

EVERGLADES: THE CATALYST TO COMBAT THE WORLD WATER CRISIS

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ABSTRACT

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A healthy Everglades is directly linked to sufficient clean fresh water. The plan to restore the Everglades, the Comprehensive Everglades Restoration Plan (CERP), is the most ambitious and largest ever. If executed now, it will serve as the model, example, proof of purpose, and catalyst for ecosystem restoration around the world. There were many challenges to developing CERP. Similarly, there are serious challenges to executing it now. Its future is no doubt fragile. CERP affords mankind a premiere opportunity to undo past errors and more importantly secure a future with water through a healthy ecosystem. With water, the ecosystem with mankind will flourish and survive.

EVERGLADES: THE CATALYST TO COMBAT THE WORLD WATER CRISIS

Nature is delicate, dynamic, and complex; ecosystems are vital components of nature's inner workings. An ecosystem is a place where a-biotic factors consisting of air, chemical elements, energy, rocks, and water interact with biotic factors consisting of animals, microorganisms, and plants.¹ Earth consists of a series of interdependent ecosystems which are multifaceted and complicated as nature itself. In a natural and healthy state, an ecosystem like the Florida Everglades is unmanaged and harmonious. When mankind affects even a single factor of an ecosystem, both short term and long term consequences are potentially catastrophic.

Ambitions and efforts to develop the Florida Everglades over a hundred year period resulted in the near destruction of an important, extensive ecosystem. It was a long and difficult battle as nature and the ecosystem reacted in violent, resistant, but resilient ways toward human encroachment and development. In the 1960's, it seemed that humans had temporarily won the battle for development. Unfortunately, the well-intended efforts to drain the land of water for the purpose of development resulted in numerous, unintended, and negative consequences. Fortunately, some individuals recognized the error and stark reality ahead; they formed a coalition of the willing from among numerous diverging interests as well as achieved the consensus and political will to restore and protect the ecosystem. Their achievement is known as the "Comprehensive Everglades Restoration Plan" or CERP. It is the largest, most ambitious restoration plan in the world. Its intended objective is restoration of the ecosystem through management of the flow of water. Its long term success will provide and protect the water vital for life in the Southeastern United States. The CERP model

is worthy of much discussion and study. Within its powerful example are the catalysts for the restoration of other ecosystems around the world, a principal step of great magnitude if humans are to keep the ensuing water crisis from reaching apocalyptic proportions.

This paper identifies the vitality of fresh water to life. It further describes the world crisis for fresh water. It suggests parallel solutions to the crisis to include conserving and reusing available fresh water, desalinating seawater, and the restoration of ecosystems such as the Florida Everglades. Understanding the Florida Everglades is crucial to understanding the world water crisis as well as finding ways to avert it.

Mankind is a major and growing factor of the ecosystem. The water crisis was largely created by them. Their actions discussed in this paper, notably over the last century in Florida, were well-intended but unfortunately included unintended and undesirable consequences for the ecosystem. Similar stories are true for many parts of the world. This paper explicitly and directly links a healthy ecosystem to sufficient clean consumptive fresh water. The link was not always known or appreciated. There is much goodness, known and unknown, from a healthy ecosystem to include available consumptive fresh water. The selfish need for survival with sufficient and clean freshwater is motive for mankind to restore the ecosystem. For this motive and others and in many parts of the world today, mankind recognizes the link, the crisis, and the need to restore ecosystems now.

The CERP is the largest undertaking in the world to restore an ecosystem. As such, it sets the example, models the way, and provides proof in purpose for Florida, the United States, and the world. This paper documents the spectacular effort in

creating and executing the CERP, its current challenges, its value, and consequences of not doing it now. Two very limited resources affect the CERP, time and funding. Time is of the essence for the ecosystem and maintaining the willing coalition necessary to restoring it. Past funding is insufficient. Immediate funding is essential. The CERP is postured for execution but not yet physically begun on the land. Its future is fragile. If it endures and succeeds, it is the catalyst to combating the world water crisis. If it fails, other similar efforts will follow furthering the crisis for water.

International Context for Everglades Restoration: Life and Water

Life begins with water and quickly ends without it. Life on earth is sustained by sufficient quantities of clean, potable water. The symbolic vitality of water is reflected in the oldest traditions and rituals to include century's old baptisms; "by the gift of water you nourish and sustain us and all living things."² The United Nations Committee for Economic, Social, and Cultural rights similarly reflected the vitality of water in a more recent resolution dated November 2002 declaring; "Water is fundamental for life and health. The human right to water is indispensable for leading a healthy life in human dignity. It is a prerequisite to the realization of all other human rights."³

Although few would disagree with the United Nations resolution that water is a human right, great disparity exists across the world in terms of the availability and consumption of fresh water. The human body consists of 60-70% water depending on gender and other factors.⁴ At a minimum, it takes approximately 7500 gallons of water per year to sustain a human life to include food production.⁵ The largest requirement for the finite volume of available fresh water is agriculture, (70%), followed by industry (22%), and finally, residential and municipal (8%).⁶ In some nations in Africa, a person

survives on just over one gallon of water per day whereas in Los Angeles, California, a person consumes about 130 gallons per day.⁷ Other reports define a daily adequate supply of clean potable fresh water as thirteen gallons per person to include 10% for drinking, 40% for hygiene and sanitation, 30% for bathing, and 20% for cooking.⁸

Whatever the human consumption rates of fresh water, minimum required versus adequate, the undisputed fact is clean, potable fresh water is a fundamental part of daily life. Biological science accounts for appreciable human reactions associated with water composition in the human body: a 1% deficiency results in thirst, 5% results in fever, 8% results in no saliva and a blue body, 10% results in inability to walk, and 12% results in death.⁹ These human physical reactions clearly substantiate that life perishes without water.

Underlying the importance of clean fresh water is the fact that only 1% of the earth's water is available for human use. The earth's composition is deceiving at first look. Despite being 75% water, 97% of the earth's water is seawater/saltwater and unsuitable for human consumption. Two-thirds of the earth remaining 3% water is withheld in glaciers, snow, and ice, and unavailable to humans. That leaves approximately one percent of the earth's water in rivers, lakes, and aquifers available for human consumption.¹⁰ A fraction of this remaining one percent of fresh water is contaminated. Consumption of contaminated water causes sickness, serious illness, disease, and even death. The United Nations and World Health Organization estimate that more than two million people die every year from consuming contaminated water.¹¹ The United Nations reports that 9500 children alone die from polluted water each day.¹² Reality is that less than one percent of the earth's water is fit for human consumption.

The old mariner rime best summarizes this reality “Water, water everywhere and all the boards did shrink; Water, water everywhere nor any drop to drink.”¹³

The challenge for mankind is thinking and behaving differently from the past in regards to water. Despite the stark realities about available fresh water and its consumption, scientists believe sufficient water exists when humans act in prudent ways toward nature and its delicate ecosystems.¹⁴ Mankind is endowed with a fixed number of water molecules on earth. The number of water molecules is a constant.¹⁵ Despite their actions, inaction, and often ignorance, mankind cannot create or destroy water molecules. Water transforms through the hydrological cycle from vapor, solid, and liquid, moving hundreds of miles, underground and aboveground, remaining constant in quantity of molecules within the biosphere.¹⁶ Unfortunately, many parts of the world consume water faster than the hydrological cycle can sustain.¹⁷ Compounding the water challenge is the fact that water is a basic essential to life of which there is no known alternative.¹⁸ For example, the current energy crisis of the 21st Century is centered on oil. However, unlike water, there are numerous alternatives to energy other than oil. A significant challenge of the looming water crisis is maintaining water at the right flow, time, place, and quantity in each stage of the hydrological cycle to support the human and ecological requirements.

Water Requirements

Unlike the fixed quantity of water molecules, the world’s population and their desire for water are not fixed. The requirements for fresh water are growing at unprecedented rates. The world’s population doubled from 2.5 billion in 1950 to 5.3 billion in 1990. The approximate current world population as of 2008 is 6.6 billion.¹⁹

Estimates project a world population of 10 billion by 2050, potentially stabilizing at 12 billion by the end of the 21st century. Most alarmingly, estimates suggest that 90% of the population growth is occurring in the developing world where the challenges of providing clean potable fresh water are most significant.²⁰

The desire for water grows most significantly in the developed world. The per capita world water consumption rates are increasing twice as fast as population growth.²¹ Some experts contend that the thirst for water in the civilized and developed world is insatiable.²² The challenges of a looming water crisis bring innovative solutions for making clean potable water into focus to include conserving and reusing fresh water, desalination of seawater, maximizing and sustaining the hydrological cycle, protecting and restoring the ecosystem, and distributing water where and when it is needed in the right quantities. Multiple solutions, which cumulatively can provide sufficient quantities of clean potable water, do exist. However, the “crux of the matter is the political will.”²³ Former Russian Leader and President of Green Cross International, Mikhail Gorbachev, once challenged world leaders with the “universal responsibility to ensure that the forecast of a world, where in 25 years’ time two out of every three persons face water stress, is proven wrong.”²⁴ Gorbachev and others have recognized that despite the emergence of good, innovative, and multiple solutions for water, if political will is insufficient to affect the future of water, the consequences of the pending crisis are very serious.

Current estimates report that 1.2 billion people reside in fresh water stressed areas where water requirements, to include agricultural, industrial, residential and ecological, exceed availability.²⁵ The United Nations projects that forty eight nations

totaling 2.8 billion people will face a similar dark reality of fresh water stress by 2025.²⁶ Other sources suggest that as many as 65 nations will face this stress by 2025.²⁷ More than half of the world's wetlands, essential to the ecosystem and sustainment of the hydrological cycle, were destroyed in the last century in support of developing civilization.²⁸ Global withdrawals of fresh water continue to exceed the production of fresh water by the hydrological cycle. This shortfall perpetuates a prioritization of fresh water for agricultural, industrial, and residential purposes at the expense of the ecosystem and environment.²⁹ Extraction of fresh water from century old aquifers at rates faster than the ecosystems recharge has resulted in significant drops in water tables. The drops in the water tables are enormous to include a 150 foot drop in parts of Texas, Kansas, and Oklahoma due to extractions from the Ogallala aquifer, one of the worlds largest located across the Great Plains.³⁰ Alarmingly, hydrologists believe that as much as 60% of the water extracted from sources, to include the extensive amounts from aquifers, is wasted.³¹

Apocalypse and Water

The harsh possibilities of the looming water crisis are near apocalyptic. A little known example of human harm of a delicate ecosystem occurred in the Aral Sea near Uzbekistan beginning in 1967. Two- thirds of the Aral Sea, the third largest inland sea in the world, dried up and disappeared completely due to the diversion of water for agricultural purposes, primarily the production of cotton. Today, the harbor, 75 feet in depth, appears like a sand dune and is dry as far as the eye can see. The fishing industry of 60,000 people is gone. A study in 1989 reported that 30 million people were affected by the unintended consequences of actions regarding the water and the sea to

include toxic dust and dry salt. Two-thirds of the people in the area suffer from diseases like hepatitis and throat cancer.³² The Aral Sea tragedy is not an anomaly—it is an alarming likelihood for many places in the world with frail and damaged ecosystems to include the United States.³³

Recognizing that there are more catastrophic crises looming regarding water is the first major step in positively affecting the future. Immediate and extensive actions are required along with the tireless emphasis and support of world leaders. The United States can lead by example in this enormous task. There are many parallel options for leaders. Among them are conservation and reuse of available fresh water, aggressive and renewed effort to desalinate seawater, and most importantly, rehabilitation and restoration of the ecosystem and environment. The last option, restoration of an ecosystem like the Florida Everglades, is a premiere opportunity for the United States to lead in the largest, most significant restoration effort in its history. However, it is important first to consider and discuss why water conservation and desalination in the United States is important to the context and appreciation of an Everglades restoration.

Wasted Water

Experts agree that water is wasted in the United States. As previously noted, hydrologists estimate that as much as 60% of the consumed fresh water is wasted. It is wasted due to leaks in the aging distribution systems and infrastructure, unintended evaporation within the systems, inefficient appliances, and human carelessness and ambivalence.³⁴ A common example of the waste is American tendency to leave the water running while brushing their teeth. This wastes four and a half gallons per incident.³⁵ The largest source of waste in an American home is the toilet. Many

American toilets use as much as five gallons per flush. Americans flush without thought. By comparison, in Japan, toilets have two settings for heavy and light flushes and utilize wash basin water to flush. The Japanese incentive to reuse water in this manner is the high cost of fresh water.³⁶ A strong indicator of the residential and municipal waste of fresh water is the fact that the U.S. population has more than doubled in the last century while the per capita consumption rates increased more significantly, five to eight times higher than before.³⁷

Agriculture, the largest consumer of fresh water, is a subject of attention. Farmers in the United States buy water cheaply and inexpensively. In seventeen irrigation districts across the west, farmers pay only one percent of the cost of providing the water to them. In many cases, their cost is one cent per 1000 gallons. When the cost is exceptionally cheap, it is no surprise that water is wasted without consideration or remediation.³⁸

Conservation steps, if taken seriously, could have immediate effects on the fresh water supply.³⁹ A proposal for reducing the consumption of fresh water is to increase the cost for the water, and in many cases, charge the consumer the actual cost of the water. A large potential benefit of inspired conservation through charging consumers the actual costs for fresh water is the renewed interest, emphasis, and investment in desalination. Conservation and reuse of available fresh water, renewed efforts to desalinate seawater, and the rehabilitation of ecosystems can and will fulfill mankind's growing thirst for water in this century.

Why not Desalination?

Cost effective desalination technologies and facilities are a means to relieve the pressure of the water crisis by affording alternatives, supplements, and contingency sources for fresh water. However, desalination is expensive and requires significant amounts of energy. Given the reliance of the United States on oil for energy, current desalination technologies are not favored. On the other hand, population growth, severe ecosystem degradation, increased per capita consumption of fresh water, poor land management, and prioritization of human interests over the environment and ecosystem inspire a relook of desalination technologies.⁴⁰ Proponents argue that desalinated seawater provides an endless supply of fresh water which is essentially drought proof. Critics argue that desalination of seawater has significant economic costs, social effects, and environmental impacts.⁴¹

Approximately 130 countries employ desalination technology.⁴² In the United States, most desalination facilities are small and operated for industrial or commercial reasons.⁴³ In 2005, there were approximately 2,000 desalination facilities in the United States with the vast majority located in Florida, Arizona, California, and Texas.⁴⁴ The current cost of desalinated water is 10 times or more greater than the cost of available inland fresh water. With this cost differential, it is difficult to justify desalination.⁴⁵ Prior to the 1980s, the United States led the world in desalination investments and research. With no cost incentive, it abandoned efforts and ended federal funding for desalination in 1982.⁴⁶ Desalination is a viable option but not without consequences and certainly no immediate benefits. Some argue that United States should renew efforts and investments in desalination, but not in lieu of ecosystem restoration. More importantly, Americans conserve and reuse what they have in available fresh water as well as work

to restore the unintended consequences of the past. Immediate efforts are essential. Cumulatively, these options will provide sufficient quantities of clean potable fresh water when and where it is needed within the United States.

From an international perspective, the United States is not experiencing the degree of water stress found elsewhere in the world. It is, however, an emerging situation for particular regions of the United States. The rapidly growing states of California, Texas, and Florida, which include five of the fastest growing cities, are experiencing the water stress. Ironically, each of these states has vast coastlines with enormous volumes of seawater unsuited for immediate use.⁴⁷ So goes the mariner's rime.

Florida and Water

Florida's history, vitality, and legacy are intertwined with water. A simple and common example is most recorded images of Florida include water. An appreciation and understanding of Florida and water begins with a general understanding of the Florida's climate, topography, and hydrology.

Unique to Florida is its climate. It is the only sub-tropical area in the United States with wet and dry seasons. The wet season ranges from May to October producing 75 percent of Florida's rainfall amounting to on average 60 inches of rain. The dry season, running from November to April, accounts for the rest.⁴⁸ Florida, the "Sunshine State," consistently experiences sunshine 70 % of the year. Daily temperatures range from just below freezing on limited occasions in the northern parts to 90 plus degrees Fahrenheit in the south. The sub-tropic climate produces substantial humidity averaging 75 percent

each year.⁴⁹ Florida's climate is important to water as it affects the storage and flow of its fresh water.

Florida is essentially a very shallow bowl slightly canted southwest. Florida's geology is very porous consisting of sand and limestone. Seepage to the sea therefore is a condition and challenge.⁵⁰ The elevation change over hundreds of miles is not substantial (20 feet in 100 miles through the Everglades) resulting in a natural "unhurried and leisurely" flow of water.⁵¹ The elevation of Everglades National Park is indicative of the situation. Most of the 1.5 million acres are nearly at sea level and nearly 70% of the park is less than 3 feet above sea level.⁵²

Florida is characterized by water as much of its history includes the flow or journey of water. The water is stored in marshes, wetlands, sloughs, rivers, and lakes in a journey to the sea. It comes as no surprise, therefore, that Florida's water crisis is in large part about the storage and flow of water. Some of the notable terrain features along the journey are the Atlantic Ocean, Gulf of Mexico, Kissimmee River, Lake Okeechobee, Caloosahatchee River, St. Lucie Canal, Big Cypress Swamp, Everglades, and Biscayne and Florida Bays. The Atlantic Ocean and the Gulf of Mexico border Florida on the east and west coasts respectively.⁵³ The Kissimmee River flows north to south feeding into Lake Okeechobee. Lake Okeechobee, the second largest fresh water lake in the United States, is located just north and east of Fort Meyers.⁵⁴ The Indian word "Okeechobee" means "Big Water."⁵⁵ The Caloosahatchee River and St. Lucie Canal are east and west respectively of Lake Okeechobee, but do not connect it to the Atlantic or Gulf of Mexico.⁵⁶ South of Okeechobee and slightly west is the Big Cypress Swamp.

Approaching the southern tip of Florida are the Everglades. An area originally covering three million acres, it is reduced by half today.⁵⁷ Water travels out from the Everglades through a series of sloughs. Water flows through Shark River Slough to an area called Ten Thousand Islands in the Gulf of Mexico.⁵⁸ Taylor Slough carries the water from the Everglades to Florida Bay. Three rivers, Hillsboro, Miami, and New, flow the water from the Everglades to Biscayne Bay. Biscayne Bay is located east of the Everglades and just south of Miami. At the very southern point of Florida is Florida Bay. At the points where inland joins with the sea, the freshwater completes its journey and mixes into the seawater.⁵⁹ These features of terrain once constituted all of Florida's historic Everglades.

Water, Ecosystems, and the Everglades

Water and ecosystems are interdependent. Water is an a-biotic factor of an ecosystem like the Florida Everglades.⁶⁰ A healthy ecosystem and its multitude of a-biotic and biotic factors require water at specific times, places, flow rates, and volumes. Additionally, the sufficient availability of clean fresh water is dependent upon the capacity of a healthy ecosystem to absorb, store, clean, and move water at specific times, places, rates, and volumes. Ecosystems are analogous to absorbent filters. For example, a healthy ecosystem absorbs heavy rainfall from storms that could otherwise flood developed areas. It also retains fresh water to recharge subterranean aquifers and prevent inland intrusion of seawater.

The ecosystem is delicate and complex. Changes to the ecosystem, small or grand, natural or manmade, affect all factors of the ecosystem to include the quality and quantity of fresh water. As an ecosystem is reduced, damaged, or destroyed, so is its

capacity to absorb, store, and clean fresh water. It is a delicate balance that is easily affected but difficult to measure, replicate or restore. As is the case with Florida Everglades, “getting the water right” or more specifically, the flow of water right, is essential to not only maintaining a healthy ecosystem but also for a long term sufficient supply of clean consumptive fresh water.⁶¹

Generally, mankind recognizes and appreciates the requirement for sufficient and clean consumptive fresh water. However, as the water crisis worsens, more people are aware and appreciative of the crisis. The link between a healthy ecosystem and sufficient availability of consumptive fresh water is the motive and means of achieving ecosystem restoration. Continuing to promote this awareness is paramount so vital ecosystems, such as the Florida Everglades, can be restored.

The Everglades: A Battle for Water

The Everglades is a national gem. It is “the most famous wetland on earth.”⁶² Marjory Stoneman Douglas, a respected author and environmentalist, described the Everglades as “one of the unique regions on earth, remote, never wholly known.”⁶³ She further narrated the beauty and interrelation of grass and water which slowly and gracefully are the meaning of the Everglades. “It is a river of grass.”⁶⁴ The word “glade” is from the English word “glaed” first used on a map in 1823 after the United States purchased Florida from Spain in 1819.⁶⁵ It means shining or bright. The words together mean “ever shiny or bright.” Tragically, this is not nearly an appropriate description of the Everglades today.

The “Historic Everglades,” technically a river given the slow flow of water at approximately a quarter mile per day, encompassed a watershed area of 16,000 square

miles, flowing 50 miles wide and 100 miles long to include historic flow of water from Lake Okeechobee in the north flowing south through fresh water sloughs and prairies to Florida Bay and the Gulf of Mexico.⁶⁶ The Everglades is a river, but also, a rich ecosystem that supports a multitude of life to include vast flora and algae, mangroves, wading birds, shrimp and alligators, and of course, people. Today, the “Everglades” is commonly viewed as the Everglades National Park (ENP).⁶⁷ The Historic Everglades, the area beyond Everglades National Park, still exists in part. However, it is bisected, shaped, encapsulated, and for all intensive purposes, surrounded by the efforts, interests, and developments of mankind.

The history of Florida Everglades involves a battle for water that is extensive and complex. Many of the battles pertain to nature itself, but also, engineering, biological science, urbanization, and especially, litigation and politics.⁶⁸ The early battles, lasting well over a century, were focused on taming the land and draining it for development. The people involved were of good intention, but blissfully ignorant of the unintended consequences that would arise from their visions and actions. It was a battle to transform an uninhabitable wasteland into a “fantasyland with 7 million residents, 40 million annual tourists, and the world’s largest concentration of golf courses.”⁶⁹

For well over a century, the focus of federal, state, and local efforts in Florida were to drain the inland water in order to eliminate undesirable conditions.⁷⁰ The Everglades was viewed as a “worthless morass, an enemy of civilization, and an obstacle to progress.”⁷¹ The earliest official report on the Everglades summarized mankind’s mindset and values clearly. It stated the Everglades were “suitable only for

the haunt of noxious vermin, or the resort of pestilential reptiles.” This is how and when the notion to drain the wasteland and make something useful of it began.⁷²

Man won the early battle with the Everglades, but the unintended casualties were enormous. During the next 130 years of managing the water in support of man’s development, the Everglades were nearly destroyed forever. Among the innocent casualties are cherished wading birds (a cherished symbol of the Everglades) reduced by 90%, grossly diminished water aquifers, a phosphorous polluted littoral of Lake Okeechobee, and sixty-nine animals and plants declared threatened or endangered.⁷³

Today, the fight between man and nature is quite different. It is now a battle to complete the largest restoration project in the history of the world: the Comprehensive Everglades Restoration Plan (CERP).⁷⁴ It calls for the dismantling and reengineering of previously well-intended actions in order to restore the flow and condition of the past.⁷⁵ It is a battle to maintain a collation of interests to restore the historic Everglades at an estimated cost of nearly \$11 billion over a period of nearly four decades.⁷⁶ It is a battle to reinforce and sustain the political will essential to success. To win, man must recognize the value of the ecosystem, provide for it, and coexist with it harmoniously. An indestructible coalition of common interest formed from competing interests is essential. Collectively and collaboratively, mankind and the ecosystem can grow and thrive together. Jointly, they can stem the tide of other threats like a looming climate change. Many environmentalists view the future of the Everglades as a test. “If we pass, we may get to keep the planet.”⁷⁷

An Abridged History of the Florida Everglades:

From 1835 to 1855, different conflicts ensued within the Everglades to extricate the American Indians. These historical events produced many of the first detailed maps and personal accounts of the declared wasteland. Sadly, this dark period in U.S. history also set the conditions for the drainage and development of the land.

In 1845, Florida became the 27th state of the United States. Amongst the best known pioneers for draining the Everglades were a young entrepreneur from Pennsylvania named Mr. Hamilton Disston, a railroad developer named Mr. John Westcott, and Florida Governor Napoleon Bonaparte Broward.⁷⁸ Their efforts shaped the development and growth of Florida over several decades. However, their fight to drain and build in the Everglades was not won easily. Nature's fury brought droughts, floods, and massive hurricanes. The hurricane of 1928 killed 2500 people within the Okeechobee Region of Everglades, causing significant development setbacks.⁷⁹ In another way, nature's resistance also emboldened and fostered new efforts to conquer the land.

Within the first 100 plus years of statehood, Florida and the Everglades were significantly transformed. On many occasions, the Everglades proved resistant to man's efforts to drain it.⁸⁰ Some successful development efforts did include the construction of canals and channels for rivers, drainage of land for settlement and use for agriculture, enormous growth in population of southeast Florida from 22,961 to 228,454 from 1900 to 1930 (10 times greater in 30 years) and doubling of sugar cane production in 10 years (1931-1941). Despite the focus on industrial growth and development, the federal government took one important action which preserved and protected a portion of the poorly understood and unappreciated ecosystem being destroyed. President Harry S.

Truman dedicated a portion of the Everglades to the Everglades National Park in December 1947. This action protected 454,000 acres which would later grow to nearly 1.5 million acres.⁸¹ One cannot understate the significance of designating Everglades National Park in 1947. Without this designation and protection, it is likely there would be little to restore and protect today.

In 1948, the pressures to drain and develop the Everglades for urban, residential, municipal, and agricultural purposes as well as to provide flood protection to the people and functions occupying the drained land and surrounding areas increased. As a result of this influence, the United States Army Corps of Engineers created the Central and Southern Florida (CS&F) Project.⁸² Through the CS&F, the Corps of Engineers, “the ground troops in America’s war against nature,” also tried to drain and reshape the Everglades.⁸³

The Central and Southern Florida Project (CS&F)

The Flood Control Act of 1948 authorized the Jacksonville District, Army Corps of Engineers, to execute the CS&F Project. By 1950, it became apparent to the leaders of the Corps of Engineers involved with the CS&F project that there were numerous and diverging interests regarding water. While the water was being drained to create land for development, demand for more water came from extensive growth in agricultural, industrial, and municipal requirements.⁸⁴ Fortunately, the Department of Interior (DOI) leaders of Everglades National Park (ENP) and the U.S. Fish and Wildlife Service (USFWS) possessed great foresight that would result in the Comprehensive Everglades Restoration Plan (CERP) 50 years later. These leaders identified the requirement “to provide . . . enough water to preserve plants, fish, and wildlife in the Everglades and

other areas.”⁸⁵ Unfortunately, their vision was not shared; during this time period, mankind was neither willing nor ready to balance its needs with those of the ecosystem. That realization would come decades later with the CERP.

The CS&F Project was cost shared by the state of Florida and the federal government. The state was required to provide \$3.25 million for Phase One of the Project as well as acquire the needed land. The CS&F was a flood control project based on the benefits of the protection afforded. It was developed and implemented at a time prior to the environmental movement of the 1970s-1980s; at this time, the requirements of the ecosystem were not understood, considered, or valued. Additionally, under pressure to act quickly, members of the Jacksonville District acknowledged prior to the construction of the CS&F, that hasty estimates, not comprehensive studies, were used for the project proposal.⁸⁶ The CS&F project was completed in the mid 1960s with delays.⁸⁷ It was successful in achieving its intended purpose of flood control. However, it had an unforeseen effect on the ecosystem.

In the two plus decades following commencement of the CS&F, up to the mid 1970s, numerous battles emerged between developers and those seeking to preserve nature. They included defeated initiatives to construct a cross Florida barge canal connecting the Gulf of Mexico to the Atlantic, a jetport in the heart of the Everglades and achievement of indefinite protection of a vast area known as Big Cypress Swamp adjacent to the Everglades National Park.⁸⁸ This period was the coming of an important change in mindsets and ways of doing business. Environmentalists secured their movement and demonstrated they had the influence to stop damaging development on the ecosystem. It was the beginning of a transformational period for the Corps of

Engineers as well. The Corps recognized the value of the green movement by inculcating ecosystem and environmental concerns into their construction mission focus.⁸⁹

In 1971, environmental scholars warned Florida Governor Reubin Askew of the water crisis in Florida to include the grave consequences of sloppy land and water planning and management. Scholars were most notably concerned with the degradation of Lake Okeechobee from nutrients like phosphorous and the need to restore the interdependent Kissimmee River from the effects of the CS&F project. Compounding the water crisis was Florida's exponential growth. Florida's overall population had doubled every 22 years since 1920, with the greatest growth doubling in Southern Florida where the population doubled every 14 years. Exacerbating the challenges of poor planning, management, and population growth were emerging consumptive water requirements like the new 27,000 acre Disney World in Orlando. The greatest effects of the development included an increased water demand and significant water quality issues as sewage and wastes were dumped untreated into the ecosystem.⁹⁰

By the 1970s, the unintended consequences of the CS&F were realized. Heavy rains and flooding were endangering deer populations from 1966 to 1970. In May 1970, the Fish and Wildlife Service declared that man's manipulation of the ecosystem caused nature to "react violently" to the consequences. The natural flow of water was disrupted. Everglade's Kite, an endangered bird, as well as cranes, gallinule, and alligators were suffering the effects of reductions in water estimated to drop three feet every 30 days.⁹¹ Another serious development was the eutrophication of Lake Okeechobee. Introduction of nitrogen from sugar cane farming and phosphorous from dairy cows was killing the

lake's wildlife. The straightening of the Kissimmee River through the CS&F project had removed marshes which ordinarily acted as filters and would have otherwise removed and prevented much of the contamination.⁹² The threat then reached across the state as the water of Lake Okeechobee flowed and was pumped south into Everglades National Park.

In February 1981, *Sports Illustrated* released its swim suit edition which was photographed in Florida. The expectations were that it would portray the beauty of sunny Florida and its beaches. Instead it spotlighted Florida with an article describing "rampant population growth" and "frenetic new construction." The article included an assessment that "in no state is the environment being wrecked faster and on a larger scale."⁹³ Harsh in its tone, this article in a well read and known magazine, instigated by the executive director of the Florida Wildlife Foundation, spotlighted a sober reality that required immediate public and political attention.⁹⁴ The actual effects of the article are subjective, but what would follow was spectacular. The desire to restore the Kissimmee River and restudy the consequences of the CS&F would result in the CERP.⁹⁵

Kissimmee River Restoration: Promise for CERP

Despite opposition from varying political groups and the Corps of Engineers' insistence that de-engineering the CS&F elements of the Kissimmee River was unnecessary and required Congressional approval, the Kissimmee River was restored in the 1990s.⁹⁶ The response of the ecosystem to restoration was extraordinary, and it gave people a sense of the possibilities for ecosystem system restoration.⁹⁷ The Kissimmee River restoration also brought credibility to the Corps of Engineers as it was the first project ever for environmental concerns.⁹⁸ As an indicator of the international

water crisis and a sign for hope, officials from Brazil, England, Hungary, Italy, and Japan visited the Kissimmee River Restoration “to learn how to bring a river back from the dead.”⁹⁹ Incredible success with Kissimmee River restoration, impending intensification of federal interest in Florida, continuing reports of ecosystem degradation by passionate leaders, and other well intended movements and initiatives, also fostered the restudy of CS&F and the beginning of CERP. However, the Kissimmee River restoration was the most critical step to securing the CERP.

By the mid 1990s, the political conditions had changed, and the federal government now recognized the necessity to restore the Everglades on the verge of an ecological disaster.¹⁰⁰ Vice President Albert Gore Jr. argued in his book *Earth in Balance* that “environment problems were the most urgent global challenge” and that “the United States had a responsibility to lead the world community.”¹⁰¹ By the summer of 1993, a restudy of the CS&F project was identified as the best way to secure a comprehensive restoration of the Everglades.¹⁰² Unfortunately, for the next three years, development interests flourished while the preservation and restoration of the Everglades did not. Triumphantly, due in large part to Mr. Michael Davis, Assistant Secretary of the Army for Civil Works, and other visionary leaders, Congress authorized a feasibility study as part of the Water Resources Development Act of 1996 to develop “a proposed plan for the purpose of restoring, preserving, and protecting the South Florida ecosystem.”¹⁰³ The challenge ahead was finding common ground and consensus among competing interests, to include addressing political leaders and Congress with one voice.

Comprehensive Everglades Restoration Plan (CERP)

Restoration of the ecosystem finally achieved parity with flood control, navigation, and water supply projects when President Clinton signed the Water Resource Development Act of 2000 on 11 December 2000; this act authorized the CERP.¹⁰⁴ Many involved with the CERP at that time felt it was a “miracle.”¹⁰⁵ To achieve the CERP, numerous interests groups amidst dissent, litigation, and disagreement of the preceding 52 years came together. Part of the genius in CERP was crafting it in a manner that all interests received benefits from the water gained from restoration.¹⁰⁶ Essential to the successful realization of the CERP were the coupling of flood protection benefits and increased water storage with the protection and restoration of the ecosystem.

“The CERP is a framework for the restoration, preservation, and protection of the natural system that also provides for other water-related needs of the region, including water supply and flood protection, and is the centerpiece of the restoration to get the water right in South Florida.”¹⁰⁷ In its truest form, the CERP is about securing the water and habitat of the Everglades while affording flood protection and water supply.¹⁰⁸ The CERP, led by Jacksonville District, U.S. Army Corps of Engineers, in partnership with the Department of Interior (DOI, its federal sponsor) and the South Florida Water Management District (SFWMD, its state sponsor), is comprised of 40 projects and 68 project components projected for completion over a multi-year period of thirty to forty years.¹⁰⁹ The focus of the plan is to achieve ecological restoration by as closely as possible reestablishing the natural system.¹¹⁰ The projects are aimed to improve water storage and quality, reduce loss to the system (conservation, evaporation, reuse, and seepage) and reestablish pre-drainage conditions wherever feasible.¹¹¹ The plan recognizes that much of the damage to the ecosystem is irreversible. The plan’s

projects are a 50/50 cost share between the state of Florida and the federal government estimated in 2004 at \$10.9 billion.¹¹² All projects require Congressional approval prior to execution.¹¹³ Land acquisition is a huge element to executing the CERP, but is the responsibility of the state of Florida.¹¹⁴

CERP's Greatest Challenges

The future of Everglades restoration is steeped with challenges. Leaders close to the CERP generally agree that the five greatest challenges to a timely restoration are: securing the federal funding for the projects, maintaining a coalition of willing interests, addressing the vastness of the area and interests, demonstrating progress and restoration success and getting through the federal project programmatic process.¹¹⁵ Many of the challenges are interdependent and interrelated.

Currently, the restoration funding challenge is in the midst of a recession and deficit, economic bailouts and stimulations exceeding over \$1.4 trillion, the largest unemployment rates in 16 years, poor economic growth, and a major change in national leadership to include the former appointees responsible for the CERP execution. It is a period of either great opportunity or pending failure by continued delays—during which the ecosystem deteriorates. In one sense, the economic crisis affords an opportunity to infuse environmental restoration with projects funded by federal stimulus money while creating the intended benefits of employment and spending. Given that the scope of the projects is expected to span decades, this opportunity secures the future by restoring an ecosystem vital to mankind's survival while providing people with a profession for a lifetime. Also, this period of opportunity may provide relief from arguably the greatest threat to the ecosystem, extensive over-development.¹¹⁶

The economic downturn has substantially curtailed the construction and development that threatens the Everglades from every direction.¹¹⁷ An example includes plans to develop a new town which was once Homestead Air Force Base, just 2.5 miles from Everglades National Park.¹¹⁸ This provides leaders an opportunity to reevaluate development to include water and land usage in order to establish sustainable population growth. Recently, to the state of Florida's credit, they began denying growth permits for additional water in some Southern Florida counties. This, in turn, forced counties to relook development, reconsider water reuse and conservation, and investigate alternatives for consumptive water to include desalination.

Certainly, without infusion of significant funding now from the federal government, limited restoration of the Everglades will occur. Recently, in November 2008, the state of Florida purchased 180,000 acres from U.S. Sugar Corporation for \$1.34 billion, leaving little to no resources for any restoration projects. However, having acquired this vast expanse of land near Lake Okeechobee for the Everglades is a significant, historical act. As was the case in federal designation and protection of Everglades National Park in 1947, protecting the valuable sugar land from development is paramount as restoration of the land can occur later, but only if it is undeveloped and available.¹¹⁹ To date, the state of Florida has outspent the federal government since 2000, and CERP projects are "shovel ready" if the federal funding is received.¹²⁰

Lack of funding which prevents and delays actual CERP restoration work will undoubtedly strain and fracture the great but struggling coalition that was so important to creating the CERP in 2000. Environmentalists, for example, who were once instrumental in securing the CERP through Congress, are "feeling pangs of buyer's

remorse.”¹²¹ Finally, and arguably, most notably, the ecosystem continues to degrade in alarming ways. A century of well intended but misguided actions, coupled with decades of conflict to achieve the consensus of the CERP, enabled much damage. Renewal of past ways increases the risk if the federal funding delay continues.

In the meanwhile, Florida remains under a federal consent order, beyond that of any other state, in regards to its water quality; specifically acceptable phosphorous levels in parts per billion (ppb).¹²² The time in court arguing over maximum acceptable limits of 10 ppb, which are reportedly not yet technically measurable, is doing little to promote restoration, open dialogue, and trust. Although well intended, it is advisable to set this litigation aside in support of achieving the broader aim of the CERP.

Addressing the vastness of the Everglades' area and its diverging interests is a complex task. The area is twice the size of New Jersey. It consists of a watershed area bigger than some states encompassing 16,000 square miles with hydrological interconnectedness where changes measuring 1/10 of an inch incite great debates. As a whole, it is difficult to fully consider its size, interconnectedness, and intricacies. For example, the coalition for the CERP thought in 1999-2000 that restoration was largely about getting the water depth right. Now, they realize it is about water flow. The genius of the CERP is it contended with hundreds of variables; however, due to its complexity, the CERP visionaries did not realize until much later that there were many factors they were not wise enough to understand and include in their analysis.¹²³

Demonstrating results and progress towards ecosystem restoration are inexplicably linked to the availability of federal funding. Those close to Everglades' restoration, however, believe the federal process to approve and fund projects requires

significant overhaul. Descriptions like “the paralysis of analysis” and the “tyranny of modeling” describe the frustration.¹²⁴ To its credit, the Army Corps of Engineers maintains a strong national record of protection and construction to include navigation and flood control projects that are well addressed and based on cost-benefit analysis within a programmatic project system. The Corps of Engineers also recognized decades ago the need to become a more green and environmentally focused organization.¹²⁵ Despite harsh criticism at times, most closest to the CERP believe that the Army Corps of Engineers is the only organization that can execute the CERP. They see it as another chance for the Corps to lead. If not the Corps of Engineers, who? If not now, when?¹²⁶ Former Chief of Engineers, LTG Joe Ballard, once said, “The Corps has nothing going on as big and complex as Everglades’ restoration.”¹²⁷ Colonel (Retired) Terry Rice, a former Corps of Engineers Jacksonville District Engineer who was deeply committed to restoration, viewed Everglades Restoration as “one of our greatest challenges on earth” to develop “the model we need to move forward in history.”¹²⁸

The question then is how does ecosystem restoration fit in with other government priorities? Proponents for change call for abandonment of a twentieth century business management process for a twenty-first century approach.¹²⁹ Visionaries see the need for separate funding and prioritization of environmental and ecosystem restoration projects. The question often asked in restoration is how does a habitat unit compete against the cost-benefit analysis of a flood control project? The answer is it doesn’t. Arguments suggest that this difficulty in determining and assigning value to restoration makes the process even more political.¹³⁰

As of February 2009, the Corps of Engineer has not commenced any CERP projects. The Water Resource Development Act of 2007 authorized three CERP projects. However, Congress, through the Office of Management and Budget (OMB), has not provided the required federal funding.¹³¹ Estimates indicate that between \$800 million to nearly \$2 billion in CERP projects have completed the programmatic process and are ready for execution.¹³² To date, the state of Florida has spent or obligated nearly \$3.34 billion to Everglades' restoration.¹³³ In 2000, Governor Jeb Bush declared in that Everglades' restoration would be "a model for the world."¹³⁴ As a sign of Florida's commitment to restoration and without precedent, in 2002, Bush authorized the SFWMD to borrow \$1.8 billion in bonding to begin restoration. In October 2004, Bush launched Acceler8, a \$1.5 billion effort to accelerate eight CERP components mostly related to water supply.¹³⁵

Countless direct and secondary consequences will result from not executing the CERP soon. Time is the greatest enemy of the Everglades' restoration. The spectacular coalition credited with producing the CERP fractures with time. Existing litigation, diverging interests, and increasing pressures for land development and water, all matched with no current tangible results of a CERP project are counter to sustaining a long term restoration project.¹³⁶ The condition of the Everglades worsens each day. Meanwhile the threats to the ecosystem like development and climate change intensify. As the ecosystem deteriorates, so does its resilience and resistance to threats. Population demands for fresh water continue to grow significantly. Restoration of the Everglades will achieve the maximum availability of clean consumptive fresh water for mankind. Additionally, many species of factors of the Everglades ecosystem are

endangered and at risk of extinction. Failure to execute the CERP now further endangers them and increases the likelihood of their extinction. Finally, the cost of the CERP logically increases in time with inflation and increased scope of restoration due to further deterioration of the ecosystem.

Conclusion

For centuries, the anthropological requirements for water have won out over ecological requirements.¹³⁷ Mankind nearly destroyed the Florida ecosystem through its ambitions and efforts to tame the “wasteland” for development.¹³⁸ Fortunately, nature and the ecosystem are resilient, but will remain in balance only if the current, reasoned solutions concerning restoration are pursued without further delay. CERP, the largest, most ambitious ecological project in the history of the world, is an unprecedented model for worldwide ecological restoration and protection. The real value in CERP is that it demonstrates a change and promise to restore the ecosystem as well as protects mankind and all species on earth from what is known, projected, and unknown.

The CERP is monumental in terms of positive change in values and perspectives regarding the ecosystem. It is an evolution.¹³⁹ The CERP is a “paradigm shift in resource management practice.” Man and the organizations like the Corps of Engineers, responsible for winning the battles to develop the land and protect people from nature, now promote ecological restoration. The ambitions of man are no longer relentlessly pursued at the expense or without strong consideration of the effects on ecosystem. The CERP is the means to “re-wild” the environment and ecosystem, heal the relationship between man and the ecosystem, prioritize “ecological renewal” and co-exist in harmony.¹⁴⁰ Selfishly, the will of man to do the CERP is recognition that water is

vital, the oil of the Twenty-First Century necessary for survival.¹⁴¹ The “bleeding” of the ecosystem however has not and will not stop without the will to execute the CERP and others like it.¹⁴²

The Kissimmee River Restoration proved that restoration of the ecosystem a century later is possible and can achieve “spectacular” results.¹⁴³ Achieving approval for the CERP proved “the power of consensus” in developing the political will essential to a large scale restoration project.¹⁴⁴ In another important and useful way, the enormous monetary cost of the CERP provides proof and promise for protection of the ecosystem as the cost of restoration is far greater than that of protection.¹⁴⁵ Also, in the long term, national leaders and nations could use the CERP model to ignite and/or sustain the will for restoration of ecosystems like the Chesapeake Bay, Great Lakes, Louisiana Coast, and Upper Mississippi River nationally and the Danube and Nile Rivers, Aral, Baltic, and Black Seas, Pantanal wetlands of Brazil, and the Okavango Delta of Botswana abroad.¹⁴⁶ As long as the CERP is alive, so are the will and hopes of other similar efforts throughout the nation and world.

The CERP is a medicine, and even potentially a remedy, to what is known, projected, and unknown. Testing and modeling for the CERP has already demonstrated that reestablishing the flow of water to an ecosystem will produce positive results even if “humans don’t get the flow right.” The ecosystem is resilient, and it will respond when water is reintroduced to it.¹⁴⁷ The Kissimmee River Restoration proved it. Wildlife to include wading birds and sunning alligators are reappearing and recovering on the Kissimmee River.¹⁴⁸

Science and engineering allow man to project a future. The will of nature, however, is never really known. Climate change arguably could produce massive ecological impacts for the United States and the world.¹⁴⁹ The effects of glacial melting in Greenland and Antarctica are not completely known. Leading scientists largely agree though that the effects will include changes in sea-level, patterns of precipitation, ambient sea and air temperatures, and frequency and intensity of storms.¹⁵⁰ The projected changes in Florida for sea-level change alone are significant. The Intergovernmental Panel on Climate Change (IPCC) projects an increase of 7 to 23 inches this century.¹⁵¹ Elements of the CERP to include the restoration and protection of wetlands offer great promise towards mitigating the effects of climate change. The ability to hold more water across the land in lakes, marshes, rivers, wetlands, and the like will recharge aquifers, raise the water table, and create the fresh water hydrostatic head to counter saltwater intrusion caused by climate change.¹⁵² Additionally, restoration of the Everglades now affords many threatened or endangered species time to recover before the full effects of climate change occur.¹⁵³ A restored Everglades also provides added protection against increased frequency and intensity of hurricanes associated with climate change. A restored Everglades can participate in the hydrologic process even better.¹⁵⁴ Scientists believe protection of the wetland and restoration projects like the CERP offer protection from the causes of climate change. Scientists assert that the peat found in wetlands will sequester carbons believed to promote climate change.¹⁵⁵ This assertion is consistent with other known effects of wetlands to filter out and sequester other pollutants like phosphorous and nitrogen.

More is unknown than known about the future. Experienced scientists and engineers are concerned with many theories and questions. What does a healthy ecosystem protect mankind from?¹⁵⁶ What disease will adversely affect man if the ecosystem collapses? Could mankind experience worse effects than those after the collapse of the Aral Sea? What happens when the DNA of an endangered species is lost forever due to an unhealthy ecosystem?¹⁵⁷ Everything occupies an ecological niche in an ecosystem. When something is lost in nature, one cannot reconnect and rediscover it.¹⁵⁸ How, therefore, does mankind fill the void? Failure to restore the Everglades and catalyze similar undertakings elsewhere in the United States and the world may include consequences unknown and unconceivable. If restoration of the Everglades fails, the “consequences are huge.”¹⁵⁹

The Comprehensive Everglades Restoration Plan (CERP), a \$10.9 billion plan to restore the Everglades is projected to take 30-40 years to complete. The first decade of the CERP is nearly complete. The state of Florida has completed non-CERP projects and acquired important land to restore the ecosystem. However, the federal government has not commenced a single CERP project. The ecosystem continues to deteriorate during these delays. Challenges of the water crisis and the CERP are emerging and intensifying daily to include exponential growth in populations, pressure to develop the natural landscape, and a looming climate change. The demand for water is enormous and growing. These problems and effects are serious, and mankind does not have an additional one hundred years to wait for the restoration and protection of the ecosystem. In order to protect long term fresh water resources, individuals must move serious ecosystem concerns, such as the Everglades, to the forefront of national and worldwide

issues. Mankind cannot even afford to wait to complete the CERP within the timeline projected. The political will to act now on the largest restoration plan in the history of the world is vital to life as the water it will provide. Success of the CERP will result in immediate benefits to Florida. More importantly, it will catalyze the will and ambitions of leaders across the United States and the world to act. Failure to act is not an option if mankind cares to survive.

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⁸⁸ Ibid., 99-124.

⁸⁹ Ibid., 123.

⁹⁰ Ibid., 133-134.

⁹¹ Ibid., 135.

⁹² Ibid., 143.

⁹³ Ibid., 163.

⁹⁴ Ibid., 164.

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¹⁰⁴ Ibid., 395.

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¹¹⁰ *Ibid.*, 46.

¹¹¹ *Ibid.*, 4.

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¹¹³ *Ibid.*, 4.

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¹¹⁵ Dan Kimball, Superintendent, Everglades National Park, National Park Service, telephone interview by author, January 5, 2009, Stu Applebaum, Program Manager for Everglades Restoration, Jacksonville District, United States Army Corps of Engineers, telephone interview by author, December 18, 2008 and Paul Souza, Field Supervisor, South Florida Ecological Services, United States Fish and Wildlife Service, telephone interview by author, January 7, 2009.

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¹¹⁷ Dan Kimball, Superintendent, Everglades National Park, National Park Service, telephone interview by author, January 5, 2009.

¹¹⁸ *Ibid.*

¹¹⁹ *Ibid.*

¹²⁰ Stu Applebaum, Program Manager for Everglades Restoration, Jacksonville District, United States Army Corps of Engineers, telephone interview by author, December 18, 2008 and Tommy Strowd, Assistant Deputy Executive Director, Everglades Restoration Resource Area, South Florida Water Management District, telephone interview by author, January 7, 2009.

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¹⁴⁵ Grunwald, *The Swamp: The Everglades, Florida, and the Politics of Paradise*, 366.

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