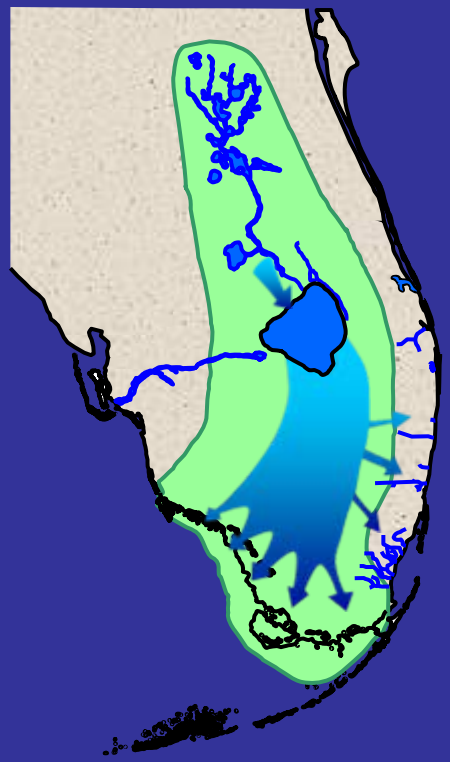
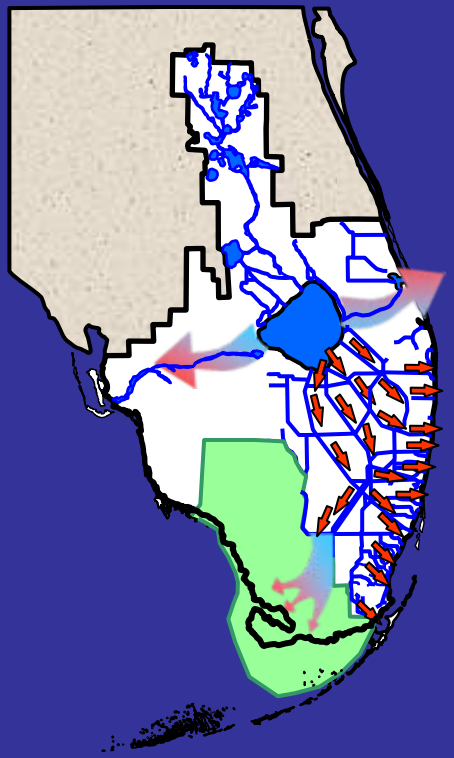
Investigation of Current Water Management System Capacity to Discharge Excess Lake Okeechobee Water to the Everglades

Cal Neidrauer, P.E., Chief Engineer
Operations Department, SFWMD



Water Resources Advisory Commission

May 8, 2008 Meeting



Purpose & Scope of Investigation

- To help educate stakeholders regarding the current regional water management system capabilities and limitations for discharging excess water from Lake Okeechobee.
- Future storage & conveyance projects are beyond the scope of this investigation.

Purpose & Scope (cont)

- Effort was initiated by request of the WRAC Lake Okeechobee Committee.
- Investigation is not part of any ongoing planning study.
- Experienced Staff from the SFWMD and USACE helped with this effort.
- Results of this investigation are preliminary.

Contributors

- Cal Neidrauer, SFWMD
- Kim Taplin, USACE
- Paul Linton, SFWMD
- Luis Cadavid, SFWMD
- Jose Otero, SFWMD
- Walter Wilcox, SFWMD
- Dan Crawford, USACE
- Richard Punnett, USACE Contractor
- Deb Drum, SFWMD
- Ken Rutchey, SFWMD
- Tracey Piccone, SFWMD
- Kirk Burns, SFWMD

How much excess Lake Okeechobee water can be discharged to the WCAs using the <u>current system's</u> physical capacity?

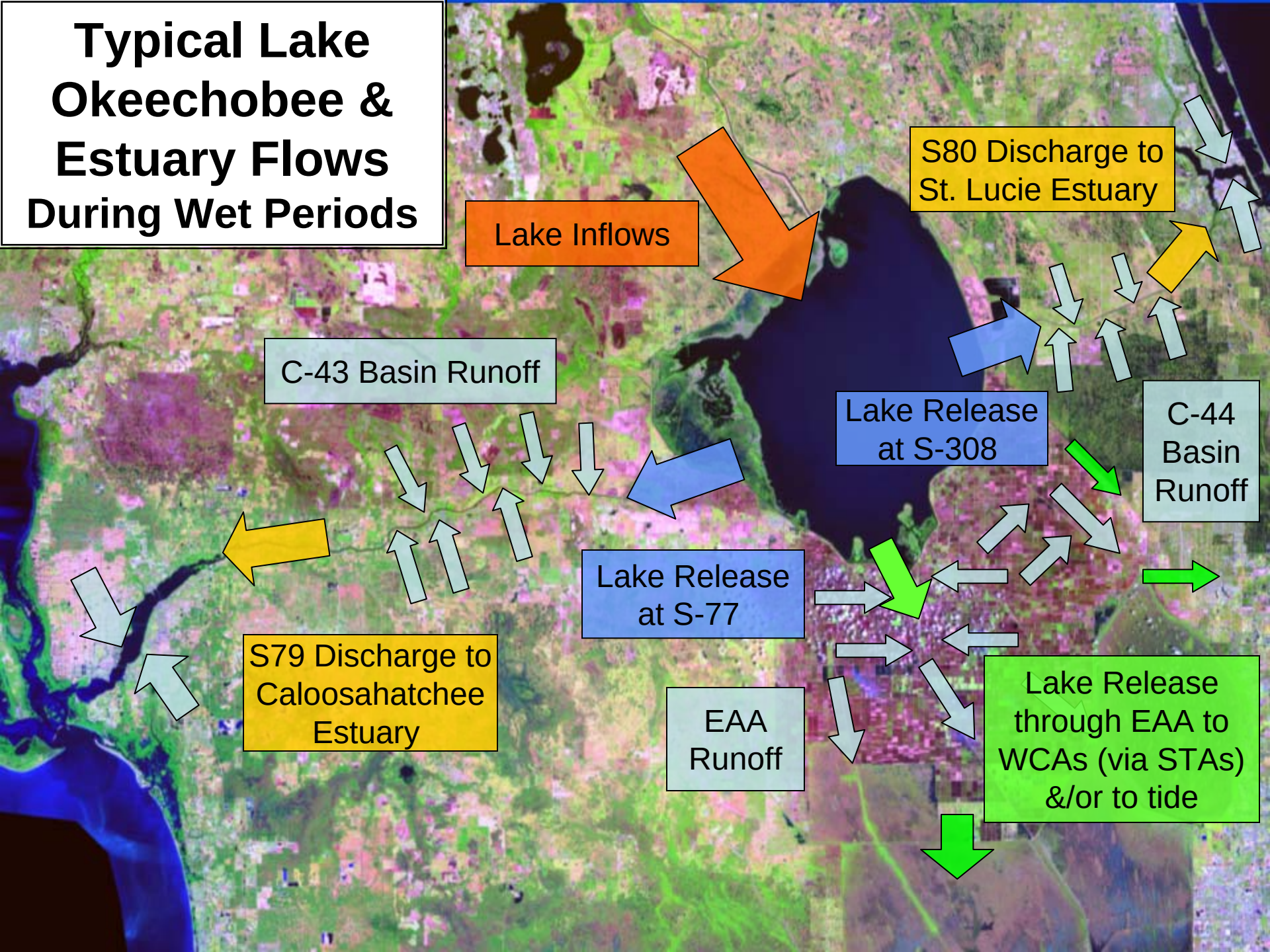
(assuming the legal and regulatory/operating constraints can be relaxed)

- What problems might this cause?
- What problems might be solved?
- Will the damaging discharges to the estuaries be eliminated?

Background

- Drainage actions in the late 19th and early 20th centuries laid the foundation for today's water management system
  - The most practical way to drain the Everglades was to divert excess water from Lake Okeechobee to the Caloosahatchee and St. Lucie & dig drainage canals through the Everglades
- Hydraulic capacity of the water control system to discharge to estuaries is ~6 times larger than the southward capacity
- Today the Remaining Everglades is only about ½ of its original spatial extent
- Many constraints on southward discharge of excess Lake Okeechobee water

Typical Lake Okeechobee & Estuary Flows
During Wet Periods



Existing Constraints on Southward Releases of Excess Water from Lake O

1. Hydraulic Conveyance Capacity
   - Primary canals (Miami, NNR, Hillsboro & WPB), pumps and spillways
2. EAA basin runoff/drainage has priority for use of the primary conveyance canal system
3. Water Quality in the Everglades Protection Area (EPA)
   - Legal requirements
   - Phosphorus concentrations & loads to the Everglades
   - STA treatment capacity
4. Everglades WCA Hydrology/Ecology
   - Tree Islands and Wading Birds
   - WCA vegetation & levee protection
   - WCA Regulation Schedules
5. Endangered Species
   - Snail Kites in southern WCA-3A
   - Cape Sable Seaside Sparrows in ENP

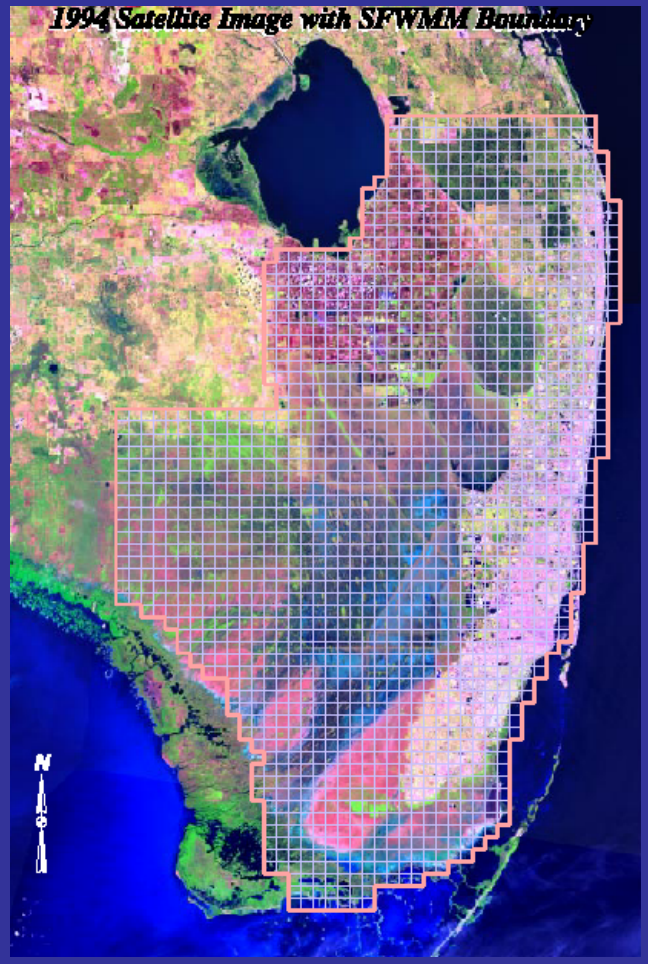
What-if the southward releases of excess Lake O water were maximized?

- Relax Regulatory/Operating Constraints
  - Do not limit southward discharges when:
  1. WCA stages are high
  2. STA treatment capacity is unavailable
  3. Endangered Species are impacted
- Maintain Structure Capacity Constraints
  - Lake releases still limited by:
  1. Hydraulic capacity of canals & structures
  2. Local drainage has first priority for use of primary canal conveyance capacity

Regional Hydrologic Simulation Modeling for testing “what-if” scenarios

South Florida Water Management Model (SFWMM)

- Continuous simulation of hydrologic and water management system response to 36-years of daily historical rainfall data (1965-2000)
- For > 25 yrs the SFWMM has been continuously updated, improved, and applied for regional-scale water resources planning in south Florida.



Two Simulations using the SFWMM

1. BASE
   - 2007 system and operating criteria (no new infrastructure)
   - same assumptions as baseline for USACE's Lake O Regulation Schedule Study (LORSS)
     - Current Lake O Regulation Schedule (WSE)
     - STA-3/4 treatment capacity assumed limited to average annual Lake O discharge of ~60 kaf/yr (assumed 146 ppb TP)
2. CASE1
   - Hypothetical "what-if" scenario
   - Lake regulatory discharges not limited by WCA levels or STA treatment capacity
   - Lake regulatory discharges to all 3 WCAs using full conveyance capacity when available
   - All other assumptions same as Baseline simulation

Simulation Results

If the regulatory/operating & legal constraints are relaxed, then…

1. How much more excess Lake Okeechobee water flows south?
2. Any effects on Lake Okeechobee stages?
3. Are there benefits to the Caloosahatchee and St. Lucie Estuaries? Are damaging discharges from Lake O eliminated?
4. What impacts result from the additional southward Lake releases on the STAs, WCAs, ENP, Endangered Species & LEC developed areas?

Simulation Results

If the regulatory/operating & legal constraints are relaxed, then…

1. **How much more excess Lake Okeechobee water flows south?**
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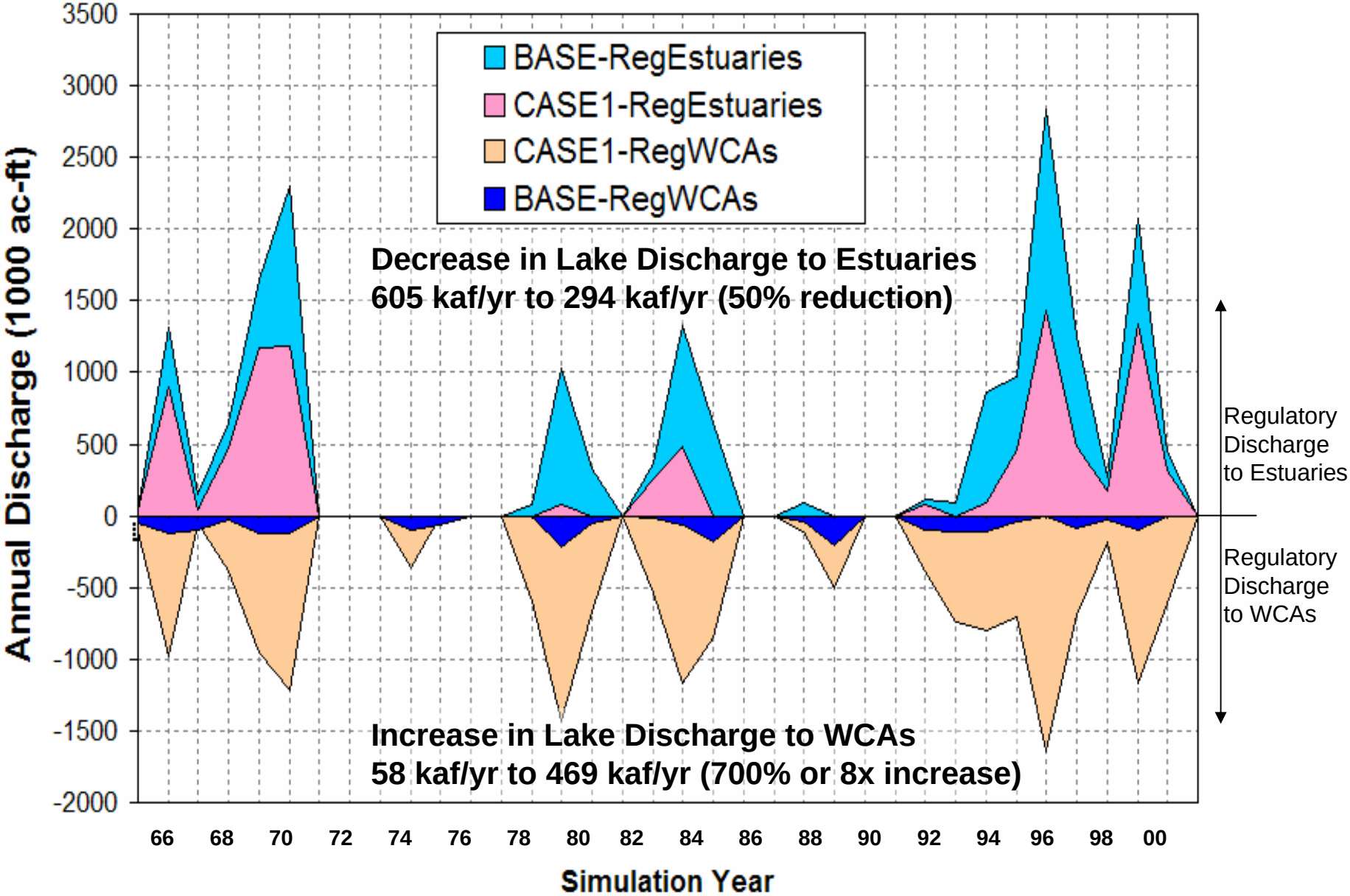
Lake Okeechobee Regulatory Discharge

(1965-2000 SFWMM Simulation)



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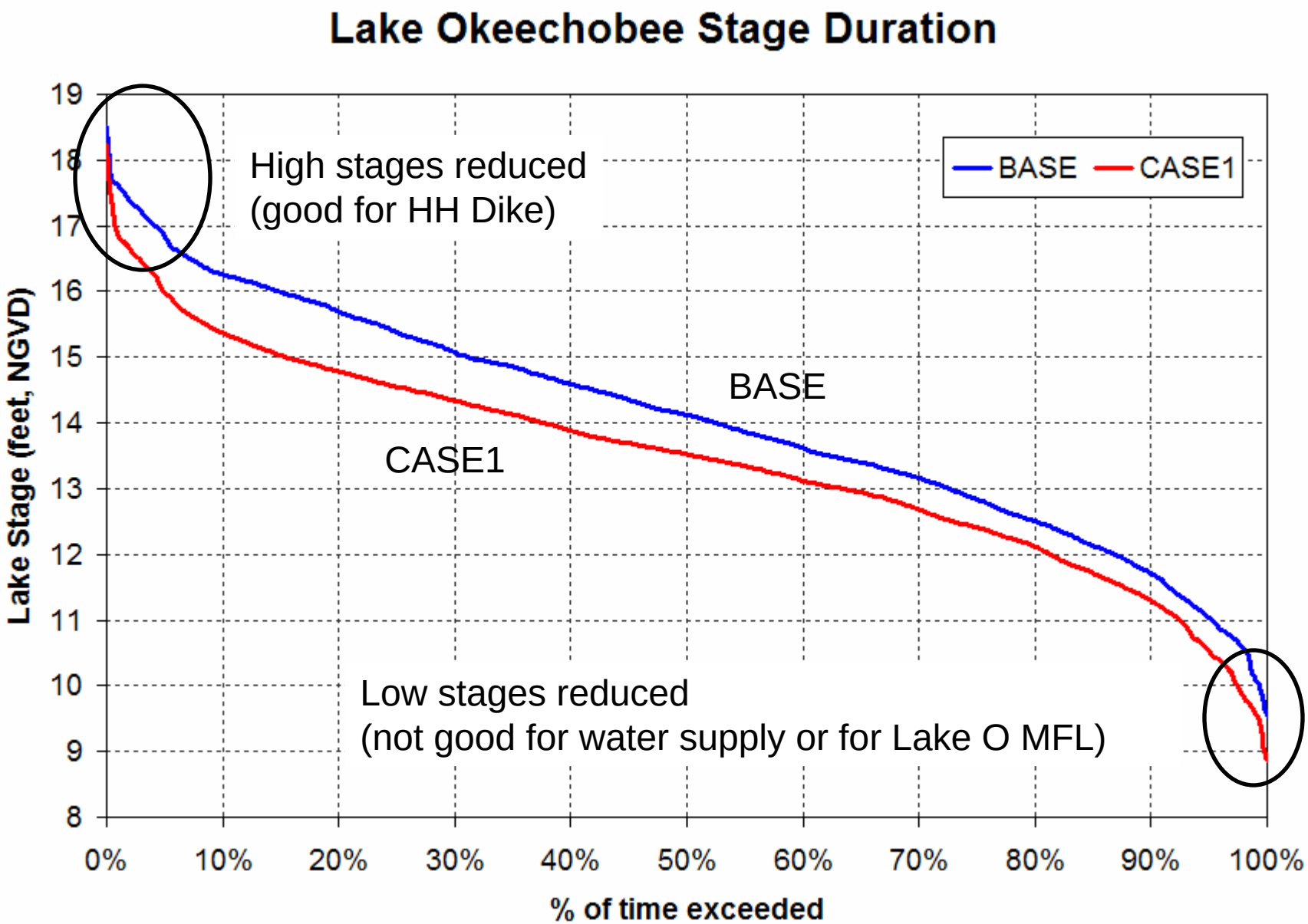
Lake Okeechobee Stage Duration
Lake Stage (feet, NGVD)
% of time exceeded
19
18
17
16
15
14
13
12
11
10
9
8
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
BASE
CASE1
High stages reduced
(good for HH Dike)
BASE
CASE1
Low stages reduced
(not good for water supply or for Lake O MFL)

Simulation Results

If the regulatory/operating & legal constraints are relaxed, then…

1. How much more excess Lake Okeechobee water flows south?
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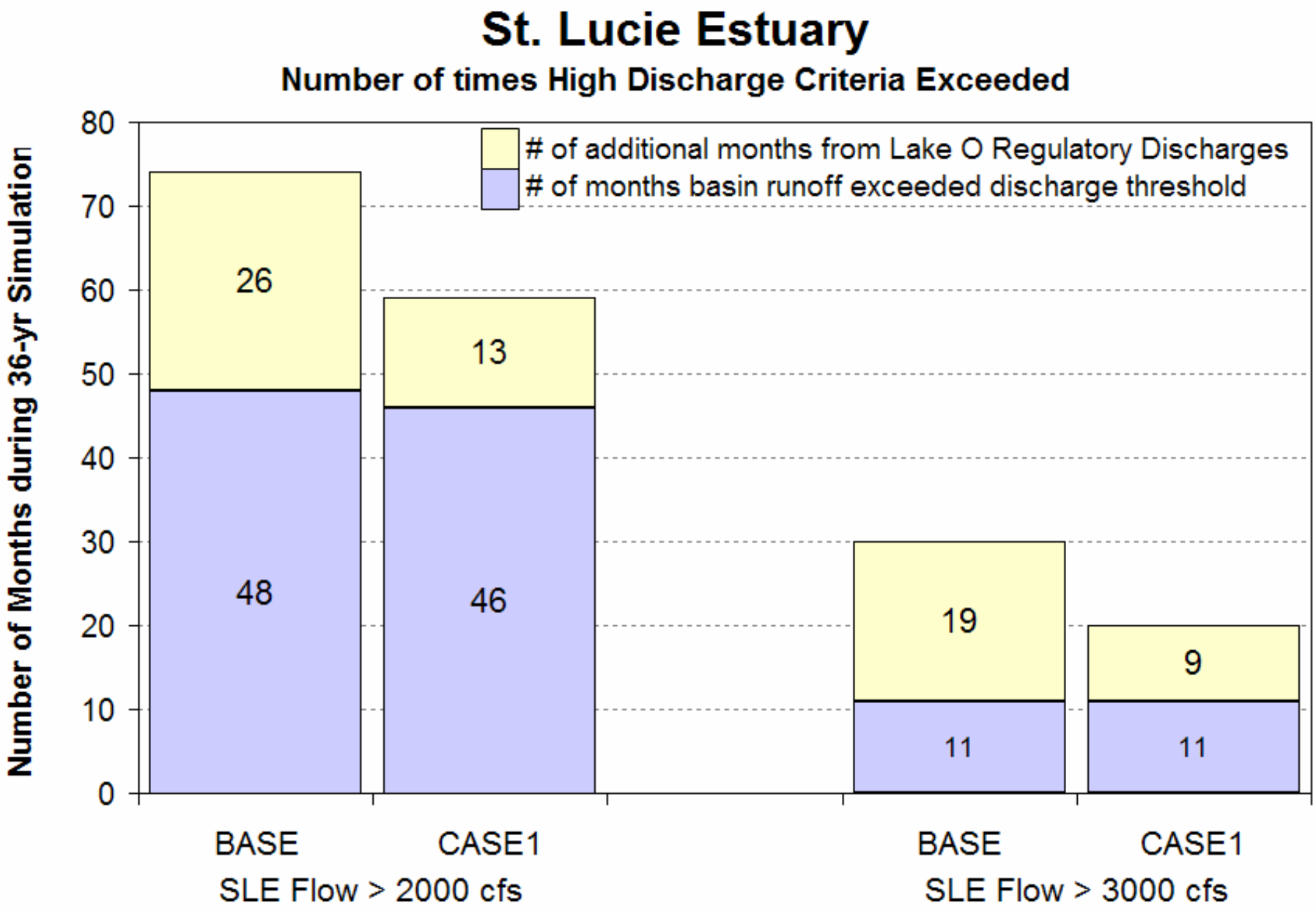
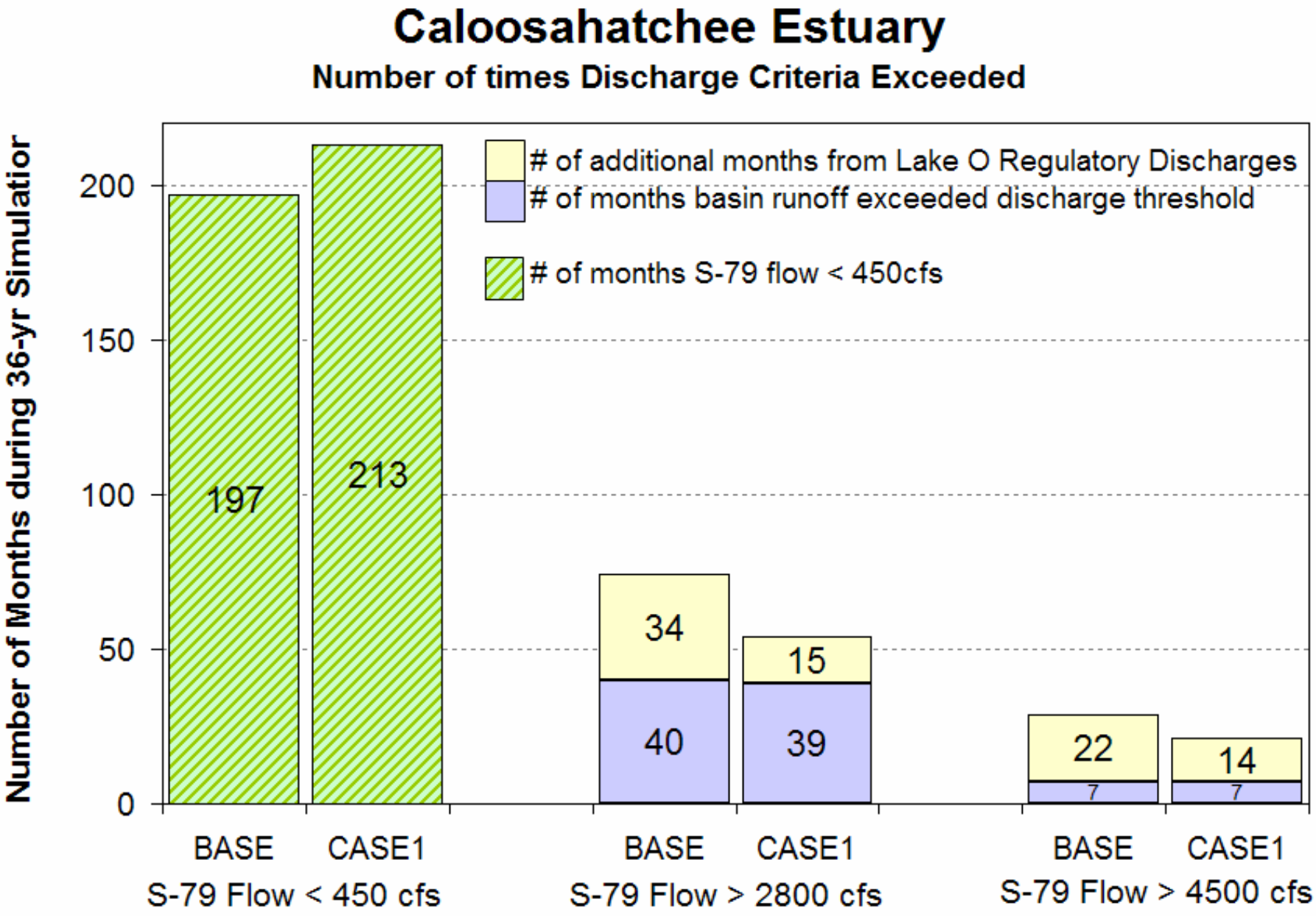

St. Lucie Estuary
Number of times High Discharge Criteria Exceeded
Number of Months during 36-yr Simulation
80
70
60
50
40
30
20
10
0
# of additional months from Lake O Regulatory Discharges
# of months basin runoff exceeded discharge threshold
26
48
13
46
19
11
9
11
BASE
CASE1
SLE Flow > 2000 cfs
BASE
CASE1
SLE Flow > 3000 cfs


Caloosahatchee Estuary
Number of times Discharge Criteria Exceeded
Number of Months during 36-yr Simulation
# of additional months from Lake O Regulatory Discharges
# of months basin runoff exceeded discharge threshold
# of months S-79 flow < 450cfs
0
50
100
150
200
197
213
34
40
15
39
22
7
14
7
BASE
CASE1
BASE
CASE1
BASE
CASE1
S-79 Flow < 450 cfs
S-79 Flow > 2800 cfs
S-79 Flow > 4500 cfs

Benefits/Impacts to the St. Lucie and Caloosahatchee Estuaries

- The CASE1 simulation reduces the number of months of high damaging discharges to both estuaries by 8-10 months over the 432-month simulation
  - CE (reduction from 29 to 21 months S79 flow > 4500cfs)
  - SLE (reduction from 30 to 20 months SLE flow > 3000cfs)
  - Local basin runoff contributes significantly to the problem
- Significant hydrologic events still require large regulatory discharges from Lake Okeechobee
- Also, 16 more months S-79 flows < 450cfs
  - Note: there is currently no legal obligation to make environmental water supply releases to the Caloos Estuary to meet it's MFL until the C-43 reservoir is built & operational.

Simulation Results

If the regulatory/operating & legal constraints are relaxed, then…

1. How much more excess Lake Okeechobee water flows south?
2. Any effects on Lake Okeechobee stages?
3. Are there benefits to the Caloosahatchee and St. Lucie Estuaries? Are damaging discharges from Lake O eliminated?
4. **What impacts result from the additional southward Lake releases on the STAs, WCAs, ENP, Endangered Species & LEC developed areas?**

Impacts to the Everglades Construction Project (ECP) Stormwater Treatment Areas (STAs)

- CASE1 simulation shows ~400 kaf (33%) increase in average annual flows through STAs
  - 1995 shows 1.6 million af more Lake discharge to STAs
  - ~300 kaf (50%) increase in Lake discharge through STA-3/4
- STAs would be overloaded & damaged
- STAs not designed to treat this much Lake O discharge
  - Only STA-3/4 has a limited allowance for Lake O discharge
    - 1994 ECP design:
      - 40,000 acres of STAs
      - Target 50 ppb outflow concentration
      - Assumed 70 ppb Lake inflow P concentration
      - Allowance for 236 kaf/yr Lake O discharge
    - 2003 Everglades Forever Act & 2005 EAA Regional Feasibility Study
      - 18,000 acres STA expansion
      - Target 10 ppb outflow concentration
      - Assumed 70 ppb Lake inflow P concentration
      - Allowance for 139 kaf/yr Lake O discharge

Legal issues pertaining to Everglades water quality

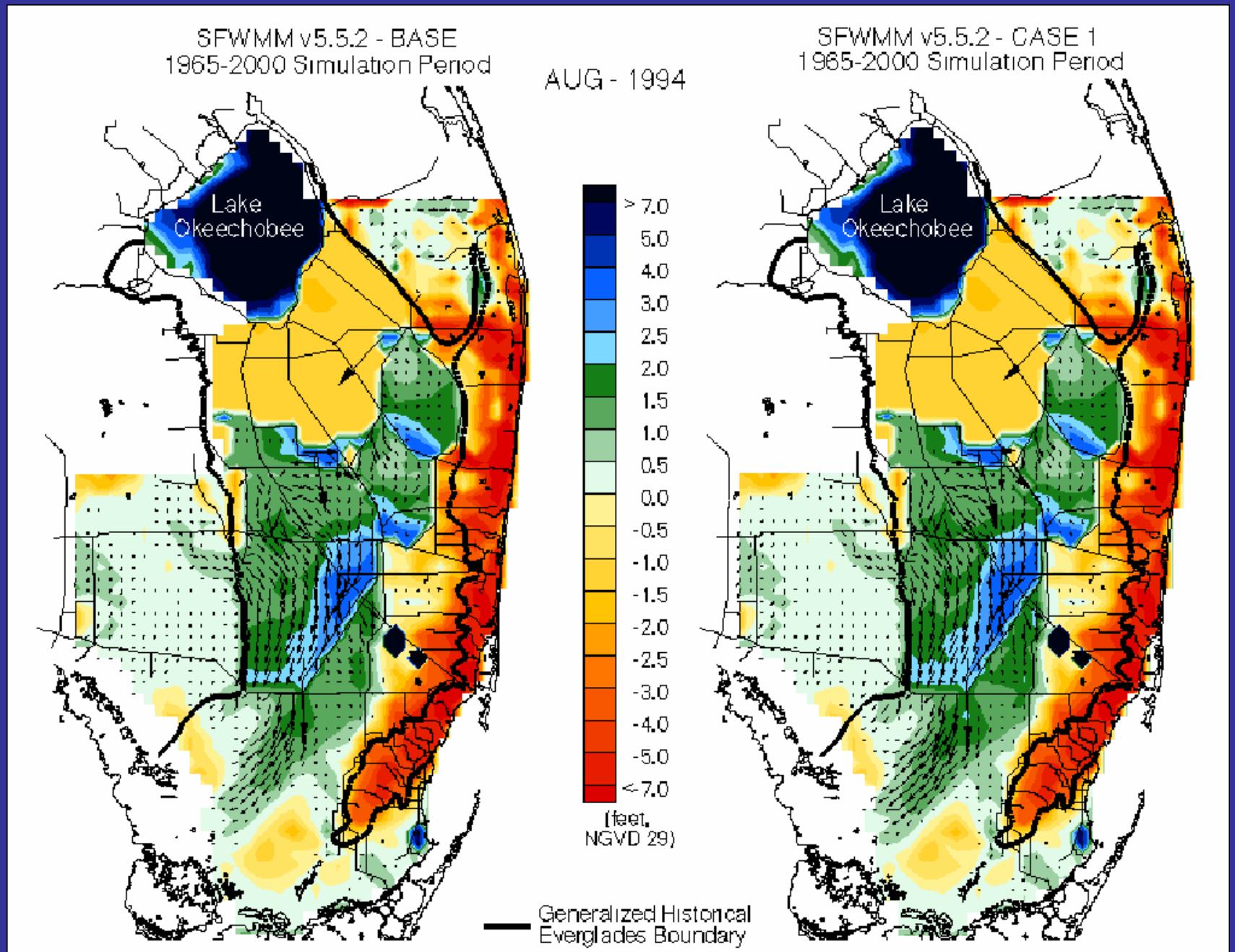
- Overloading the STAs would most likely cause violations of the Everglades Forever Act (EFA) and the State's new phosphorus water quality standard for the Everglades. It would also result in violations of both EFA and NPDES permits.
- Increase phosphorus concentrations and loads entering WCA-3 would result in violations of the Miccosukee Tribe's water quality standards.

Impacts to the WCAs

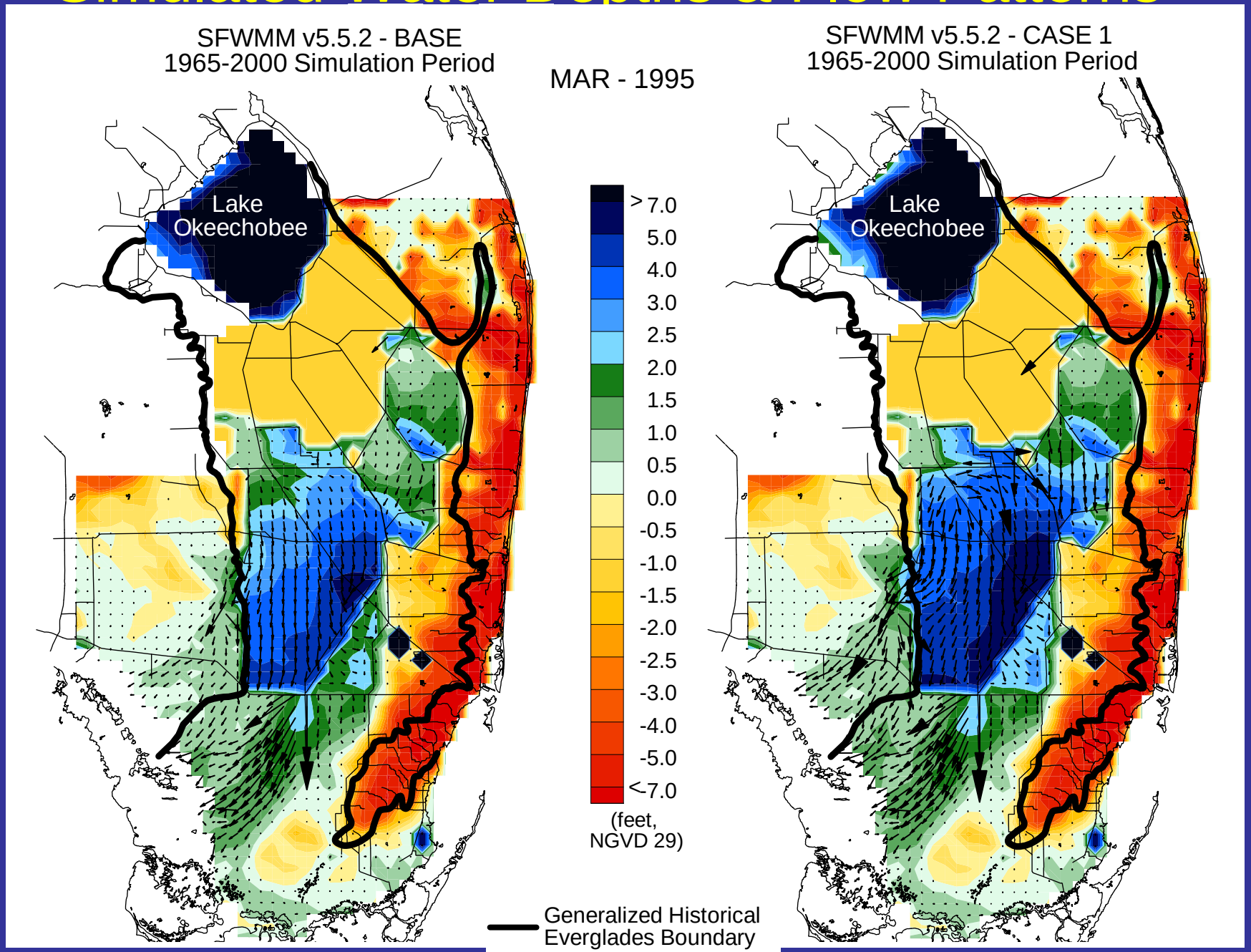
Lake Okeechobee generally has excess water during the same times when WCA-3A also has excess water

- For the BASE simulation, Lake O stages rise into its regulation schedule during 20 of the 36-yrs.
- For 16 of those 20 years the WCA-3A stage is too high to allow significant Lake discharges to be made.
- Relaxing regulation schedule requirements allows a significant increase in Lake Regulatory discharge to the WCAs.
- Average annual Lake Okeechobee regulatory discharges to the WCAs
  - Base = 58,000 af/yr
  - Case1 = 469,000 af/yr (8 times more)

Simulated Water Depths & Flow Patterns



Simulated Water Depths & Flow Patterns



Hydrologic Suitability for Elevated Everglades Tree Islands			
GE-E6 Summmary Table			

	NSM46F	BASE	CASE1
IR 111 WCA-2A South			
Number of Weeks > 2.0 Feet	8	76	115
Percent Period of Record of Weeks > 2.0 Feet	1	7	11
IR 116 WCA-3A NE			
Number of Weeks > 2.0 Feet	0	90	177
Percent Period of Record of Weeks > 2.0 Feet	0	9	17
IR 117 WCA-3A NW			
Number of Weeks > 2.0 Feet	6	85	172
Percent Period of Record of Weeks > 2.0 Feet	1	8	17
IR 123 WCA-3A South Central			
Number of Weeks > 2.0 Feet	10	251	382
Percent Period of Record of Weeks > 2.0 Feet	1	24	37
IR 124 WCA-3A South			
Number of Weeks > 2.0 Feet	27	507	608
Percent Period of Record of Weeks > 2.0 Feet	3	49	58

Summary of Impacts to WCAs

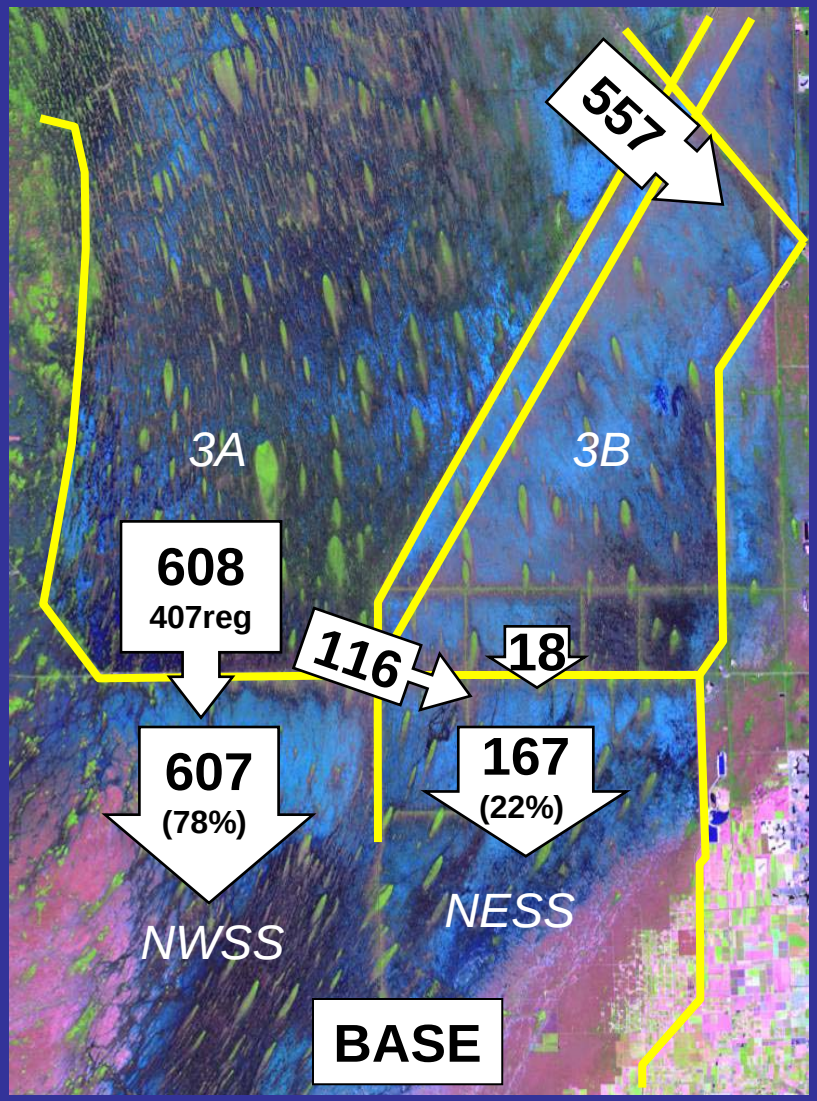
- CASE1 Simulation vs BASE shows Everglades WCAs receive an additional ~400 kaf/yr (avg annual) of inflow from Lake O regulatory discharges.
  - exceedence of water quality standards since STAs overloaded and/or bypassed (partially-treated or untreated flow)
  - adversely affect flora (plant) and fauna (animal) diversity, which will have an impact on food web dynamics
- Poor timing of the additional Lake O inflows
  - WCA water levels are already too high when Lake discharge occurs
- Increased water depths during wet periods contribute to:
  - increased mortality of trees
  - adverse affects on apple snail production and snail kite utilization
  - adverse affects on foraging and nesting success for wading birds
- Rapid water depth changes may affect current ridge and slough patterning and cause mortality to brush and/or sawgrass communities

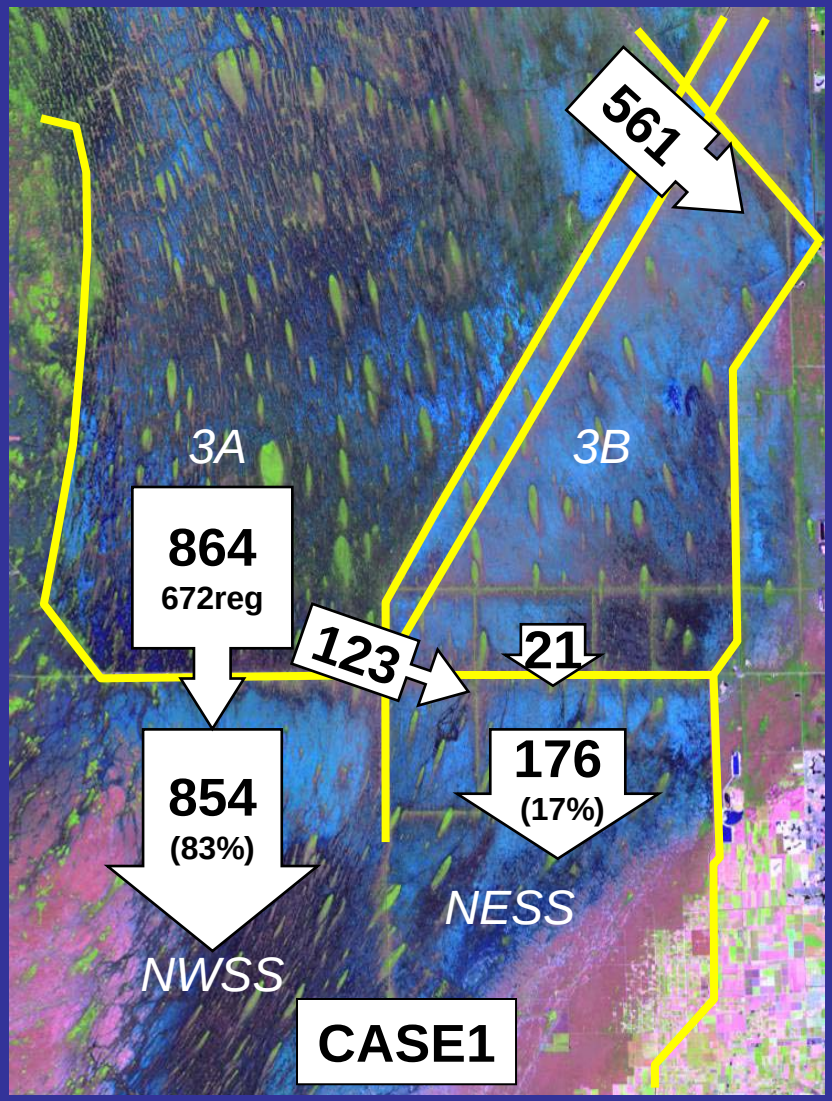
Impacts to ENP

- Reminder - Simulated Operations for flows to ENP
  - CASE 1 assumptions same as BASE
  - Rainfall Plan (1985) defines the flow to ENP
    - rain-driven target + WCA-3A regulatory flow
    - target distribution (55% to NESS, 45% to NWSS)
  - Current operating constraints (G-3273 and L-29 canal) limit flow to Northeast Shark Slough (NESS)
- CASE 1 Flows to ENP not natural & influenced heavily by upstream water management (Lake O regulatory discharges)
  - 256 kaf/yr (33%) increase in total flow to ENP
  - 65% increase in average regulatory discharge from WCA-3A to NWSS
- East-West Flow distribution for Shark Slough distorted further from target (45% west – 55% east)
  - from 78%-22% (BASE) to 83%-17% (CASE1)

ENP Shark Slough Flow Volume Comparison

(mean annual simulated values in thousand acre-feet per year)





Impacts to Endangered Species

- Snail Kite in southern WCA-3A
  - Deeper water for longer durations in southern 3A adversely affect Snail Kite habitat
  - WCA-3A snail kites are affected by rapid water level increases during Feb. 15-May 15 that drown apple snail eggs
- Cape Sable Seaside Sparrow in northwest Shark Slough in ENP (Subpopulation A).
  - Excess discharge to Western SRS increase water depths and durations.
  - adversely impacts CSSS Subpopulation A

Impacts to LEC Developed Areas

- Increased high WCA water levels may destroy WCA vegetation, thereby increasing potential for wind-tide impacts on WCA levees during hurricanes
  - Increased risk to public health and safety
- More water in WCAs
  - Less need for Lake O to deliver supplies to LECSAs
  - Slight increase in groundwater/levee seepage
    - good during dry season for recharging canals
    - Increases drainage to tide during wet periods

Summary

- The current system has the hydraulic capacity to discharge more excess water from Lake Okeechobee to the WCAs, but cannot do so due potential impacts to:
  - Water Quality in the Everglades Protection Area (EPA)
  - Everglades WCA Hydrology/Ecology
  - Endangered Species
- Simulation results show if regulatory/operational and legal constraints were relaxed, then:
  - Lake regulatory discharges to the WCAs increase by 8-times
  - Lake regulatory discharges to the Estuaries decrease by 50%
- If such discharges were made, the <u>benefits</u> would be:
  - Moderate decrease in frequency and duration of high Lake discharges to the Caloosahatchee & St. Lucie Estuaries.
  - Slight decreased risk to HH Dike failure

Summary (cont)

- If such discharges were made, the <u>impacts</u> would be:
  - Overloading and damage to STAs
  - Increased P-load to WCAs (violation of water quality standards)
  - Increase in high water levels in the WCAs
    - Damage to tree islands
    - Damage to WCA vegetation
    - Increased risk of WCA levee failure
    - Adverse impacts to wading birds
    - Adverse impacts to endangered species (CSSS and Snail Kite)
  - Increased flood risk in EAA
  - Increase in frequency of low Lake O stages and MFL exceedences
  - Increase in LOSA water shortages
  - Increase in frequency of flows < 450cfs to the CE
- But there will still be times when large releases from Lake O to the St. Lucie and Caloosahatchee Estuaries would be required.

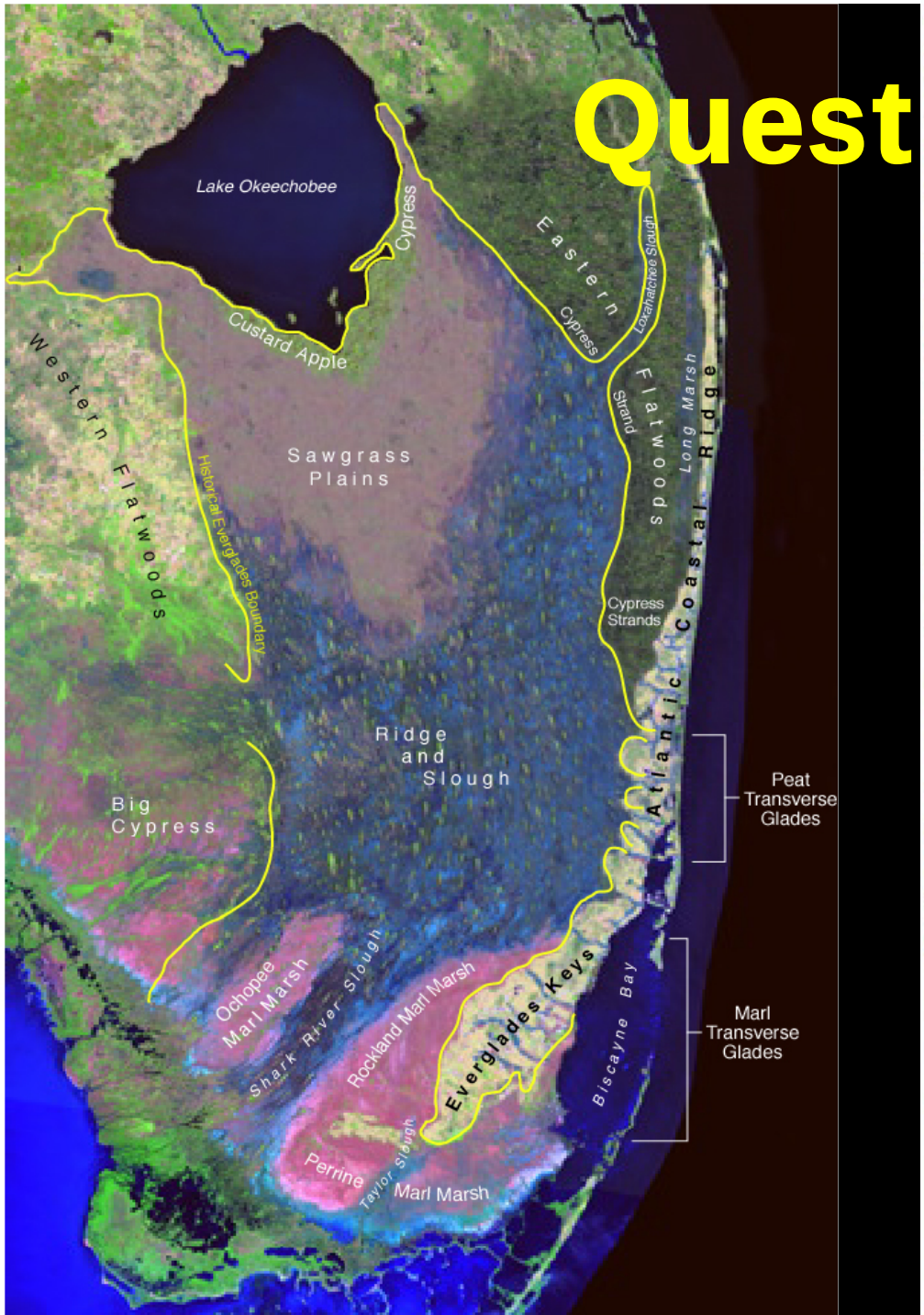
Conclusions

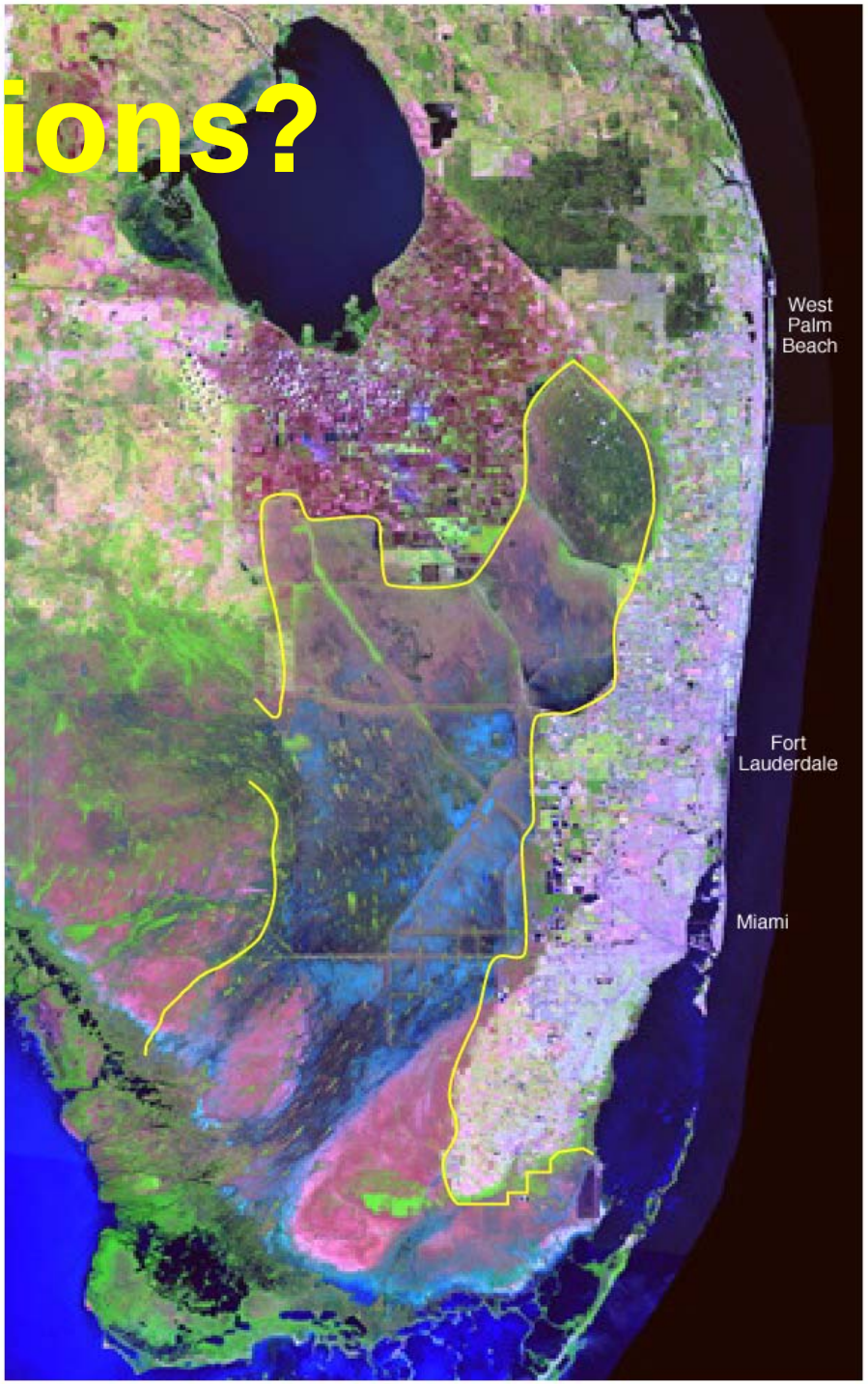
- Current system needs <u>more storage capacity</u> to hold water during times of excess and deliver it when and where it is needed.
  - More storage has been the focus of south Florida water resources planning efforts during the past ~15 years
    - Governor's Commission for a Sustainable South Florida (mid-1990's)
    - C&SF Project Restudy (1999) → CERP
    - Northern Everglades & Estuary Protection Plans (2007-09)
- Several storage areas are being built now, others soon…
  - EAA A1 Reservoir (190,000 acre-feet)
  - C43 Reservoir (170,000 acre-feet)
  - C44 Reservoir (51,000 acre-feet)
- Where is the best place to build <u>more</u> storage?
  - Public opinions vary due to various social and economic issues
  - Decision best determined by planning studies and benefit/cost analysis

Ongoing planning efforts that address the need for more storage and/or improved flows to the Everglades

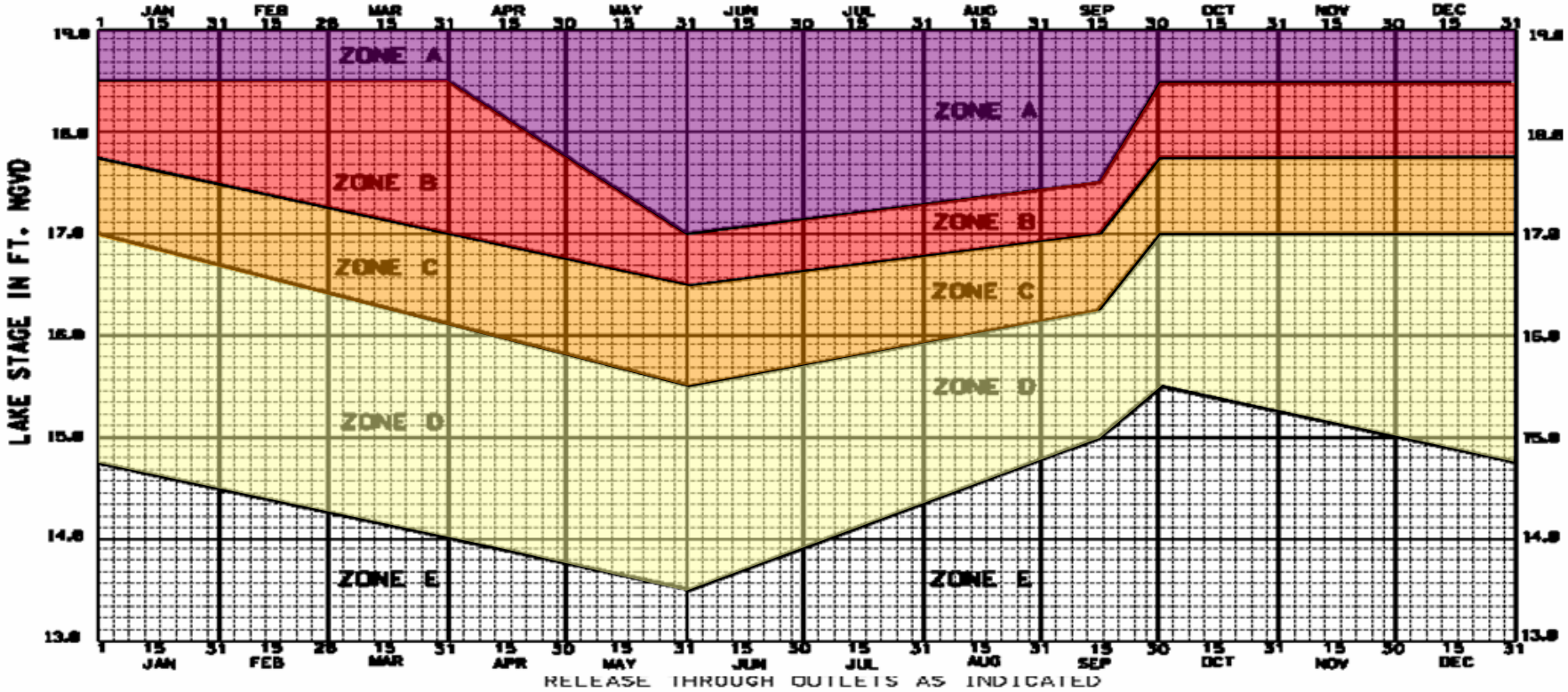
- Northern Everglades
  - Lake Okeechobee Technical Plan
  - St. Lucie & Caloosahatchee River Watershed Protection Plans
- CERP & A8
  - EAA Reservoir Phase 1 is under construction
  - WCA Decompartmentalization
  - System Operating Manual Study
  - EAA Reservoir Phase 2
    - USACE has stated this planning effort will consider the EAA storage that is needed while considering storage proposed by the NETP and watershed protection plans
- Modified Water Deliveries to ENP

Questions?


Lake Okeechobee
Cypress
Custard Apple
Eastern
Cypress
Loxahatchee Slough
Western Flatwoods
Sawgrass Plains
Historical Everglades Boundary
Strand
Flatwoods
Long Marsh
Ridge
Cypress Strands
Coastal
Atlantic
Ridge and Slough
Big Cypress
Peat Transverse Glades
Ochopee Marl Marsh
Shark River Slough
Rockland Marl Marsh
Everglades Keys
Biscayne Bay
Marl Transverse Glades
Perrine
Taylor Slough
Marl Marsh


West Palm Beach
Fort Lauderdale
Miami

Lake Okeechobee Regulation Schedule (WSE)



ZONE	AGRICULTURAL CANALS To WCAs (1,2)	CALOOSAHATCHEE RIVER AT S-77 (1,2,4)	ST. LUCIE CANAL AT S-80 (1,2,4)
A	PUMP MAXIMUM PRACTICABLE	UP TO MAXIMUM CAPACITY	UP TO MAXIMUM CAPACITY
B (3)	MAXIMUM PRACTICABLE RELEASES	RELEASES PER DECISION TREE (THESE CAN RANGE FROM MAXIMUM PULSE RELEASE UP TO MAXIMUM CAPACITY)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM MAXIMUM PULSE RELEASE UP TO MAXIMUM CAPACITY)
C (3)	MAXIMUM PRACTICABLE RELEASES	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 6500 CFS)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 3500 CFS)
D (3,5)	AS NEEDED TO MINIMIZE ADVERSE IMPACTS TO THE LITTORAL ZONE WHILE NOT ADVERSELY IMPACTING THE EVERGLADES. (SEE NOTE 5.)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 4500 CFS)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 2500 CFS)
E	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE

NOTES:
(1) SUBJECT TO FIRST REMOVAL OF RUNOFF FROM DOWNSTREAM BASINS
(2) GUIDELINES FOR WET, DRY AND NORMAL CONDITIONS ARE BASED ON: 1) SELECTED CLIMATIC INDICES AND TROPICAL FORECASTS AND 2) PROJECTED INFLOW CONDITIONS. RELEASES ARE SUBJECT TO THE GUIDELINES IN THE WSE OPERATIONAL DECISION TREE, PARTS 1 AND 2.
(3) RELEASES THROUGH VARIOUS OUTLETS MAY BE MODIFIED TO MINIMIZE DAMAGES OR OBTAIN ADDITIONAL BENEFITS. CONSULTATION WITH EVERGLADES AND ESTUARINE BIOLOGISTS IS ENCOURAGED TO MINIMIZE ADVERSE EFFECTS TO DOWNSTREAM ECOSYSTEMS.
(4) PULSE RELEASES ARE MADE TO MINIMIZE ADVERSE IMPACTS TO THE ESTUARIES
(5) ONLY WHEN THE WCAs ARE BELOW THEIR RESPECTIVE SCHEDULES

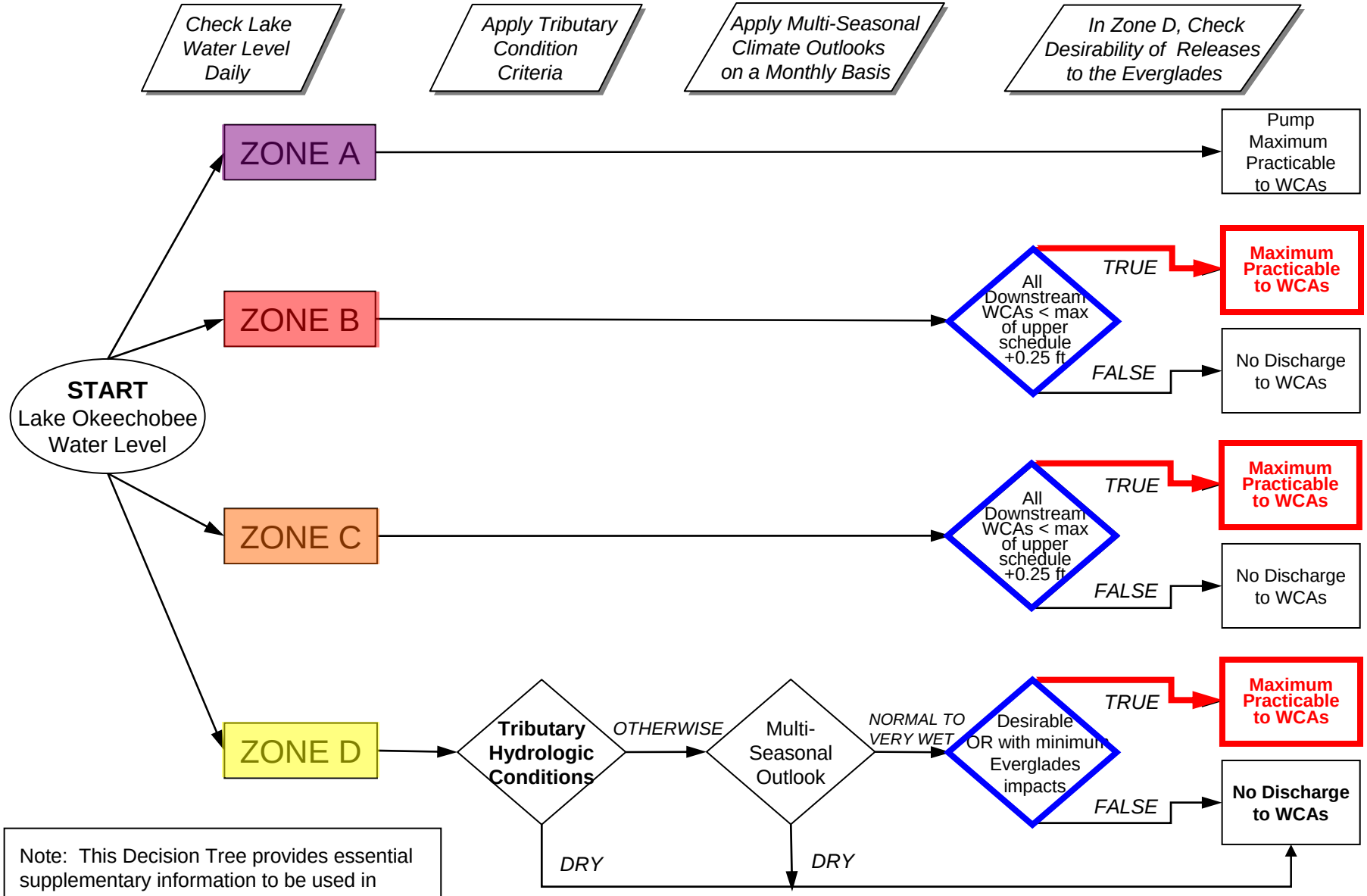
CENTRAL AND SOUTHERN FLORIDA
INTERIM REGULATION SCHEDULE
LAKE OKEECHOBEE

DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA
DATED: 5 NOVEMBER 1999

WSE (WITH CLIMATE OUTLOOK)

WSE Operational Guidelines Decision Tree

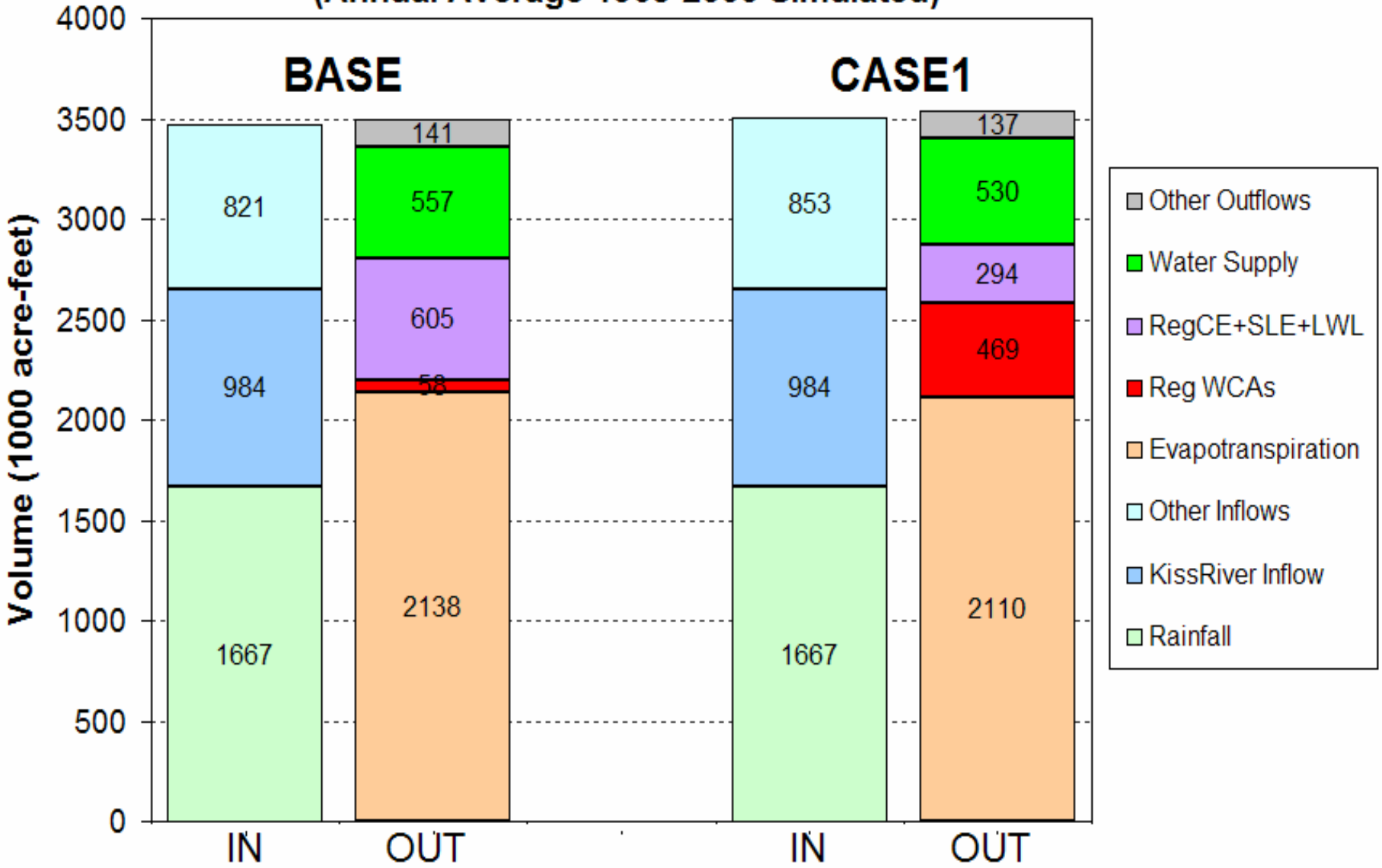
Part 1: Define Lake Okeechobee Discharges to the Water Conservation Areas



Note: This Decision Tree provides essential supplementary information to be used in conjunction with the WSE regulation schedule.

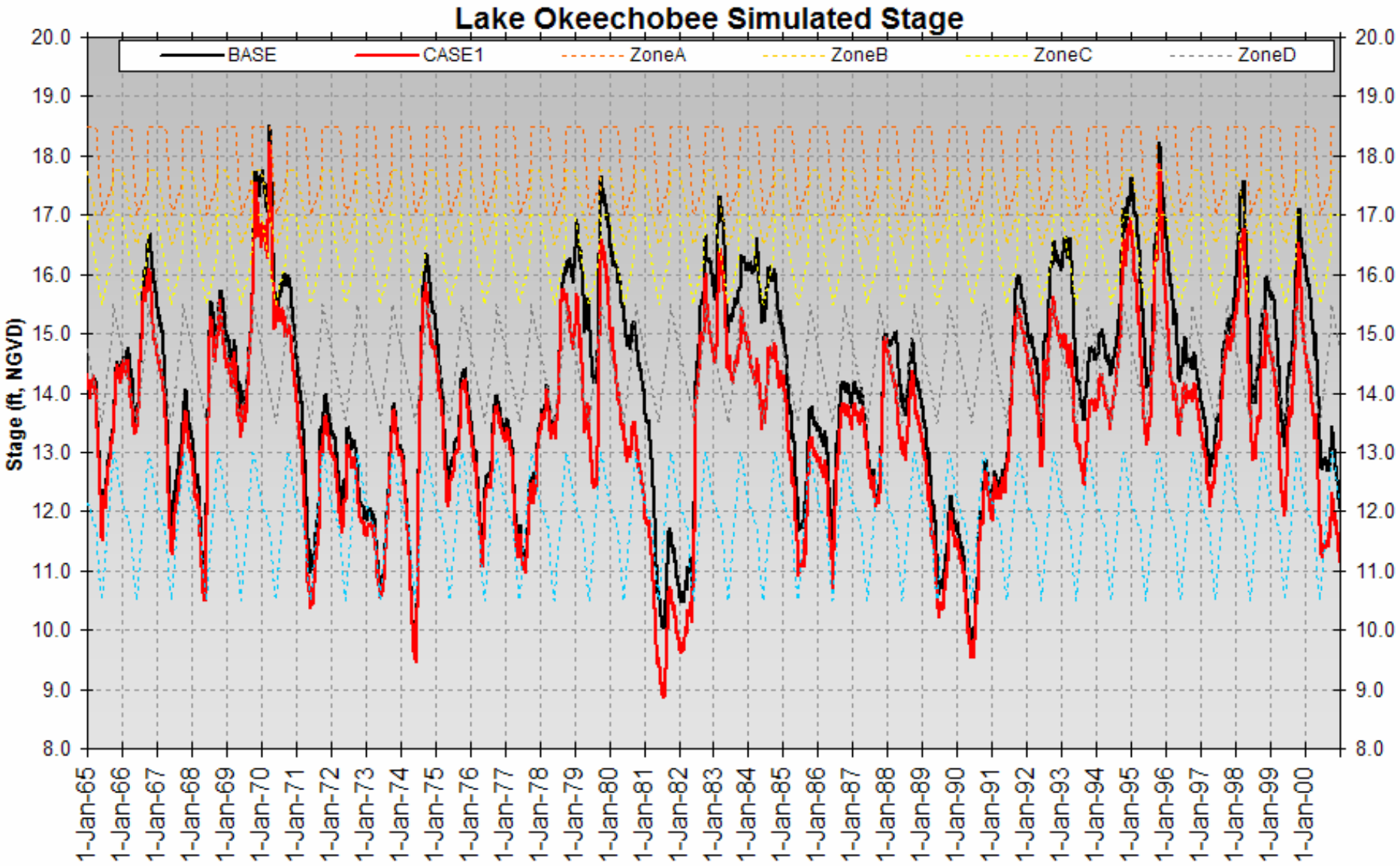
Lake Okeechobee Water Budget

(Annual Average 1965-2000 Simulated)



IN-OUT=ΔS
3472-3498 = -26

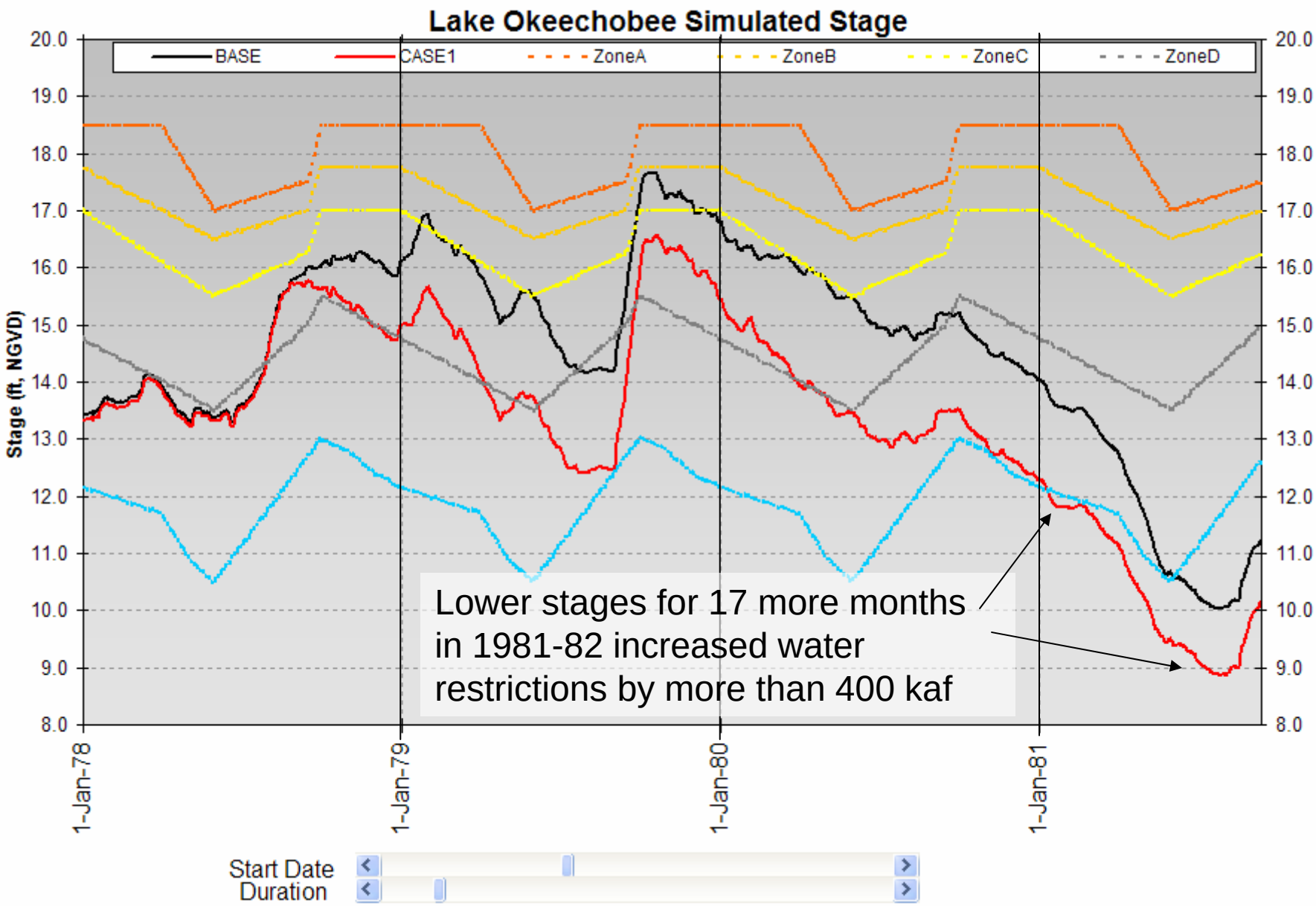
IN-OUT=ΔS
3504-3539 = -35

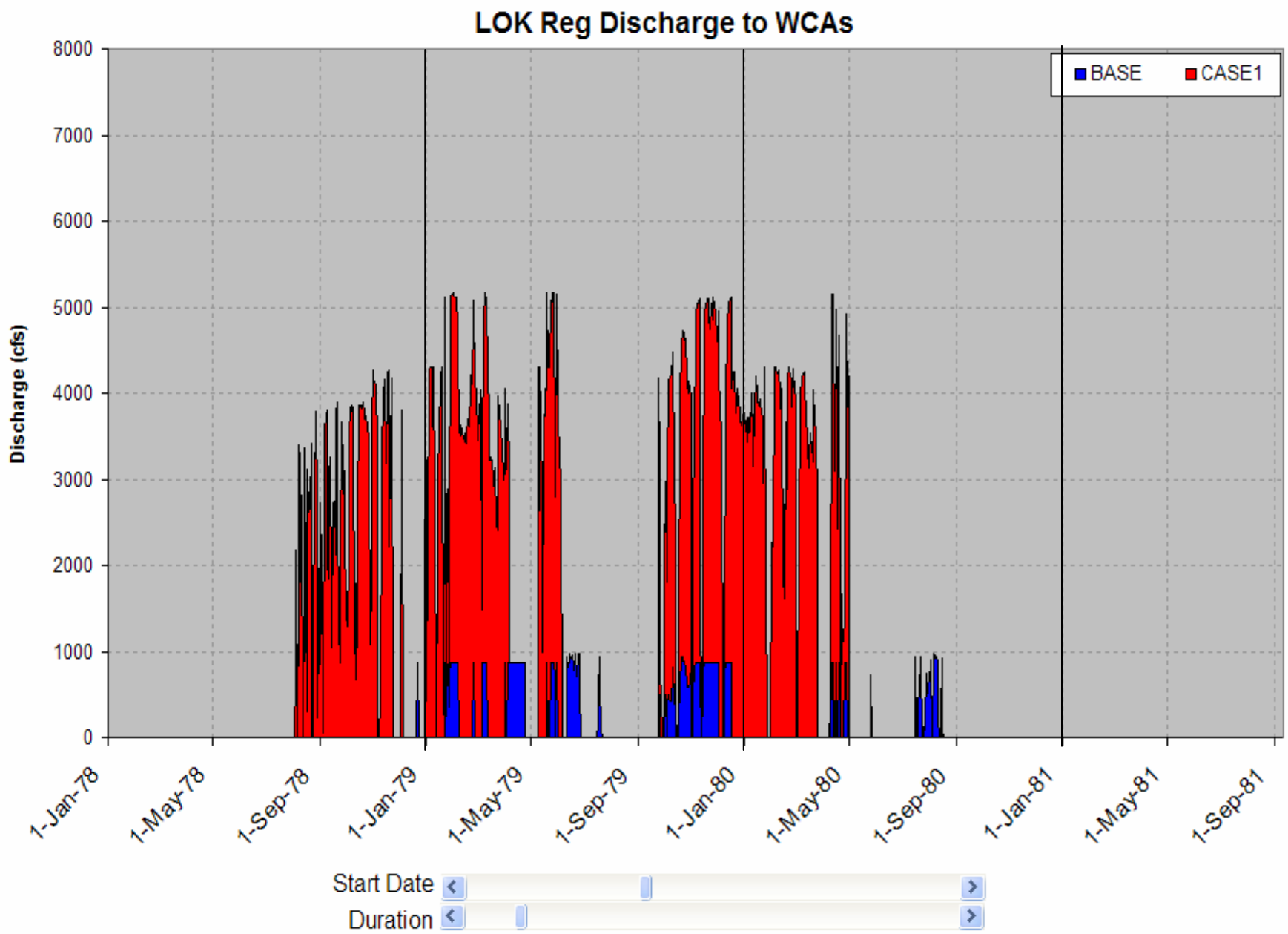


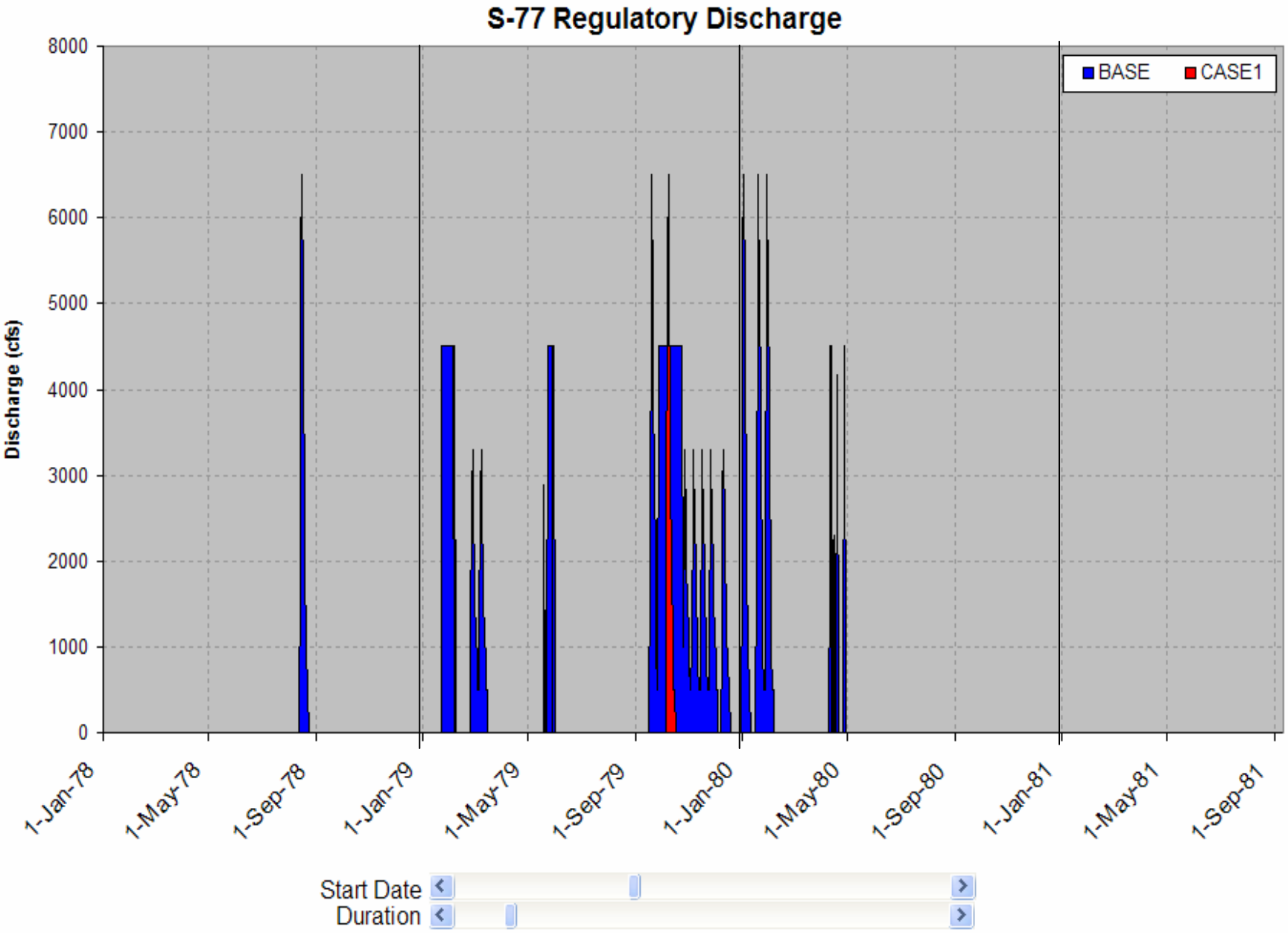
- Slight decrease in peak stages
- Increase in frequency and duration of low stages (< 11’)
- 3 additional exceedences of the Lake O MFL

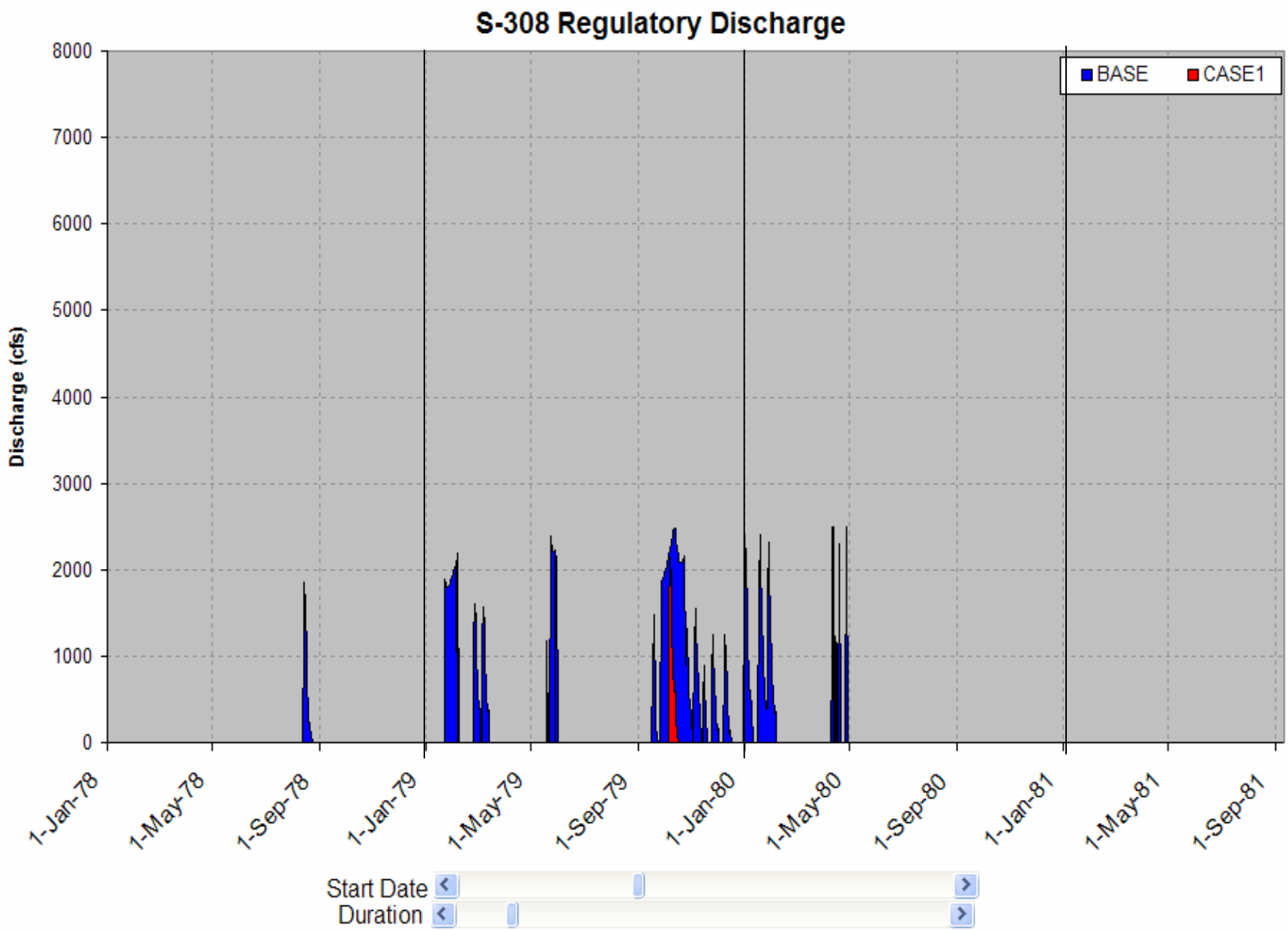
Closer Look #1

- 1978-1981
- Significantly more Lake discharge to WCAs
- Large reduction in Lake discharge to Estuaries
- Lake stage lowered additional 2 feet prior to 1981-82 drought


Lake Okeechobee Simulated Stage
BASE
CASE1
ZoneA
ZoneB
ZoneC
ZoneD
Stage (ft, NGVD)
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
Lower stages for 17 more months in 1981-82 increased water restrictions by more than 400 kaf
Start Date
Duration

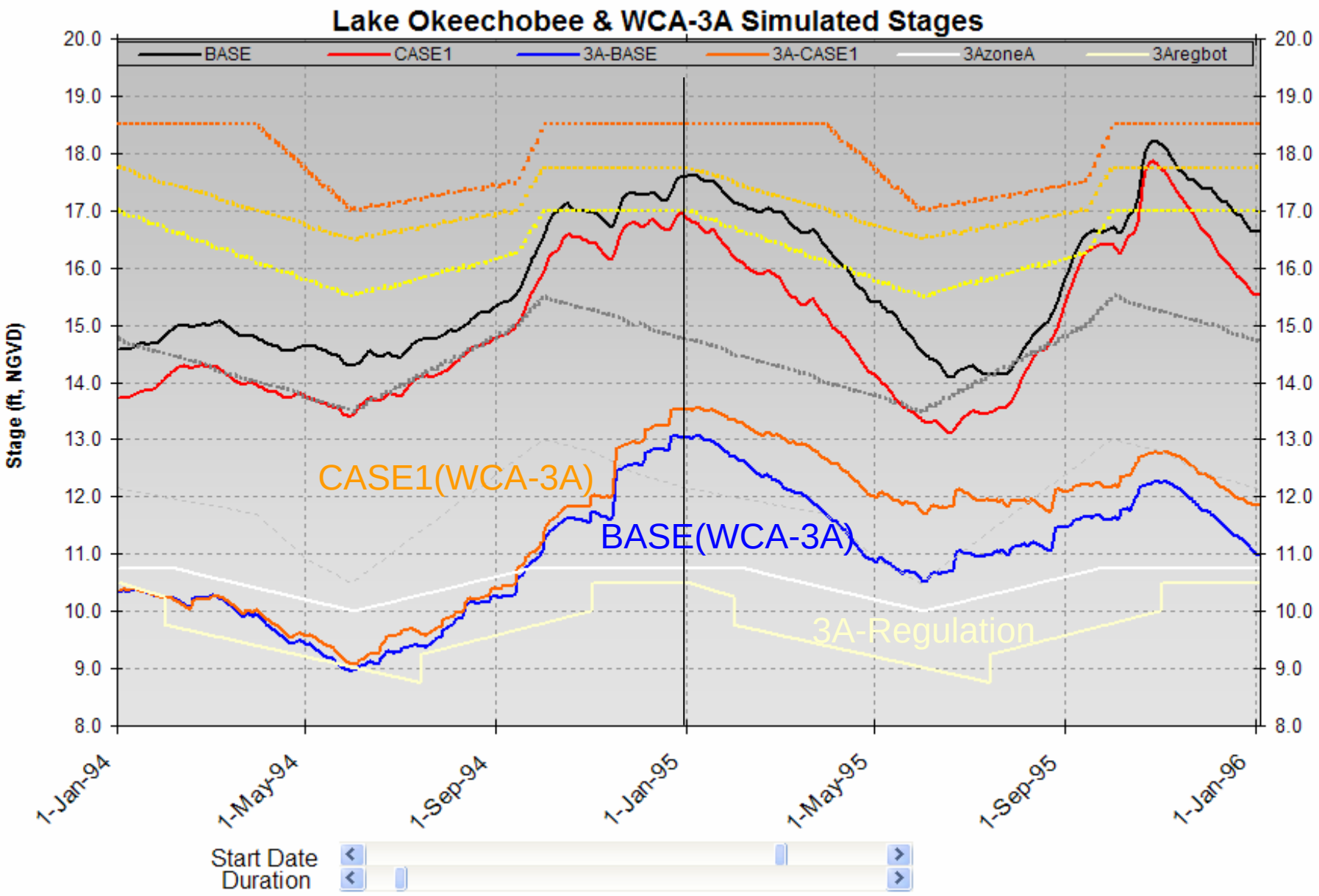

LOK Reg Discharge to WCAs
BASE
CASE1
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-78
1-May-78
1-Sep-78
1-Jan-79
1-May-79
1-Sep-79
1-Jan-80
1-May-80
1-Sep-80
1-Jan-81
1-May-81
1-Sep-81
Start Date
Duration

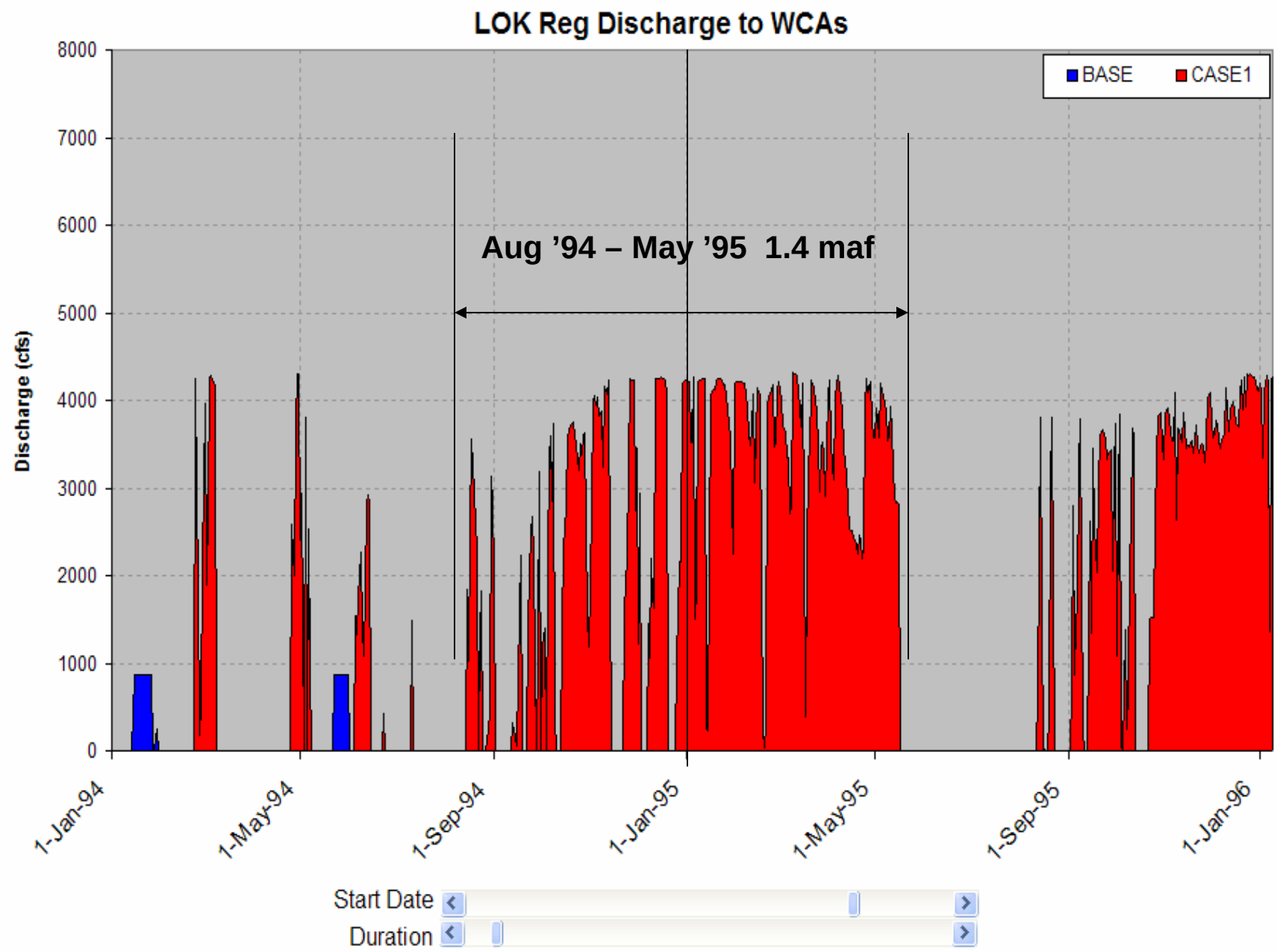

S-77 Regulatory Discharge
BASE
CASE1
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-78
1-May-78
1-Sep-78
1-Jan-79
1-May-79
1-Sep-79
1-Jan-80
1-May-80
1-Sep-80
1-Jan-81
1-May-81
1-Sep-81
Start Date
Duration

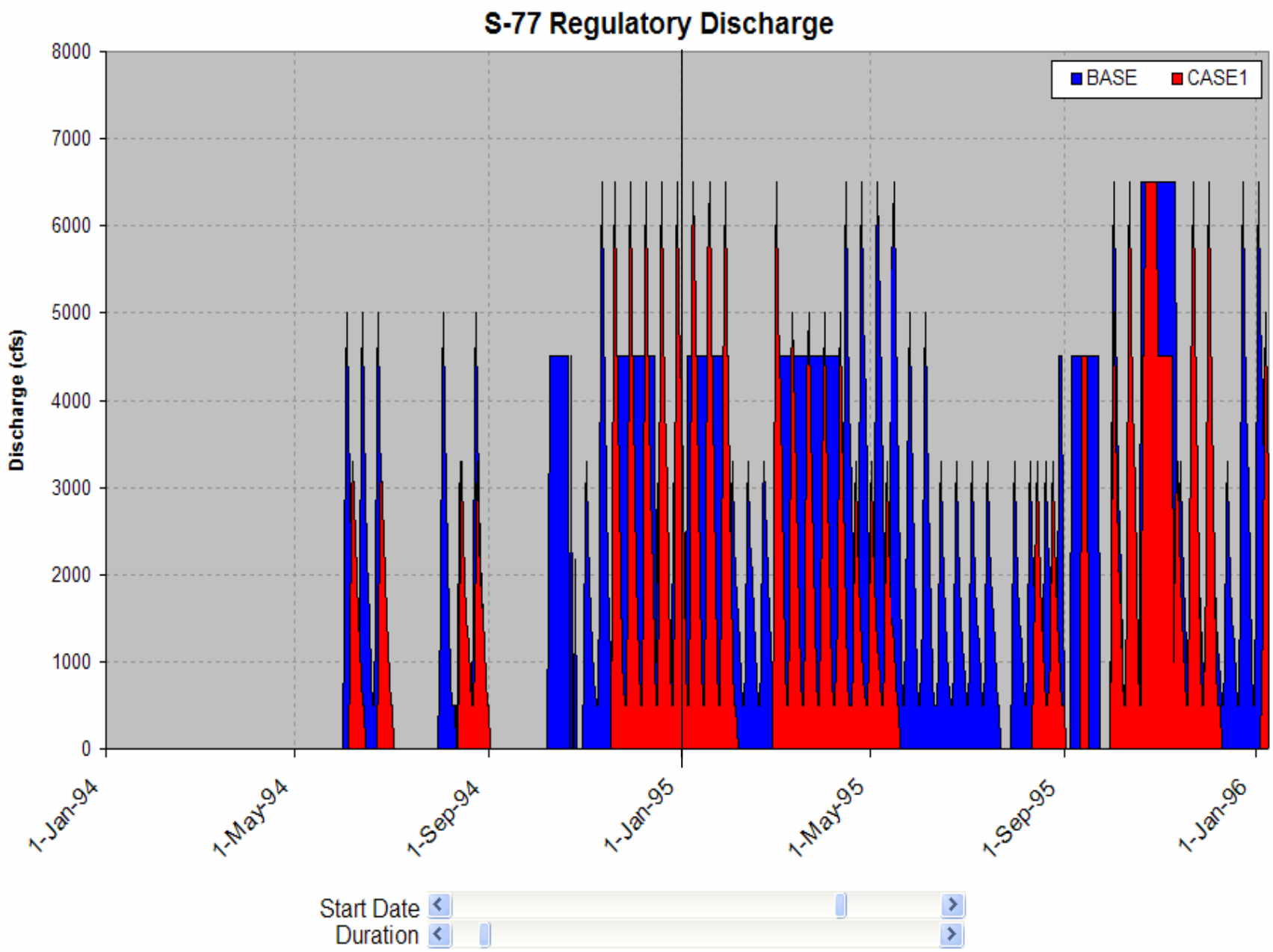

S-308 Regulatory Discharge
BASE
CASE1
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-78
1-May-78
1-Sep-78
1-Jan-79
1-May-79
1-Sep-79
1-Jan-80
1-May-80
1-Sep-80
1-Jan-81
1-May-81
1-Sep-81
Start Date
Duration

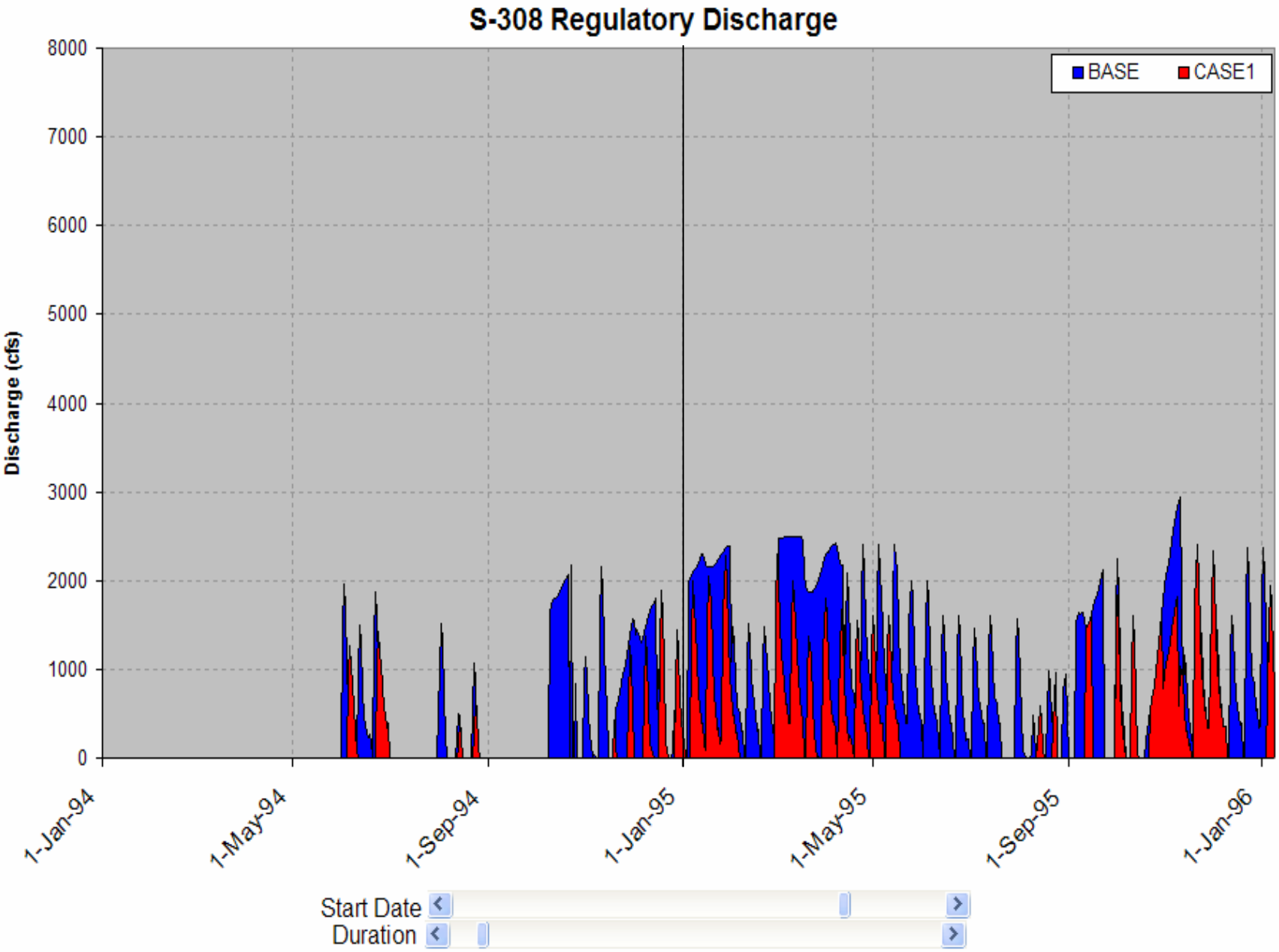
Closer Look #2

- 1994-1995
- Significantly more Lake discharge to WCAs
- Only a small reduction in Lake discharge to Estuaries


Lake Okeechobee & WCA-3A Simulated Stages
BASE
CASE1
3A-BASE
3A-CASE1
3AzoneA
3Aregbot
Stage (ft, NGVD)
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
CASE1(WCA-3A)
BASE(WCA-3A)
3A-Regulation
1-Jan-94
1-May-94
1-Sep-94
1-Jan-95
1-May-95
1-Sep-95
1-Jan-96
Start Date
Duration


LOK Reg Discharge to WCAs
BASE
CASE1
Aug '94 – May '95 1.4 maf
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-94
1-May-94
1-Sep-94
1-Jan-95
1-May-95
1-Sep-95
1-Jan-96
Start Date
Duration


S-77 Regulatory Discharge
BASE
CASE1
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-94
1-May-94
1-Sep-94
1-Jan-95
1-May-95
1-Sep-95
1-Jan-96
Start Date
Duration


S-308 Regulatory Discharge
BASE
CASE1
Discharge (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-94
1-May-94
1-Sep-94
1-Jan-95
1-May-95
1-Sep-95
1-Jan-96
Start Date
Duration

Everglades Construction Project (ECP)
Stormwater Treatment Areas (STAs)
How They Work and Consequences of Overloading

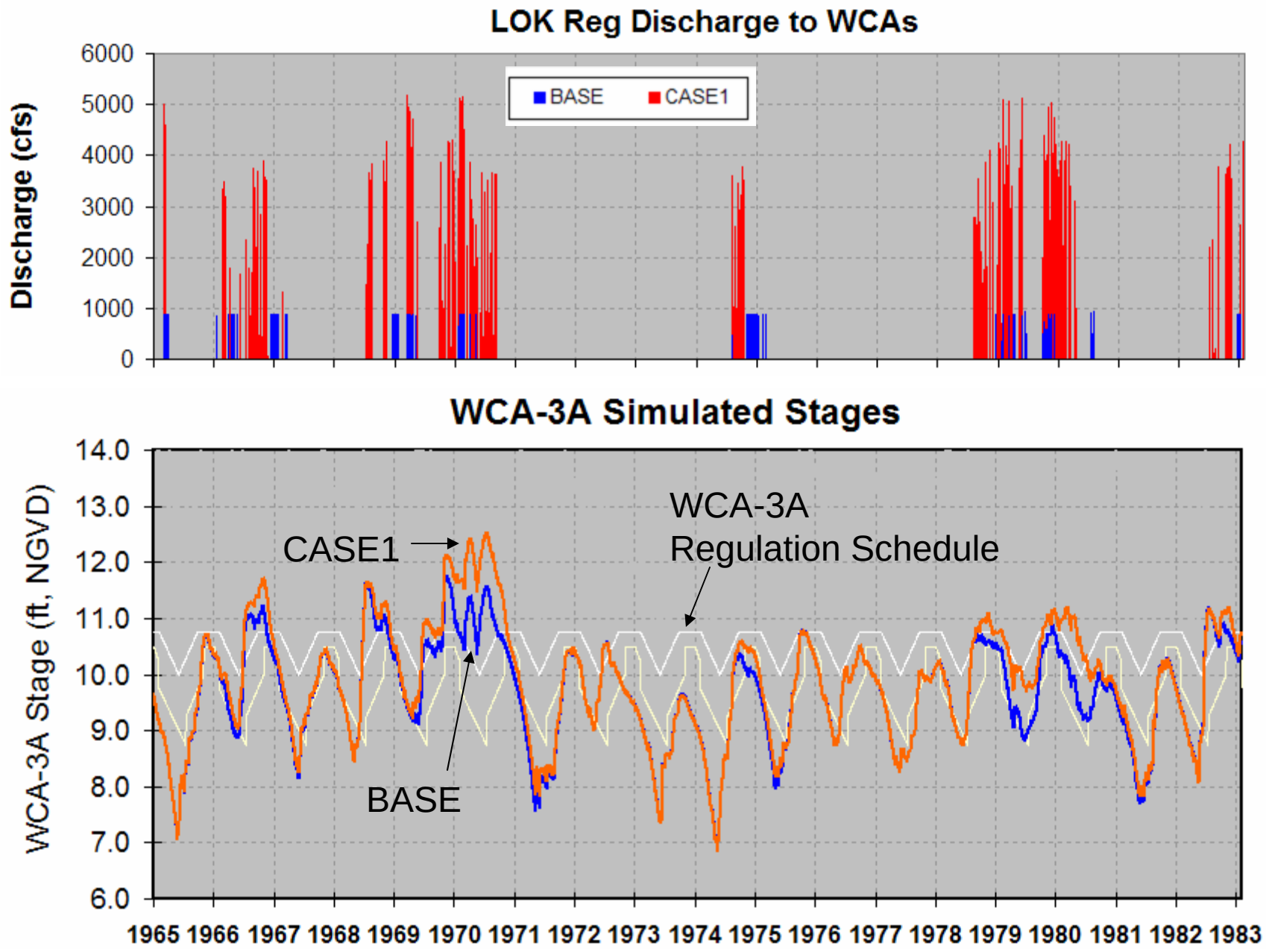
- STA outflow phosphorus concentrations are directly related to the inflow volumes, phosphorus concentrations and associated phosphorus loads.
- STAs have legally mandated performance requirements which are regulated through state and federal permits; STAs which receive more than the allowable phosphorus loading will not meet the permitted outflow concentrations, placing the District in a position of permit non-compliance.
- The primary purpose of the STAs is to treat basin runoff for delivery to the Everglades; an allowance for Lake releases was included. Lake regulatory releases are discretionary STA inflows and therefore should not be sent to the STAs if they will impact the District's ability to treat basin runoff.
- STAs were designed under the assumption that they receive highly variable inflows, including wet season and dry season inflows.
- The dry season is the time for the STAs to "rest" in preparation for the wet season; if we force more water through them in the dry season than they were designed to receive, the inflow loads will increase, and the corresponding outflow concentrations will increase, thereby impacting the District's ability to meet mandated outflow concentrations.
- Excessive overloading will destroy an STA; the soils become overloaded, water clarity is impacted, vegetation die, and the STA is no longer able to treat water (see photos below).
- Rehabilitating STAs costs millions of dollars, and while the STA is off line, there is a high risk that untreated water will be delivered to the Everglades.

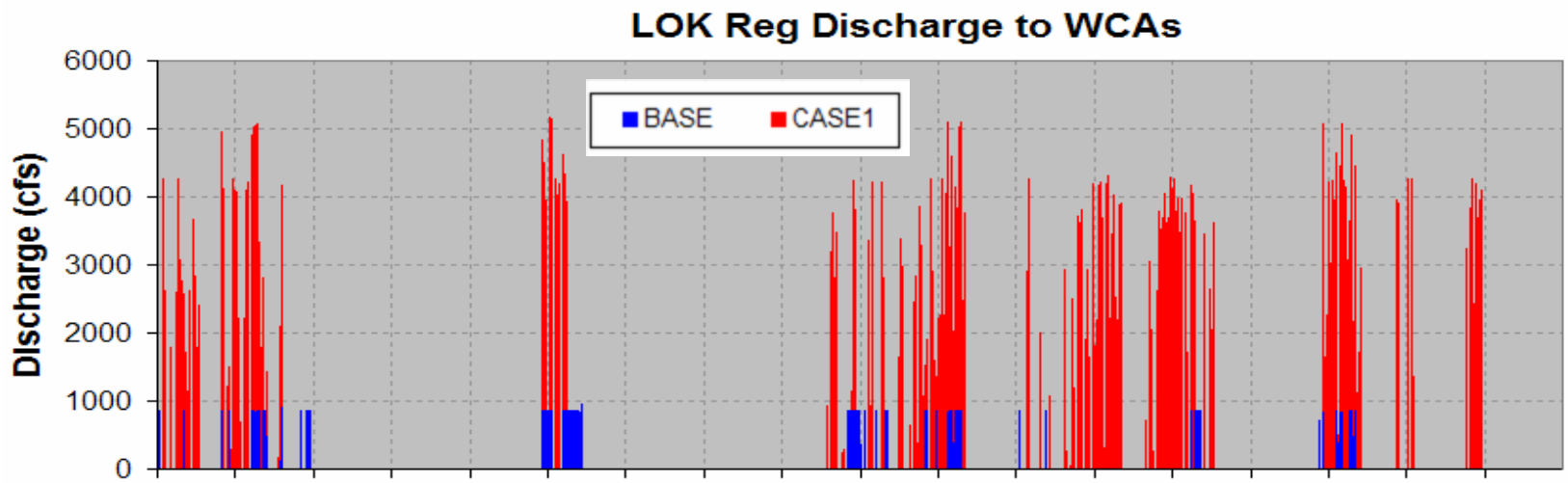
Photos of a failed STA. This condition required a multi-million dollar rehabilitation effort.

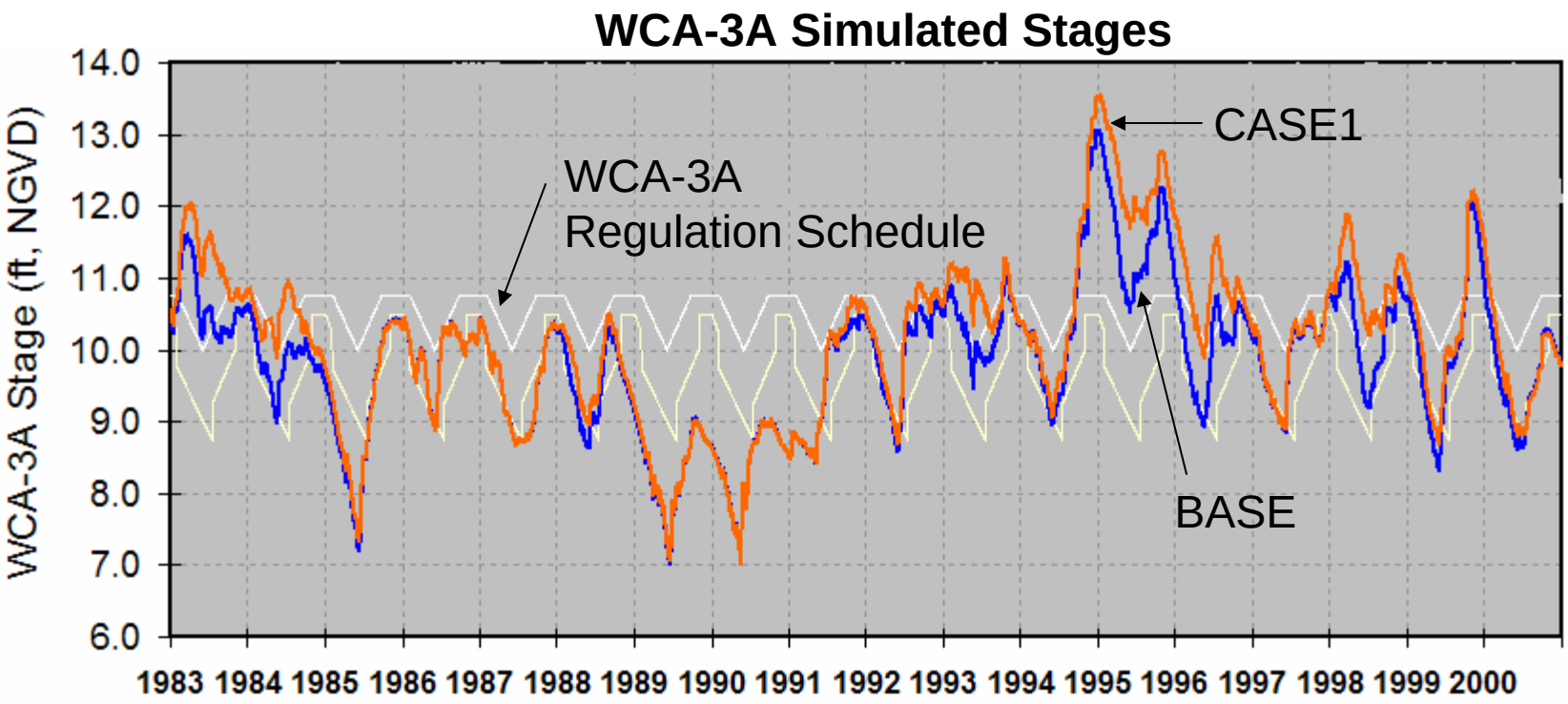
Legal issues pertaining to Everglades water quality (cont)

The Consent Decree…

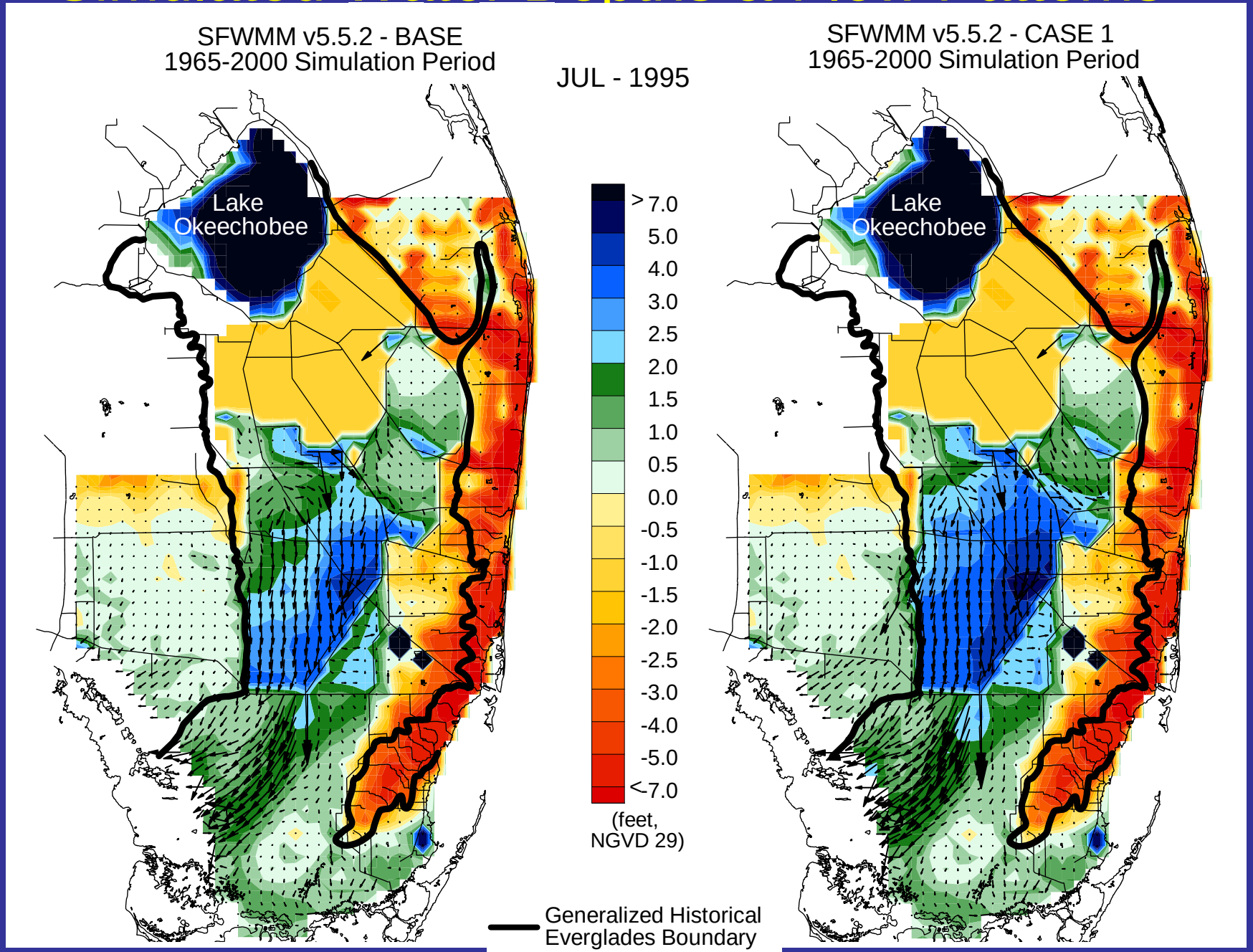
- In 1992, the state of Florida and the United States settled a lawsuit brought by the U.S.A. claiming the state had failed to enforce water quality standards for waters flowing from the EAA to the Everglades.
- Establishes certain phosphorus limits for the Loxahatchee National Wildlife Refuge (Refuge) and Everglades National Park (ENP)
- Contemplates total loading to the Everglades Protection Area (EPA) to be reduced by 80%, and to the Loxahatchee National Wildlife Refuge (WCA-1, aka Refuge) by 85%, as compared to mean levels measured from 1979 to 1988.


LOK Reg Discharge to WCAs
Discharge (cfs)
6000
5000
4000
3000
2000
1000
0
BASE
CASE1
WCA-3A Simulated Stages
WCA-3A Stage (ft, NGVD)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
CASE1
WCA-3A
Regulation Schedule
BASE
1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983


LOK Reg Discharge to WCAs
Discharge (cfs)
6000
5000
4000
3000
2000
1000
0
BASE
CASE1

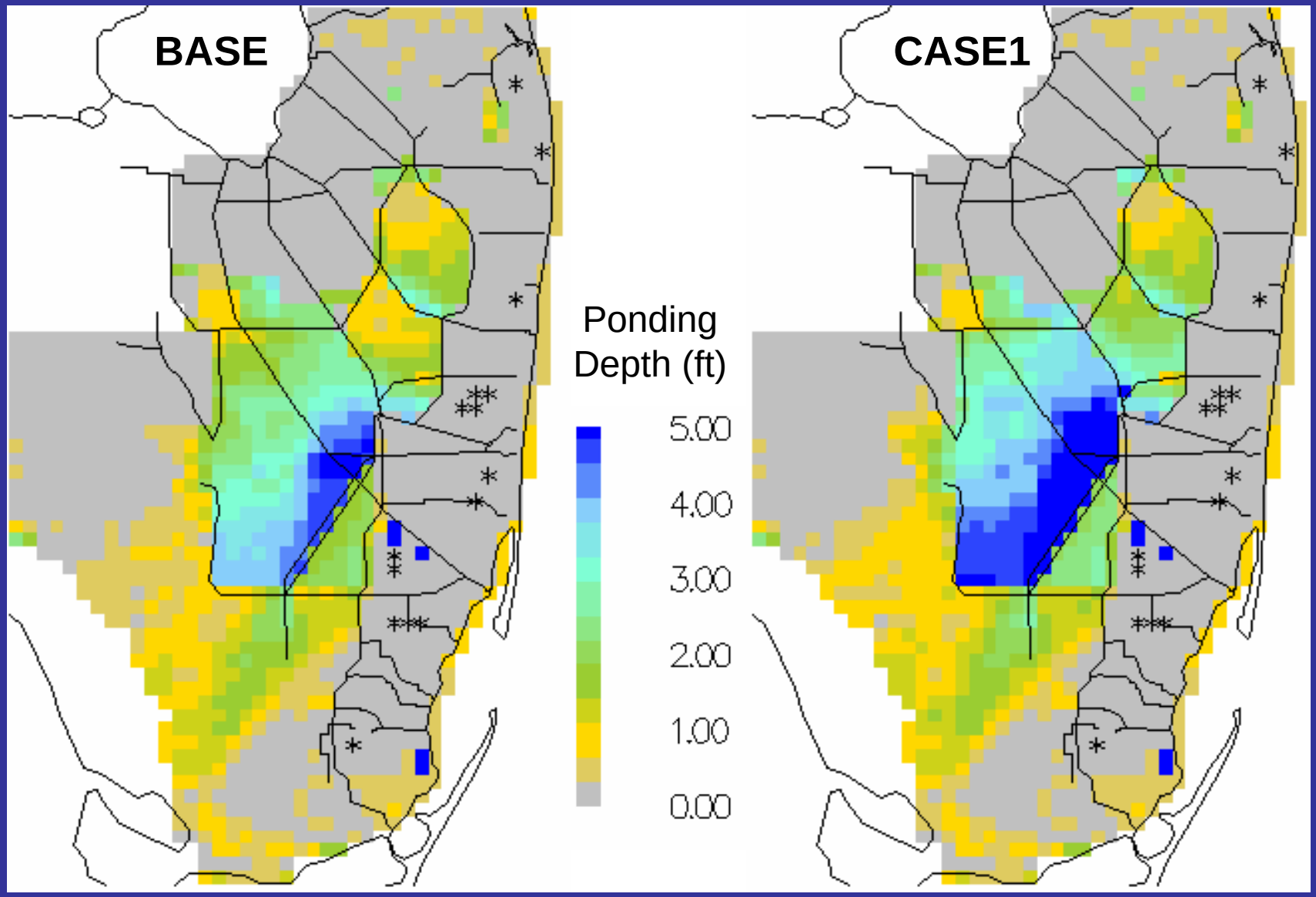

WCA-3A Simulated Stages
WCA-3A Stage (ft, NGVD)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
CASE1
WCA-3A
Regulation Schedule
BASE

Simulated Water Depths & Flow Patterns



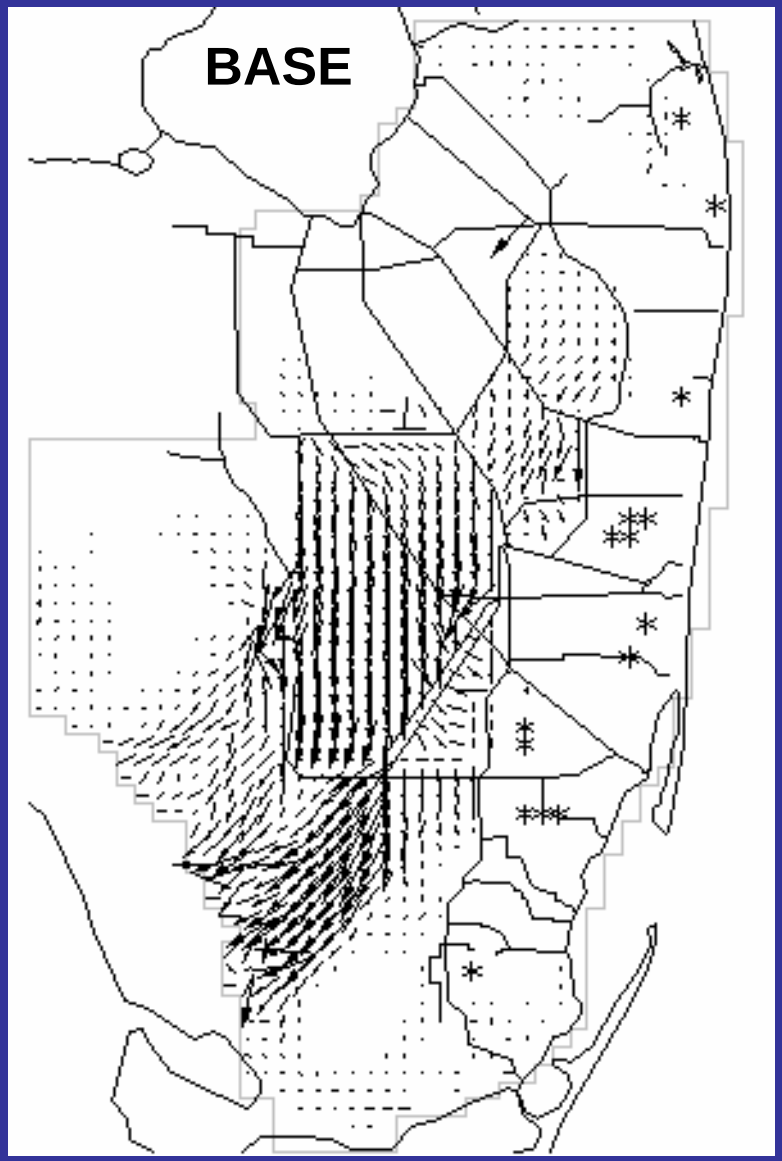
Simulated Surface Water Ponding Depths

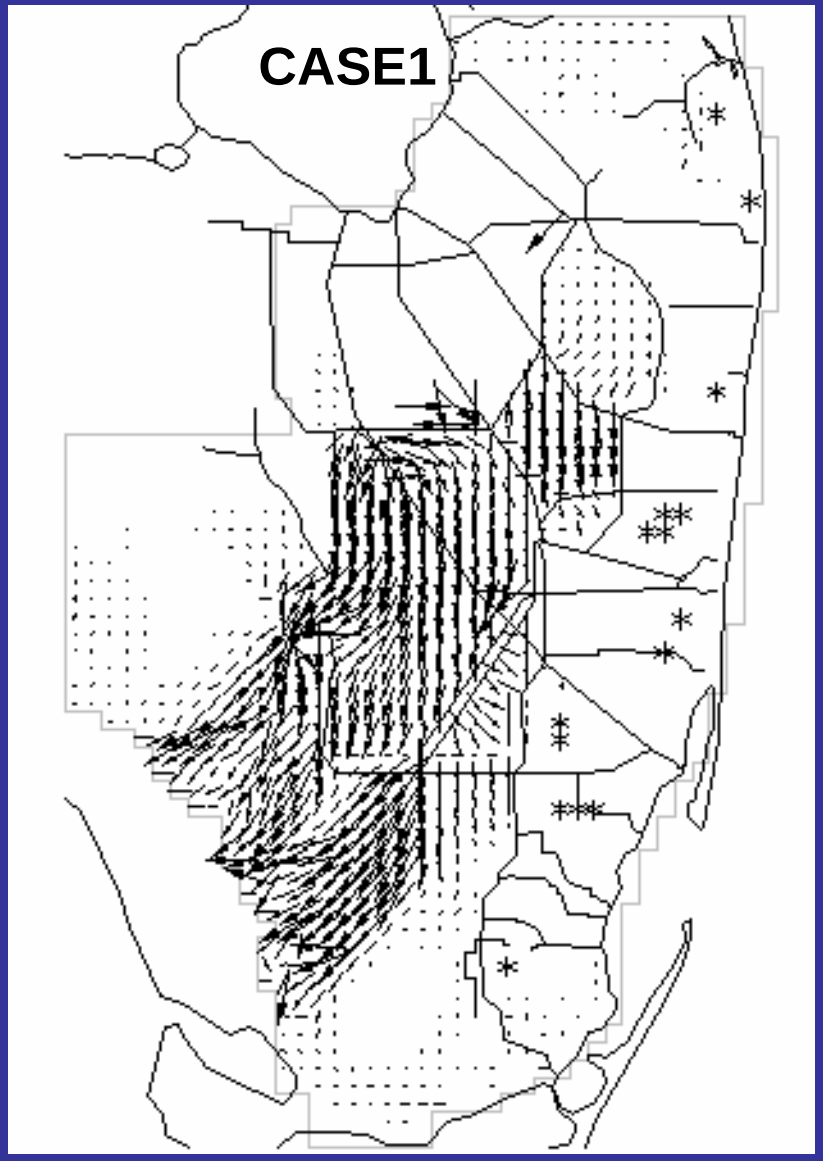
March, 31 1995



Simulated Surface Water Flow Pattern

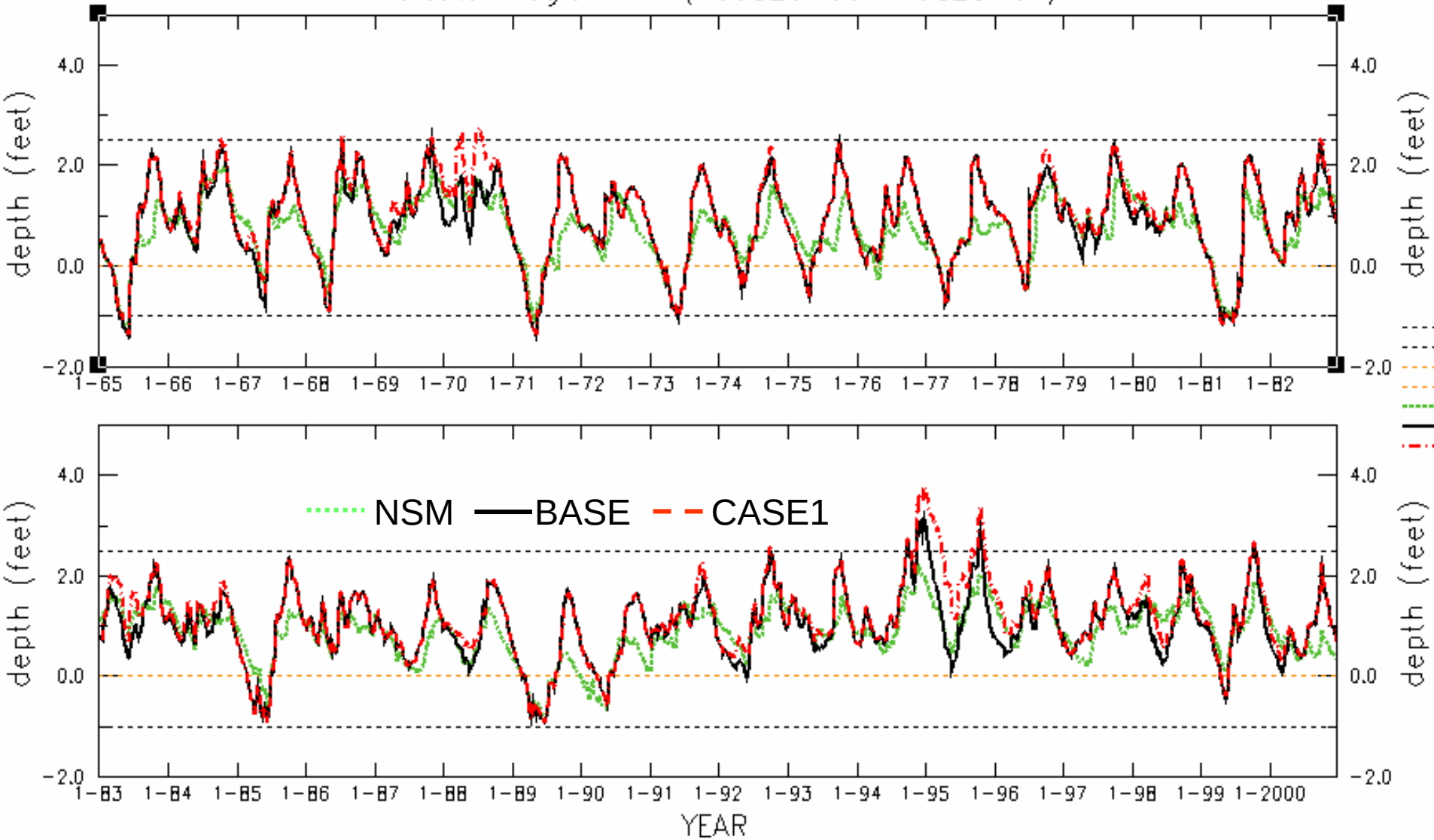
March, 31 1995





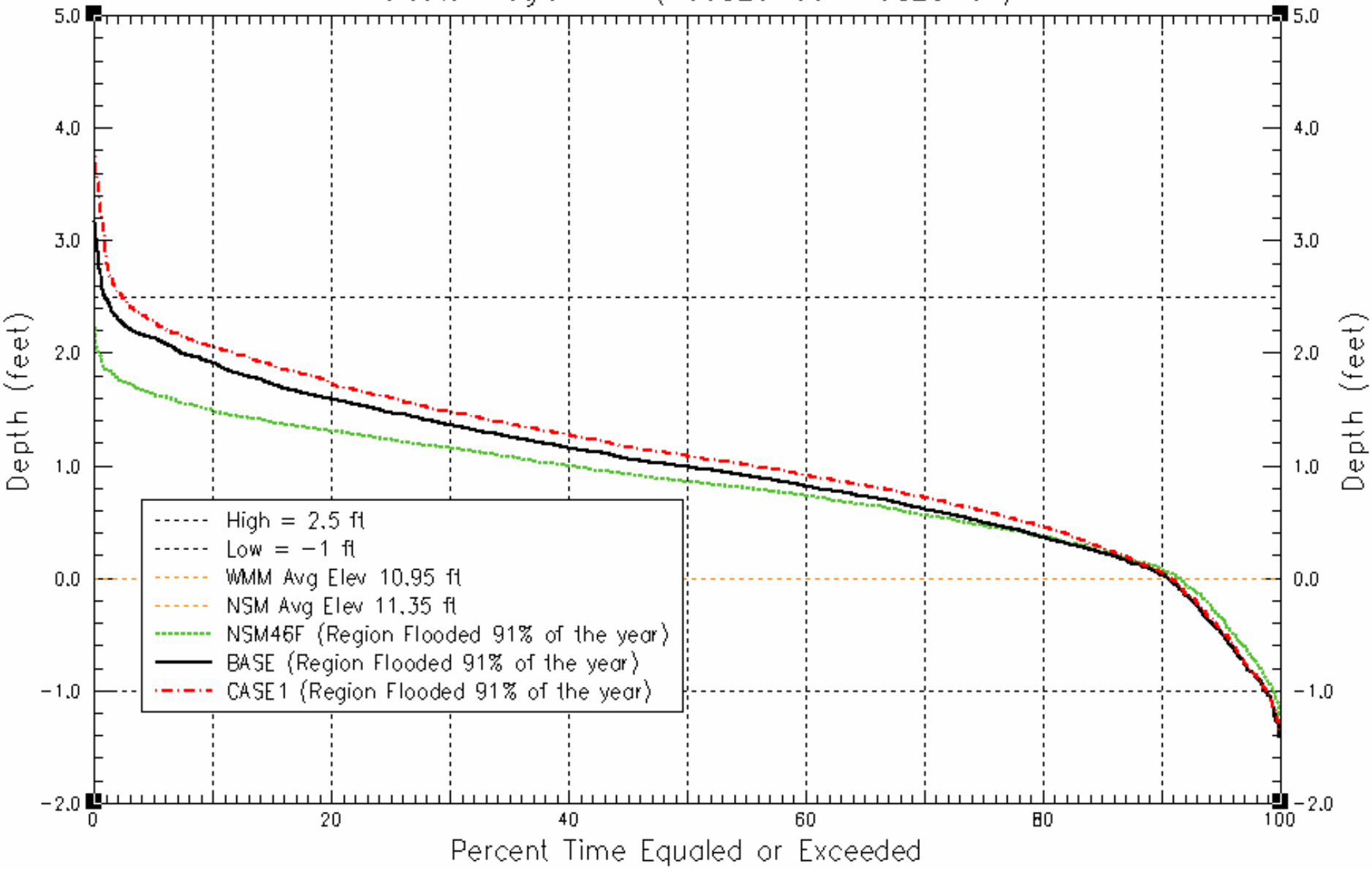
Normalized Weekly Stage Hydrograph for WCA-2A South

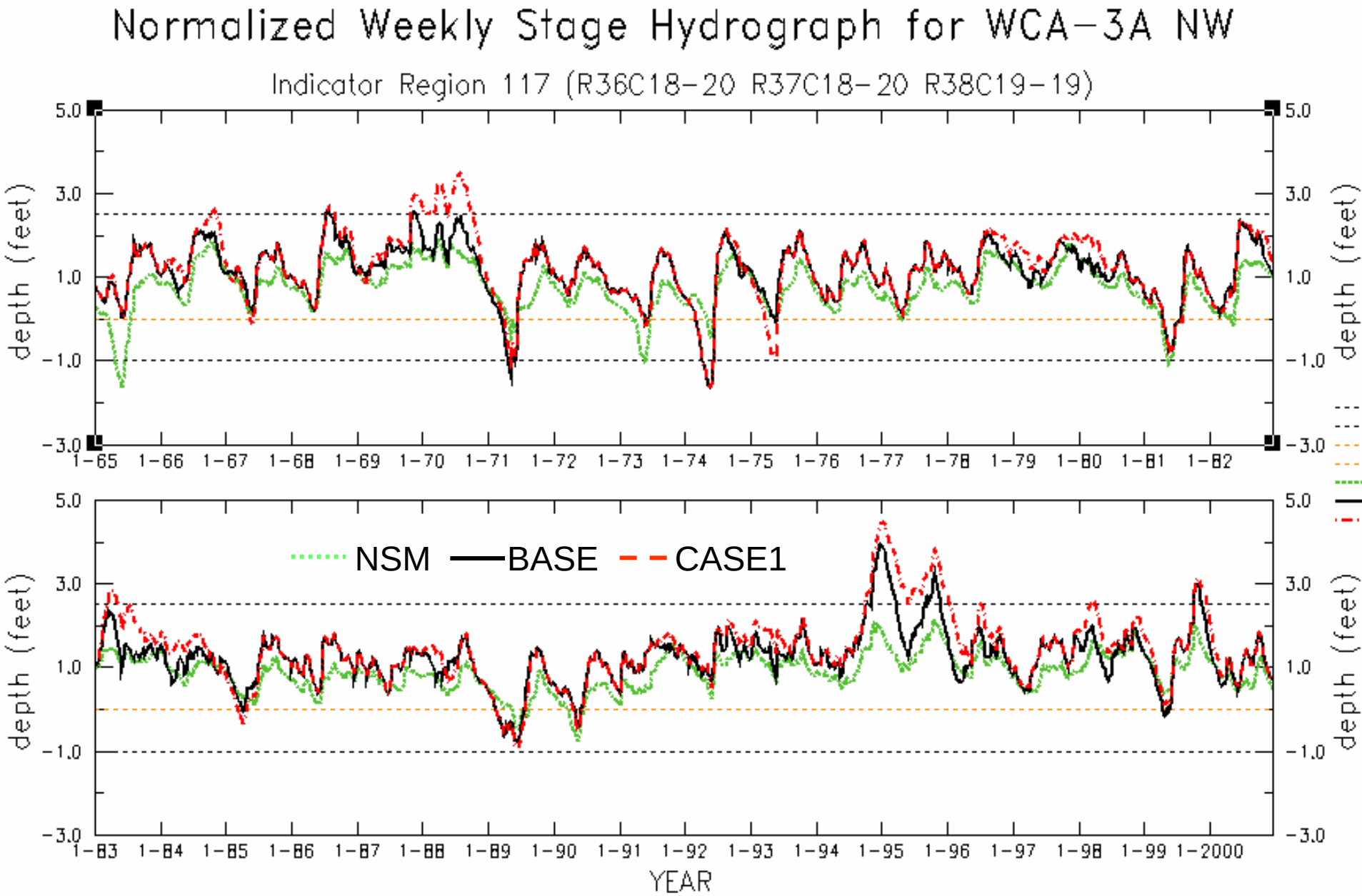
Indicator Region 111 (R39C29-30 R40C28-31)

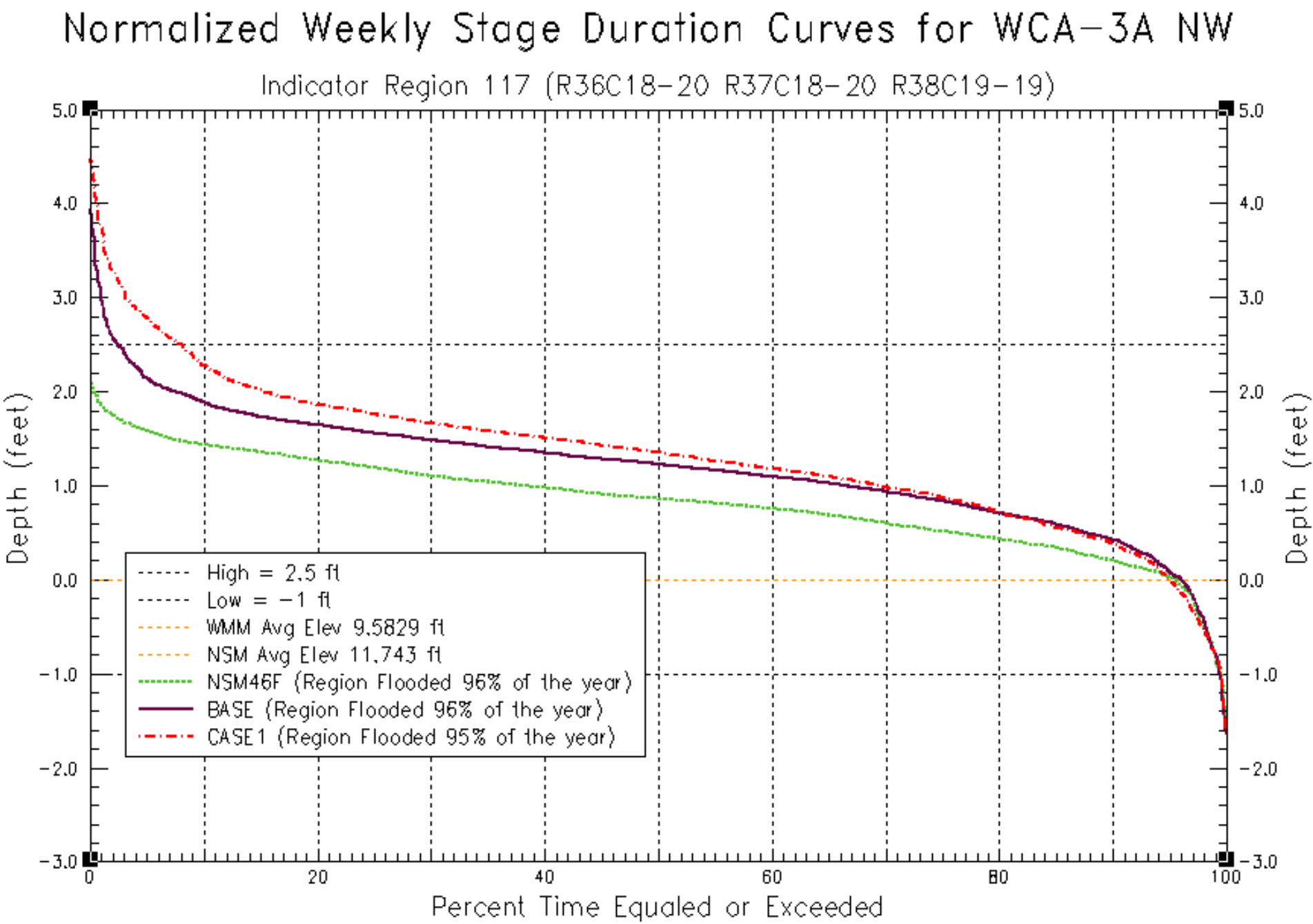


Normalized Weekly Stage Duration Curves for WCA-2A South

Indicator Region 111 (R39C29-30 R40C28-31)

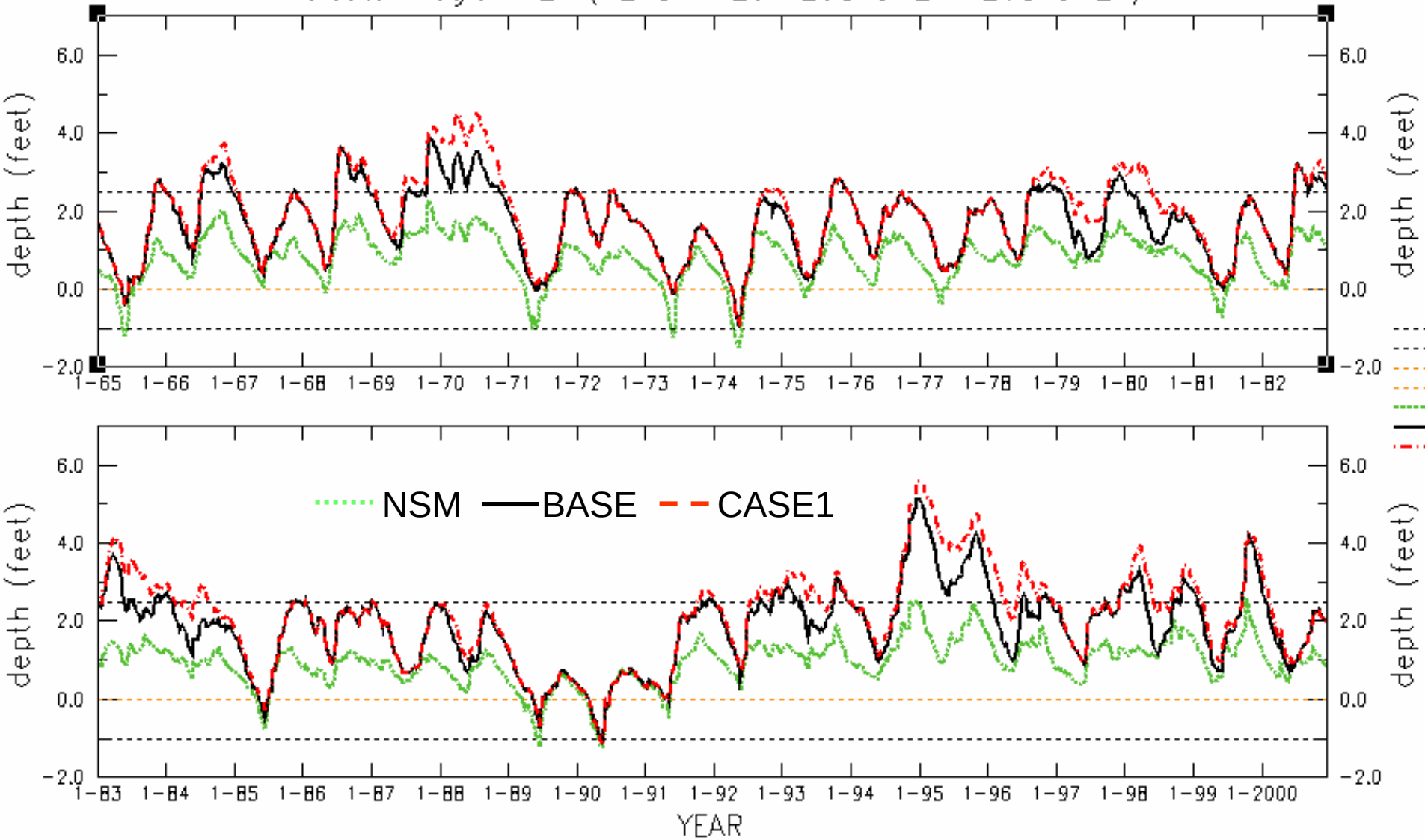



Normalized Weekly Stage Hydrograph for WCA-3A NW
Indicator Region 117 (R36C18-20 R37C18-20 R38C19-19)
depth (feet)
5.0
3.0
1.0
-1.0
-3.0
1-65 1-66 1-67 1-68 1-69 1-70 1-71 1-72 1-73 1-74 1-75 1-76 1-77 1-78 1-79 1-80 1-81 1-82
NSM
BASE
CASE1
1-83 1-84 1-85 1-86 1-87 1-88 1-89 1-90 1-91 1-92 1-93 1-94 1-95 1-96 1-97 1-98 1-99 1-2000
YEAR


Normalized Weekly Stage Duration Curves for WCA-3A NW
Indicator Region 117 (R36C18-20 R37C18-20 R38C19-19)
Depth (feet)
Percent Time Equaled or Exceeded
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
0
20
40
60
80
100
High = 2.5 ft
Low = -1 ft
WMM Avg Elev 9.5829 ft
NSM Avg Elev 11.743 ft
NSM46F (Region Flooded 96% of the year)
BASE (Region Flooded 96% of the year)
CASE1 (Region Flooded 95% of the year)

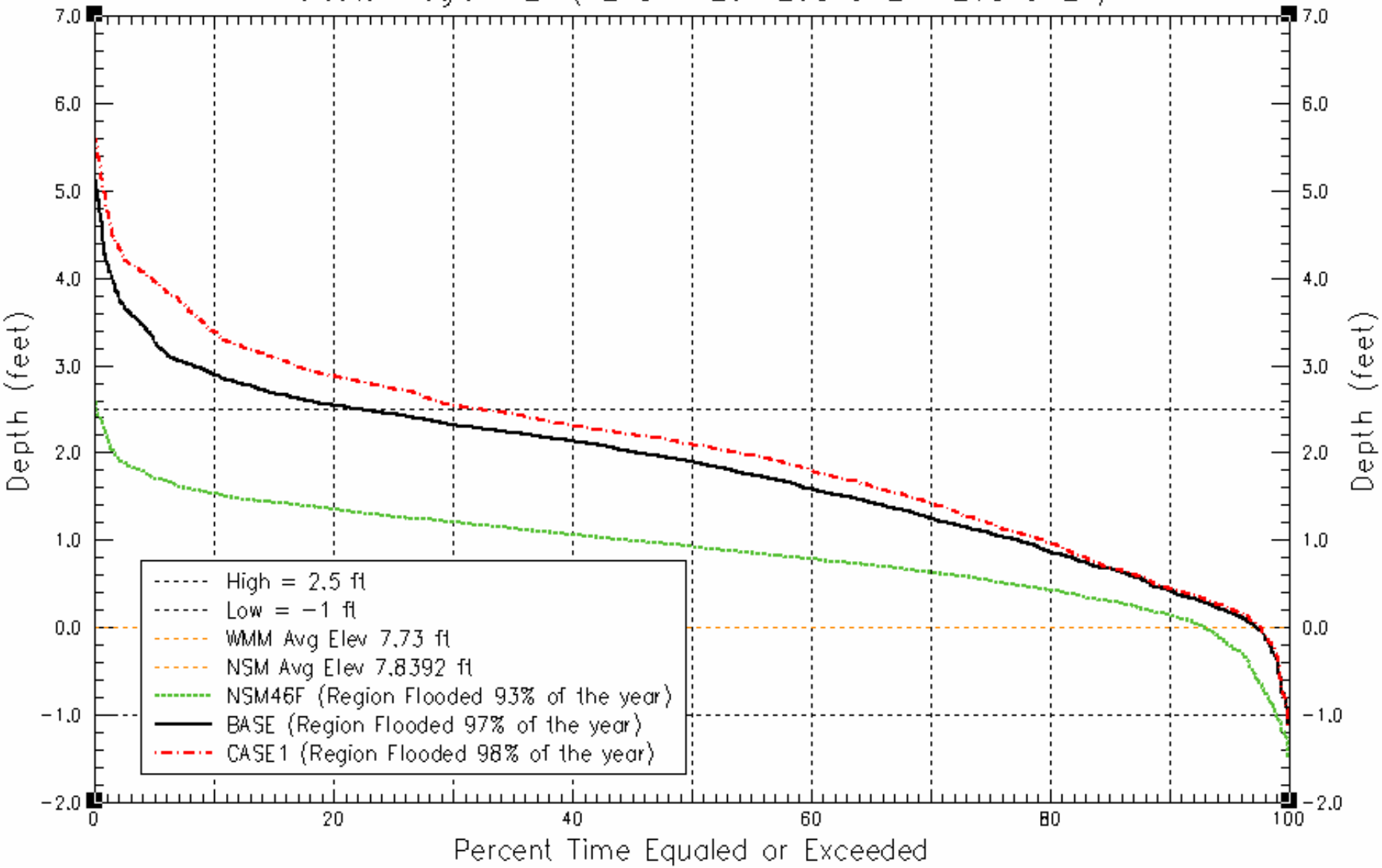
Normalized Weekly Stage Hydrograph for WCA-3A South

Indicator Region 124 (R24C17-20 R25C18-21 R26C18-21)



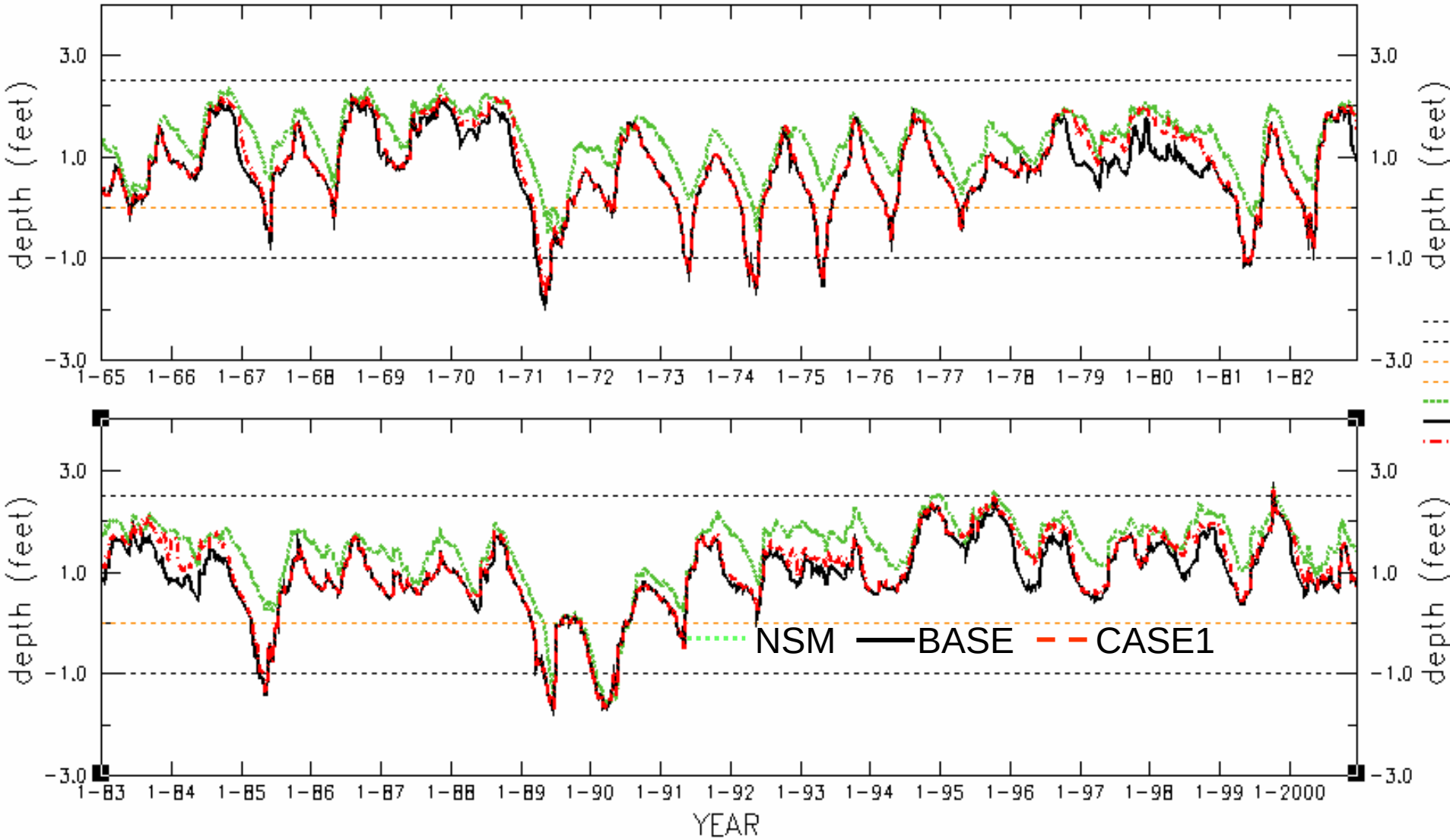
Normalized Weekly Stage Duration Curves for WCA-3A South

Indicator Region 124 (R24C17-20 R25C18-21 R26C18-21)



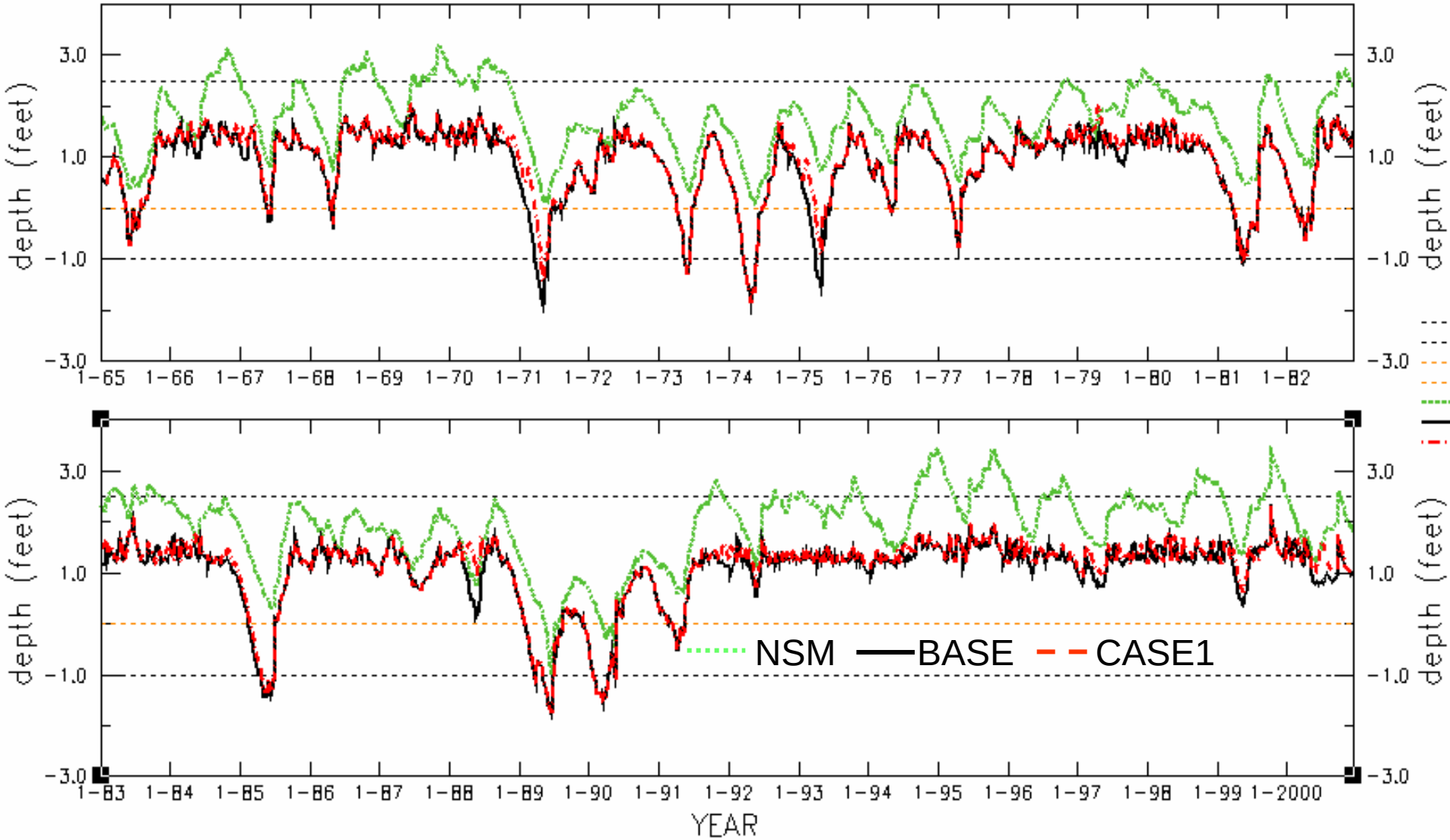
Normalized Weekly Stage Hydrograph for Mid Shark Slough

Indicator Region 130 (R16C18-19 R17C18-20 R18C19-20)



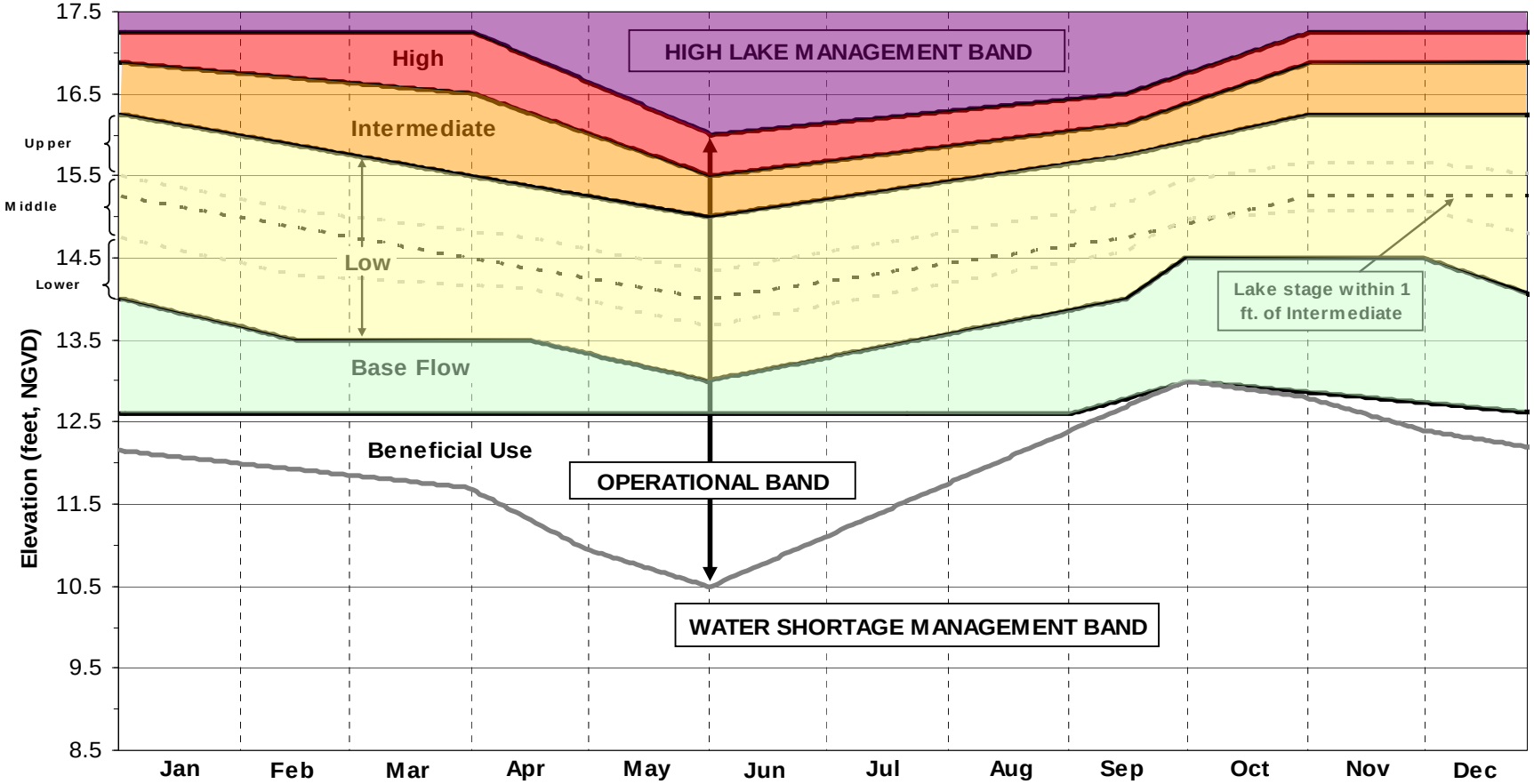
Normalized Weekly Stage Hydrograph for NE Shark Slough

Indicator Region 129 (R19C22-23 R20C22-26 R21C22-26)



Questions?

2008 Interim Lake Okeechobee Regulation Schedule (2008 LORS)



NOTES:

High Lake Management Band: Outlet canals may be maintained above their optimum water management elevations.

Operational Band: Outlet canals should be maintained within their optimum water management elevations.

Water Shortage Management Band: Outlet canals may be maintained below optimum water management elevations.

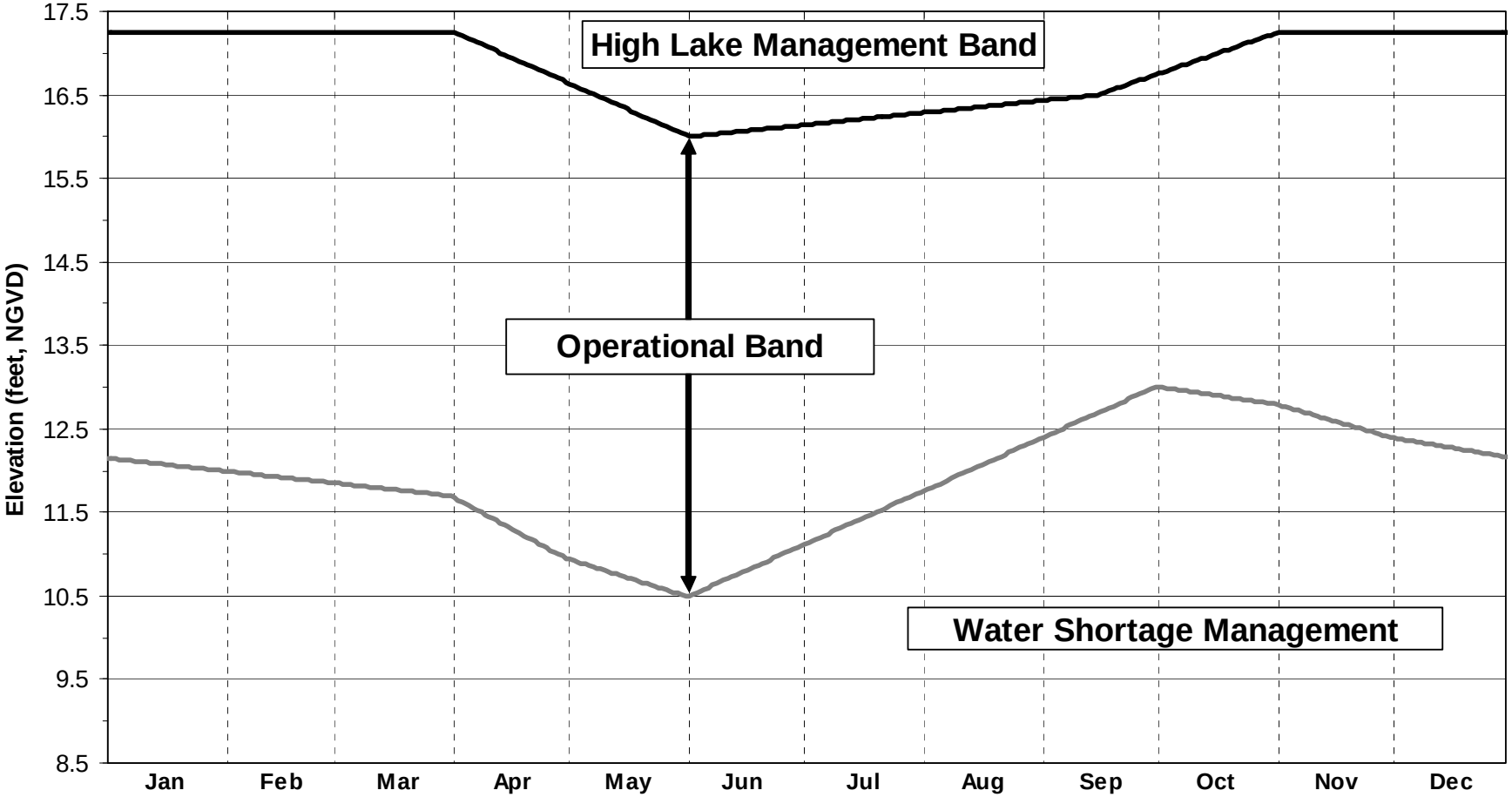
CENTRAL AND SOUTHERN FLORIDA PROJECT

2008 LAKE OKEECHOBEE
INTERIM REGULATION SCHEDULE

PART B

DATED: March 2008
DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA

Figure 7-2



NOTES:

High Lake Management Band: Outlet canals may be maintained above their optimum water management elevations.
Operational Band: Outlet canals should be maintained within their optimum water management elevations.
Water Shortage Management Band: Outlet canals may be maintained below optimum water management elevations.

CENTRAL AND SOUTHERN FLORIDA PROJECT

2008 LAKE OKEECHOBEE INTERIM REGULATION SCHEDULE

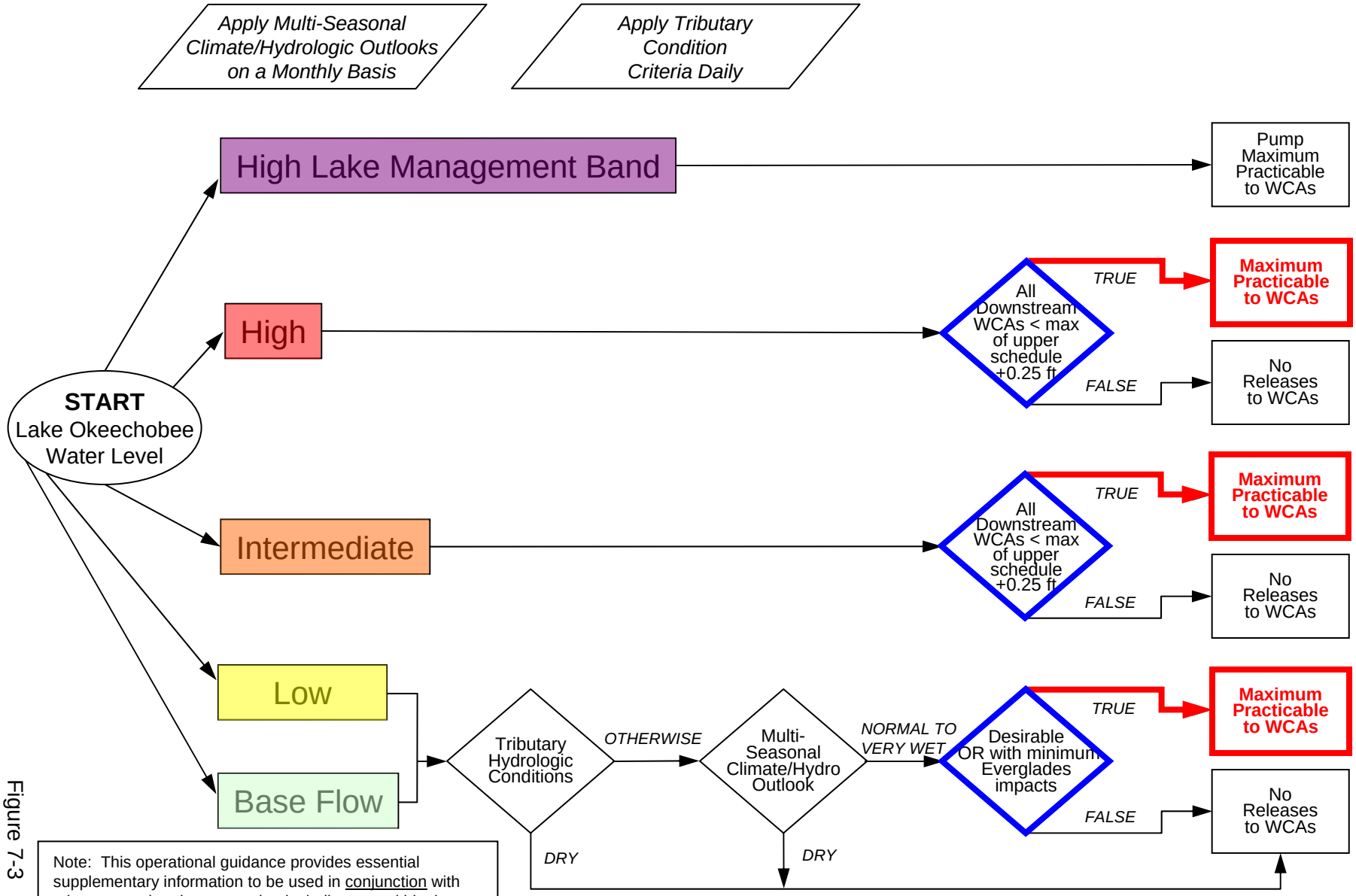
PART A

DATED: March 2008
DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA

Figure 7-1

2008 LORS

Part C: Establish Allowable Lake Okeechobee Releases to the Water Conservation Areas



Note: This operational guidance provides essential supplementary information to be used in conjunction with other supporting documentation including text within the Water Control Plan.

Figure 7-3

2008 LORS

Part D: Establish Allowable Lake Okeechobee Releases to Tide (Estuaries)

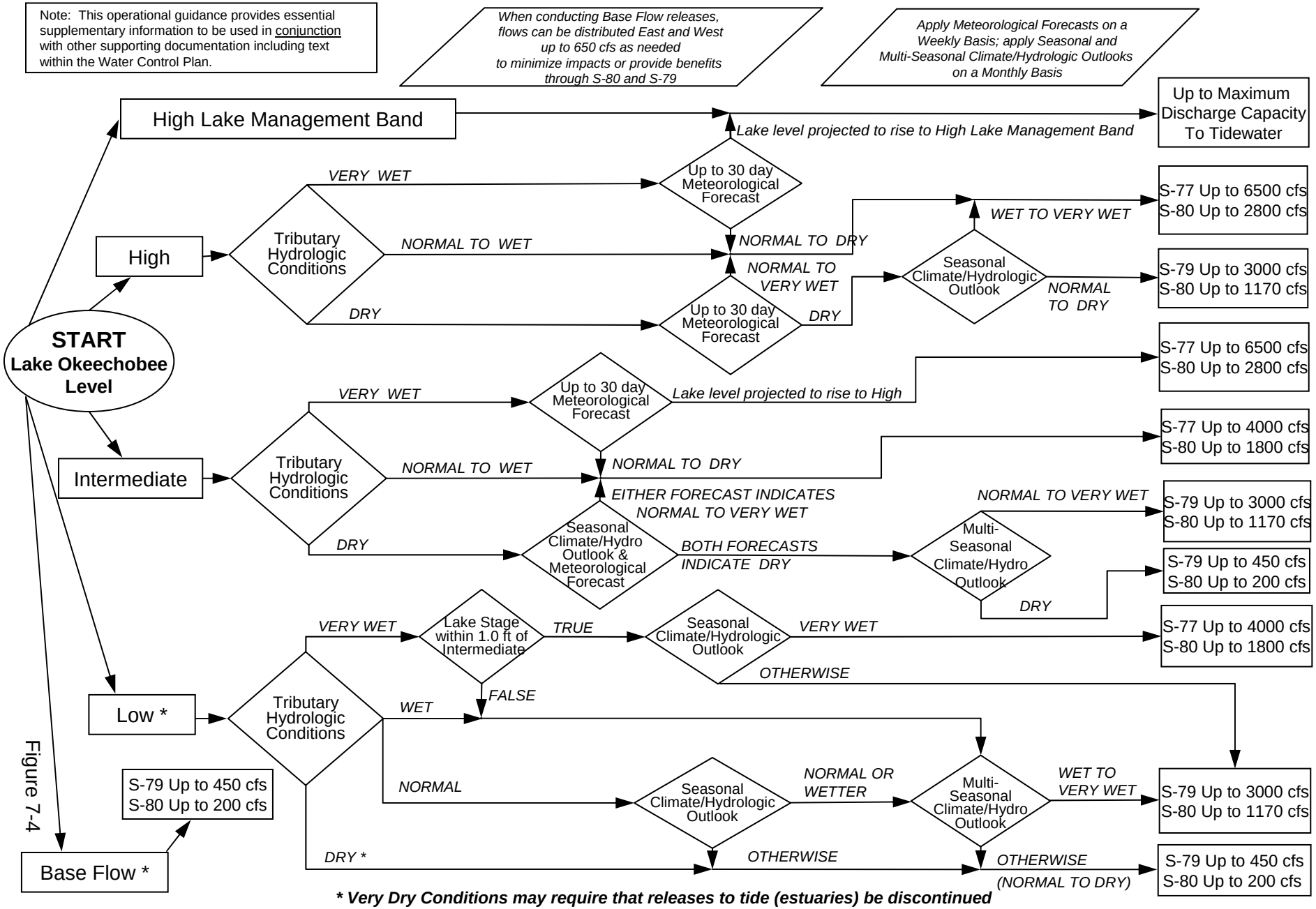


Figure 7-4

Other misc info

- S12s have limited capacity
  - 1994-5 max Q was ~7500cfs w/all gates full open, <25% of the design capacity of 32,000cfs. Downstream resistance to flow causes high tailwater & limits flow.

- Tamiami Trail L-29 canal constraint (7.5’)
  - TSP for CSOP 8.0’. To go 8-8.5 cost $21M.

Legal issues pertaining to violating the Caloosahatchee MFL

- Caloosahatchee River has experienced MFL violations & is in recovery
  - Lack of regional storage
- Lake Okeechobee is projected to experience MFL violations
  - New Lake regulation schedule
- MFL recovery strategy adopted in regional water supply plans
  - CERP / A8 Projects
  - New Lake Regulation schedules & interim actions
- Implications of altering Caloosahatchee Deliveries & Lake Okeechobee levels
  - Potential increased MFL violations
    - Need for modified recovery strategies (CERP / A8 implications)
  - Existing legal user interference
    - Public water supply, energy plant, irrigation, & agriculture
    - Currently below standard level of certainty (1 in 10)

Legal issues pertaining to Everglades water quality (cont)

Skip. Already touched on these w/STA slides

- Substantially increased flows, combined with STA overloading, would likely cause exceedences of phosphorus limits and loads.
- Overloading the STAs would likely result in discharges above 50 ppb and a violation of the Total Phosphorus (TP) limits.
- If the Consent Decree phosphorus limits to either the Refuge or to ENP are exceeded, the District would be required to implement additional remedial measures to meet them.

csss_popA_discont_hydrop.fig

File Data Plot Options Help

G0: X, Y = [0.738577, 481.949]

This is complicated for the LO Committee.
Any way to summarize via a bullet or a different graphic?

Draw

AutoT

AutoO

ZX ZY

AX AY

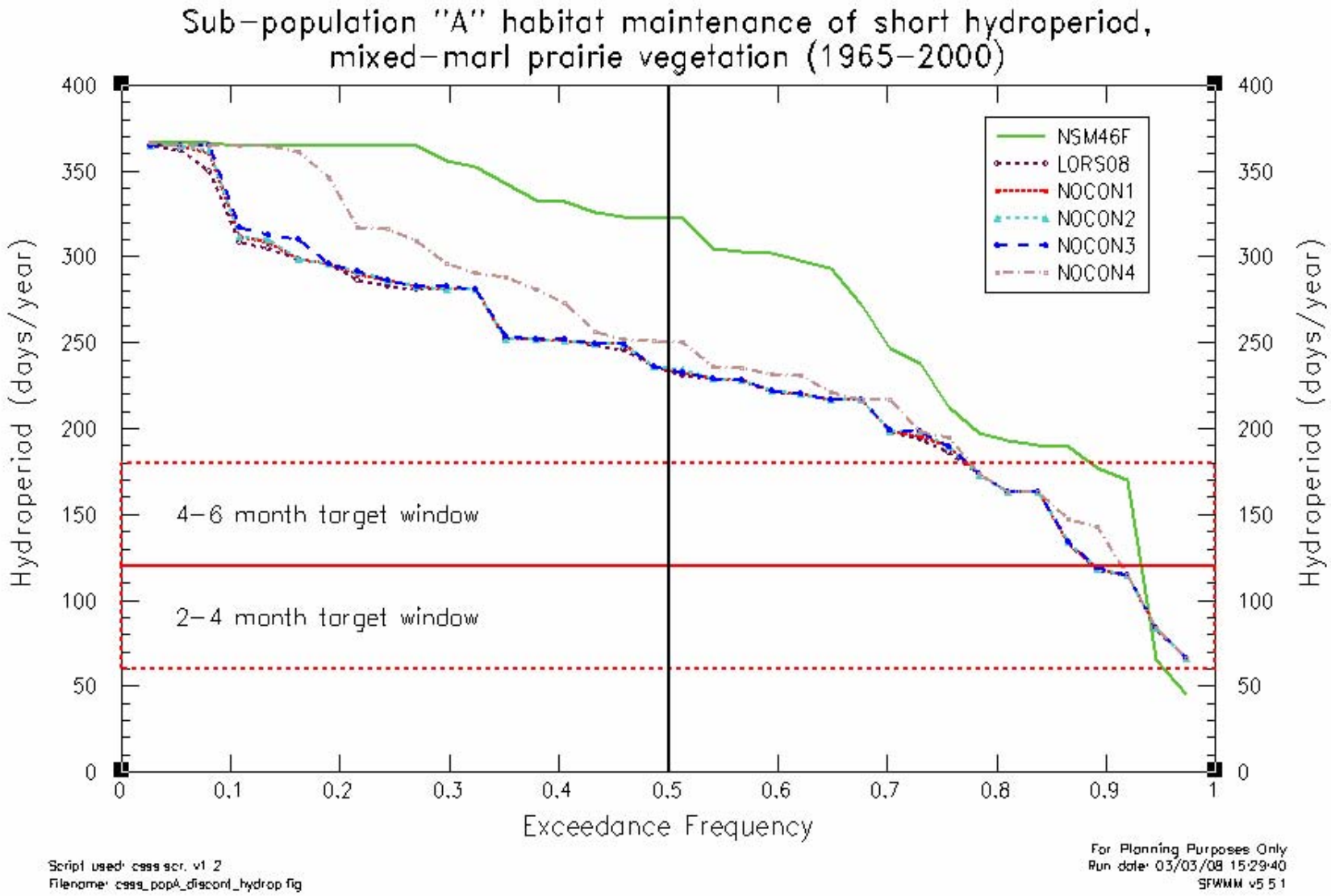
PZ Pu

Po Cy

SD:1

CW:0

Exit



flood, localhost:16.0, Tue Mar 18 14:36:15 2008, csss_popA_discont_hydrop.fig

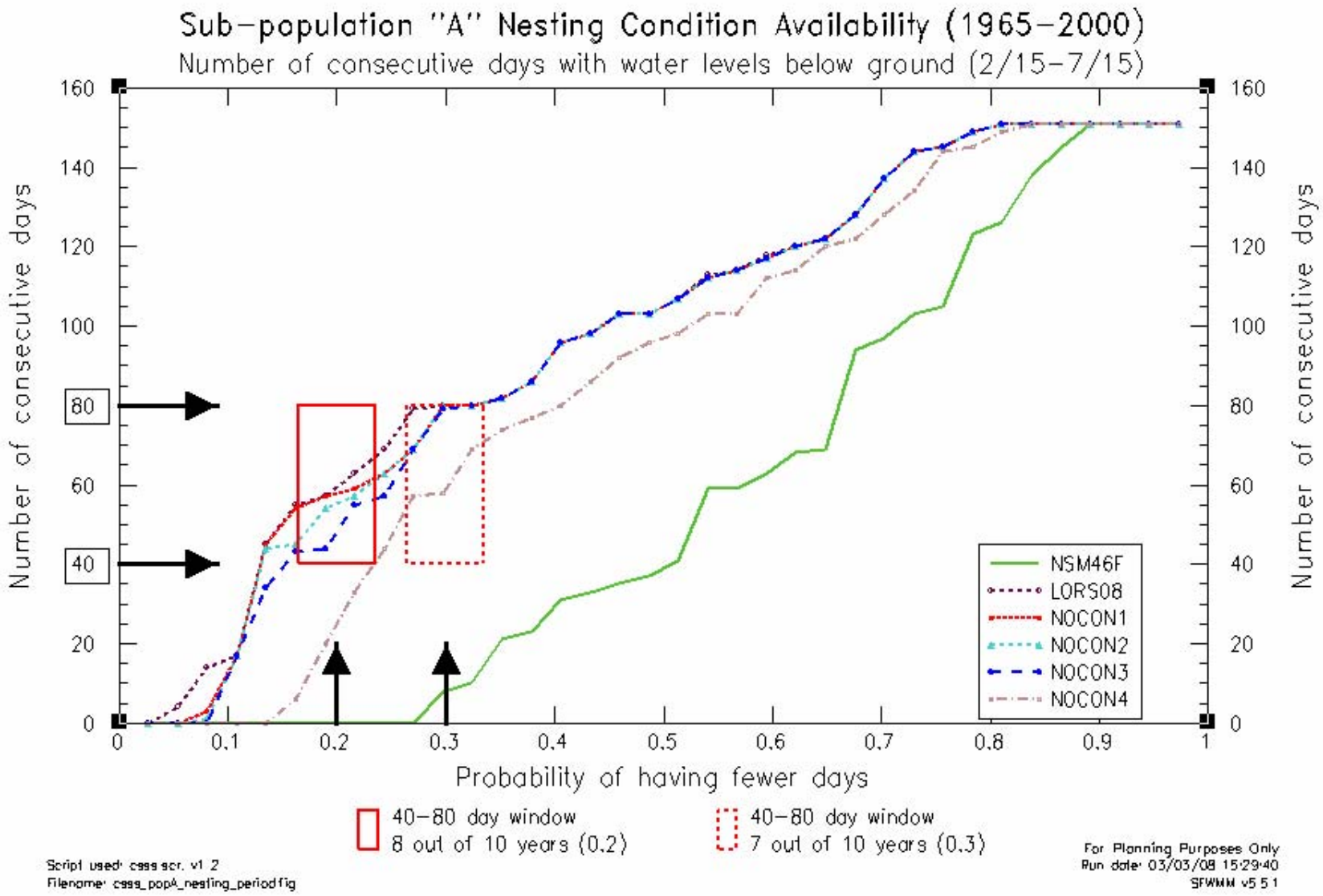
csss_popA_nesting_period.fig

File Data Plot Options Help

G0: X, Y = [0.615674, 167.32]

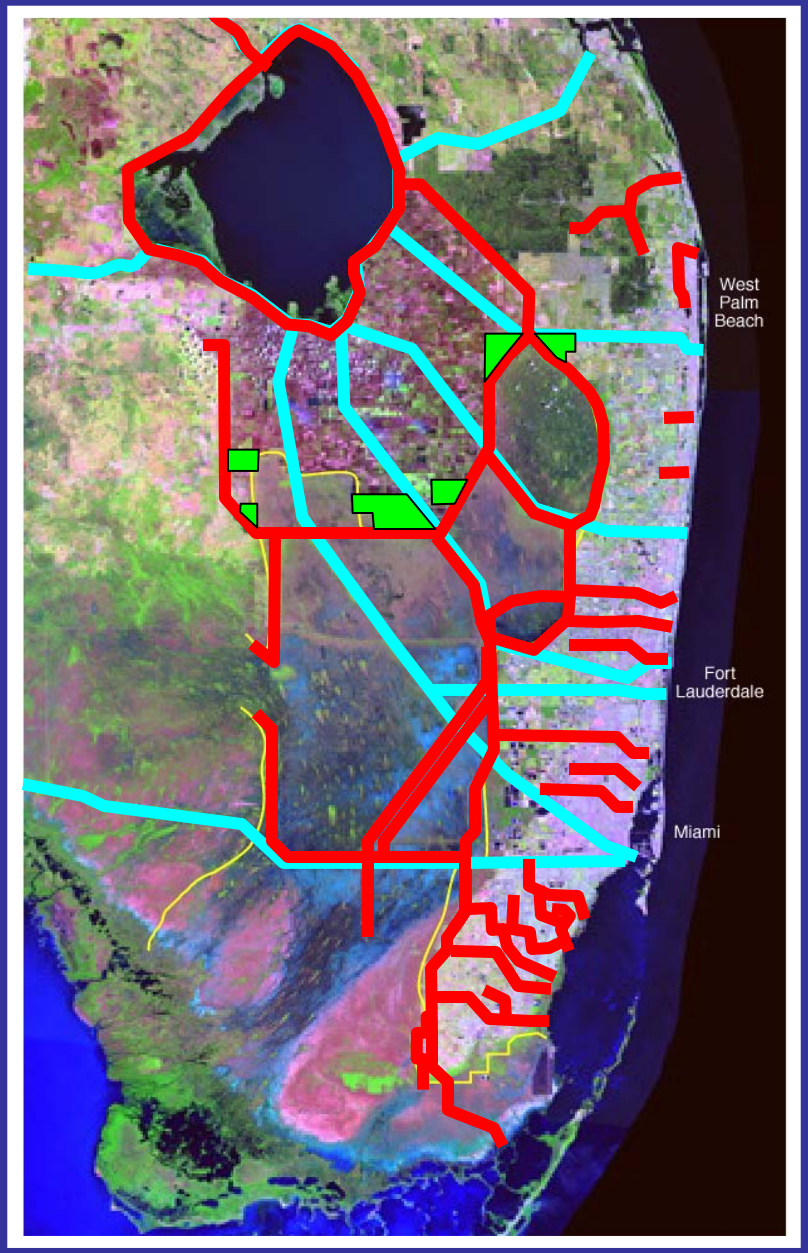
This is complicated for the LO Committee.
Any way to summarize via a bullet or a different graphic?

Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit



flood, localhost:16.0, Tue Mar 18 14:37:55 2008, csss_popA_nesting_period.fig

Chronology of Water Management Changes



Managed System (2003)

Pre-Central & South Florida Projects

- Caloosahatchee/Kissimmee Rivers 1881-93
- East Coast Canals/St. Lucie Canal 1905-24
- Tamiami Trail – 1915-28
- Lake Okeechobee HH Dike – 1932-38

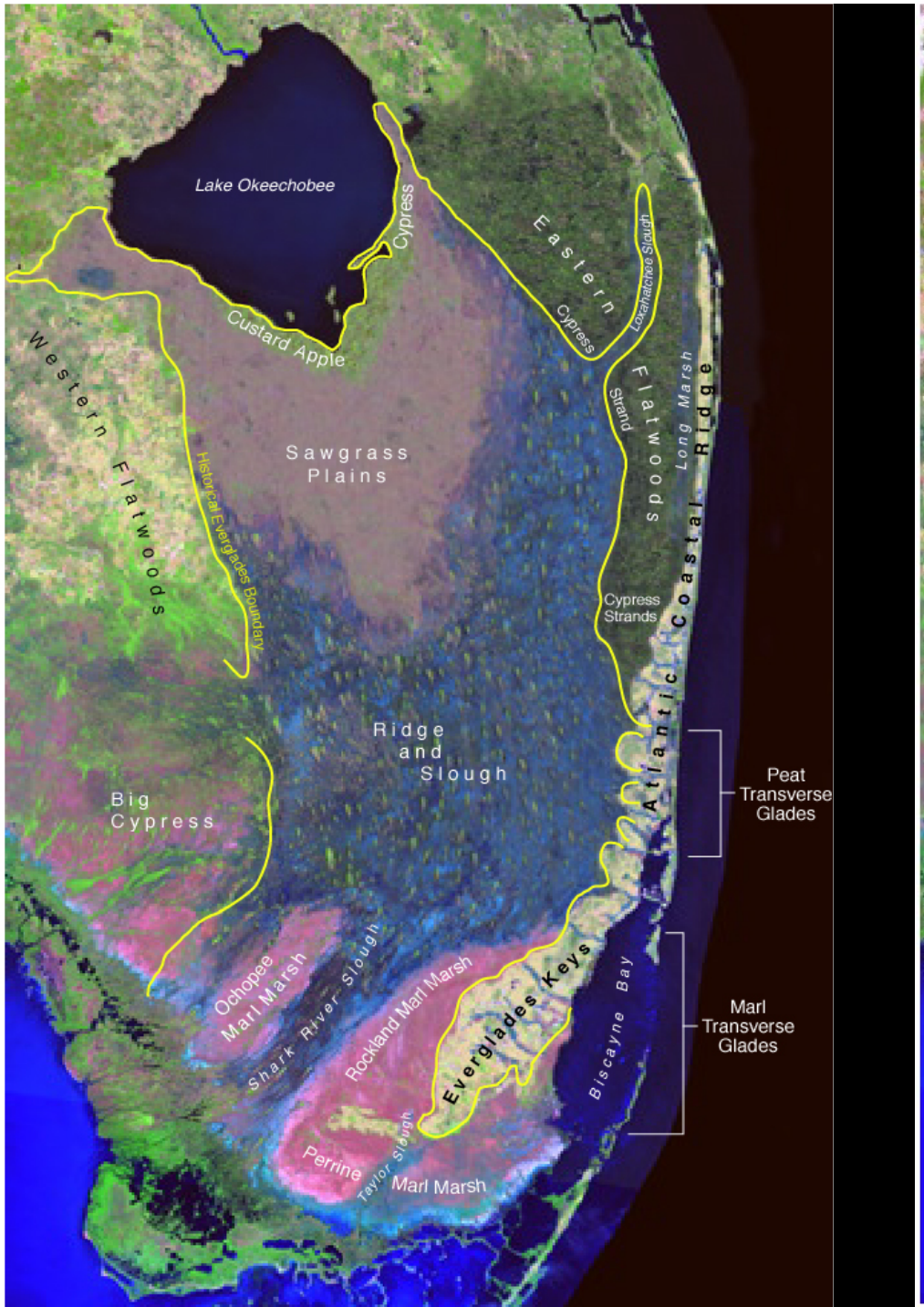
Central & Southern Florida Project

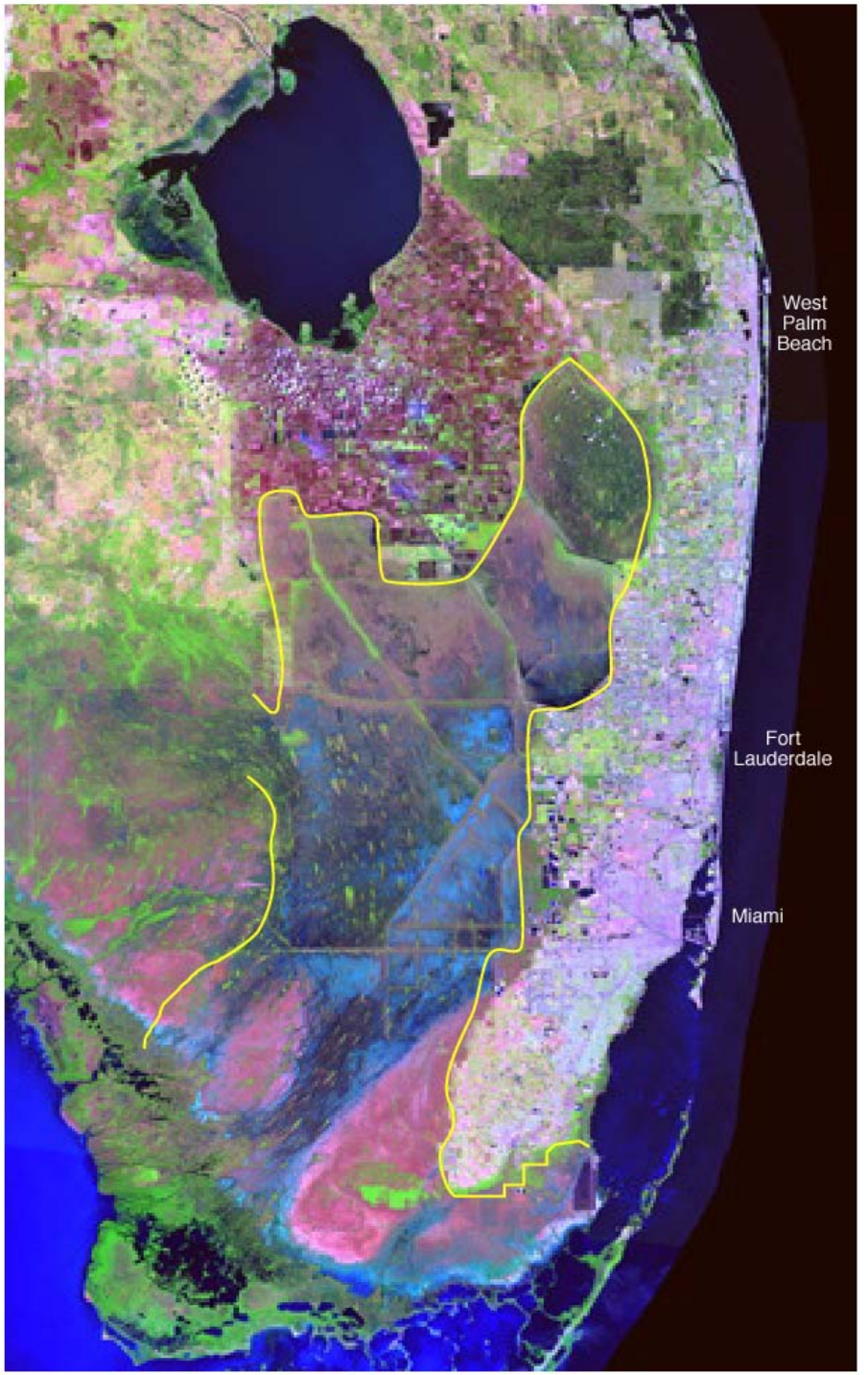
- Eastern Protective Levee System – 1952-54
- Everglades Agricultural Area – 1954-59
- Water Conservation Area Levees – 1960-63
- Lower East Coast Canals – 1954-65
- Lake Okeechobee Levees – 1960-64
- Kissimmee River Channelization – 1962-71
- South Dade System – 1965-83

Everglades Construction Project

- Stormwater Treatment Areas – 1994-2003

Source: Light and Dineen, 1994; SFWMD & USACE, 2008


Lake Okeechobee
Cypress
Custard Apple
Eastern
Cypress
Loxahatchee Slough
Western Flatwoods
Sawgrass Plains
Historical Everglades Boundary
Strand
Flatwoods
Long Marsh
Coastal Ridge
Cypress Strands
Ridge and Slough
Atlantic
Peat Transverse Glades
Big Cypress
Ochopee Marl Marsh
Shark River Slough
Rockland Marl Marsh
Everglades Keys
Biscayne Bay
Marl Transverse Glades
Perrine
Taylor Slough
Marl Marsh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Fort Lauderdale
Miami