APPENDIX F

Incorporation of a Periodic Managed Recession Lake Okeechobee, Florida

Prepared by the
South Florida Water Management District

June 2007

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Incorporation of Periodic Managed Recessions into the TSP

Background

The hurricanes of 2004 and 2005 devastated the submerged aquatic vegetation (SAV) community in Lake Okeechobee, significantly degrading the lake's health. SAV stabilizes the fine, nutrient-laden sediments; reduces phosphorus concentrations in the water; increases water column oxygenation; and provides habitat for fish and other aquatic organisms. Experience gained from the managed recession (MR) and drought of 2000-2001 and the low summer lake stages of 2006 as well as reports in the scientific literature suggest that managed recessions have the potential to stimulate regrowth of SAV if a viable seed bank and suitable water quality exist. Re-growth of SAV typically improves overall lake health. This potential for improvement has produced requests to have the LORS DEIS acknowledge the future potential need for infrequent periodic managed recessions to preserve this critical component of the lake ecosystem and have them included in the new lake regulation schedule

The LORSS TSP will significantly reduce the sustained high water conditions that lead to the need for a managed recession. Nevertheless, conditions may arise where this action is considered necessary, so authorizing its use in this EIS is important. It is important to recognize, as was apparent when the first managed recession was implemented in 2000, that forecasting future climate conditions is not possible. Therefore, unless the lake's SAV community has been excessively damaged by hurricanes or other exceptional conditions that require immediate action, no managed recession will be attempted unless the stage/time window of 12 weeks below a stage of 12 feet during the SAV growing season has not occurred during the preceding four years. In addition, due to concerns about apple snails in the interior marsh, and consequent effects on the snail kite, no more than a single 2 consecutive year recession in any 8 year period (thus no more than 1 recession occurring during the anticipated life of this schedule revision).

The decision to implement a managed recession will be contingent on several factors, including climatic conditions and lake health. These factors will include determining:

- Whether a viable seed bank is present.
- The chance of reaching the stage target of 12' by April 15 for a minimum of 12 weeks.
- Whether attempting to reach the stage target will adversely affect other ecosystems.
- Potential impacts to the Herbert Hoover Dike from low lake stages.
- Once committed to a managed recession, what lake stage thresholds would be cause for abandoning the attempt
- Changes in average salinity regimes due to lake discharges to the downstream estuaries;

- Increased phosphorus loading from lake discharges to the STAs and the Everglades; and
- The risk of reduced water supply for agricultural, utilities, and the natural environment if conditions following the recession became drier than expected (Steinman et al. 2002).

Conditions

- If by early November of any year, it is determined that the conditions are favorable to implement a managed recession, then an analysis similar to the preliminary analysis contained in this report will be conducted to determine the range of possible impacts.
- A Position Analysis (PA), defined below, will be the basis of the proposed operations to determine the chance of meeting the recession target of 12 feet by April 15th of the following year. The 12' for 12 weeks alternative schedule (Figure XX) corresponds to the peak SAV growing season, when chances are best to restore a healthy SAV population.
- For the preliminary analysis below, the proposed Lake Okeechobee Water Supply Management (LOWSM) Plan was included, and the temporary forward pumps were assumed to be available to deliver water supplies at low lake stages, for both the TSP and the Managed Recession model runs.
- A PA is a projection of possible lake stages and discharges from a set point in time; simulations are typically used for short-term (<6 months) projections
    - PA simulations are 36 consecutive 1-yr simulations, differing from the period-of-record continuous simulations with the SFWMM (one 36-yr simulation);
    - Each 1-yr simulation:
        - starts with the same initial condition
        - is driven by historical rainfall data
        - represents one prediction of what could happen in the future
        - Outputs are typically reported using probabilities

The decision tree in Figure X summarizes the planning process that would be considered for any future periodic recession. Experience gained in the 2000-2001 drawdown and drought led to the target of 12' or below lake stage for 12 weeks from April through June for the best SAV recovery. Experience also indicates that the decision making process should begin with the November 1st position analysis. Contributing decision factors are lake bathymetry, Minimum Flows and Levels (MFL), as well as the time it took for a measurable SAV response to occur in 2000.

Analysis Methodology

If conditions require consideration of a managed recession, then further analysis similar to that presented here would be performed to evaluate the potential benefits and impacts. The analysis presented in this document is based on a simulation of three initial lake stage conditions: High or Wet (16.0' NGVD), Average or Normal (14.0' NGVD) and Low or Dry Condition (12.5' NGVD). Low, average and high refer to the canal and groundwater levels selected for initial conditions at the beginning of each dry Season: low = November 1, 1987, average = November 1, 1965, and high = November 1, 1982. Six simulations will be run for the two alternatives: three initial conditions for the official regulation schedule (aka TSP) and three for the base with the Managed Recession target of approximately 12' for 12 weeks.

A preliminary analysis of the projected benefits and impacts of the TSP with a managed recession were quantified using the following set of performance measures;

1. Lake Okeechobee
    a. Chance of achieving the target Lake stage/time window of 12' or below for 12 consecutive weeks during the peak SAV growing season.

2. Caloosahatchee and St. Lucie Estuaries
    a. Percent of time with damaging low salinity (salinity below the lower limit of the salinity envelope)

3. Lake Okeechobee Service Area (LOSA) Water Supply
    a. Chance (% of years) of water use cutbacks

4. Everglades
    a. Peat dryout
    b. Tree island inundation

Performance Measure Evaluations

Lake Okeechobee Performance

The potential for achieving a managed recession is best when the lake stage is less than 14' on November 1st, and the probability of success decreases as lake stage on that date increases towards 16'. It should not be the risk determined by the probability alone that determines whether to proceed with a recession, but many other factors, including the degree of ecological necessity. Although the ideal recession reaches a lake stage of 12' and maintains it from mid April to mid July, decision analysis should not discount recessions achieving stage elevations of up to 12.5' shifted either slightly forward or slightly backward in time. However, the 12 week duration should remain fixed, based on our experience of the length of time required to obtain a positive SAV response.

Chance of Achieving the Stage Target		
(Percent chance that the lake stage remains at 12 ft. NGVD for at least 12 consecutive weeks)		
01- Nov initial stage condition	**TSP**	**Managed Recession**
Low (12.5')	51	60
Average (14.0')	37	40
High (16.0')	6	17

Water Supply Performance

Water supply performance for the TSP and Managed Recession alternatives was evaluated by considering the frequency of water shortages in the Lake Okeechobee Service Area. The simulations covered 35 full water years (November to October), and years with one or more months with cutbacks greater than 18,000 acre feet were counted as water shortage years. The 18,000 acre feet is a criterion used in CERP evaluations. The summary below shows that while the starting lake level has a significant influence on the likelihood of water shortages, the operations under the managed recession criteria have only a small or no impact on this likelihood.

Frequency of Water Shortages in the Lake Okeechobee Service Area*		
(Percents)		
01- Nov initial stage condition	**TSP**	**Managed Recession**
Low (12.5')	22.9%	28.6%
Average (14.0')	8.6%	8.6%
High (16.0')	2.9%	5.7%
* Percent of years out of the 35 complete water years simulated. Years with one or more months with cutbacks greater than 18,000 acre feet were counted as water shortage years.		

Estuarine Performance

Effects of a Lake Okeechobee managed recession on the Caloosahatchee and St. Lucie Estuaries were evaluated using regression models that related freshwater discharge to salinity at critical locations in each system. Effects were quantified by comparing results from the Tentatively Selected Plan (TSP) with the proposed MR commencing on November 1. The SFWMM output consisted of a 35 year (Nov 1, 1965 to Oct 31, 2000) record of daily discharge at S-79 on the West Coast and at S-80 on the East Coast.

Methods and Assumptions:

St. Lucie Estuary:

Discharge from the C-44 canal at S-80 is only part of the total surface water discharge to the St. Lucie estuary. Estimates of runoff from basins other than C-44 were added to the SFWMM output at S-80 to derive a total daily inflow to the St. Lucie estuary for each of the six alternatives. Using two different regression models, daily average salinity at the Roosevelt and A1A Bridges was estimated fro the 35 1-yr simulations.

A preferred salinity envelope has been previously developed for each site based on the requirements of the eastern oyster, *Crassostrea virginica*. The salinity envelope for the Roosevelt Bridge is 8 to 25 ppt. The envelope for the A1A Bridge is 20 to 31 ppt. Results were expressed as average annual number of days that salinity was above or below the salinity envelope at the two sites.

Caloosahatchee Estuary:

The discharge at structure S-79 is only part of the runoff entering the Caloosahatchee Estuary. A significant portion enters from the tidal basin, downstream of the structure. The discharge from Tidal Caloosahatchee Basin was estimated and added to the SFWMM output at S79 to derive a total daily inflow to the estuary. The tidal basin runoff calculation was based on the median value of a 30-year record generated by linear reservoir model driven by rainfall and evaporation (Konyha, 2002, Peterson, 2002).

Using separate regression models, the combined flow to the Caloosahatchee was converted to salinity at three locations: Ft. Myers, Iona Cove and the Sanibel causeway. The results are presented as the annual average number of days that salinity at Ft. Myers was above 10 ppt; below 12 ppt in Iona Cove (station H4) and below 25 ppt at the Sanibel Causeway. These threshold values are based on the salinity tolerances of various species of SAV. In the upper estuary near Ft. Myers the freshwater species, *Vallisneria americana*, prefers salinities below 10 ppt. In Iona Cove, shoal grass, *Halodule wrightii*, will be stressed when salinity falls below 12 ppt. Similarly, salinities below 25 ppt at Sanibel will stress turtle grass, *Thalassia testudinum*, in San Carlos Bay.

The salinity analysis indicates that the most opportune time for a managed recession is when the lake is relatively low on Nov. 1. An analysis of mean monthly

flows to the Caloosahatchee indicates that the number of months of high (>2800 cfs) flows occurring during a MRLow condition (60 months) does not exceed the number occurring during the average condition experienced under TSP3 (TSPAvg = 60 months). Therefore, the adverse conditions due to high flows under the MRLow conditions are equivalent to those experienced by the Caloosahatchee during an average year of operations under TSP3.

Results:

St. Lucie Estuary:

Number of Days (Average Annual)	Roosevelt Bridge (< 8 ppt)	Roosevelt Bridge (>25 ppt)		A1A Bridge (<20 ppt)	A1A Bridge (>25 ppt)
TSP Low	49	110		61	101
MR Low	57	108		69	99
%Diff (mr-tsp)/tsp	**16.0**	**-1.4**		**14.0**	**-1.6**
TSP Avg	60	85		72	79
MR Avg	71	84		83	77
%Diff (mr-tsp)/tsp	**18.3**	**-2.1**		**15.6**	**-2.8**
TSP High	79	72		92	66
MR High	101	68		111	62
%Diff (mr-tsp)/tsp	**28.4**	**-6.1**		**21.8**	**-6.0**

A Managed Recession necessitates releases from the Lake above and beyond what would occur under normal operating procedures. Regardless of the Lake's initial stage, the Managed Recession increased the number of days below the lower limit of the salinity envelope at both sites. Conversely, the number of days above the salinity envelope decreased. Salinities below 8 ppt will cause stress and eventual mortality of juvenile oysters after about 7 days and adults after 14 days. The managed recession increased the number of days by 8 days (low), 11 days (avg) and 22 days (high). Considering these differences as consecutive days of exposure, low or average stage MRs would not significantly increase mortality of adult oysters, but the high stage MR would cause significant mortality. All managed recessions would affect juvenile oysters with the severity increasing as the initial Lake stage of the MR increased.

Caloosahatchee Estuary:

Number of days (total 12784 days)	Daily salinity at Ft. Myers>10 ppt	Daily salinity at Iona Cove<12 ppt	Daily salinity at Sanibel<25 ppt	Number of days (total 12784 days)
TSP low	207	58	30	TSP low
MR low	199	67	37	MR low
% Diff (mr-tsp)/tsp	**-4.3**	**17.0**	**23.0**	**% Diff (mr-tsp)/tsp**
TSP average	187	67	36	TSP average
MR average	173	80	49	MR average
% Diff (mr-tsp)/tsp	**-7.5**	**19.0**	**39.0**	**% Diff (mr-tsp)/tsp**
TSP high	155	91	53	TSP high
MR high	127	119	79	MR high
% Diff (mr-tsp)/tsp	**-18.0**	**30.6**	**49.8**	**% Diff (mr-tsp)/tsp**

Caloosahatchee	Mean Monthly Flows at S-79: Number of Months in each Class			
Alternative	**<450 cfs**	**450 – 2800 cfs**	**2800 – 4500 cfs**	**> 4500**
TSP Low	226	158	32	16
MRLow	217	155	35	25
TSPAvg	213	159	35	25
MRAvg	189	166	38	39
TSPHigh	160	180	48	44
MRHigh	124	177	75	56

All MR scenarios decreased the number of days that salinity exceeded 10 ppt in the upper estuary. Therefore, none of the MR scenarios increased stress of *Vallisneria* in the upper estuary relative to normal operations under the TSP. In fact, the higher the initial Lake stage, the better salinity conditions become in the upper estuary because the amount of water released from the lake increases as the MR stage increases.

Salinity effects of an MR will be felt in the lower estuary and San Carlos Bay where marine seagrasses are found. During a low Lake stage MR, the number of days of stressful salinity range from 7 to 9 depending on location. This is unlikely to cause ecologically significant damage. Stress for marine seagrasses increases by an average of nearly two weeks per year when MRs begin at an average Lake stage and by nearly a month when Lake stages are high. The latter situation may result in significant mortality.

Discussion and Conclusion:

Analysis of the data suggests that the most opportune time for a MR is when initial Lake stages are low. The most inopportune time is when they are high. As indicated by results for the St. Lucie, MRs that begin at average Lake stages may affect the more sensitive stages of indicator species, while more tolerant live stages may survive.

Greater Everglades Performance

Indicator Regions representing a variety of habitat types in the Everglades were used to compare the hydrologic performances of the Managed Recessions relative to the Tentatively Selected Plan. The Indicator Regions (IR's) represent subsets of the major Everglades ecosystems with differing hydrologic and ecological conditions, ranging from the southern end of the Everglades Agricultural Area (EAA) through the conservation areas to the southern tip of the Everglades National Park (see Fig. X).

Hydrologic Performance Measures were used in these analyses to evaluate impacts of the Managed Recessions under low, average, and high water conditions. Water quality was not evaluated. The Everglades Performance Measures were 1) peat dry-out and 2) tree island inundation, the two ends of the spectrum regarding water depths. Thirty-six areas were evaluated. For each Indicator Region, the number of weeks that the water table fell a foot or more below the surface or that water depths were above those deemed appropriate for tree island vegetation to survive and thrive were recorded. The model simulations produced values for the tentatively selected plan and for that plan with the managed recessions factored in. The following results report the differences between those sets of comparisons (low TSP vs. low TSP with managed recessions).

Peat Dryout

Under managed recession conditions, peat dryout did not change in any ecologically significant ways in the WCA Indicator regions under either the low or average scenarios (only two weeks or less for the 36-year period of simulation).

However, under the high water scenarios, large differences between the TSP and the Managed Recession scenarios were seen in the southern Everglades, producing a net decrease of 114 weeks (3.8%) of high water levels for the Everglades overall. Other than these changes in the southern Everglades, differences between the TSP and MR in the Water Conservation Areas were very small. A decrease in the number of weeks of dryout is an improvement to the ecosystems of the Everglades. Therefore, the Managed Recession scenario for high water conditions represents a net improvement of 114 weeks over the TSP.

The reductions in dryout were largest in Indicator Regions 141, 142, 147, and 148, which are in the Ochopee Marl Marsh west of Shark River Slough and the Rocky

Glades east of Shark River Slough. In these four Indicator Regions, the Managed Recession scenarios reduced the number of weeks in quantities that provide ecologically significant improvements (total weeks and percent change).

Below is a table that summarizes the number of weeks and the percent differences they represent for the four southern Indicator Regions:

Table 1. Comparisons of TSP and the Managed Recession scenarios under high water conditions for Indicator Regions showing significant changes. Decreases in dryout duration and frequency are considered an improvement.

Indicator Region Number	TSP_high weeks	MR_high weeks	Dif. weeks	% dif (MR-TSP)
141	173	159	-14	-8.09%
142	250	229	-21	-8.40%
147	305	272	-33	-10.82%
148	207	181	-26	-12.56%

Tree Island Inundation

As with the peat dryout, only a few of the Indicator Regions changed significantly under the Managed Recession scenarios. These changes were increases in the number of weeks that tree islands would be inundated, and of these, only two were in areas that experience excess inundation at present. For low and average water conditions, the differences between the TSP and the MR scenario do not appear to be ecologically significant. The high water scenarios produced significant increases in two Indicator Regions (119 and 124) in the southern areas of WCA-3. These areas experience water depths great enough to harm tree island vegetation now, so an increase in duration or depths in these two IR's would not be preferred. The other two IRs (116 and 118) are located in the northern and central section of WCA-3A, where water depths are not harmful to tree islands, so in these areas, higher water or longer duration would probably not cause additional harm to tree island vegetation.

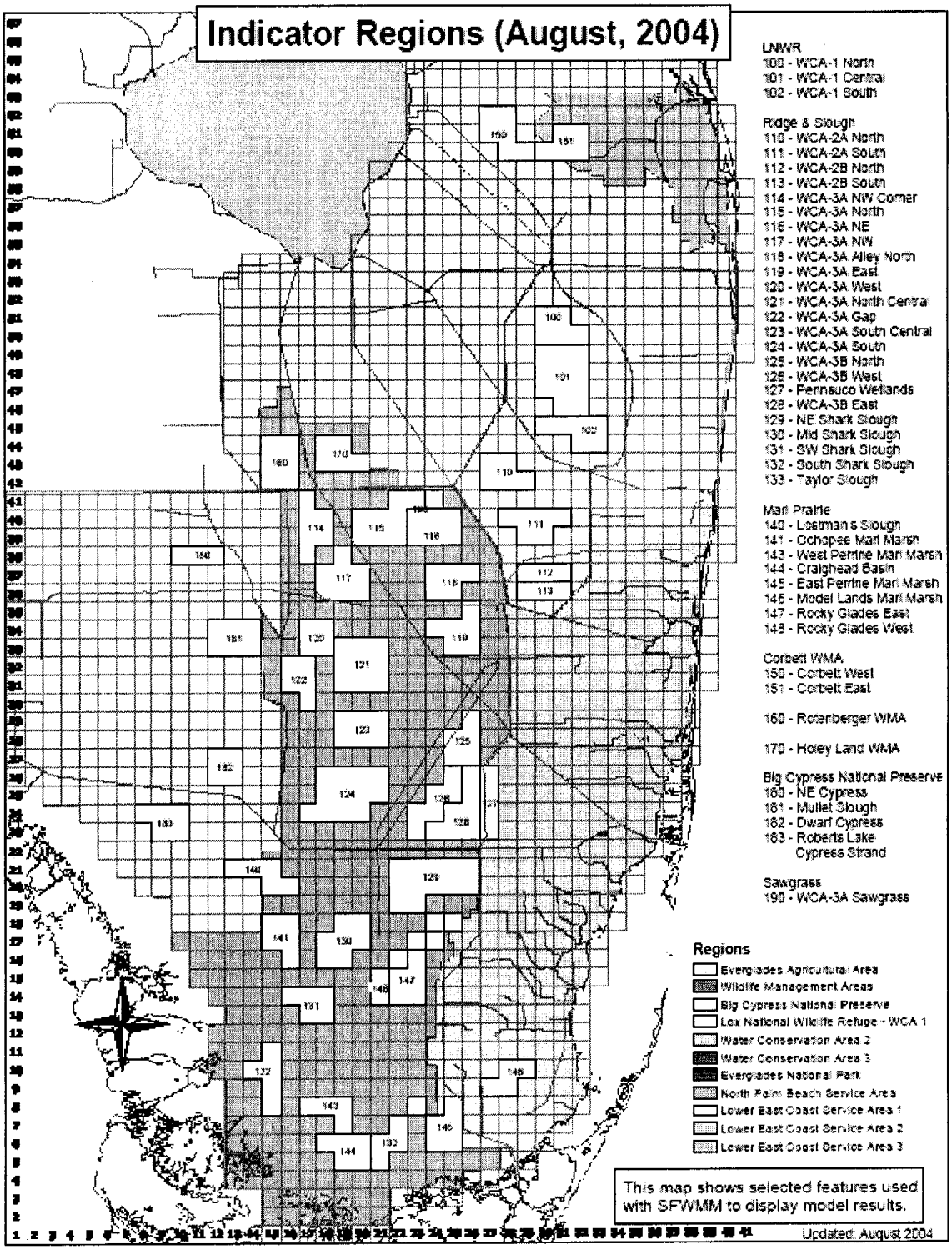
Below is a table that summarizes the number of weeks and the percent differences they represent for the four WCA-3 Indicator Regions:

Table 2. Comparisons of TSP and the Managed Recession scenarios under high water conditions for Indicator Regions showing significant changes. Increases in inundation duration and frequency may harm tree islands in IR's 119 and 124 because of their location with current high water depths.

Indicator Region Number	TSP_high weeks	MR_high weeks	Dif. (MR-TSP)	% dif (MR-TSP)
116	130	138	8	6.2%
118	154	163	9	5.8%
119	1167	1203	36	3.1%
124	592	632	40	6.8%

In summary, negative impacts on the Everglades from the Managed Recession water management are restricted to a few indicator regions under only the high water scenarios. Increases in water depths or duration may be harmful for IR's 119 and 124 in WCA-3. However, for peat dryout, the southern Everglades would show improvement under the Managed Recession conditions along the edges of Shark River Slough.

Figure X Indicator Regions for Greater Everglades Performance Measures.



Overall Performance Summary Table

Based on the above performance measure evaluations, the managed recession has a better chance of success when the November 1 stage (initial condition) is relatively low (12.5') or relatively high (16.0') but chances of success are probably not worth the effort for the average (14.0') initial conditions. Adverse impacts to all other areas are significant for the high initial conditions. But for the low initial conditions, the adverse impacts apply to water supply and possibly navigation, which is not presented here. It appears that a successful managed recession would be achieved only in an exceptionally dry year without additional releases to the estuaries.

Initial Conditions on 01-Nov	**Lake Okeechobee**	**Estuaries**	**Water Supply (& navigation)**	**Everglades**
High (16.0')	+	-	-	-
Average (14.0')	+	- / 0	0	0
Low (12.5')	+	0	-	0

Managed Recession Effects (+ good, 0 neutral, - bad)

(The following section may be more relevant in an appendix, exclusive of the 2 graphics at the end, which need to stay in the body of the above summary)

Benefits of the 2000 Managed Recession

The SFWMD has documented that seven of the nine years between 1991 and 1999 resulted in high lake stages and impacted the ecology of Lake Okeechobee by allowing less light to reach the bottom of the lake, resulting in the loss of submerged vegetation. Increased turbidity levels may have also resulted in light limitation of bulrush (*Scirpus* sp.), which in turn may have weakened the plants, making them more susceptible to uprooting by wind-driven waves (Steinman et al. 2002). The combination of high lake stages and wind driven waves likewise resulted in an increase in phosphorus concentrations in the nearshore regions, as phosphorus-rich sediments were transported from the central mud zone toward the littoral zone, which may have favored algal bloom formation; further reducing the light available for the growth of SAV (Havens and James 1999).

The loss of SAV threatened the survival of a multi-million dollar sport fishery, which previously had been documented to rely on this habitat as spawning and nursery grounds (Furse and Fox 1994). Thus, the decision to lower the water level in Lake Okeechobee was driven by a combination of political and environmental factors (Steinman et al. 2002).

Implementation of the 2000 Managed Recession

In 2000, the Governing Board of the SFWMD adopted Resolution No. 00-31, SFWMD 2000). Although this plan had the greatest potential to meet the desired ecological outcome for Lake Okeechobee, it also had the highest risk for impacting the estuaries, the Everglades, and water users surrounding and depending on the lake. As a consequence, the potential risks and adversity were shared among the stakeholders. Resolution No. 00-31 was implemented immediately after adoption. Commencing on April 25, 2000 discharges to the east, west, and south continued for 27 days, until May 21, 2000, at which point a lake stage of 13 ft had been attained and releases from the lake were terminated.

Results

Hydrology. The hydrologic goal of lowering water levels in Lake Okeechobee to 13.0 ft was met on 21 May 2000, 10 days earlier than anticipated, due to the extremely dry conditions during the recession. The additional goal of maintaining water level at or below 13.0 ft for 8 weeks also was met, as summer 2000 was one of the driest on record in South Florida. The loss of water directly attributable to the managed recession was estimated to be approximately 1 ft, with evapotranspiration accounting for the additional lost water. Lake levels continued to drop through the summer, as areas north of the Lake experienced a severe hydrologic drought and provided no inflow.

Lake Okeechobee. Over the course of the summer of 2000, transparency in the water column increased from 0.08 - 0.12 in to near 3.3 ft (near bottom) and phosphorus concentrations declined from about 60–70 µg/L to near 20–30 µg/L, in regions where SAV recovered (Havens et al. 2001). The number of sites with SAV increased from two (of 42) in April 2000 (just prior to the managed recession) to 23 sites in August 2000. Low lake stages also allowed for the removal of an organic berm that had formed along the NW shore of the littoral zone. Over 5.5 miles of mostly organic debris, which accumulated from years of high lake stages, was mechanically removed by earth-moving equipment and consolidated by the FFWCC into several wildlife islands in the lake.

A lake survey was conducted in October 2000 for presence–absence of SAV (Havens et al. 2002). Based on this survey, it was estimated that SAV covered > 42,000 ac in Lake Okeechobee. This is similar to the spatial extent documented in a survey of the SAV in 1989–1991, coincident with another severe drought and low lake stage (Zimba et al. 1995). Although a comparable survey was not conducted prior to the managed recession in 2000, SAV cover in October 1999 was no more than 30,000 ac. Additional environmental responses to the recession can be found in Havens et al. (2001) and Steinman et al. (2002).

Additional support for the 12' for 12 weeks recommendation is evident in Figure X. Post-recession SAV monitoring indicated that after eight weeks, more than 60% of monitoring sites still lacked detectable vegetation while after 10 weeks, the percent of non-vegetated sites had decreased to less than 40%.

Monitoring of invasive species during and after the drought suggests that torpedograss expanded its cover at an accelerated rate in the littoral zone of Lake Okeechobee. Sampling of plant densities in reference plots that had been monitored since 1999 indicated that during the drought period, the rate of expansion of torpedograss increased by two- to three-fold. However, the drought also provided dry conditions that allowed the SFWMD and coordinating agencies to carry out controlled fires and treatments of torpedograss with herbicide. These treatments continued through 2001, and as of July 2002, treated areas were not displaying significant regrowth of torpedograss.

Estuaries. Monitoring conducted as part of the managed recession revealed results consistent with prior research at the SFWMD, which indicated that short-term releases of water can have immediate negative impacts, but that these systems are resilient (Doering et al. 1999, Kraemer et al. 1999). Once discharges to the St. Lucie Estuary ceased, turbidity subsided within four days and salinity returned to ranges tolerable to oysters within one week. Impacts to seagrasses along the Atlantic coastline were localized and did not persist past June 2000. Recovery of environmental conditions was slower in the Caloosahatchee Estuary because there was seagrass mortality in the lower estuary. A cyanobacterial bloom (*Anabaena* spp.) was documented in the upper estuary, presumably related to the recession operation. A working hypothesis is that the water from Lake Okeechobee "seeded" the estuary with cyanobacteria, which then proliferated to bloom levels in a subsequent period when flow was maintained at near 300 cfs for a number of weeks, keeping conditions oligohaline. This low flow rate maintained an isohaline front

near the city of Fort Myers. The bloom ended when freshwater discharges were stopped and salinity levels began to increase. However, the Caloosahatchee estuary also showed blue green algal bloom activity during the summer of 2006 when there was virtually no flow from Lake Okeechobee to the river.

Everglades. Impacts of the managed recession on the Everglades were minimal. There was no apparent impact on tree islands as a result of recession related discharges. In addition, the year 2000 turned out to be one of the most successful nesting seasons in several decades for wading birds in the Everglades as a whole (SFWMD 2001). Because the managed recession took place late in the spring, much of the nesting season was already completed and not impacted by the releases. Flow sampling during the recession revealed that relatively little canal-to-marsh water exchange occurred, because many of the marsh water levels were below land surface. There were no apparent water quality impacts, as determined from phosphorus sampling in the marshes and canals during the course of the recession.

Water Supply. Contrary to pre-recession model predictions, the region experienced a serious drought, and severe water restrictions were imposed on all water users throughout South Florida. This ranged from substantial cutbacks on agricultural users to restrictions on use of home sprinklers and car washing. The managed recession accounted for approximately 1 ft of lost water on the lake (with > 5 ft subsequently lost to evapotranspiration and water deliveries), so it is likely that these restrictions would have taken place regardless of whether or not the recession had been approved. However, it is unknown how the managed recession may have affected the initiation date or duration of these restrictions. Although normal to above-normal precipitation returned to South Florida in the fall of 2001, thereby abating the water shortage crisis, the restrictions during 2000–2001 resulted in economic hardships throughout the region. Not only were there water use restrictions in the South Florida region, but also economic impacts were felt by citrus, rice, and other agricultural industries, bait shop owners, hotel operators, fishing guides, trailer parks, and other segments of the economy integrally linked to public use of the lake resource. During the drought, a state of emergency was declared, allowing small-business owners to apply for low-interest loans. The main users of these loans were the commercial seine-fishing operators, who were not able to do any fishing when lake stage levels were low (SFWMD, *unpublished data*).

Figure X. Lake Okeechobee Managed Recession Decision Tree

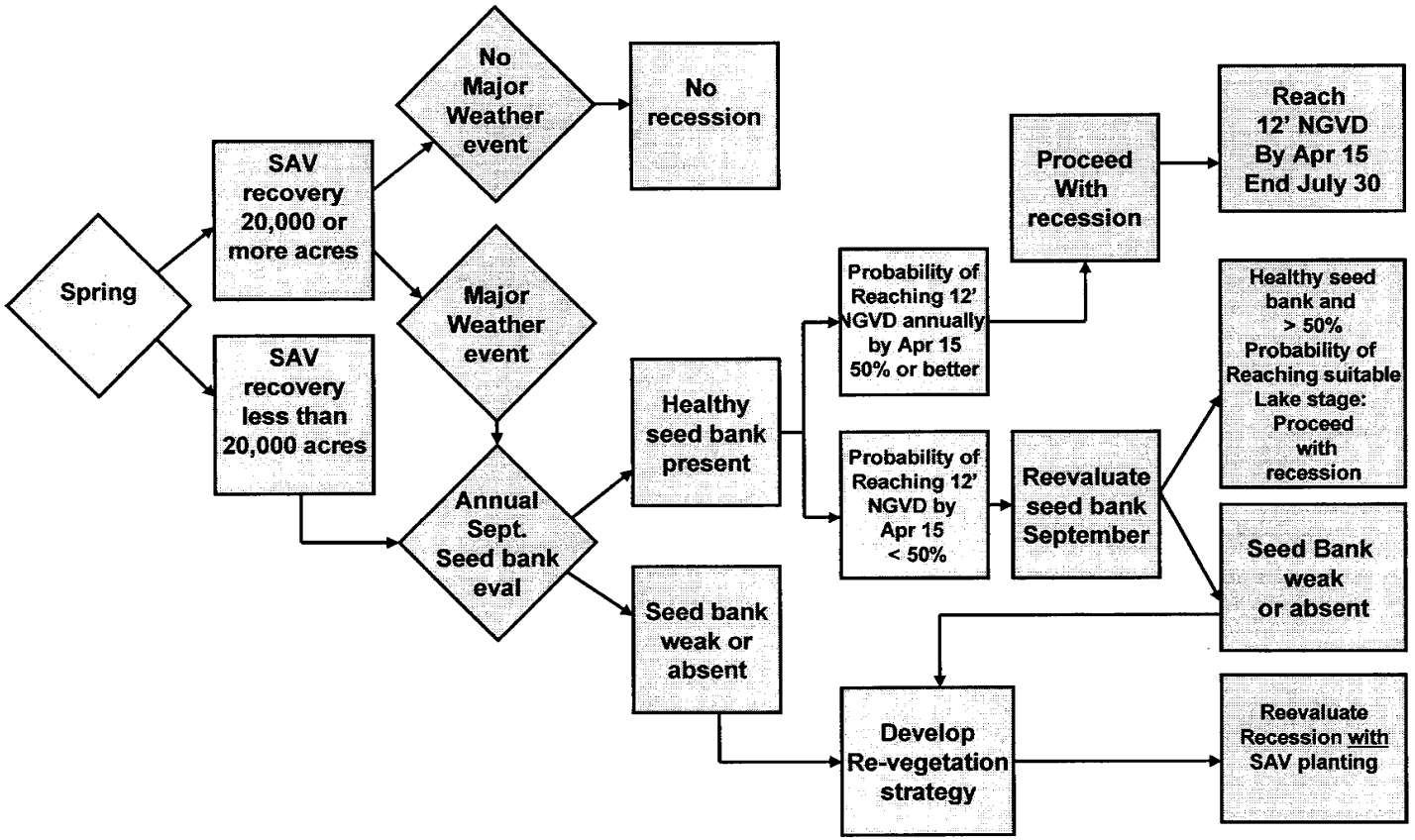
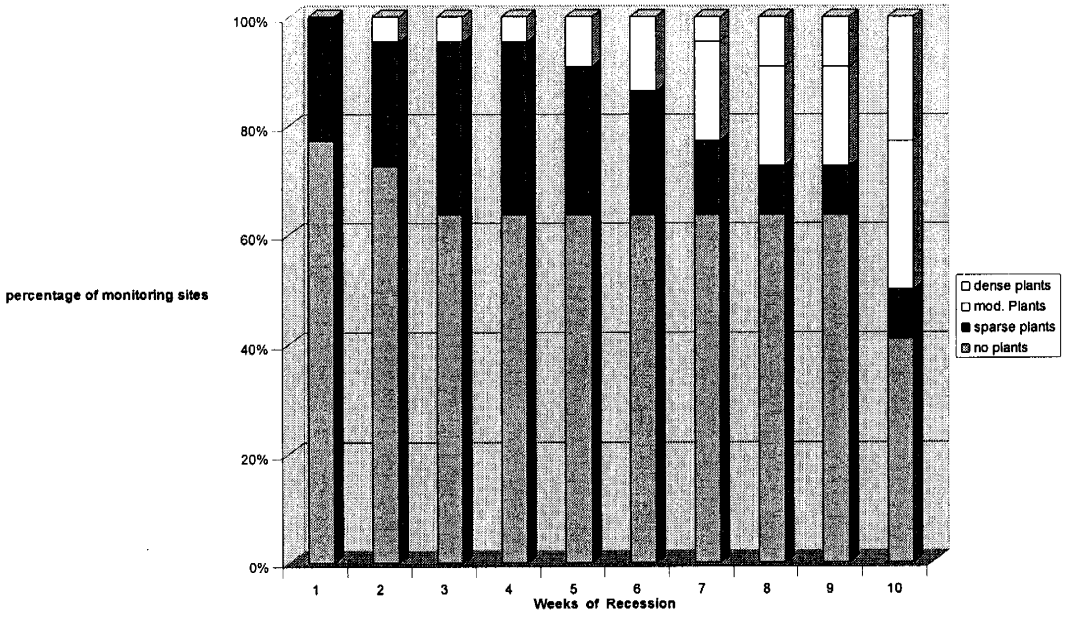


Figure X. Progression of Re-Growth of SAV Post- 2000 Recession

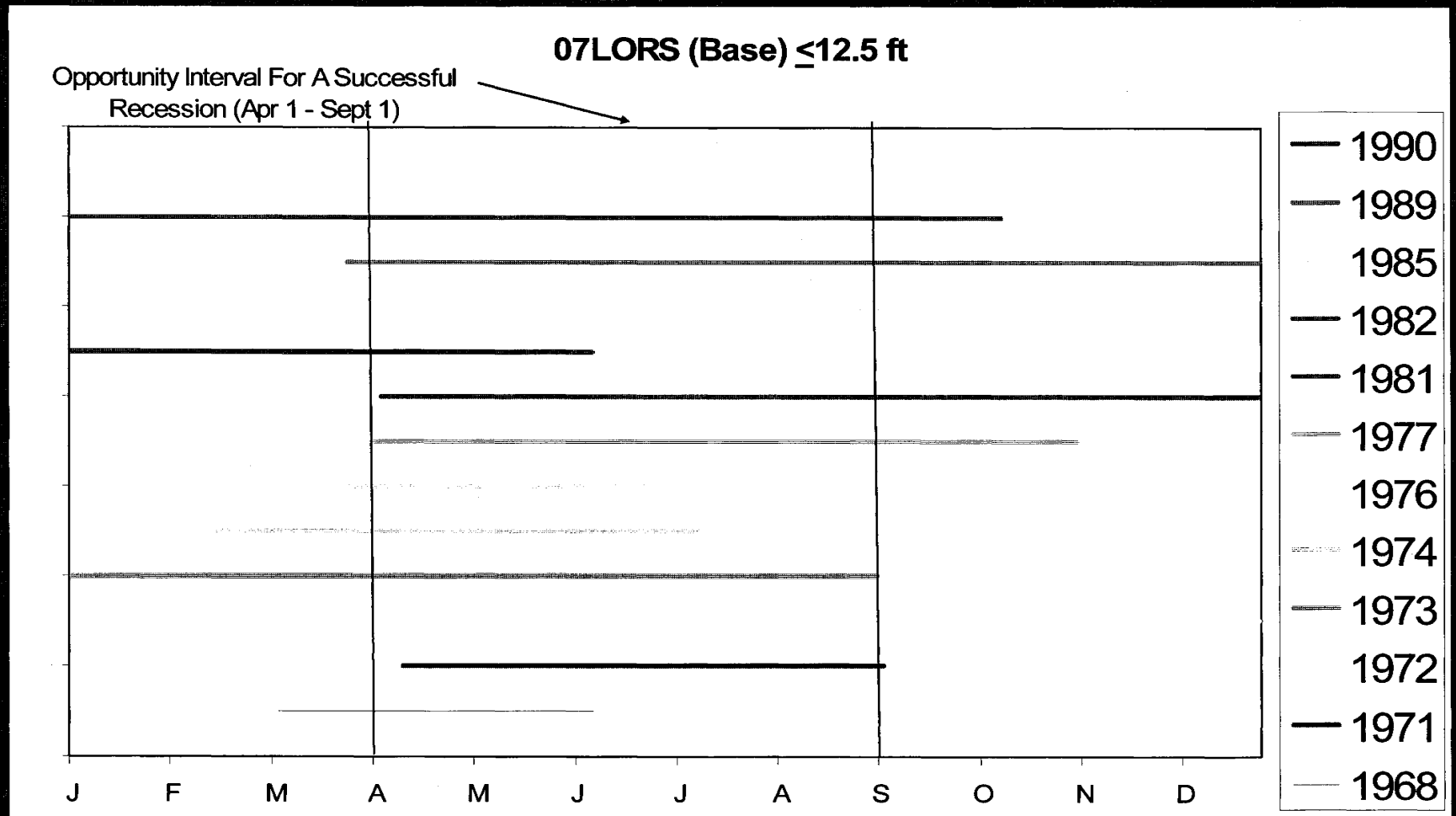


NATURAL RECESSION FREQUENCY

Bruce Sharfstein and Andy Rodusky
SFWMD

Premise and Goal

- Examine the frequency of natural recessions under the current operating schedule and under the TSP.
- Natural recessions considered capable of improving SAV in Lake Okeechobee defined as:
  - An elevation of <12.5' NGVD.
  - A duration of 12 weeks or more.
  - During the period April 1 to September 1.


07LORS (Base) ≤12.5 ft
Opportunity Interval For A Successful Recession (Apr 1 - Sept 1)
J
F
M
A
M
J
J
A
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O
N
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1981
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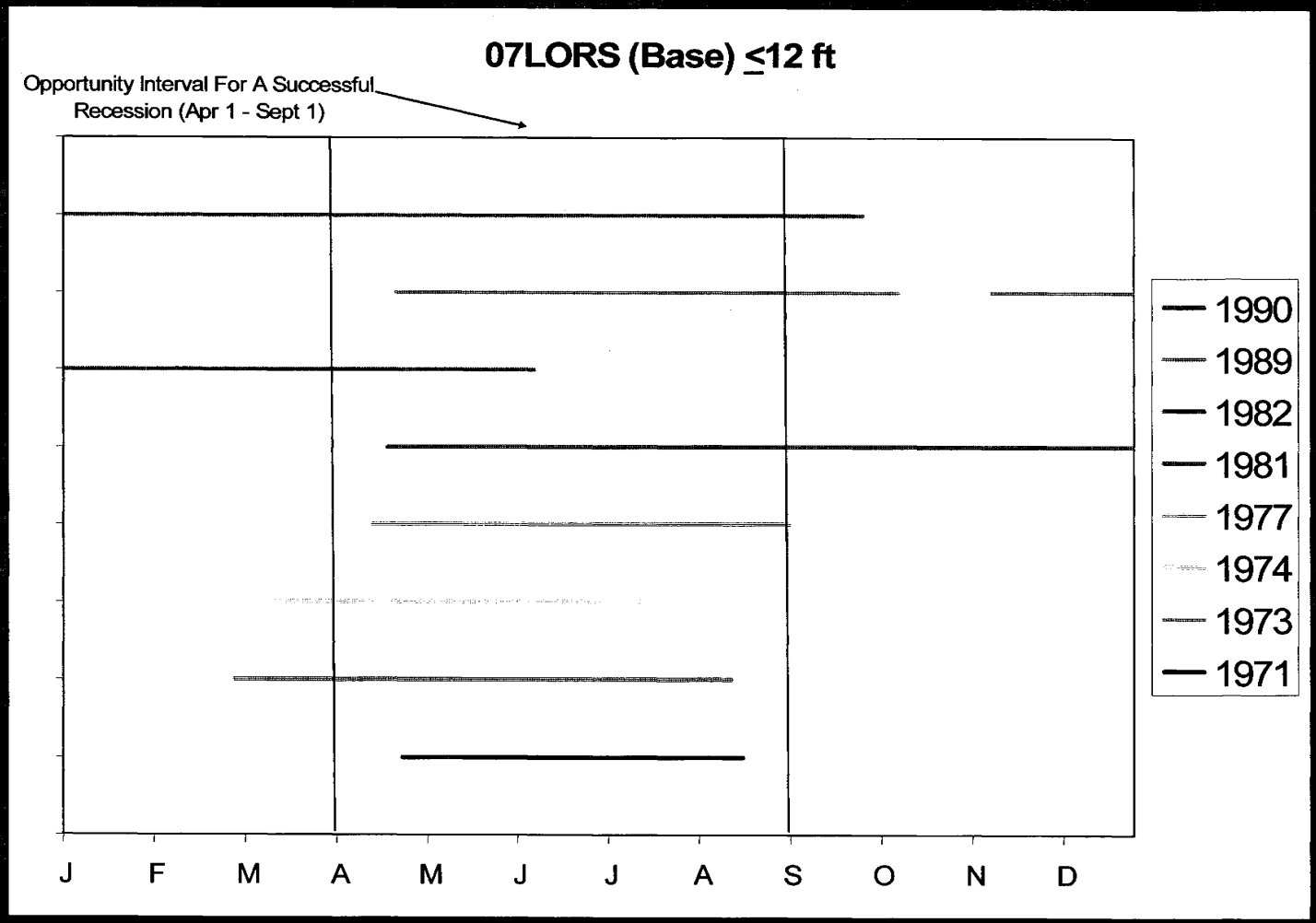
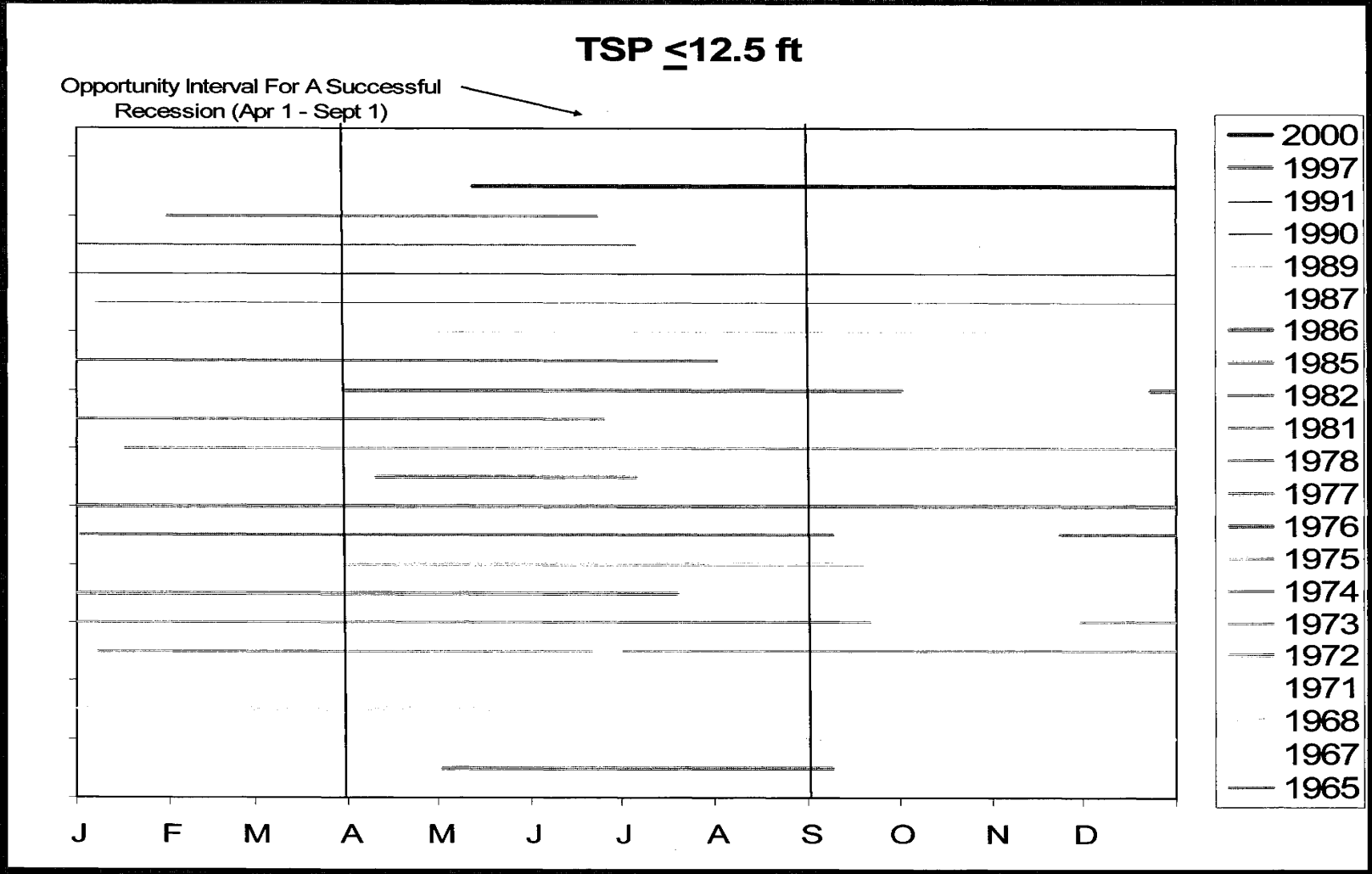
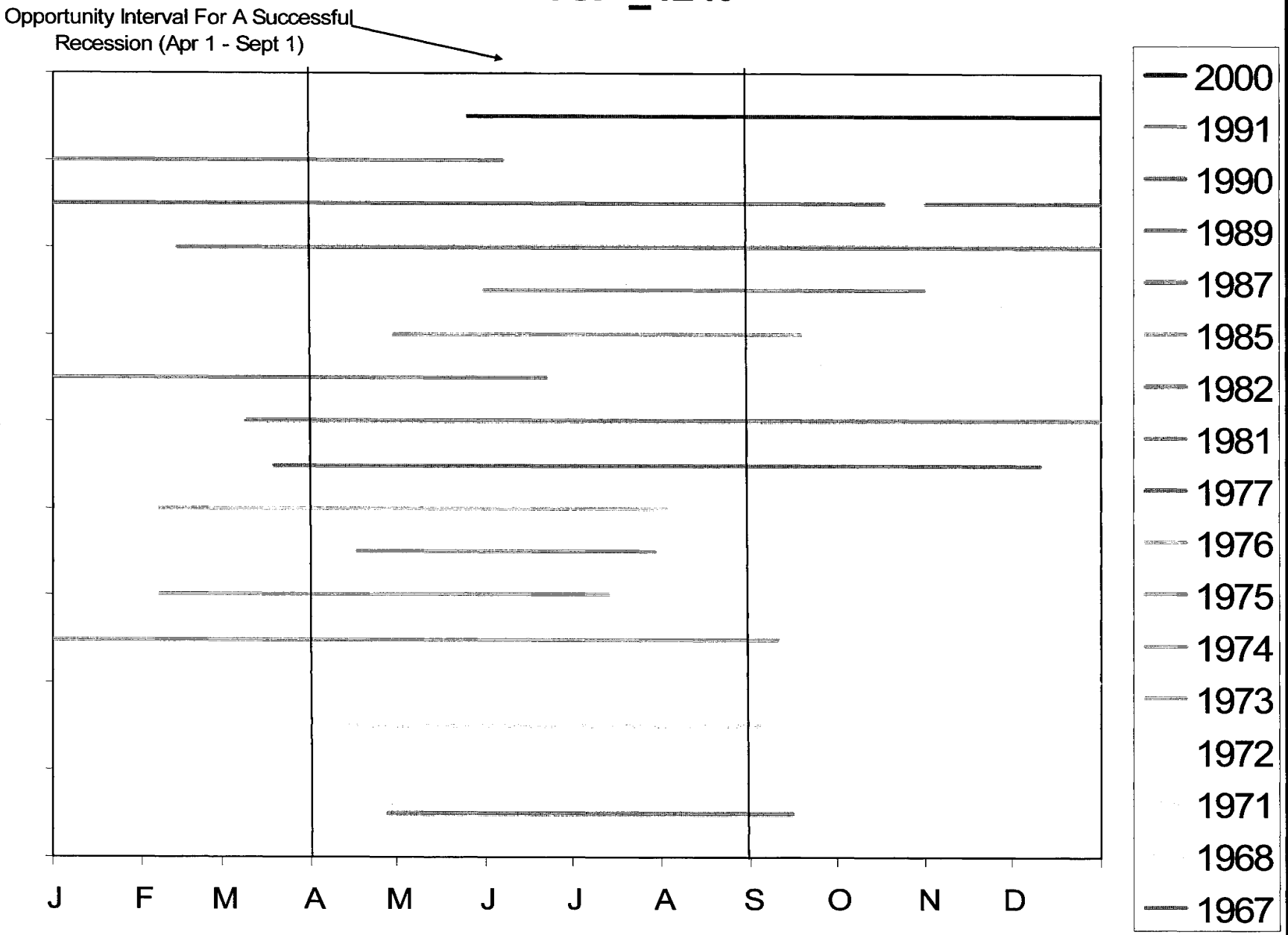
1976
1974
1973
1972
1971
1968


07LORS (Base) ≤12 ft
Opportunity Interval For A Successful Recession (Apr 1 - Sept 1)
J
F
M
A
M
J
J
A
S
O
N
D
1990
1989
1982
1981
1977
1974
1973
1971


TSP ≤12.5 ft
Opportunity Interval For A Successful Recession (Apr 1 - Sept 1)
J
F
M
A
M
J
J
A
S
O
N
D
2000
1997
1991
1990
1989
1987
1986
1985
1982
1981
1978
1977
1976
1975
1974
1973
1972
1971
1968
1967
1965

TSP ≤12 ft


Opportunity Interval For A Successful Recession (Apr 1 - Sept 1)
J
F
M
A
M
J
J
A
S
O
N
D
2000
1991
1990
1989
1987
1985
1982
1981
1977
1976
1975
1974
1973
1972
1971
1968
1967

Summary Table

CONDITION	PROBABILITY OF A RECESSION BASED ON 36 yr por.
LORS 07 $\leq$ 12.5 ‘	19%
LORS 07 $\leq$ 12.0’	19%
TSP $\leq$ 12.5’	50%
TSP $\leq$ 12.0’	36%

Conclusions

- TSP has a high probability of having natural recessions relative to the current schedule.
- Consequently, need to use managed recessions as a tool should be relatively infrequent.
- Nevertheless, ability to do managed recessions should remain an option to be used to promote recovery from catastrophic situations when absolutely necessary.