

THE PLAN SIX CONCEPT

An Analysis of a Storage Flowway Plan To Restore and Protect the St. Lucie and Caloosahatchee Estuaries, Lake Okeechobee and the Everglades

Prepared for: Rivers Coalition Defense Fund

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Plan Six Report also available at: riverscoalition.org

Summary: The Plan Six Concept

The “Plan Six Concept” refers to a proposed storage flowway that would allow a large amount of water from Lake Okeechobee to flow south instead of being sent destructively “to tide” through canals and estuaries to the east and west.

The storage flowway would occupy and move through approximately one-fifth of the Everglades Agricultural Area, much of which already is in public hands and some that is readily available.

The term Plan Six itself comes from the numerical designation given this option by the U.S. Army Corps of Engineers when the Everglades Restoration program was originally developed in 1993/94. Other numbered alternatives would have provided some of the same features. For this purpose, Plan Six may be thought of as a concept subject to various modifications for use in 2006 and years ahead.

When the Restoration Program was conceived, it was commonly acknowledged that drainage releases from the lake were causing damages to the estuaries in many ways and that the water shunted to the ocean should instead be returned to the natural River of Grass system.

Unfortunately, that goal will not be achieved under the present Comprehensive Everglades Restoration Plan, in the judgment of many scientists, organizations and citizens.

In fact, it is now clear that the coastal discharge problems will be even worse because Florida is in the midst of a 30- to 40-year “wet cycle” that intensifies inflows to the lake and surrounding areas.

These discharges occur more frequently during the 30 year wet cycle, though not every year.

In 2005, the east and west releases amounted to 2.6 million acre feet. This totaled 855 billion gallons of turbid fresh water containing excess nutrients and other contaminants. Martin County sustained unprecedented damages as the St. Lucie was covered with toxic blue-green algae. Health Department officials warned citizens not to touch the water. Threats of serious health problems were cited.

Estuary damages are considered certain to occur repeatedly under present drainage structures and practices, and under the CERP as now planned. Only a storage flowway south from Lake Okeechobee can largely alleviate the destruction of the east-west estuaries--rivers that were once acclaimed as the most bountiful in the nation.

The Plan Six concept, formulated from research undertaken over years by leading agency scientists, is the most practical way to achieve the goals of restoration.

An Historic River In Deep Trouble

The majestic St. Lucie Estuary, located on the southeast coast of Florida, flows into the southern stretch of the Indian River Lagoon and to the Atlantic Ocean. The St. Lucie River is the main tributary into the Indian River Lagoon, which is considered by marine scientists as the most biologically diverse ecosystem in North America.¹

Indian River Lagoon recreational activities such as boating, fishing, water sports, and ecotourism generate approximately \$465 million annually. Commercial fishing enterprises in the Indian River Lagoon generate \$140 million in revenues, and account for nearly 15% of the national fish and shellfish harvest.² The marine industry along the Treasure Coast employs nearly 8,000 workers and generates \$900 million in economic activity in the region.³

Historically, the estuary was a fresh water system influenced by ephemeral ocean inlets. When the St Lucie Inlet was permanently established in 1898, the system became an estuary, characterized by abundant mangroves, oyster bars, and home to a kaleidoscope of marine life.

The major tributaries to the St. Lucie River, the north and south forks, provided a relatively constant supply of fresh water from extensive wetland systems within the tidal basin. This stable inflow of fresh water supported a unique and thriving estuarine habitat which served as a nursery grounds for a wide variety of fish. The broad lower reaches of the North and South Fork historically supported sea grasses and oyster beds and extraordinary fisheries ranging from black bass to snook, tarpon, goliath grouper and many other species.

Until the past decade, the lower reaches of the St. Lucie River continued to be major opportunities for fishing, boating, recreational diving, and water sports.

The Condition of the St. Lucie River Today

Today, the St. Lucie River is damaged to a point where it has been a human health hazard. In most years, fish and wildlife have virtually disappeared and recreation on the river has nearly ceased. The Florida Department of Health has concluded that this historic river is unsafe for human contact.⁴

The plight of marine biologist Bjorn Tunberg highlights the degraded status of the St. Lucie River and the risk it poses to humans in 2006. Tunberg, a Fort Pierce-based marine ecologist who has been studying the habitat on the bottom of the St. Lucie River on

¹ Harbor Branch Oceanographic Institute at <http://www.indianriverlagoon.org/stats.html> (Located on Florida's east central coast, it is home to over 4,000 plant and animal species. The overall ecosystem of the Indian River Lagoon is home to approximately 50 species listed under the Endangered Species Act).

² Smithsonian Marine Station at Fort Pierce, *Where is the Indian River Lagoon and Why Is It So Important*, at <http://www.sms.si.edu/IRLspec/Maps.htm>.

³ Kate Grusich, *Leaders Say Help Needed to Revitalize Sagging Industry*, The Stuart News, September 27, 2006.

⁴ See Rivers Coalition, *Killing the St. Lucie River, How Politics and Wasteful Projects Have Rendered a Great River Unfit for Human Contact*, at www.riverscoalition.org/whitepaper.htm.

behalf of the SFWMD stated the following while recovering from a life-threatening bacterial infection caused by contact with mucky river water:

"That sediment is really contaminated. It's really dangerous," said Bjorn Tunberg, a Fort Pierce-based marine ecologist who has been studying the habitat on the bottom of the St. Lucie River . . . for two years. We have to be really careful when we work down there," he added. "It's disgusting. That's the only word I can use."

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Timeline of recent water woes⁶

- *Sept. 6, 2002:* For the first time, Martin County health officials close the waters under the Roosevelt Bridge because of high bacteria levels. They deem the water safe a week later.
- *Sept. 17, 2004:* State environmental officials warn residents not to swim or fish in the river because of high fecal coliform bacteria levels. The warning lasts about 10 weeks.
- *March 18, 2005:* Elevated bacteria levels again lead officials to warn residents away from the St. Lucie River. Nearly a month later, the warnings are canceled once the levels fall within state standards.
- *April 15, 2005:* High fecal coliform bacteria levels force another warning to avoid contact with the waterway. In June, the warning area expands from the Palm City to the Evans Crary bridge. In July, "no swimming" signs are installed along the North Fork.
- *Aug. 7, 2005:* Tests reveal that a bloom of blue-green algae, a bacteria called microcystis, is toxic. **Health officials warn residents to avoid the water from Lake Okeechobee to the St. Lucie Inlet.**

The degradation of the pristine estuary began when the Florida Legislature created a board of drainage commissioners in 1905 to reclaim swamps and overflowed lands. Agricultural and urban drainage projects beginning in the 1910s expanded the area that now drains into the estuary. The historic watershed was approximately one-third of its present size of almost 775 square miles. Major drainage canals constructed in the watershed include the C-23 and C-24 canals.

The Everglades Drainage District completed the St. Lucie Canal (C-44) in 1928. The C-44, which connects to the south fork of the St. Lucie River proved to be an efficient waterway for traversing from Lake Okeechobee to the sea.⁷ Lake Okeechobee drainage that formerly went south to the Everglades was redirected to the St. Lucie River via the C-44 canal.

⁵ Suzanne Wentley, *Biologist: Estuary Could Be Deadly*, St. Lucie News, September 14, 2006, pg. A1.

⁶ *Id.*

⁷ See South Florida Water Management District, NE-1 St. Lucie Estuary Salinity Envelope, at www.evergladesplan.org.



Regulatory Releases Take Their Toll

In the winter of 1997-98 extreme amounts of rainfall occurred over much of South Florida during the “El Niño” event. Lake Okeechobee reached dangerously high levels. The U.S. Army Corps of Engineers (ACOE) and South Florida Water Management District (SFWMD) made maximum regulatory releases to the estuary through C-44.

Shortly thereafter, in early March 1998, anglers from Martin and St. Lucie counties began reporting lesioned or ulcerated fish from the St. Lucie Estuary. Within weeks, 33 species of sick fish had been reported to the Florida Fish and Wildlife Conservation Commission.⁸

⁸ South Florida Water Management District, *Focus on the St. Lucie River*, November 1999, pg 5, at <http://www.sfwmd.gov/images/pdfs/stlucie.pdf>.

Fish are very sensitive to changes in the aquatic environment. Rapid changes in salinity, temperature, and/or water quality can cause fish to become stressed, leaving them open to infection. Relatively small changes in salinity in estuaries can occur from natural occurrences such as local watershed basin run-off or run-off from severe storms and hurricanes, but during the winter of 1997-8, large amounts of freshwater from Lake Okeechobee were released into the C-44 – ultimately impacting the biological balance of the St. Lucie River and Indian River Lagoon.⁹

In Florida, the St. Lucie Estuary and the Caloosahatchee River are connected to Lake Okeechobee by a canal system. When the level of Lake Okeechobee becomes too high, freshwater is released into the St. Lucie Estuary and the Caloosahatchee River. This massive amount of freshwater influx (up to billions of gallons/day) can dramatically lower the natural salinity of the estuary.

As evidenced by the discharge totals below, the large discharges from Lake Okeechobee into the St. Lucie Canal and estuary now occur in most years.

Year	Gallons ¹⁰
1995	326,000,000,000
1996	61,000,000,000
1997	36,000,000,000
1998	344,000,000,000
1999	64,000,000,000
2000	50,000,000,000
2001	(23,000,000,000)
2002	48,000,000,000
2003	178,000,000,000
2004	189,000,000,000
2005	303,000,000,000

It must also be noted that lower-range discharges in the amount of 50 billion gallons are considered highly deleterious to the estuarine habitat as well. Moreover, discharges to the west coast from Moore Haven (S-77 structure) constitute even larger volumes of water, though to a correspondingly longer manmade canal.

These rapid changes in the aquatic environment may stress the fish and increase their chances of infection by various diseases. Along with stressing the fish, this influx of freshwater provides a favorable environment for *Aphanomyces invadans*, allowing it to encounter and infect estuarine fish hosts.¹¹

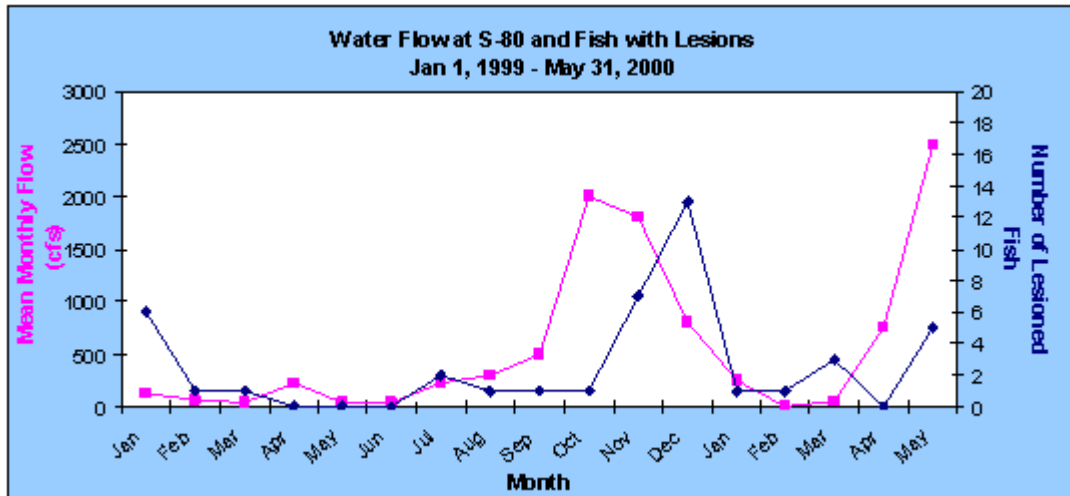
⁹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, *Ulcerative Mycosis in Florida – Perspectives on Estuarine Fish Health – Lesions in Florida are Often Caused by Fungal Infection*, at: http://research.myfwc.com/features/view_article.asp?id=25293.

¹⁰ SFWMD DBHydro Data, from Mark Perry, Florida Oceanographic Society, October 2006.

¹¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, *Ulcerative Mycosis in Florida – Perspectives on Estuarine Fish Health – Lesions in Florida are Often Caused by Fungal Infection*, at: http://research.myfwc.com/features/view_article.asp?id=25293.

The ACOE has publicly conceded that “extreme fluctuations between too much and too little freshwater discharge into the Caloosahatchee and St. Lucie estuaries result in detrimental salinity conditions and physical alterations of fish and wildlife habitat.”¹² Excess stormwater that is discharged to the ocean and the gulf through the Caloosahatchee and St. Lucie rivers is very damaging to their respective estuaries.¹³

An increase in the prevalence of lesioned fish has been correlated with flow rates through the S-308 structure on the St. Lucie Canal.¹⁴



The ACOE also concedes that the transportation of sediment in the C-44 canal to the St. Lucie River is negatively impacting the estuary. Presently, material from the banks that sloughs off the banks is transported and deposited as shoals in the estuary.¹⁵ Sediment traps bacteria, nutrients and pollutants. When muck is disturbed by wind, waves, currents or boat traffic, trapped pollutants are readily released. Disturbed sediment can create vast areas of cloudy waters that stress sea grasses - that are vital habitat to juvenile fish populations and other plant and animal life.¹⁶

Efforts to reduce erosion of canal banks and secure holding areas for water to allow sediment to settle and be filtered are some proposed solutions to these problems.¹⁷

¹² Central and Southern Florida Project Comprehensive Review Study, Summary, pg iii, 1999.

¹³ Id. at pg. viii.

¹⁴ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, *Ulcerative Mycosis in Florida – Perspectives on Estuarine Fish Health – Lesions in Florida are Often Caused by Fungal Infection*. (Changes in the aquatic environment (such as a change in salinity or water temperature) cause *Aphanomyces invadans* to undergo asexual reproduction. During sporulation (asexual reproduction) thousands of swimming zoospores are released into the water. These zoospores then search for a fish host. The zoospores infect the skin of the fish and cause the development of bloody skin ulcers. If a host is not found, the zoospores become cysts and sink to the mud or sediment).

¹⁵ ACOE, *Central and Southern Florida Project Reconnaissance Report*, November 1994, pg 213.

¹⁶ St. Johns River Water Management District, Muck Removal Project Enters first Phase, at http://sjr.state.fl.us/programs/outreach/pubs/irl_update/00fall02.html.

¹⁷ SFWMD, The St. Lucie River, at <http://www.sfwmd.gov/org/exo/mslsc/slr/index.html>.

A variety of species are affected

The most commonly affected estuarine fish are snook (*Centropomus undecimalis*), spotted seatrout (*Cynoscion nubulosus*), striped mullet (*Mugil cephalus*), silver mullet (*Mugil gyrans*), and sheepshead (*Archosargus probatocephalus*). Other affected species have included black drum (*Pogonias chromis*), pinfish (*Lagodon rhomboides*), American shad (*Alosa sapidissima*), pigfish (*Orthopristus chrysoptera*), red drum (*Sciaenops ocellatus*), Atlantic croaker (*Micropogonias undulatus*), and gray snapper (*Lutjanus griseus*).¹⁸



Photo: FWCC Fish and Wildlife Research Institute: Mullet with severe lesions. A lesion (or ulcer) is defined as the localized shedding of necrotic skin tissue, with exposure of the underlying dermal or muscle tissue.

Everglades Restoration: Not Getting the Water Right

The reestablishment of the natural hydrology of the Everglades ecosystem – proper water quality, quantity, timing and distribution – is often referred to as “getting the water right.” It is pivotal for saving the St. Lucie estuary and restoring ecological “connectivity” – the linchpin of Everglades restoration.

Before the Everglades was drained, diked and compartmentalized by governmental authorities, the waters of Lake Okeechobee would spill over creating a sheet flow of freshwater creeping southward by hammocks and through ridges and sloughs 100 miles south to Florida Bay. Given the critical role Lake Okeechobee, a 730 square mile lake, plays in the Everglades ecosystem, it has been described as the heart and lungs of the Everglades.

Today, Lake Okeechobee has been relegated to a reservoir, with water managers holding and releasing water through pump stations to satisfy the needs of agricultural and urban interests. The St. Lucie River has fallen victim to these regulatory releases and to a Comprehensive Everglades Restoration Plan (CERP) that fails to focus on restoring original Everglades hydrological patterns through natural means.

¹⁸ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, *Ulcerative Mycosis in Florida – Perspectives on Estuarine Fish Health – Lesions in Florida are Often Caused by Fungal Infection.*, at: http://research.myfwc.com/features/view_article.asp?id=25293.

Patchwork Attempts at Restoration

The SFWMD and the ACOE, the two lead agencies of CERP, are now addressing the impacts to the St. Lucie estuary through a host of separate initiatives.

LOER

For instance, The Lake Okeechobee and Estuaries Recovery (LOER) will include the creation of storm water treatment areas (STA)s and the implementation of Best Management Practices (BMP)s. The goal of LOER is to reduce phosphorus loading into Lake Okeechobee from farmland water runoff and utilizing STAs to improve water quality released into the C-44 canal before it reaches the St. Lucie Estuary.¹⁹

Lake Regulation Schedule

The Lake regulation schedule was most recently modified in 2000 and the ACOE has recently published a Draft Environmental Impact Statement (DEIS) for comment on the revised Lake regulation schedule. The discharge schedule seems to be driven by two primary objectives. The ACOE is concerned with flood control, while the SFWMD is tasked with holding lake levels high enough for water supply. The objectives are subtly referenced in the notice of the DEIS where the ACOE states that “[t]he preferred alternative regulation schedule attempts to balance competing objectives including flood control, water supply, navigation and enhancement of fish and wildlife resources.”²⁰

Unfortunately, a revised lake regulation schedule is likely to yield little benefit to the St. Lucie estuary because of the utilization of a flawed economic model and flawed climate data sets in determining appropriate lake levels.

Economic flaw

Water levels and flows are stringently manipulated in the canals to achieve optimum crop growth.²¹ Lake stages are maintained higher than necessary because theoretical models predict economic losses by agricultural interest – especially within the EAA – when irrigation supplies are inadequate. SFWMD publications predict more than \$100 million of losses to the sugar industry during droughts due to inadequate water storage in Lake Okeechobee, yet; there is no actual economic loss recorded during the period of 1971 to 2002 to validate such theoretical predictions.²² The root cause of the failure of lake regulation to protect the lake and estuaries is the model used by the SFWMD. This model, the South Florida Water Management Model, places the EAA at the center of all decisions by holding its water table approximately 18-24 inches below ground. Holding 600,000 acres at a constant water level and a constant water table, irregardless of wet season or dry season, forces the rest of Florida to compensate for seasonal fluctuations in rainfall for the benefit of the EAA. **In essence, sugar farmers are exempted from sharing in the adversity that burdens the rest of south Florida.**²³

¹⁹ SFWMD, Lake Okeechobee and Estuary Recovery, at <http://www.sfwmd.gov/site/index.php?id=727>

²⁰ Federal Register Notice of Lake Okeechobee Lake Regulation Study, August 18, 2006, at http://www.saj.usace.army.mil/cco/orss_draftSEIS.htm.

²¹ *Central and Southern Florida Project Comprehensive Review Study*, pg 1-15.

²² Rivers Coalition, *Killing the St. Lucie River, How Politics and Wasteful Projects Have Rendered a Great River Unfit for Human Contact*, pg 6-8, at www.riverscoalition.org/whitepaper.htm.

²³ *Id.*

The close relationship between the SFWMD and sugar farming interests in the EAA can best be illustrated by the following statement. "In the current water management district, sugar has friends," says Eric Draper, a lobbyist for Audubon of Florida. "Their whole future is governed by water-use permits and water-discharge permits. The entire Everglades water management system is run for the benefit of the sugar farms. They get water when it's dry, they get drained when it's wet."²⁴

Flawed climate “data sets”

Moreover, the lake levels are held higher than necessary because the modeling for CERP was conducted using average rainfall from 1965 to 1995 – a relatively dry period when there were 5 “wet” years and 25 “dry years.” The model produced skewed results that now cause water managers to hold too much water in Lake Okeechobee. We are currently in a period of Oscillations in the North Atlantic Sea Temperature (AMO).²⁵ This weather pattern produced a cold phase (dry) from 1970 – 1994, while 1995 to 1998 was the start of the hot phase (wet). The table below demonstrates the variability of rainfall entering the Lake during cold and hot phases.²⁶

Parameter	Cold Phase	Warm Phase
Mean net input water to Lake O	24.7 in/yr	51.5 in/yr
Standard deviation	23.2	39.7
Number of years (1913-1998)	37	47

The following quote by SFWMD scientists concedes that previously based CERP rainfall models were skewed and did not favor a flow-way conveyance system because the models predicted much less water. This anomaly is magnified as the scientific community believes that we are in the midst of a 30 year wet cycle.

We are currently in the warm phase (versus the cold phase) of a decades-long cycle of North Atlantic sea surface temperature. This phenomenon, known as the Atlantic Multidecadal Oscillation (AMO), describes temperature changes in the ocean surface that typically last several decades. The last previous warm phase

²⁴ David Fleshler, *Despite Primary Loss, Big Sugar Still a Player in Governors Race*, Sun Sentinel, September 10, 2006.

²⁵ Dr. Paul N. Gray, Presentation modified for the SFWMD Climate Workshop, Audubon of Florida, August 14, 2006.

²⁶ *Id.*

occurred from the middle 1920s through 1960s, when South Florida also experienced very wet conditions. Ring patterns in the cross-sections of old trees have a lot of information about past climatic patterns. Scientists, by studying the relationship between tree-ring data and past climate variation over the continents of North America and Europe, have been able confirm that the Atlantic Multidecadal Oscillation (AMO) phenomenon is a consistent feature in the global climate.²⁷

IRL Restoration

Improving the water quality and quantity outside the urban areas is the purpose of the Indian River Lagoon Restoration Plan. It calls for reservoirs to hold excess rainwater and filter marshes to clean runoff before returning water to the rivers. It calls for natural solutions, such as filling in ditches and removing dikes on farmlands, allowing the land to return to its original role in holding and cleaning water. Also included are dredging and removing polluted ooze that has built up on the river bottom over many years. The estimated cost of the plan is \$1.2 billion dollars.²⁸ It is essential to realize that The IRL Plan, while considered desirable, is not related to discharges from Lake Okeechobee.

The Everglades Agricultural Area Reservoir – Phase 1

The SFWMD recently announced its intent to create a 25 square mile Everglades Agricultural Area Reservoir intended to reduce discharges in to the St. Lucie estuary. The reservoir will be constructed in the eastern portion of the Talisman property²⁹ and it is heralded as one of the biggest reservoirs in the world. Yet, when completed, the reservoir will have the capacity to draw down Lake Okeechobee by only 9 inches. The reservoir will not have the capacity to draw down the lake during rain events of ¾ inches or more. This limitation highlights the need for more storage capacity south of Lake Okeechobee to prevent harmful discharges into the St. Lucie and Caloosahatchee canals during prolonged periods of rain.³⁰

Government officials are hailing the reservoir as a sign of their commitment to ecosystem restoration. Everglades conservation groups took a dimmer view. The 16,700 acre size of the reservoir and its limitation for water conveyance southward will provide little benefits to the estuaries.

While such projects will provide some ecosystem benefit, the piecemeal measures approach is not bold enough to save biological integrity of the St. Lucie River.

In 2005 the Everglades Coalition, an alliance of 45 highly regarded local, state and national environmental and conservation organizations dedicated to full restoration of the Everglades ecosystem,³¹ passed a resolution calling on CERP to be expanded to include at least 150,000 acres for water storage within the EAA.³² It called on federal and state

²⁷ SFWMD, Trimble & Obeysekera, *Current Climate/Weather Scenario Highlights Rare Conditions Not Seen for 50 to 100 years*, News Release, September 7, 2005.

²⁸ See SFWMD, Indian River Lagoon, at http://www.sfwmd.gov/org/wrp/wrp_ce/2_wrp_ce_lagoon/irl.html.

²⁹ The Talisman tract consist of 50,00 and was purchased in 1999 for \$135 million dollars, or \$2,700/per acre.

³⁰ SFWMD, *Everglades Agricultural Area Storage Reservoir A-1 Preliminary design Report for Structures*, WRAC Issues Workshop, August 24, 2006. Comments of Shawn Waldeck, Accelr8 Project Manager.

³¹ See The Everglades Coalition, at <http://www.evergladescoalition.org>.

³² *Id.*

agencies to fully fund a land acquisition plan for the EAA, including funding to purchase land and development rights from willing sellers as it leaves current agricultural production or sooner. Yet, the ACOE and SFWMD have pursued only 50,000 such acres for water storage.

The resolution went on to state that, “All agencies involved in restoration should recognize the need to restore flow through the Everglades. The connection between Lake Okeechobee and the remaining Everglades should be reestablished by managing water and water flow within the EAA.”³³

Therefore, it is necessary to acquire considerably more land in the EAA to increase the conveyance capacity between Lake Okeechobee and the Water Conservation Areas (WCA) – south of Lake Okeechobee - and to increase water storage capacity in the system. The present conveyance system is not adequate since hundreds of billions of gallons of water are discharged to sea each year eastward through the S-308 structure to the St. Lucie River, to the detriment of the receiving estuary. Even greater volumes are released out of the lake west to the Caloosahatchee River.

In water years 1983-1992, the average annual discharge from Lake Okeechobee to the Caloosahatchee was about 350,000 acre ft., ranging between 76,000-1,500,000 acre ft. Net discharges from Lake Okeechobee to the St. Lucie Canal occurred in 6 of the 10 water years, 1983-1992, amounting, to a 10-yr average annual discharge. of 267,000 acre ft.

Recapturing a large portion of this water for freshwater wetlands and discharge downstream to Florida Bay in a natural rain-driven pattern is absolutely critical to the restoration effort.³⁴

Reversing an Unnatural Flow

The regulatory discharges from Lake Okeechobee to the St. Lucie and Caloosahatchee estuaries show no signs of abatement. Due to a current long term wet-cycle, inflows into Lake Okeechobee were more than 1.5 times the long term average and the lake’s outflow was nearly two times the historical average. The rise in volume had a cascading effect on the St. Lucie estuary which received more fresh water than anticipated, up sharply from historical averages. Conversely, WCA3 inflows and outflows were similar to historical averages – and inflow to Everglades National Park (ENP) was only 65% of historical levels.³⁵

During periods of sustained rain events, the ACOE was dumping water east into the C-44 canal above historic average, while ENP received water below historic average. These management practices are symptomatic of the mechanized pumping of water, upon which CERP is based, and will be examined more closely. Present water management practices

³³ *Id.*

³⁴ See James Weaver, et al., *Federal Objectives for The South Florida Restoration by The Science Sub-Group of The South Florida Management and Coordination Working Group*, November 15, 1993.

³⁵ South Florida Water Management District, 2006 South Florida Environmental Report, March 1, 2006, pg. 22.

are “not getting the water right” if east and west discharges spike sharply during rain events, while water entering ENP is actually reduced below historic averages.

2005 discharges from Lake Okeechobee to the St. Lucie Canal: 303 Billion Gallons³⁶

The disjointed and unnatural inflows into various areas of the Everglades ecosystem underscore the importance of re-establishing the natural flow of the Everglades – reflowing vast amounts of Everglades water from Lake Okeechobee southward.

River of Grass Disappearing

The famed River of Grass originates in the Kissimmee lake region chain of Lakes and meanders down the Kissimmee River to Lake Okeechobee. The waters of Lake Okeechobee once spilled over creating a sheet flow of freshwater creeping southward to Florida Bay. The Everglades ecosystem is home to 68 federally listed threatened or endangered species and claims more biodiverse wildlife than Yellowstone National Park.³⁷ Unfortunately, because people have altered the water’s natural flow pattern, the Everglades ecosystem is at the tipping point of collapse.

Although some hinted at the importance of the Everglades system and the need for its preservation in the 1920s, the economic push for development proved too strong. Marjorie Stoneman Douglas's book, *The Everglades: River of Grass* (1947) could do nothing to stop drainage and flood control for urbanization, agriculture, and development. Drainage and ditching has destroyed 67% of the initial 3,600 square miles of wetlands that originally formed the Everglades.³⁸

Changes in the hydrologic structure of South Florida culminated in the creation and implementation of the Central and Southern Florida Project in 1948. The enabling legislation gave the ACOE the responsibility for construction and oversight of water management structures throughout the Kissimmee-Okeechobee-Everglades basin. The State created the Central and Southern Florida Flood Control District in 1949, which has since become the SFWMD. Flood control made possible massive land use changes that decreased the land available for water storage and recharge.³⁹

Sugar plantations occupied much of the land directly south of Lake Okeechobee – bisecting the ecosystem. There are 400,000 acres in production. Today, the largest pollution, predominately phosphorus comes from huge sugarcane plantations that not

³⁶ Revised data from the SFWMD - DBHydro. The revised data shows substantial increased discharges into the C-44 from previously released data. See South Florida Water Management District, 2006 *South Florida Environmental Report*, March 1, 2006, pg. 21.

³⁷ See The Everglades Foundation, Inc., at <http://www.evergladesfoundation.org>.

³⁸ Jennifer Bolger, *Creating Economic Incentives to Preserve Unique Ecosystems: Should Wisconsin Adopt a Private Wetlands Mitigation Banking Policy?*, 83 MARQ. L. REV. 625, 635 (2000).

³⁹ James Weaver, et al., *Federal Objectives for The South Florida Restoration by The Science Sub-Group of The South Florida Management and Coordination Working Group*, November 15, 1993.

only emit vast amounts of pollutants into the water of the Everglades, but also redirect and lose much of the water needed to help restore the Everglades.⁴⁰

The impact *and* the promise held in the EAA sugarcane production lands can't be overstated. The purchase of acreage for a flowway holds the promise of restoring the historic flow though the least mechanized means. Since EAA sugar production phosphorus pollution is the main culprit in destroying the Everglades water quality, purchasing such land for a flowway would reduce phosphorus loading into the Everglades and terminate the redirection of water from Lake Okeechobee eastward to the C-44 canal into the St. Lucie estuary. CERP, through its self-proclaimed "adaptive management" is the framework from which a natural flow from Lake Okeechobee through the EAA and south to Florida Bay may still be achieved.

A Better Way:

Plan Six Flowway

Restoring the natural southward flow of the Everglades ecosystem is absolutely critical to restoring the Everglades and saving the St. Lucie estuary from ruin. A flowway within the EAA was endorsed early in the pre-CERP scientific studies and has received renewed media interest.⁴¹ CERP was the outcome of several scientific reports and regulatory reports that endorsed ecological connectivity through a flowway.

The first flowway report, *The Federal Objectives for The South Florida Restoration by The Science Sub-Group of The South Florida Management and Coordination Working Group* was completed in November of 1993 by a team of highly respected scientists. The report made the clarion call for an ecosystem based restoration – stating that recapturing water diverted by manmade structures and naturally re-flowing Everglades water in a north to south direction was critical to Everglades restoration.⁴²

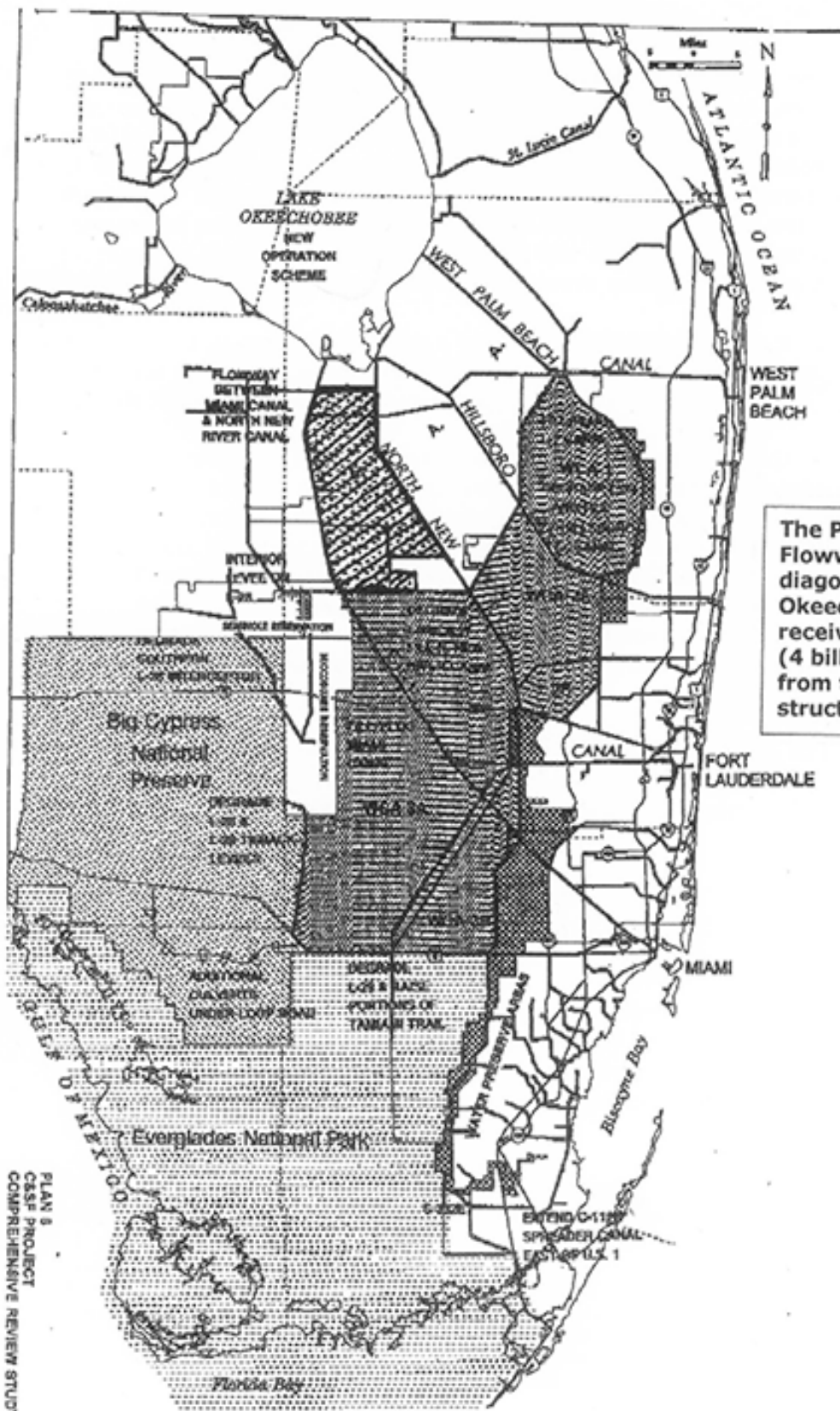
The report called for the restoration of the historic hydrological linkage from Lake Okeechobee to the Water Conservation Areas by providing adequate conveyance capacity to carry the volumes of water that otherwise would be released to tide in Lake Okeechobee discharges. The scientists concluded that the minimum level of restoration required the creation of a flowway for sufficient conveyance and transient storage within the EAA to allow the natural volumes and timings of flows through the Everglades.⁴³

⁴⁰ The Everglades Foundation, Inc., *America's Garden is Dying*, See <http://www.evergladesfoundation.org>.

⁴¹ Florida Sportsman, *Plan Six, The Only Fix*, August 2006, at <http://www.floridasportsman.com>.

⁴² See James Weaver, et al., *Federal Objectives for The South Florida Restoration by The Science Sub-Group of The South Florida Management and Coordination Working Group*, November 15, 1993.

⁴³ *Id.* at sub-region 4 EAA.



The Plan Six Storage Flowway is shown in diagonal lines below Lake Okeechobee. It would receive up to 6,600 cfs (4 billion gallons per day) from two enlarged control structures at lakeside.

PLAN 3
 C&S PROJECT
 COMPREHENSIVE REVIEW STUDY
 01. APR 68

The *Central and Southern Florida Project Reconnaissance Report* by the ACOE followed in 1994. The report was authorized by the Water Resources Development Act (WRDA) 1992 and analyzed how the current Central & Southern Florida (C&SF) system of dikes levees and canals was to be restructured to promote revitalization of the Everglades. The C&SF Project provides water supply, flood protection, water management and other benefits to south Florida. Included in the report was “Plan Six,” a proposal for a flowway through the EAA that efficiently and naturally restored hydrologic function to the Everglades – in other words, getting the water right!

A flowway is generally described as a broad, shallow marsh area that is used to freely flow water from Lake Okeechobee to one or more of the Water Conservation Areas. The Plan Six flowway was described as follows:

This plan provides even further restoration of the south Florida ecosystem by greatly increasing spatial extent. This plan . . . creates a flowway within the EAA that encompasses the area between the Miami Canal and the North New River Canal, beginning south of South Bay to avoid relocating residences. . . . The flowway would start two miles north of the Bolles Canal. The flowway varies in width at 7.2 miles from the upper end to 13.1 miles at the lower end⁴⁴ and is 22.5 miles long and has a capacity of 6,600 cfs. The existing east levee of the Miami Canal and the west levee of the North New River Canal would serve as levees for the flowway.⁴⁵

The *Central and Southern Florida Project Comprehensive Review Study*, also referred to as the “Restudy,” by the ACOE and SFWMD followed in 1999. The Restudy laid out the framework intended to restore the Everglades and was the foundation for CERP. The Plan Six flowway failed to make it into CERP.

CERP was approved in the Water Resources Development Act of 2000. It includes more than 60 elements, will take more than 30 years to construct, and will cost an estimated \$10 billion.⁴⁶

CERP was born out of political consensus that gave top priority to complete agricultural drainage while leaving ecosystem restoration a secondary priority. The WRDA 2000 bill stated that the “overarching purpose” of the bill was restoration, but its substantive provisions included much stronger protection for flood control and water supply; leaving ecosystem restoration as an afterthought.⁴⁷

⁴⁴ It should be noted that the dimensions were likely inverted in the original document due to typographical error and should read: The flowway varies 7.2 miles from the upper end to 13.1 miles at the lower end.

⁴⁵ ACOE, *Central and Southern Florida Project Reconnaissance Report*, November 1994, pg 143. The report went on to state that “[a] 2,940 cfs pump station would pump water into the northeast corner of the flowway from the North New River Canal. A railroad crosses the flowway near the upper end. Eight 400 foot bridges may be required and spaced at even intervals across the flowway. “

⁴⁶ SFWMD, *Comprehensive Everglades Restoration Plan*, at <http://www.evergladesplan.org>.

⁴⁷ Michael Grumwald, *The Swamp, The Everglades, Florida and the Politics of Paradise*, Simon & Schuster 2006, pg. 341.

CERP was the same plan that the Everglades National Park's own scientists had said "does not represent a restoration scenario for southern, central and northern Everglades." The latest version of CERP did not even guarantee that the project would do no harm to the Everglades – only that no one's level of water supply or flood control would be reduced.⁴⁸

Hence, it should come as no surprise that the Plan Six flowway was dismissed by the ACOE in the final CERP framework – the previously stated objections by the ACOE follow with scientific rebuttals supporting the feasibility of a flowway.

Stated Objections to a Flowway

OBJECTION:

A flow-way could not operate as a passive "natural" conveyance system under today's conditions. Soil subsidence in the Everglades Agricultural Area has changed the slope and contour of the land by reducing land elevations. A flow-way in this area would require additional canals, levees, and pumping facilities to get the water into the Everglades;⁴⁹

ANSWER:

It's understood that any constructed flowway-type conveyance or reservoir in the EAA will require a pumping station because soil subsidence from farming has created lowered elevations in the EAA than the surrounding areas. This is an operational variable that has already been incorporated into restoration by the ACOE and SFWMD. For instance, the proposed 25 square mile EAA Reservoir A-1, south of the EAA, will require a pump in the NE corner of the reservoir. The pump will draw runoff water from the EAA and rainfall into the reservoir and direct into STA 3-4. The pump will have the capacity to pump 5,000 cfs – making it the most powerful pump in the SFWMD pump arsenal.⁵⁰

OBJECTION:

A flow-way between Lake Okeechobee and the Water Conservation Areas has appeal regarding re-connecting the "river of grass" with the Lake. However, modeling has shown that the flowway concept fails to restore ecological values to the remaining Everglades, given the reduced size and water storage capacity of the remaining natural system compared to pre-drainage conditions, and;⁵¹

ANSWER:

This capacity of the southern Everglades system to receive water from Lake Okeechobee is an operational factor to be considered given that the Everglades is now 1/2 its original size. A flowway provides an array of benefits such as conveyance, storage and cleansing capacity – even recreation. For instance, a flowway can work as a pretreatment mechanism for phosphorus, thereby

⁴⁸

Id.

⁴⁹

Central and Southern Florida Project Comprehensive Review Study, Appendix – Comment 4, 1999

⁵⁰

SFWMD, Everglades Agricultural Area Storage Reservoir A-1 Preliminary design Report for Structures,

WRAC Issues Workshop, August 24, 2006. Comments of Shawn Waldeck, Accelr8 Project Manager.

⁵¹

Central and Southern Florida Project Comprehensive Review Study, Appendix – Comment 4, 1999.

increasing the efficiency of existing STAs. Therefore, stakeholders could decide which combination of benefits would work best for ENP and southward. The flowway concept should not be dismissed. It provides a desirable option for large scale conveyance of water from Lake Okeechobee to the WCAs and the south Everglades ecosystem. The versatility of a flowway provides more operational flexibility and thereby more options to water managers.

There has been no ecological modeling of a flowway. Moreover, the only hydrologic modeling was at an extremely coarse and conceptual level; a "screening" model. There was no ecological component, processes such as evaporation and flow were not explicitly analyzed, and there is no comprehensive published scientific analyses supporting this contention.⁵²

OBJECTION:

Water flowing from the lake to the WCAs, is not present in dry or even normal years! For example, during long periods from 1970-1982 or 1985-1994, no significant excess lake water was available for the flowway. Only demand releases to the Everglades were made from the lake during those periods. Water delivered to the Everglades on a demand basis, through a flowway, would not be effective with increased travel times and increased evapotranspiration losses. The only years where water could flow for long duration are wet periods like 1969-1970, 1982-1983, and 1994-1995.⁵³

ANSWER:

During the above mentioned dry years, the SFWMD released water through the S-308 into the C-44 and St. Lucie estuary on a regular basis – while at times, water from the C-44 basin was released into Lake Okeechobee. The inherent flaw with this argument is that the ACOE used a flawed CERP rainfall “data sets” that skewed the model results towards less rainfall – thus precluding the viable use of a flowway-type conveyance system. Moreover, as new lower Lake levels are considered to provide added dike safety to the Herbert Hoover Dike, more water will likely be available to discharge southward into an EAA flowway.⁵⁴ A flowway may assist in relieving water pressure on the Herbert Hoover Dike.

Aquifer Storage and Recovery (ASR)

CERP's planned alternative to creating a storage flowway is Aquifer Storage and Recovery (ASR). It is central to CERP and consumes almost \$2 billion of the overall program. The ASR wells are dual purpose, since they are intended to pump water underground for storage during summer wet periods and recover the water and release it during dry winter periods. Managers hope that the technology will provide a dependable water storage mechanism that can supplement surface storage reservoirs and provide water supply to the Lake Okeechobee ecosystem, Everglades ecosystem, agricultural irrigation, urban interests and others. CERP recommends approximately 333 ASR wells.

⁵² Conversation with Dr. Van Lent, Hydrologist, Everglades Foundation, August 2006.

⁵³ *Central and Southern Florida Project Comprehensive Review Study*, Appendix – Comment 54, 1999.

⁵⁴ SFWMD, Herbert Hoover Dike Analysis: Report Findings and Recommendations, May 16, 2006. (The report concludes that **the Herbert Hoover Dike as constructed today does not meet current dike safety criteria**).

The proposed injection and recovery pumping rate is approximately 1.65 billion gallons per day which is unprecedented in terms of other past or present ASR applications.⁵⁵ Total cost of the proposed CERP ASR System is approximately \$1,700,000,000.⁵⁶

The ASR system is predicted to store cumulative water of approximately 5 million acre feet.⁵⁷ By way of comparison, 5 million acre feet of water is equivalent to all the water in Lake Okeechobee at a water level of 11 feet.⁵⁸

ASR proponents emphasize that water stored underground isn't subject to evapotranspiration losses. This point, however, ignores the fact that evaporated water basically comes back to the ground, anyway, in the form of rain. A flowway would require less energy than ASR and therefore may be a more efficient way of storing and distributing the water.

The ASR projects are estimated to take 25 years. It may be noted, moreover, that previous projects normally require much longer than originally estimated, and large cost overruns are more the rule than exception.

By contrast, the basic components of the Plan Six concept already exist and a much shorter deployment period could be utilized if the political will were present.

Converting Farms to Flowway Acreage

An appropriate comparison may be made between an acre of EAA farmed land and an acre of flowway. Based on annual averages, each EAA farm acre requires 2 acre feet be stored in Lake Okeechobee, and an additional 4 acre feet of drainage and water quality treatment be provided by STAs and WCAs. A flowway may require some supplemental water supply, but much of the water required for a flowway is already stored and drained to benefit EAA sugar farms. The benefits of conversion from farmland to wetlands extend well beyond the boundaries of the flowway by reducing the operational requirements for irrigation and drainage throughout the system.⁵⁹

It may be true that a flowway based system could dry up during long periods of drought conditions. Yet, there's no valid reason to dismiss it on that basis. It is a natural occurrence for riverbeds throughout the world to dry up during extended dry seasons (cold phase). Given that Florida is in the midst of an extended wet season (warm phase), keeping the flowway wet will not be an operational consideration for decades. Moreover, the flowway doesn't have to stay flooded in dry years; it would serve as a utilitarian space. It would require less water each year than the farm fields that currently occupy the land thereby allowing reduced Lake Okeechobee water levels.

⁵⁵ Christopher J. Brown, PhD., et al, *ASR Regional Study: Benchscale Modeling*, July 2006.

⁵⁶ National Research Council, *Reengineering water storage in the Everglades: Risks and Opportunities*, 2005.

⁵⁷ *Id.*

⁵⁸ Conversation with Dr. Van Lent, Hydrologist, Everglades Foundation, August 2006.

⁵⁹ Conversation with Hydrologist, Dr. Kevin Henderson, August 2006.

What If ASR Doesn't Work?

The SFWMD has squarely questioned whether ASR is technologically feasible. The SFWMD states that the proposed scale of ASR in the CERP is unprecedented - "accordingly, significant uncertainties remain."⁶⁰

These uncertainties make scientists uncomfortable about solely relying on the extensive use of ASR as part of the CERP to achieve restoration goals. There is little doubt that ASR will work nearly everywhere in South Florida at some scale and to some degree of efficiency. In the event, however, that ASR implementation in some (or all) areas is not feasible, contingency plans have been considered.

During the planning of the CERP, alternative ASR performance scenarios were considered. These scenarios included reduction of ASR recovery efficiency from 70% to 30% and eliminating proposed ASR facilities. The failure of ASR could derail any hope of ecosystem restoration and doom the estuaries to more disastrous inundations.

The scenario removing Lake Okeechobee aquifer storage and recovery more than tripled Lake Okeechobee regulatory discharges to the St. Lucie Estuary and doubled discharges to the Caloosahatchee Estuary. In addition, if the Lake Okeechobee ASR is removed, southerly discharges from the Lake to the Everglades Agricultural Storage Area and Water Conservation Areas would increase via a Plan Six type of storage flowway.⁶¹

Herein lies the promise of redirecting funds from ASR and into EAA land purchases to convey and store water more effectively via a flowway. Rather than aggressively purchasing EAA farmland, the ACOE and the SFWMD have placed a \$ 2 billion bet on ASR to provide additionally required water storage capacity.

ASR technology has never been attempted on such a large scale and pilot programs are being conducted and evaluated to determine the feasibility of storing water underground during the wet season and then retrieving it during the dry season.

The SFWMD has anticipated anywhere from a 30% to 70% efficiency ratio for ASR – depending on the suitability of site-specific geological formations. The table below illustrates how many acre feet can be stored at various efficiency ratios, and how much CERP taxpayer dollars are wasted with ratios less than 100% efficiency.

%	Acre feet of storage	CERP opportunity cost
0	0	\$1.7 billion
30	1.5 million acre feet	\$1.19 billion
50	2.5 million acre feet	\$ 850 million
70	3.5 million acre feet	\$510 million

⁶⁰ See SFWMD, *Comprehensive Everglades Restoration Plan Aquifer Storage and Recovery Program*, at http://www.evergladesplan.org/docs/asr_whitepaper.pdf.

⁶¹ *Id.* at pg 10.

100	5 million acre feet	0
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STAs

It is important to note what function Stormwater Treatment Area (STA) play in Everglades restoration. An STA is typically a natural wetland or reconstructed wetland utilized to cleanse water by naturally treating / absorbing phosphorus from a tributary or drainage supply source. The STA that can be incorporated into the Plan Six flowway is STA 3-4. STA 3-4 is the only current STA located within the proposed flowway corridor and is the world's largest operational constructed wetland.⁶² It is 6,543 acres in size and is located in the Southeast corner between the Miami Canal and the New River Canal. It receives phosphorus laden water from the EAA and delivers it to Water Conservation Area (WCA) 3A.

To date, more than 40,000 acres of STA treatment wetlands have been created throughout the Everglades area by the ACOE and the SFWMD, as mandated in the 1994 Everglades Forever Act.⁶³ Total phosphorous concentrations on average were reduced from an average inflow of 147 ppb to an average outflow of 41 ppb.⁶⁴

STA3-4 was designed to treat up to 250,000 acre-feet of Lake water per year, but due to higher than anticipated EAA drainage volumes in 2004 and 2005, the SFWMD has advised the ACOE that there is no treatment capacity left for Lake waters. SFWMD is constructing another 18,000 acres of STAs because EAA drainage was underestimated due to faulty climate data sets.⁶⁵

The limitations of STA3-4 are significant. This STA can only cleanse 6 inches of Lake Okeechobee water per year, and during very wet years, as little as 2 inches of Lake Okeechobee water per year.⁶⁶

Bold New Pipeline 'Pipedream'

Faced with the STA shortcomings and the increasing doubts about storage wells , the ACOE recently suggested what it calls a "bold new approach" to consider--a buried pipeline running from Lake Okeechobee to the Miami area.

The pipe would carry untreated, high-phosphorous lake water directly to South Florida where it could drain into the aquifer or be sent to tide. The concept immediately was branded more of a pipedream than a viable solution.⁶⁷

⁶² South Florida Water Management District, 2006 South Florida Environmental Report, March 1, 2006, pg. 18.

⁶³ The 1994 law said that by the end of this year, farms and other businesses could discharge only 10 parts of phosphorus for every billion parts of water. Phosphorus, a fertilizer, abets the growth of plants like cattails that choke out native grasses and ecosystems.

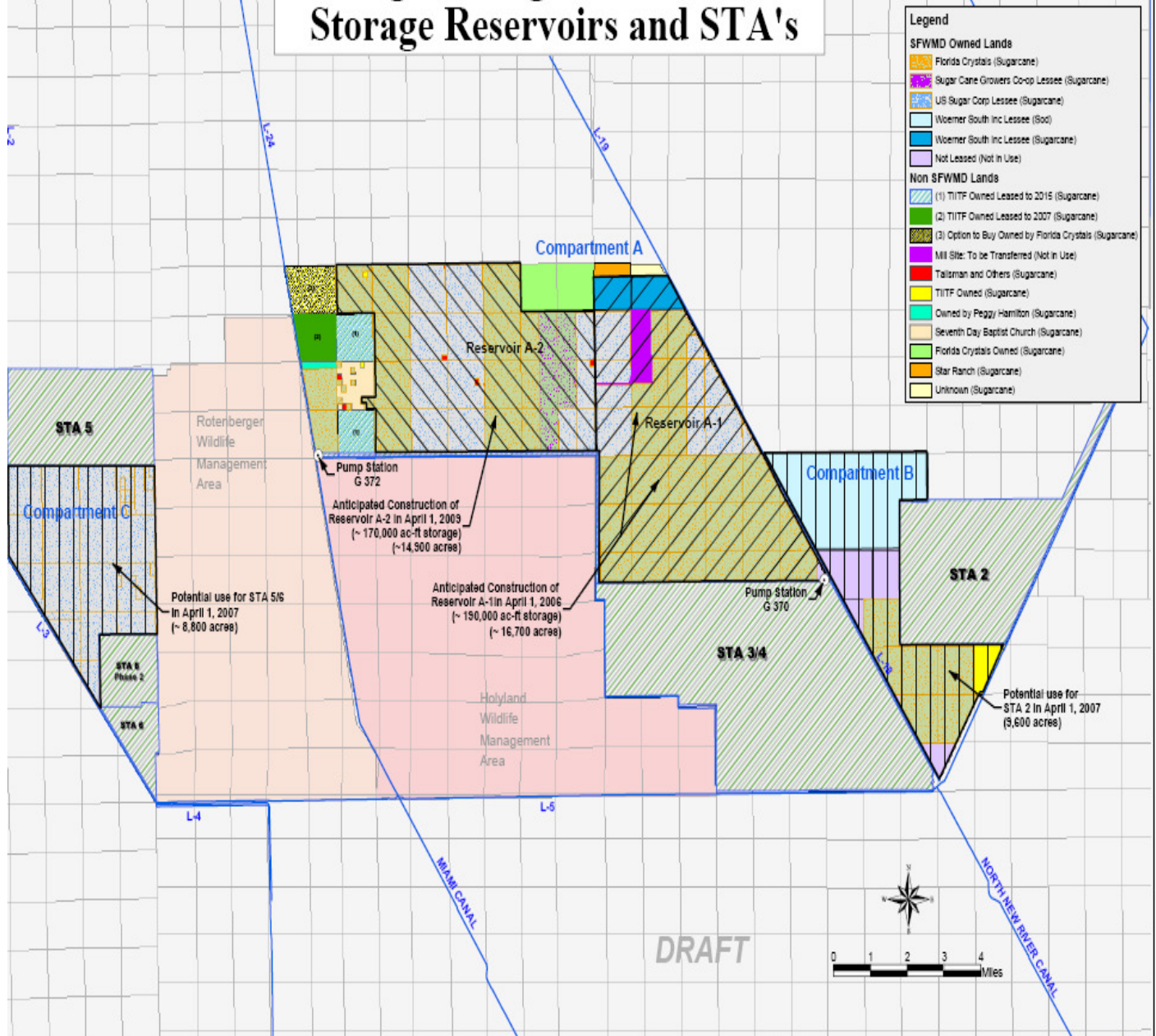
⁶⁴ South Florida Water Management District, 2006 South Florida Environmental Report, March 1, 2006, pg. 18.

⁶⁵ Conversation with Hydrologist, Dr. Kevin Henderson, August 2006.

⁶⁶ Conversation with Hydrologist, Dr. Paul Gray, Audubon of Florida, August 2006.

⁶⁷ Curtis Morgan, *Engineers' Fix for Everglades Restoration is in the Pipeline*, Miami Herald, October 21, 2006.

Everglades Agricultural Area Storage Reservoirs and STA's



South Florida Water Management District
Comprehensive Everglades Restoration Plan
3301 Gun Club Road, West Palm Beach, Florida 33416-4680

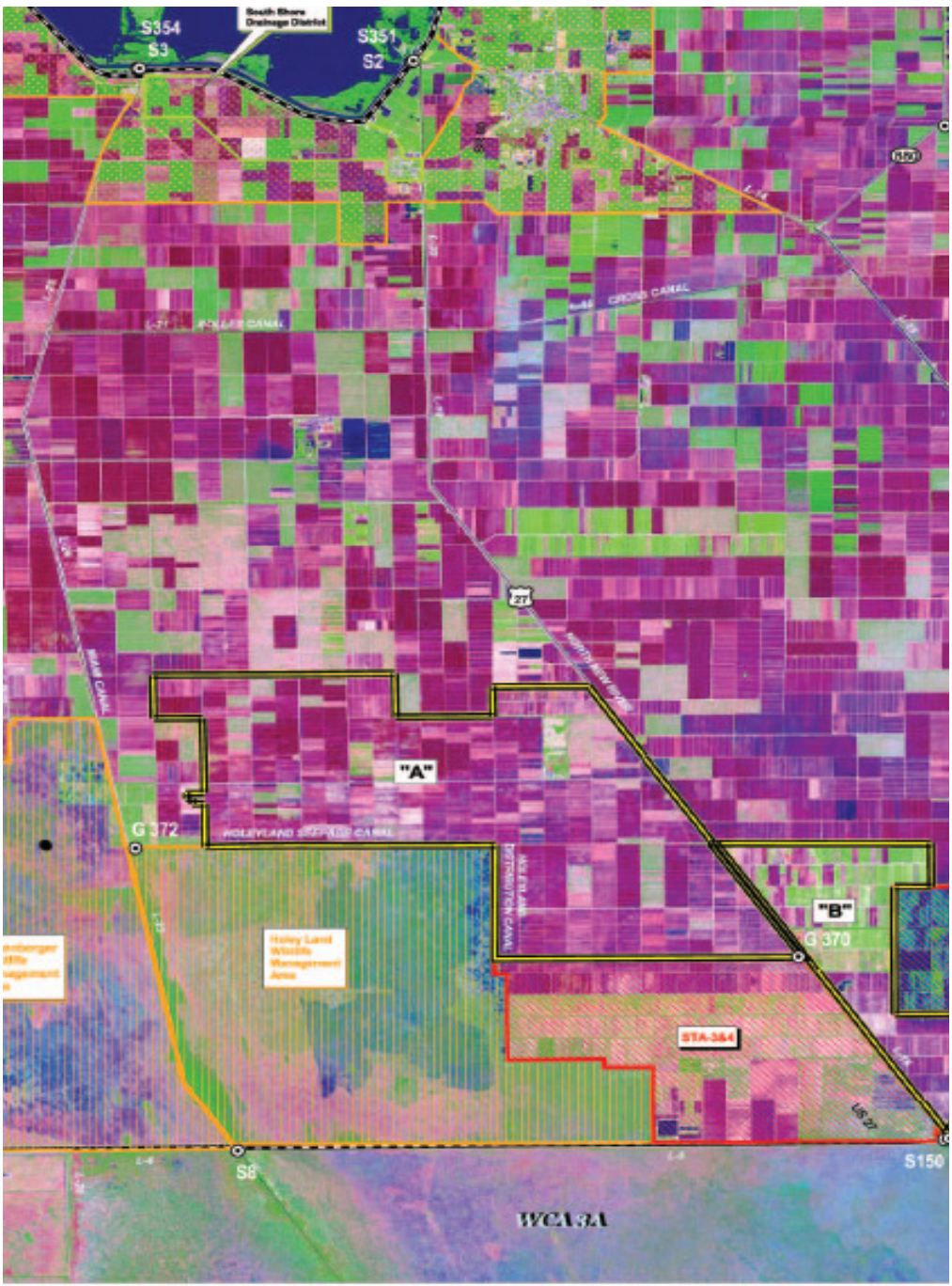
Everglades Agricultural Area
Storage Reservoirs and STA's

This map is an internal working draft and for conceptual purposes only. This map is not self-executing or binding, and does not otherwise affect the interests of any persons including any vested rights or existing uses of property.

Figure 2
April 2004
© 2004 South Florida Water Management District

Among other factors, the proposed pipe could move only 1,100 cubic feet per second, compared to 6,600 cfs envisioned in Plan Six.

SFWM map of STA 3-4 and the future site of EEA Reservoir A-1 and EEA Reservoir A-2. Note that both structures are within the Miami Canal and the North New River Canal, which is in the lower part of the proposed Plan Six storage flowway.



SFWMD aerial map of the EAA between the Miami Canal and North New River Canal. Map identifies area “A” as the Talisman tract upon which EAA Reservoir A1, and A-2 will be constructed with outflow directed to STA 3-4 in the southeast corner above WCA

3A. Note that there are large tracts of land feasible for acquisition between points several miles north of the Bolles Canal and the EAA reservoir.

The Plan Six Flowway Concept – Enlargement of Conveyance Capacity and Co-Benefits

It is important to note that the fundamental tenet of Everglades restoration is that hydrologic restoration is a necessary starting point for ecological restoration. Water built the South Florida Ecosystem. Water management changes are seriously *damaging* the Everglades ecosystem. And restoration begins with the reinstatement of the natural distribution of water in space and time. The spatial extent of the hydrologically restored area is critical to ecological restoration.⁶⁸

The restoration of the flow of southbound water is and has always been the major tenet of Everglades restoration.

The Plan Six Flowway alternative, introduced by the ACOE in 1994 in the *Central and Southern Florida Project Reconnaissance Report*, provides a framework for developing a flowway to move water from Lake Okeechobee southward – and reducing discharges and impacts to the St. Lucie estuary. The ACOE went on to state that one of the most important elements in restoring the Everglades is the “enlargement in conveyance capacity from Lake Okeechobee through the EAA.”⁶⁹

Ecological Benefits

The co-benefits of a flowway-based conveyance system

A flowway based conveyance system can provide many co-benefits to Everglades restoration – by partially meeting both ACOE and conservation NGOs stated requirements for additional land for water storage and cleansing. While there may be scientific disagreement on how much additional land is required for water storage and STAs, a Plan Six-type flowway is capable of satisfying future additional water storage and STA requirements. The following table produced by Audubon of Florida displays how much land has been or is planned to be purchased to satisfy CERP requirements – and how much additional land and acre-feet storage is required to minimally restore essential Everglades ecological functions (Table 1, Column 4).

Table 1. Essential Ecological Functions of EAA Lands to Achieve Everglades Restoration

Function	Total Goal	Existing/Planned	Additional Need
Water Storage	1,000,000 Acre-Feet	360,000 Acre-Feet	640,000 Acre-Feet
Water Retention	375,000 Acre-Feet	225,000 Acre-Feet	150,000 Acre-Feet
Water Treatment	10 ppb Phosphorus	41,400 Acres STAs	30,700 ⁱⁱⁱ Acres STAs
Habitat	80,000 Acres	65,000 Acres	15,000 Acres

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⁶⁸ See James Weaver, et al., *Federal Objectives for The South Florida Restoration by The Science Sub-Group of The South Florida Management and Coordination Working Group*, November 15, 1993.

⁶⁹ ACOE, *Central and Southern Florida Project Reconnaissance Report*, November 1994, pg 188.

⁷⁰ Audubon of Florida, *Sustainability Plan for the Everglades Agricultural Area*, 2004.

The following SFWMD table describes the land purchased for CERP implementation as of 2001. According to SFWMD officials, no efforts are underway to purchase additional land within the EAA for water storage or STAs.⁷¹

Closed 1-1-94 through 4-30-2000	Acres	Closed 5-1-99 through 4-30-2000	Acres
Everglades Agricultural Area	51,210.08	Everglades Agricultural Area	-
Stormwater Treatment Areas	46,488.21	Stormwater Treatment Areas	988.92
Water Preserve Areas	9,855.38	Water Preserve Areas	1,740.94
Southern Glades (C-111)	9,239.57	Southern Glades (C-111)	107.16
Model Lands	6,719.41	Model Lands	1,208.01
8.5 Square Mile Area	495.95	8.5 Square Mile Area	118.12
Water Conservation Areas	3,014.03	Water Conservation Areas	-
Total Land Acquisition	127,020.61	Total Land Acquisition	4,159.15

72

Given the Audubon of Florida estimates in Table 1, the SFWMD must purchase another 40,000 acres within the EAA for STAs and land capable of holding another 640,000 acre feet of water for storage. The flowway can effectively meet these requirements in a feasible economic and ecological fashion.

Conveyance

Costs of a flowway-type conveyance may vary depending on the width of the conveyance mechanism and the water level within the conveyance system. The costs of establishing such a conveyance are broken into two components, purchase of land and construction.

Cost of Plan Six Flowway as envisioned in *Central and Southern Florida Project Reconnaissance Report*, was: \$86.6 million dollars for construction; \$506.2 million dollars for land acquisition for a total of: \$592.8 million dollars (in 1994 dollars).⁷³ The cost of the Plan Six conveyance system is relatively low because its spatial extent is contained within existing levees or the North New River Canal to the east and the Miami River Canal to the west.

The cost of a more constrained flowway conveyance was also considered in the *Central and Southern Florida Project Reconnaissance Report*. A flowway with less spatial extent would require the construction of embankments to control the water. A 3 mile-wide flowway originating from the Bolles Canal running through the EAA was anticipated to cost: \$126.9 million dollars for construction; \$244.8 million dollars for land acquisition for a total of \$373.3 million dollars.⁷⁴ Note that a 3 mile wide flowway involves more up front construction costs due to the need for construction of embankments east and west to contain the water.

It is important to note that a flowway and a reservoir serve primarily different needs. A reservoir holds water for urban, agricultural, and ecosystem benefit, while a flowway serves as more of a natural conveyance of water between two points. Nevertheless, a

⁷¹ Conversation with Shawn Waldeck, P.E., Acceler8 Project Manager, SFWMD WRAC Workshop, August 24, 2006. See Also SFWMD, 2006 *South Florida Environmental Report. Section 6-14 Land Acquisition and Management*.

⁷² ACOE, 2001 *Everglades Consolidated Report*, 2001.

⁷³ ACOE, *Central and Southern Florida Project Reconnaissance Report*, November 1994, pg 192.

⁷⁴ *Id.* (in 1994 dollars).

flowway can work in conjunction with already planned reservoirs (EAA A-1, A2) in conveying water southward. An EAA flowway could convey water to the EAA A-2 reservoir, where a pump station would drive it south to STA 3-4 and into WCA 3A and WCA 2.

Storage

While a conveyance southward is critical to restoration, managing lower Lake Okeechobee levels and saving the St. Lucie estuary; water storage is also necessary to provide for the water needs of all stakeholders. The ACOE and SFWMD has estimated that 360,000 acre feet of storage is necessary within the EAA to meet the demands of south Florida,⁷⁵ while conservation groups insist on a minimum of 1 million acre feet of storage with the EAA. It is important to note that reservoir construction is prohibitively expensive.

For instance, the EAA Reservoir phase-1 is 16,700 acres or 25 square miles. The EAA Reservoir phase 1 construction cost (embankment and reservoir with a 25 foot seepage wall) will cost \$339,000,000. Therefore the cost per square mile of reservoir construction is \$13,560,000.⁷⁶

The EEA A-1 reservoir will be fed by EEA runoff, rain and drawdowns of Lake Okeechobee – although the capacity of the reservoir is limited to only a 9 inch reduction of Lake Okeechobee water levels. How will storage targets within the EAA be met in a way that can effectively reduce water levels in Lake Okeechobee and prevent discharges into the C-44 canal and St. Lucie Estuary? Again, the piecemeal projects described above will help improve the St. Lucie estuary, but the lack of large water conveyance capacity to move water from Lake Okeechobee to ENP condemns the St. Lucie estuary to further regulatory discharges.

While the EEA Reservoir plays a water storage role in restoration, it is fed by the North New River Canal which has a limited capacity to convey water southward. A flowway concept plays a necessary role in conveying water southward, as well as providing some storage benefits, and STA cleansing benefits.

STA - Type Benefits

For instance, STA3-4 can only handle limited amounts of Lake Okeechobee water and thus additional purchases of STA land would be required to handle any significant southward conveyance. Fortunately, a flowway conveyance from Lake Okeechobee to the EAA reservoirs ending in STA 3-4 at water levels of 3 -4 feet could serve as a pretreatment mechanism for phosphorus.⁷⁷

The net effect would be to increase the efficiency of STA 3-4 by allowing it to receive water with less total phosphorus. As long as the flowway would remain wet, it could accumulate peat soil, as do the STAs, and use an anaerobic process to store phosphorus.

⁷⁵ *Central and Southern Florida Project Comprehensive Review Study*, Appendix – Comment 100.

⁷⁶ *Everglades Agricultural Area Storage Reservoir A-1: Preliminary Design Report for Structures*, WRAC Issues Workshop, August 24, 2006. (\$339,000,000 / 25 = \$13, 560, 000 per square mile).

⁷⁷ Conversation with Dr. Van Lent, Hydrologist with the Everglades Foundation, August 2006.

Economic Benefits of Plan Six Flowway

Plan Six proposes a flowway 22.5 miles in length and an average width of 10.2 miles. Hence, the flowway would comprise 230 square miles, or 147,200 acres. Approximately 60,000 acres have since been purchased by the ACOE and SFWMD for STAs and proposed storage. This leaves approximately 70,000 to 90,000 acres for a Plan Six flowway purchase.⁷⁸ Anecdotal evidence suggests that land prices within the EAA are approximately \$ 5,000 to \$ 9,000 dollars per acre. Therefore, the purchase price for land at a median price of \$7,000 per acre would amount to a total purchase price of \$560 million dollars.⁷⁹ Construction costs would be well below the square mile cost of EAA Reservoir A-1. The construction of levees would not be a significant financial consideration as the Miami Canal and the North New River Canal would serve as east west levees. Plan Six calls for a 2,490 cfs pump station at the northeast corner of the of the flowway from the North New River Canal and a 4,170 cfs pump station at the northwest corner of the of the Miami Canal. Some secondary canals within the flowway track would be degraded to ground and engineering considerations would be given to a railroad that crosses the flowway near the upper end.⁸⁰

A four foot water level within the flowway would provide 320,000 acre feet of storage. A six foot water level would provide 480,000 acre feet of storage. Coupled with the planned EAA reservoir storage of 360,000 acre feet, water storage within the EAA begins to approach the 1 million acre feet required for ecosystem restoration.

The investment in a flowway is offset by reducing reliance on untested technologies such as large scale ASR. Just consider that if after construction is complete and ASR only retrieves 30% of the water it has stored, the wasted taxpayer funds allocated to the technology will be \$1.19 billion dollars. Moreover, the importance of above ground water storage of a flowway will be invaluable should ASR fail to perform adequately.

Some practical challenges that could affect creation of a Plan Six flowway may involve unwilling sellers, a possibility of moving excessive amounts of water south in extreme rain events and flowway seepage. Yet, with the resources available, while considering the flowway benefits, such roadblocks can be overcome.

The implementation of a flow-way conveyance is then a matter of determining the flowway route, spatial extent, water level, and allocation of funds for land purchase and flowway construction.

⁷⁸ Exact acres purchased will depend on operational factors. For Ariel views of townships within the flowway tract evidencing approximately 70-90,000 acres available for purchase see <http://www.labins.org>, and www.pbcgov.com/papa.

⁷⁹ 80,000 acres x \$7,000 = \$560,000,000

⁸⁰ ACOE, *Central and Southern Florida Project Reconnaissance Report*, November 1994, pg 143.

As previously mentioned, besides water conveyance, a flowway can incorporate water storage and STA benefits. Yet, the higher the water level, the less phosphorous reduction one might expect from a flowway, because; higher water levels will destroy submerged aquatic vegetation needed for removing phosphorus. Therefore, a water level could be established that optimizes all three benefits simultaneously: conveyance; storage; and phosphorous reduction.

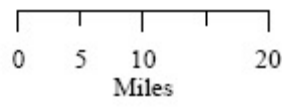
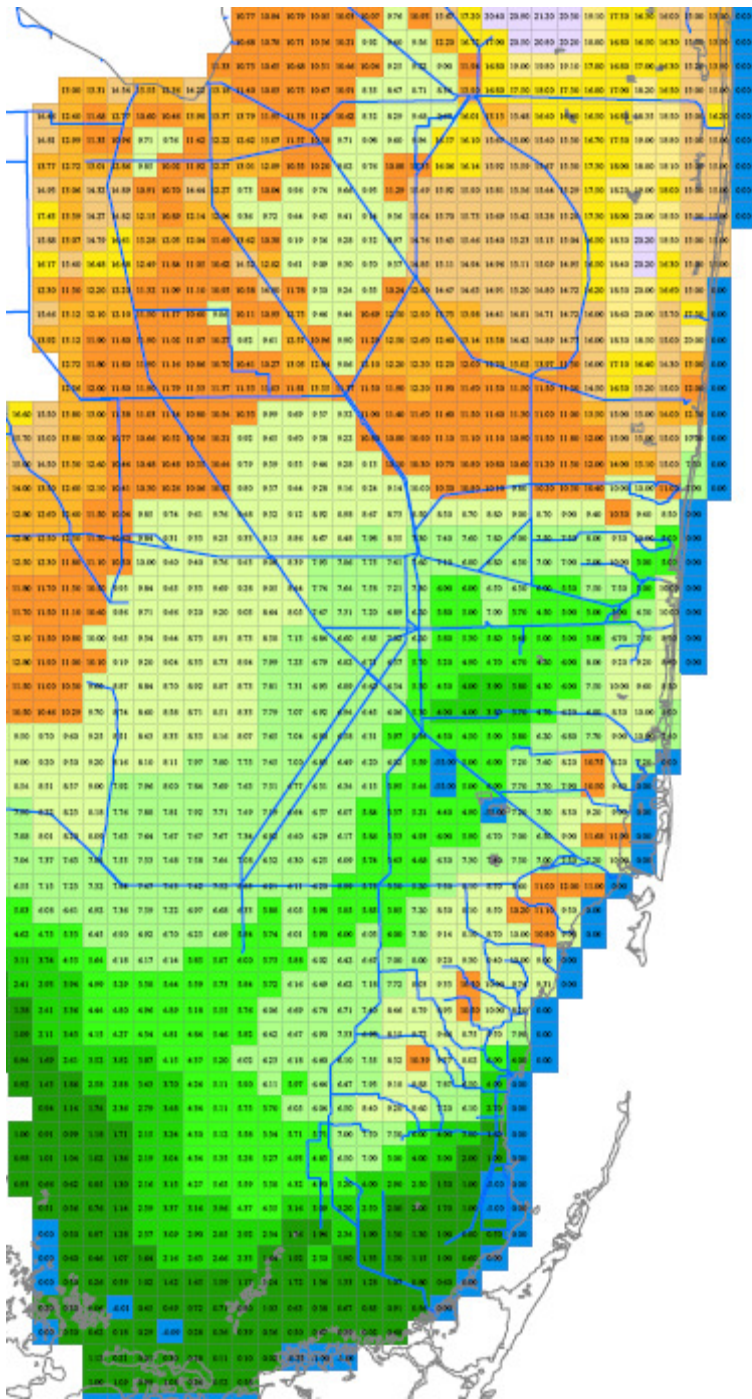
EAA subsidence provides opportunity

The flowway conveyance is achievable since much of the EAA is subsiding - losing soil and its ability to maintain crops.⁸¹ The soil loss begins on the north end of the EAA and is more severe as one heads southward. This is why the first purchase in the EAA, the Talisman purchase, was in the southern most end of the EAA. As the northern areas of the EAA continue to erode, opportunities will abound for willing seller purchases if the SFWMD directs its resources to such purchases.

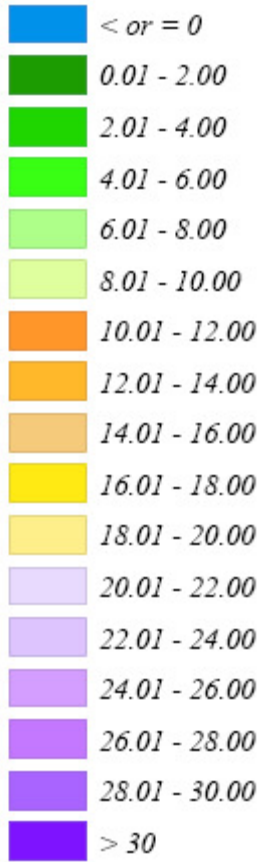
The following SFWMD topographic map indicates the elevation of the EAA land between the Lake and WCAs is 10-12 feet in elevation, and down to 8 feet in the eastern areas. Thus if the Lake is about 12 feet, you have the benefit of gravity to flow the flowway and depths that could be in the 3-4 foot range, which will likely allow submerged aquatic vegetation to grow. At this water level, there would be considerable phosphorus and nitrogen treatment capacity during wet periods. The 5,000 cfs pump in the proposed EAA Reservoir will aid in pumping the water south through the reservoir and into STA 3-4.

Ultimately, stakeholder input would provide the parameters for the spatial extent and use of the flowway. The spatial extent and water levels within the flowway would be determined by the selected function of a flowway: conveyance; storage; and, or pretreatment. The flowway offers water conveyance and storage certainty while providing water managers flexibility in utilizing the flowway to benefit restoration goals.

⁸¹ James Weaver, et al., *Federal Objectives for The South Florida Restoration by The Science Sub-Group of The South Florida Management and Coordination Working Group*, November 15, 1993 (Soil subsidence (primarily oxidation) is occurring at the rate of 3 cm per year because of drainage).



**ELEVATION
(feet NGVD 29)**



Conclusion

The tide can be turned on ecological devastation of the St. Lucie estuary. Creation of a storage flowway through a comparatively small part of the Everglades Agricultural Area land holds the promise of eliminating harmful discharges from Lake Okeechobee to the St. Lucie estuary, and providing historic connectivity between Lake Okeechobee and the Everglades ecosystem.

Plan Six offers a preferred framework for an ecologically and economically feasible conveyance of water southward from Lake Okeechobee. The Plan Six flowway is capable of providing multiple restoration functions, including conveyance, storage and pre-treatment of excess nutrients. The flowway may lessen the financial exposure of CERP by reducing reliance on untested technologies, such as large scale aquifer storage and recovery wells.

Plan Six continues to be a viable restoration option since its introduction in 1994. It was dismissed then by authorities who sought to avoid a flowway south and instead concentrate on the ASR approach without any change in the agricultural drainage area.

The tragic degradation of the St. Lucie estuary is a sad testament to the inadequacy of present CERP policy. Now, through CERP's adaptive management policy, an EAA Plan Six-type flowway can and should become the focus of Everglades restoration.

The St. Lucie estuary is resilient and capable of recovering from the brink of collapse. The future of the St. Lucie ecosystem depends on it. Plan Six offers a roadmap to recovery of the St. Lucie and the southern Everglades ecosystem.

A compelling case has been made that investment in a flowway can reduce “downside” economic exposure while increasing “upside” ecological benefits. No plan is without its operational challenges, and Plan Six is no exception. Yet, the net benefits substantially outweigh current CERP plans. It is not too late for state and federal authorities to embrace the net benefits of the Plan Six flowway concept. The resuscitation of the St. Lucie estuary and eco-based Everglades restoration demands it.

George S. Cavros, Esq. prepared the Plan Six Concept analysis for the Rivers Coalition Defense Fund, the non-profit corporate entity created by the Rivers Coalition of Martin County which represents more than 40 organizations in the St. Lucie Estuary community. Cavros is a South Florida attorney experienced in legal research who has worked with the National Environmental Trust, Florida Sierra Club Legal Committee, Environmental Land Use Law Center, Nova Southeastern University and the Environmental Protection Agency.