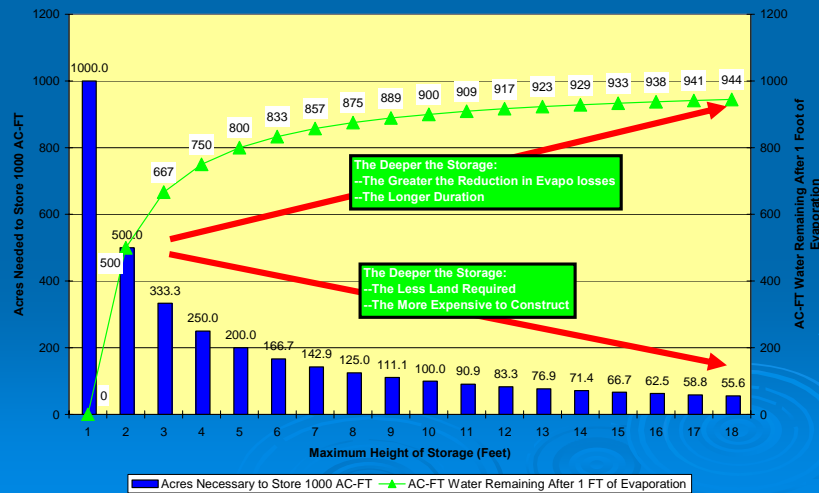
Storage Alternatives are not fungible ... must choose the **Right Combination** of Storage Alternatives considering at least:

- Objectives
- Water Quality
- Duration (the more the Evapotranspiration & Seepage, the less time the water is available)
- Land Requirements &/or Availability
- Costs

**TO ACHIEVE THE DESIRED BENEFITS**

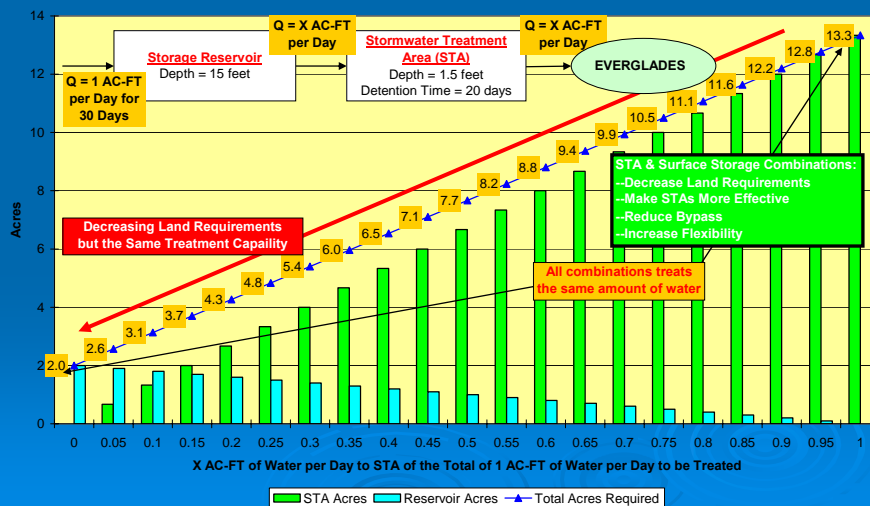
# Shallow v. Deep Surface Storage

Surface Storage Only  
Example of Pro's & Con's of Shallow v. Deep Storage



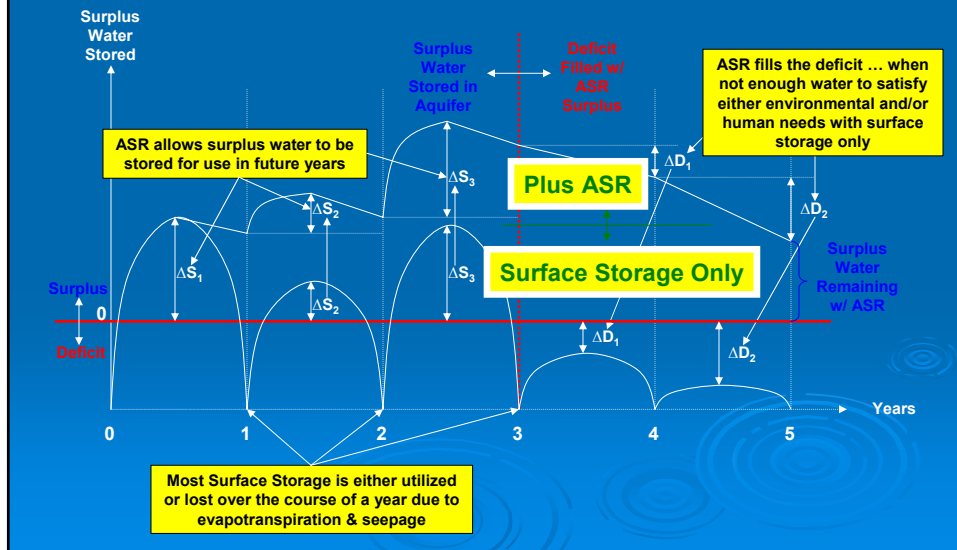
# STAs & Surface Storage

Surface & STA Storage  
Example of Pro's & Con's of Different Combinations of Surface & STA Storage  
Design Event Scenario: 1 AC-FT Per Day for 30 Days



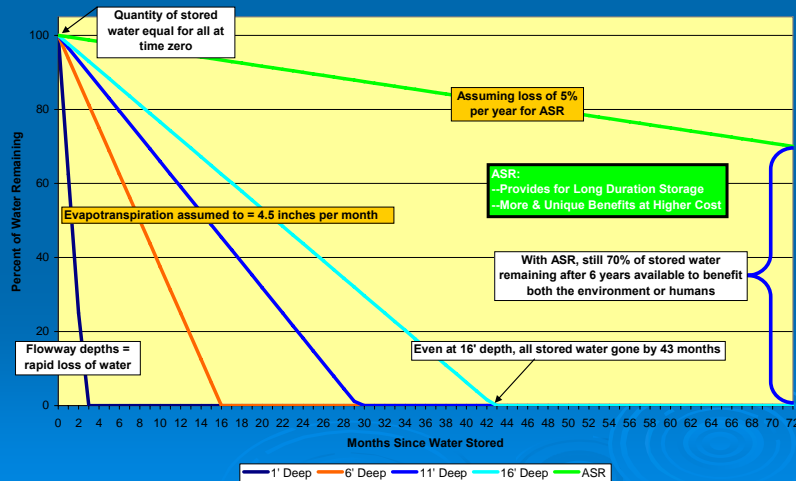
# Surface Storage v. ASR

Why surface storage does not substitute for ASR ... each has its unique benefits which are not fungible



# Surface Storage v. ASR

Surface Storage & ASR  
Example of Pro's & Con's of Surface Storage v. ASR





## Storage

Constraint: If Storage  
Decisions Are Not Made  
Based on Scientific &  
Engineering Principles, the  
Desired Benefits Will Not Be  
Achieved ... the Tail Cannot  
Wag the Dog

The Bottom Line Constraint:  
No Unity of Effort ... the  
Pursuit of the  
Unnecessary, Unreasonable,  
and Impossible  
Prevents the Achievable ...  
and the Everglades Continues  
to Be Irreversibly Destroyed