WERP: How an Obsolete Levee and an Abandoned Jetport Hold the Key to a Rain-Driven Swamp
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WERP: How an Obsolete Levee and an Abandoned Jetport Hold the Key to a Pre-Drainage Swamp
WERP: How an Obsolete Levee and an Abandoned Jetport Opened the Door
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What do we mean Pre-drainage?
What do we mean Pre-drainage?
Answer:
Answer: Prior to Post-Drainage
Answer:
Prior to Post-Drainage
1998
watershed
An area of land that drains to a particular point
The preserve is a self-contained rain driven watershed that flows unfettered as sheetflow to the mangrove coast.
The preserve is a self-contained rain driven watershed that flows unfettered as sheetflow to the mangrove coast.
The preserve is a self-contained rain driven watershed that flows unfettered as sheetflow to the mangrove coast.
The preserve is a self-contained rain driven *watershed* that flows unfettered as *sheetflow* to the mangrove *coast*
Sky view of watershed

sole input: rainfall
Sky view of watershed

sole input: rainfall

sole output: estuarine coast
Sky view of watershed

Rain-driven swamp
Ground view of watershed
Ground view of watershed

Natural flow ways called strands and sloughs flow uncontrolled by gates to estuaries in downstream ENP.
Natural flow ways called **strands** and sloughs flow uncontrolled by gates to estuaries in downstream ENP.
Ground view of watershed

Natural flow ways called **strands** and sloughs flow uncontrolled by gates to estuaries in downstream ENP.
Natural flow ways called **strands** and sloughs flow uncontrolled by gates to estuaries in downstream ENP.
Natural flow ways called **strands** and sloughs flow uncontrolled by gates to estuaries in downstream ENP.
Where did we get this story?
1974
Origin myth
Everglades Jetport

From Miami Times: *Fiery Debate Over Miami Air Show in Everglades*, by Jessica Weiss, 2015
From Miami Times: *Fiery Debate Over Miami Air Show in Everglades*, by Jessica Weiss, 2015
From Miami Times: *Fiery Debate Over Miami Air Show in Everglades*, by Jessica Weiss, 2015
We're busy TODAY

...getting ready for TOMORROW!

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JETPORT SITE

WATER CONSERVATION AREA NO. 3

OPA-LOCKA WEST AIRPORT

PROPOSED TRANSPORTATION CORRIDOR

MIAMI INTERNATIONAL AIRPORT

MIAMI

EVEGLADES NATIONAL PARK

NEW TAMIAI AIRPORT

OPA-LOCKA AIRPORT

DADE COUNTY PORT AUTHORITY

MAYOR CHUCK HALL
Chairman

EARL M. STARNES
Vice Chairman

EARL J. CARROLL
Commissioner

ALEX S. GORDON
Commissioner

STUART E. TUPPEN
President

ROBERT H. PATTEN, JR.
Commissioner

DAVID O'MALLEY
Commissioner

BEN SHEPARD
Commissioner

ALAN C. STEWART
Director

P.O. Box 2075 A-M-F - Miami, Fla. 33159

Many of the world's great population centers are less than a day away from Miami, by today's jet aircraft. Tomorrow's supersonic planes will bring these cities even nearer, cutting the time in half, as shown in parentheses.
We're busy TODAY
...getting ready for TOMORROW!

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EVERTGLADES NATIONAL PARK
NEW TAMIAI AIRPORT

JETPORT SITE
WATER CONSERVATION AREA NO. 3
OPA-LOCKA WEST AIRPORT
OPA-LOCKA AIRPORT
MIAMI INTERNATIONAL AIRPORT
MIAMI
PROPOSED TRANSPORTATION CORRIDOR

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[Map showing Miami and surrounding areas with major cities connected by lines.]

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THE SISTERS CLARICE, R. BOEY, 57
Survivor of Pan Am

"What ships did almost exclusively a generation ago; planes do today. Bigger and faster planes will do it better tomorrow... For all recorded history, cities and nations have been connected. Today it is airports - the heart of the aviation industry - that have become the new strategic locations. In this new age of the supersonic jet, South Florida has no equal... With our new supersonic jetport, South Florida is going to become a major gateway to Europe and a jumping-off place for the Pacific as well."
Promotional Brochure

We're busy TODAY... getting ready for TOMORROW!

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L-28
Promotional Brochure

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getting ready for TOMORROW!

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Miami-Collier Training and Transition Airport (TNT)
Intervention by Conservationists
Intervention by Conservationists

Joe Browder
Intervention by Conservationists

Marjory Stoneham Douglas

Joe Browder
Carved out as watershed that feeds downstream estuarine arm of Everglades National Park
ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT

UNITED STATES
DEPARTMENT OF THE NAVY
ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT
ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT
ENVIRONMENTAL IMPACT OF THE
BIG CYRESS SWAMP JETPORT

UNITED STATES DEPARTMENT OF THE NAVY
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OF THE
BIG CYPRUS SWAMP JETPORT
ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT

UNITED STATES DEPARTMENT OF THE NAVY
ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT
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BIG CYPRESS SWAMP JETPORT
ENVIRONMENTAL IMPACT OF THE BIG CYPRUS SWAMP JETPORT

Big Cypress Swamp

Everglades Nat’l Park
ENVIRONMENTAL IMPACT OF THE BIG CYPRUS SWAMP JETPORT

Big Cypress Swamp

Everglades Nat’l Park
Success, right?

Big Cypress Swamp

Everglades Nat'l Park
Everglades Nat’l Park

Big Cypress Swamp

Success, right?
Factors that fed the myth
The top of the Big Cypress Swamp’s historic watershed was the southern toe of the Immokalee Rise
Geographically separate from highly-managed Everglades to the east
Swamp mosaic contains smaller and less connected flow systems than the river of grass
Hydrologically much less impacted that Kissimmee-Okeechobee-Everglades (KOE) ecosystem
Lies outside the USACE/SFWMD Central and Southern (C&SF) project area
Swamp is as close as you get to a pre-drainage condition in south Florida
Psychologically the myth worked
It made us feel good
It was expedient

Sometimes we must choose between what is RIGHT and what is easy

{Albus Dumbledore}
It was expedient

*Sometimes we must choose between what is RIGHT and what is easy*

-Albus Dumbledore-

**expedient**

/ɪkˈspɛdɪənt/

adjective

1. (of an action) convenient and practical, although possibly improper or immoral.
   "either side could break the agreement if it were expedient to do so"

synonyms: convenient, advantageous, in one's own interests, useful, of use, beneficial, of benefit, helpful; More
It was what we were told
Who told us this story?
How was the watershed determined?

Klein Report, 1970
Boundaries and Drainage Patterns

The Big Cypress Swamp is a loosely defined but recognized physiographic province (Davis, 1943, fig. 1) southwest of Lake Okeechobee. Some generalized flow patterns through the area were shown by Parker (1955, plate 11). Neither the physiographic boundaries nor the generalized flow patterns, however, are sufficient for the hydrologic interpretations required for this report.
Boundaries and Drainage Patterns

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Davis, 1943
Figure 1.—Map of the Big Cypress showing the delineations of the drainage area and the subareas.
Subarea C occupies the central part of the Big Cypress and drains toward the Park. It constitutes about three-fifths of the Big Cypress—1,450 square miles. At present, subarea C is drained naturally except for two canals in the western part, the Barron River and Turner River Canals.
Myth of rain driven swamp is born.
Figure 1.—Map of the Big Cypress showing the delineations of the drainage area and the subareas.
Figure 1.—Map of the Big Cypress showing the delineations of the drainage area and the subareas.
BIG CYPRESS WATERSHED
FLORIDA

Jetport Advisory Board Report, 1971
547,000 acres
Tamiami Trail National Parkway

38,000 acres
Everglades-Big Cypress Recreation Area
Big Cypress National **Freshwater** Reserve
Big Cypress Conservation Act, 1973
Big Cypress Area of Critical Concern (state law)
Public Law 93-440, 1974
The Big Cypress critical area as first proposed and subsequent reduced boundaries.
8.3 The Big Cypress critical area as first proposed and subsequent reduced boundaries.
Enabling Legislation

An Act to establish the Big Cypress National Preserve in the State of Florida, and for other purposes. (88 Stat. 1255) (P.L. 93–440)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) in order to assure the preservation, conservation, and protection of the natural, scenic, hydrologic, floral and faunal, and recreational values of the Big Cypress Watershed in the State of Florida and to provide for the enhancement and public enjoyment thereof, the Big Cypress National Preserve is hereby established.
Legislative History of Public Law 93-440

Basically, the watershed can be divided into three subbasins. The central subbasin, however, remains relatively undisturbed by man. Here, except for two canals, water feeds naturally from the Big Cypress Swamp through the western portion of the Everglades National Park. It is in this subbasin that the entire Big Cypress National Preserve will be located if authorized as recommended by the Committee on Interior and Insular Affairs.
More Legislative History

C. The Big Cypress National Preserve

The proposed Big Cypress National Preserve is a large, complex, mostly undeveloped portion of the original watershed. Coupled with the contiguous northwestern portion of the Everglades National Park and its estuary, it is said to form a nearly complete hydrologic unit. Although the preserve is characteristic of the entire watershed.
1974

Reality
What actually happened
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology
Construction Chronology

1968
Big Cypress *inherited* an altered Landscape

Map View
Big Cypress **inherited** an altered Landscape

Map View
Big Cypress inherited an altered Landscape.

Map View
Big Cypress \textit{inherited} an altered Landscape
Big Cypress **inherited** an altered Landscape

**Map View**
Big Cypress inherited an altered Landscape

Map View
Big Cypress inherited an altered Landscape

Map View
Big Cypress inherited an altered Landscape
Big Cypress *inherited* an altered Landscape

Map View
Big Cypress inherited an altered Landscape

Map View
Big Cypress inherited an altered Landscape

Map View
Big Cypress **inherited** an altered Landscape

Map View
Big Cypress inherited an altered Landscape

Map View
Figure 1.—Map of the Big Cypress showing the delineations of the drainage area and the subareas.
Figure 1.—Map of the Big Cypress showing the delineations of the drainage area and the subareas.
Not a self-contained rain-driven watershed
Truncated and canal-drained watershed
But that’s not what’s surprising!
Crisscrossed with canals
Point discharging to tide
Point discharging to tide
Exacerbates saltwater intrusion
Headwater flows have been severed
Headwater flows have been severed
Including OK Slough
Again, not surprising!
Vegetation Map from Davis, 1940

Hydrographic Interpretation of 1940 map
Castle of pre-drainage enlightenment
Castle of pre-drainage enlightenment

Dragon’s den of self-contained watershed
The Jelly Bean
The Jelly Bean

Big Cypress watershed
Klein, 1970

watershed to
ENP’s estuarine arm, 1974
The Jelly Bean

Big Cypress watershed
Klein, 1970

watershed to
ENP’s estuarine arm, 1974
The Jelly Bean

Big Cypress watershed
Klein, 1970

watershed to
ENP’s estuarine arm, 1974
The Jelly Bean

Post-drainage Big Cypress watershed
Klein, 1970

Post-drainage watershed to
ENP’s estuarine arm, 1974
The Jelly Bean

Post-drainage Big Cypress watershed
Klein, 1970

Post-drainage watershed to ENP’s estuarine arm, 1974
The Jelly Bean

Post-drainage
Big Cypress watershed
Klein, 1970

Post-drainage watershed to
ENP’s estuarine arm, 1974

Pre-drainage?
The Jelly Bean

Post-drainage
Big Cypress watershed
Klein, 1970

Post-drainage watershed to ENP’s estuarine arm, 1974

Pre-drainage?
Kelly’s assignment to WERP class:
Write an essay on the swamp’s connection to Lake O?
Castle of pre-drainage enlightenment

Dragon’s den of self-contained watershed
Castle of pre-drainage enlightenment

Dragon’s den of self-contained watershed
Castle of pre-drainage enlightenment

Dragon's den of self-contained watershed
Loss of headwaters to north
Loss of headwaters to north
Not just Okeechobee

10 ft
Not just Okeechobee
Ft Thomson Falls
Ft Thomson Falls
Diagram depicting the hydraulic mechanism by which the Lake Flirt floodplain fed both surface water east to the Caloosahatchee River (over Ft Thompson Falls) and ground water south to seeps along the southern tow of the Immokalee Rise.

Source: personal communication with Jack Meeder

Go Hydrology!
Caloosahatchee corridor stage, pre-drainage and now
Caloosahatchee corridor stage, pre-drainage and now
Caloosahatchee corridor stage, pre-drainage and now
Subsidence to the East
Usually think of **just** EAA
And not just EAA
In the Everglades too
1-2 foot of subsidence
The Reality
Klein Report, 1970
Klein Report, 1970
Klein Report, 1970
Immokalee water table:

- +15 ft
- +10 ft
- +5 ft
- 1-3 ft
Immokalee water table:
- +15 ft
- +10 ft
- +5 ft
- 1-3 ft
Immokalee

data table:

1-3 ft
+5 ft
+10 ft
+15 ft

Map showing regions with water table levels of +15 ft, +10 ft, +5 ft, and 1-3 ft.
**A Role of Lake Flirt**
High pre-drainage elevation of Lake Okeechobee and Ft Thomson falls backs water in Lake Flirt floodplain up against the northern toe of the Immokalee Rise.

**Ground-water inflows from Immokalee Rise**
Higher boundary conditions to the north (i.e. Lake Flirt) and east (i.e. Sawgrass Plain) resulted in a higher ground-water mound under the Immokalee Rise, which in turn flowed south into the Big Cypress Swamp through OK Slough and other seeps.

**Surface-water inflows from Everglades**
Outflows from Mullet Slough stay within The Big Cypress which, along with inflows from the "unsubsidized" Everglades Ridge and Slough feed downstream Lostmans Slough and Sweetwater Strand.
Pre-drainage Swamp Overview

Pre-drainage swamp was **much bigger** than today’s truncated watershed.
Pre-drainage Swamp Overview

Pre-drainage swamp was much bigger than today’s truncated watershed

Pre-drainage swamp was groundwater fed by Immokalee Rise
Pre-drainage Swamp Overview

Pre-drainage swamp was much bigger than today’s truncated watershed.

Pre-drainage swamp was groundwater fed by Immokalee Rise, not just rain.

Pre-drainage swamp water Everglades fed, today it is drained into the Everglades.
Pre-drainage Swamp Overview

Pre-drainage swamp was **much bigger** than today’s truncated watershed.

Pre-drainage swamp was **groundwater** fed by Immokalee Rise, not just rain.

Pre-drainage swamp water **Everglades fed**, today it is drained into the Everglades.

Pre-drainage **flow budget** was profoundly larger than today.
Post-drainage Swamp Overview

Dredging of and draining into the Caloosahatchee was first and biggest impact
Post-drainage Swamp Overview

Dredging of and draining into the Caloosahatchee was first and biggest impact.

Pre-drainage swamp was ground-water fed, today it is ground-water drained.
Post-drainage Swamp Overview

Dredging of and draining into the **Caloosahatchee** was first and biggest impact

Pre-drainage swamp was ground-water fed, today it is **ground-water drained**

**OK Slough** sadly does not flow into Fakahatchee Strand
Post-drainage Swamp Overview

Dredging of and draining into the Caloosahatchee was first and biggest impact

Pre-drainage swamp was ground-water fed, today it is ground-water drained

OK Slough sadly does not flow into Fakahatchee Strand

The swamp is managed as a fireshed, not as a watershed as envisioned by founders
Today’s conservation lands are a derelict ruins of pre-drainage past
What do we mean by “derelict ruins?”
Think of pre-drainage swamp as a hydrologic cathedral
1900

Dredging and drainage of Caloosahatchee
1930

Leveeing of Lake Okeechobee
1950

Subsidence in Everglades
Ground water lowering and OK Slough diversions
Today's Big Cypress Drainage is collapsed ruins of its pre-drainage condition.
Today's Big Cypress Drainage is collapsed ruins of its pre-drainage condition.
Today's Big Cypress Drainage is collapsed ruins of its pre-drainage condition.
Today's Big Cypress Drainage is collapsed ruins of its pre-drainage condition.
Today's Big Cypress Drainage is collapsed ruins of its pre-drainage condition.
Future

Let's rebuild what we can by restoring the keystones to the key arches.
Future

And bring clean water down the conservation columns we still have intact.
OK Slough Status Quo

Inadequate upstream flood control

Polluted water

No flow of OK Slough into Panther Refuge or Fakahatchee

Canal diverts flow from natural flow paths

Polluted water

Point discharge to coast
With Keystone in Place

Water is cleaned in STAs and FEBs.

Pump provides flood control.

Historic headwater flows from OK Slough into Panther Refuge and Fakahatchee are reestablished.

Clean water is distributed into Big Cypress National Preserve.

Cessation of point discharge to coast.
Closer look

- STAs and FEBs to clean water to OFW standards
- New bridges and culverts
- Infilling SR29 canal to wetland grade
- Sunniland pump station
- Existing bridges
Halfway Creek – Status Quo

Existing Condition

1. saltwater intrusion

2. loss of freshwater to tide as point discharge

3. insufficient upstream flow for sheetflow
With Keystone in Place

Proposed Condition

1. Reduction of saltwater intrusion
2. Elevated and attenuated freshwater stage levels
3. Restoration of sheetflow to estuaries

Halfway Creek Saltwater Intrusion and Sheetflow Spreader Barrier
- Freshwater canal
- Bridge
- Saltwater intrusion

1 mile
Recommendations

(1) Rain-driven self-contained swamp mentality has **imperiled** Everglades Restoration
**Recommendations**

(1) **Rain-driven self-contained swamp mentality has **imperiled** Everglades Restoration

(2) **We can rebuild the Big Cypress Swamp ruins by strategic restoration at critical keystone spots**
Status Quo isn’t free
Status Quo isn’t free

Cost to fight wildfires in millions of dollars

Cumulative cost 2005-present
Status Quo isn’t free

Cumulative cost 2005-present

$70,000,000

Cost to fight wildfires in millions of dollars

0 10 20 30 40 50 60 70
2005 2010 2015 2020

Complex (est) Deep Jarhead Huckabee Orange Blossom Mud Lake Complex Parliament/Cowbell

Major wildfires by name
$70M = $0
$70M = $0

for increasing swamp’s long-term natural resilience to fight drought
Drought vulnerable
Drought vulnerable
Drought resistant
Questions