THE EVOLUTION OF THE UPPER ST. JOHNS RIVER RESTORATION PROJECT

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ABSTRACT

Agricultural development of the floodplain of the Upper St. Johns River resulted in significant "reclamation" of floodplain wetlands, with associated losses of habitat for wetland dependent wildlife, flood water storage, and degradation of water quality. The loss of floodplain water storage and the presence of agricultural development within the floodplain resulted in both increasing damages associated with flooding events and increasing water supply problems during dry years and seasons. In the late 1940s flooding associated with hurricanes caused extensive damage in southern Florida. In 1949 the U.S. Congress authorized the U.S. Army Corps of Engineers (Corps) to initiate a project to address water resource issues within the south half of the Florida peninsula, including the Upper St. Johns River Basin. The Florida Legislature created the Central and South Florida Flood Control District as the local sponsor for this project. Since then, there have been numerous plans for restoration of the Upper St. Johns River and the project has evolved as man's understanding of the ecological consequences of hydrologic manipulation has improved. In 2008, the Upper St. Johns Restoration Project received international acclaim when the St. Johns River Water Management District (District) and Corps were awarded the International Thiess Riverprize for outstanding river restoration. This paper will discuss the planning and implementation of a restoration project designed to provide multiple benefits, including water quality improvement, improved flood management, improved water supply, maintenance of minimum river flows, improved habitat for wildlife and public recreational opportunities. The paper will also discuss the importance of interdisciplinary planning and implementation, and adaptive management, utilizing improving scientific and engineering knowledge and tools to ensure that restoration activities accomplish the public objectives of the project.

1. INTRODUCTION

The upstream 160-kilometer segment of the St. Johns River in Florida is known as the Upper St. Johns River, shown in Figure 1. The Upper St. Johns River originates in marshes and swamps in Indian River and Okeechobee Counties and flows north to Lake Harney, in Seminole and Volusia Counties.

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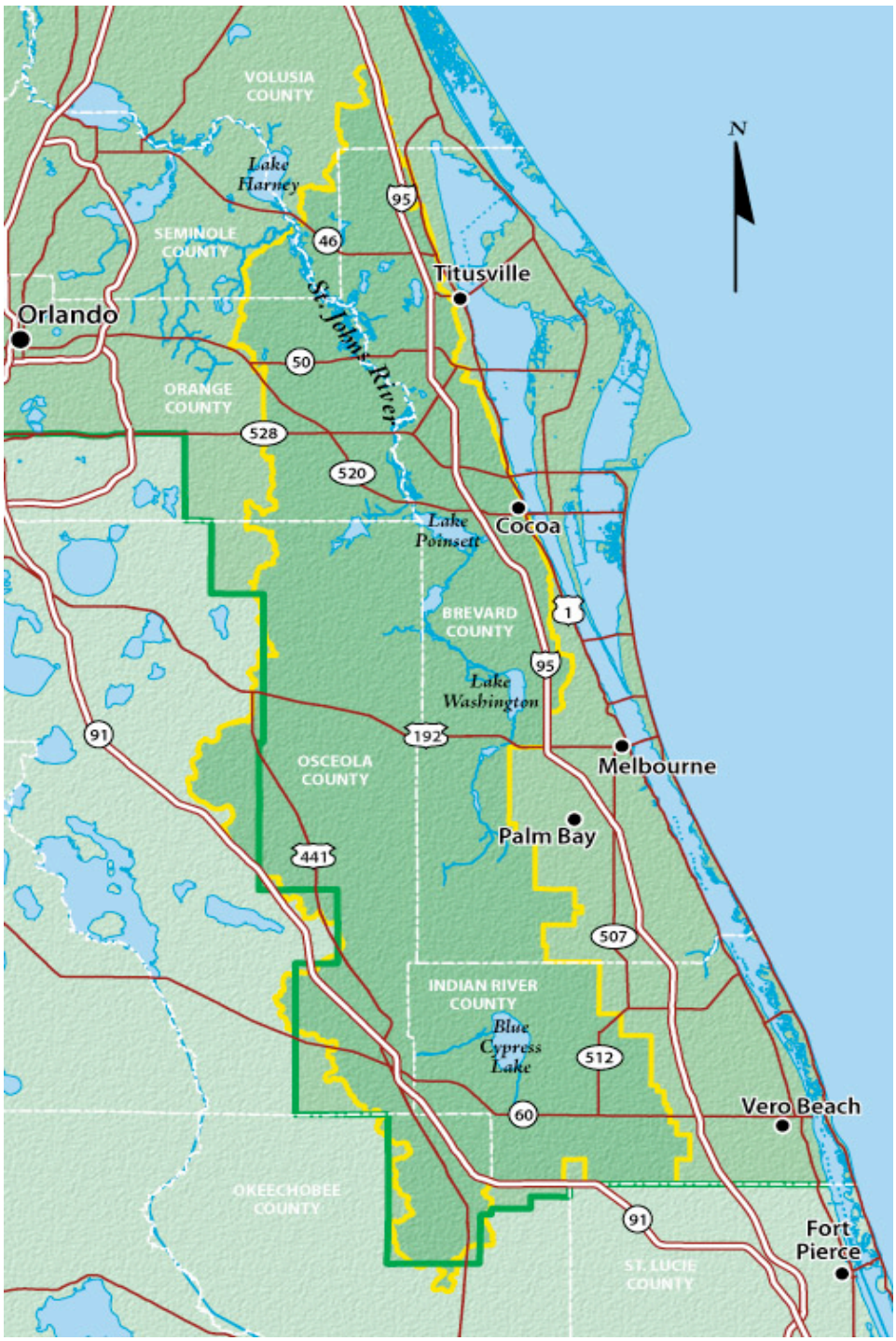

Figure 1 The Upper St. Johns River Basin

When Florida became a state in 1845 the Upper St. Johns River floodplain contained over 160,000 hectares of marshes, swamps and lakes. Like other parts of Florida, much of the land area within the Upper St. Johns watershed consisted of marshes and swamps. As a result, during the 19th century the economy and population of Florida grew very slowly. For example, in the census of 1880, Dade County had a reported population of 221 persons only (FLGenWeb Project, 2007).

In the latter half of the 19th century the Florida state government was concerned about the lack of economic growth in the state. To address these concerns the State granted lands or sold large tracts of land for a pittance to individuals who would provide drainage and reclamation of these

marshes and swamplands in order to promote economic development of the State. Initially many of these ventures failed or were only marginally successful. Drainage systems of the time could collect and eliminate surface waters to allow for cultivation of crops, but periodic tropical storms would flood lands that were not adequately protected. However, with the advent of steam powered earth moving equipment, developers now had the tools that were needed to effectively dike and drain flood prone lands, a practice that was known at the time as "reclamation."

Agricultural development of the floodplain of the Upper St. Johns River during the first three quarters of the twentieth century resulted in the drainage of 110,000 hectares or about 70% of the floodplain wetlands. The loss of floodplain water storage resulted in both increasing flooding damages in wet years and water supply problems in dry years. The agricultural land uses in the floodplain and the loss of floodplain wetlands also resulted in degradation of water quality in the lakes along the river. In the late 1940s flooding associated with hurricanes caused extensive damage in the region. This disaster resulted in action by the U.S. Congress, which in 1949 directed the U.S. Army Corps of Engineers (Corps) to initiate the Central and South Florida Flood Control (C&SF) project to address water resource issues within the Florida peninsula, including the Upper St. Johns River basin.

2. THE EVOLUTION OF A WATER PROJECT

Water resources projects are implemented to create some benefit desired at the time they are conceived. Sometimes these benefits are new, such as creating a source of irrigation water where there was none before. Sometimes the benefits involve correcting problems or avoided damages, such as in a flood control project. At the time that the C&SF Project was initiated, the primary issue of concern was the flooding damage that had occurred during the 1940s. However, what this paper will show is that water resources projects can take many years or decades to implement and during such an extended period of time project objectives and the associated benefits can change considerably.

2.1 The Flood Control Project

With authority from Congress the Corps began to make plans to address the water resource problems of central and south Florida. The Florida Legislature created the Central and Southern Florida Flood Control District (FCD) to be the local sponsor for this project. The land area within the C&SF project was massive, including most of Florida south of Orlando. The Corps developed conceptual plans for much of this area and proceeded to develop detailed construction plans for the areas that they considered the highest priority. Early in this planning process the Corps realized that the simplest solutions for providing flood protection for agricultural and urban land uses would have the consequence of draining the surface waters such that during dry periods there would be insufficient water supplies. So the early project plans included both levees and canals to control flood waters and water conservation areas to store water to meet water supply needs during dry periods. The Upper St. Johns portion of the project was not included in the first round of projects constructed in the 1950s.

In 1954 the Corps submitted a report to Congress recommending project works in the Upper St. Johns River basin, as well as other parts of the C&SF project area. The Congress approved this report and authorized funding for the first C&SF project works in the Upper St. Johns River. Pursuant to this Congressional authorization the Corps published a General Design Memorandum (GDM) for the Upper St. Johns portion of the project in 1962.

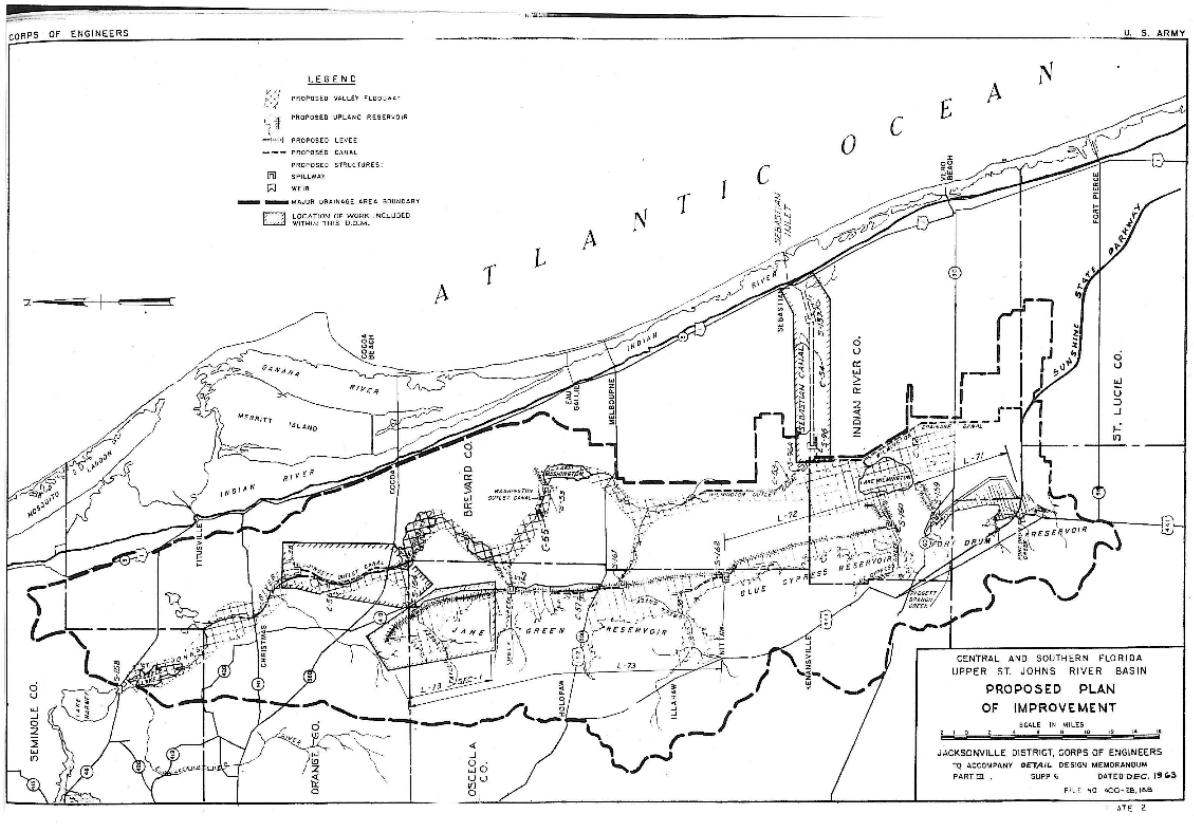

Figure 2 The 1962 Upper St. Johns Project Plan

The initial project plan for the Upper St Johns River basin called for two sets of reservoirs, four reservoirs were to be placed in the river valley and three reservoirs were to be constructed in the uplands to the west of the river floodplain. These reservoirs were designed to collect and store flood waters and convey those waters downstream. The reservoirs would also provide conservation storage for water supply during dry periods. In addition, a large canal was to be used as a relief valve to divert excess flood waters to the Indian River Lagoon, a tidal estuary to the east of the Upper St. Johns River. The 1962 GDM was approved by the Corps and construction began on the project in 1966. This project was engineered to solve the flooding problems along the Upper St. Johns River and to provide a reliable water supply for existing and future uses within the area. However, at that time the primary land use in the river valley and the lands along the west side of the river was cattle grazing and the ranchers objected to the project. The reservoirs were going to be on their property, which FCD would need to acquire. The ranchers considered this land to be important to their operations, since the lands within the floodplain were used for winter grazing of their herds. In addition, the "water supply" envisioned by the Corps was largely for row crops and citrus, crops grown in other portions of the watershed. The ranchers wanted flood protection and drainage, but they did not perceive the conservation storage of water as a benefit. In response, the Corps redesigned the project to eliminate two of the valley reservoirs and two of the upland reservoirs from the project plan, relying on the diversion canals for flood protection and the remaining reservoirs for conservation storage for water supply. The Corps approved a revised GDM in 1967.

2.2 The Environmental Era

The late 1960s was a tumultuous period in the United States. In addition to the divisions in the country over the Vietnam War, there was a growing awareness of the environment and the environmental consequences of the activities of man. In 1969 the U.S. Congress passed the National Environmental Policy Act (NEPA). This law required all federal agencies to consider the environmental consequences of their actions and set forth a process for this consideration. As a result, the Corps was required to prepare an Environmental Impact Statement (EIS) for the Upper St. Johns Project.

In 1970 two major components of the Upper St. Johns project were completed or nearly completed. The C-54 canal was designed to divert large volumes of flood water from the St. Johns River to the Indian River Lagoon. This canal is located along the boundary between Indian River and Brevard Counties. The C-54 canal was completed and operational prior to the preparation of the EIS. The other major project component was the Jane Green Reservoir. This reservoir was located on the western ridge of the watershed and was created by the construction of a 54 kilometer long levee, designated L73. This levee contained water control structures at the locations of five natural streams. At the time that the EIS was being prepared, the northern two water control structures were complete and water was impounded in the Taylor Creek area. Structures at Jane Green Creek, Wolf Creek, and Pennywash Creek were completed except for filling the bypass channels, built to divert the stream flows around the construction sites.

The 1973 EIS found that the project would result in significant negative environmental impacts. First, the Jane Green Reservoir would have flooded thousands of acres of freshwater forested wetlands. This type of wetland was considered to be important and somewhat rare, in that large areas of forested wetlands were being impacted by development activities and agriculture. These wetlands would have been replaced with open water reservoir, which was considered as a negative impact. The second major impact of the project was to the Indian River Lagoon. Studies had shown that discharge of large slugs of freshwater to an estuary like the Indian River Lagoon would have detrimental impacts upon water quality and seagrasses, an important ecological setting in the Lagoon. Also, diversion of these waters to the Indian River Lagoon was resulting in extreme low flows in the St. Johns River during dry periods, since the water storage in the Upper St. Johns was depleted by these inter-basin diversions.

As a result of the negative findings in the 1973 EIS, the State of Florida withdrew support for the Upper Basin Project as planned in the 1967 GDM and the Corps halted work on the Upper St. Johns Project until the issues raised in the EIS could be addressed.

2.3 Back to the Drawing Board

The Upper St. Johns Project was dead in the water. The ranchers that had owned the land where the Jane Green Reservoir was to be constructed, asked for the return of their lands. The local sponsors had withdrawn their support for the project as planned and one of the features which was identified as having unacceptable environmental impacts (C-54 canal inter-basin diversion) was completed and operating.

In 1972 the Florida Legislature created the St. Johns River Water Management District (District). In 1973 the Governor appointed the first Governing Board of the District and in 1977 the geographic boundaries of that agency were expanded to include the Upper St. Johns River. Two major acts enabled the District to implement a water resources project. First, in 1976 the people of Florida backed the water management system by approving a Constitutional Amendment to authorize the water management districts to collect ad valorem taxes. Second, in 1981 the Florida Legislature created the Save Our Rivers land acquisition program and authorized the use of documentary stamp taxes to be used to purchase lands associated with rivers. Stable funding sources

allowed the District to play a significant role in planning and implementing the Upper St. Johns Project. Thus, the District made the Upper St. Johns River project its highest priority.

In 1980-1981 Florida experienced an extreme drought. As predicted by the planners of the original C&SF project, the loss of floodplain water storage in the Upper St. Johns resulted in record low levels for lakes in the watershed, threatening water supplies for urban and agricultural users.

In the Indian River Lagoon the area of seagrasses declined significantly during the 1970s and 1980s. This decline was attributed to water quality degradation in the Indian River Lagoon and one cause of that decline was the diversion of flood waters through the C-54 Canal.

Not only was the Upper St. Johns Project halted, but the portions of the project that had been constructed were adversely impacting the river, water users and the Indian River Lagoon estuary. A new direction was needed. The District formed a citizens' advisory committee made up of representatives of various interests in the Upper St. Johns area. This committee worked with District staff engineers and scientists to develop a Basic Design Concept for the Upper St. Johns River project, which was approved by the District Governing Board in November 1980.

The Basic Design Concept was for a semi-structural project involving a combination of "water management areas" and "marsh conservation areas." The water management areas are reservoirs where agricultural discharges are collected and segregated from the more pristine surface waters in the basin. The water management areas provide for flood control, water quality treatment, water supply, and public recreation. The marsh conservation areas are natural wetlands that provide natural floodplain storage, water quality treatment, and restoration of wildlife habitats that had been destroyed by agricultural development of the watershed.

The Corps evaluated the Basic Concept Plan and in 1982 determined that a plan consistent with the Basic Design Concept would be economically justifiable. The Corps then restarted their planning process to redesign the Upper St. Johns River Basin Project and prepare a new GDM and an EIS for the revised project.

The District collected data on both the hydrologic and environmental conditions in the Upper St. Johns. District engineers developed a hydrologic model of the watershed from the Florida Turnpike north to State Road 46, in order to predict the performance of different project alternatives. District's environmental scientists developed an environmental water management plan (Miller, 1993), based upon the hydrologic simulation model results, after considering numerous alternatives for management of water levels within the Upper Basin. They first identified hydrologic criteria that are important to a healthy marsh system. These included mean and maximum depths, annual fluctuations, recession rates, and minimum levels for lakes. Environmental criteria were developed for each of these hydrologic criteria and using these environmental criteria the District's environmental scientists and engineers developed environmental management schemes that would be best able to meet the criteria. These schemes were then compiled into the project plan.

2.4 The Current Upper Basin Plan

The District Governing Board approved a plan in February 1983 and requested that the Corps prepare a GDM and EIS based upon this plan. The Corps completed the current plan and the associated EIS in August 1986 as shown in Figure 3. Construction of the revised project plan commenced in 1988, 15 years after the original project was halted due to unacceptable environmental impacts and 39 years after the initial authorization by Congress for the C&SF project. Construction was anticipated to take approximately 12 years, but 24 years later the Three Forks Marsh Conservation Area is still incomplete, awaiting completion of a plan to address historical resources discovered in the project area.

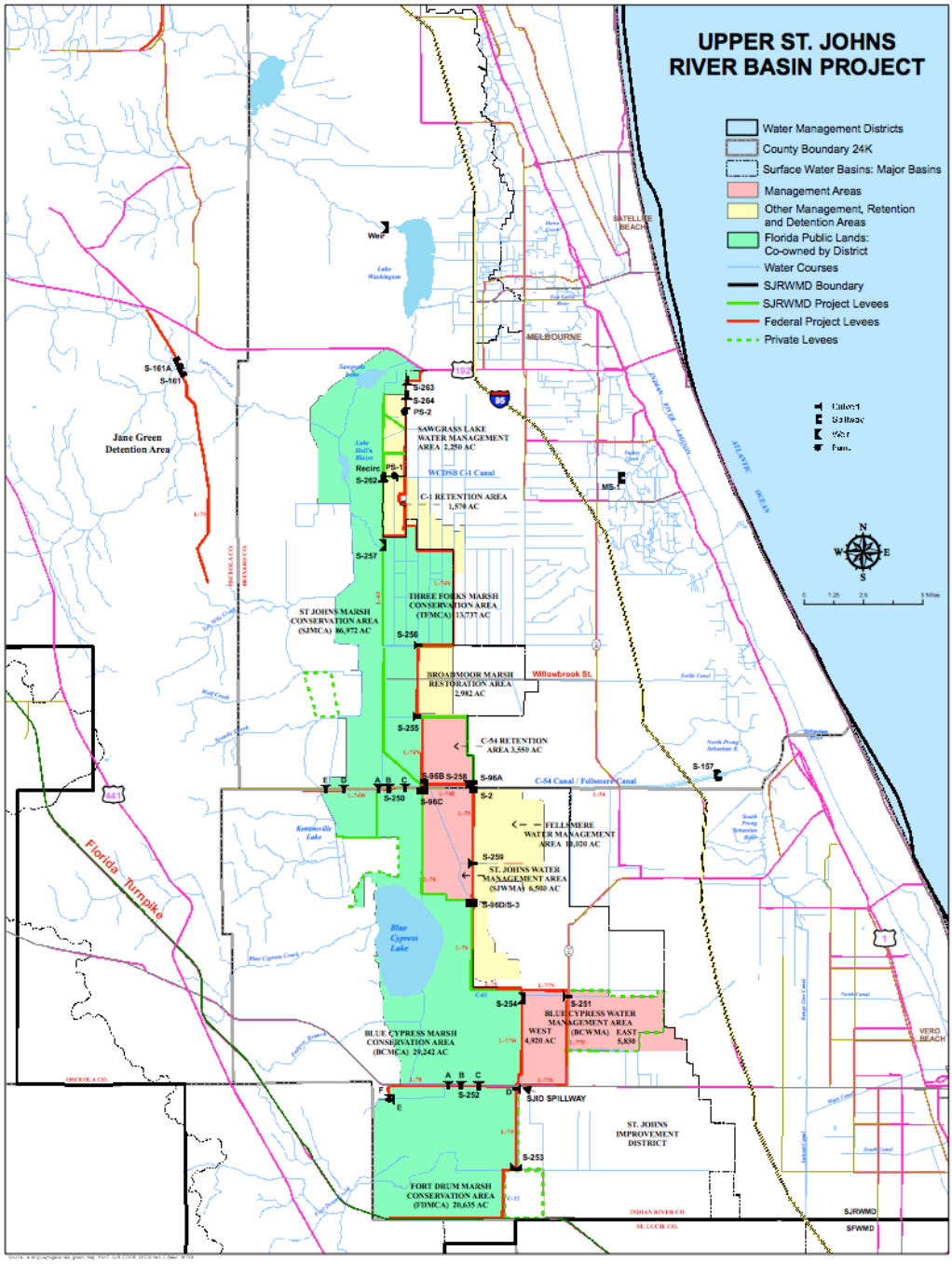

Figure 3 The 1986 Upper St. Johns River Project Plan

The 1986 project plan included three "water management areas" and four "marsh conservation areas." The plan included levees along the east side of the river system to protect low lying lands to the east from flooding. No levees were required along the western side of the river, as the project would reduce flood levels from the pre-project condition. The plan also included a detention area on Jane Green Creek, a reservoir on Taylor Creek and the C-54 canal. The Taylor Creek Reservoir and C-54 canal were completed prior to the original Upper St. Johns Project being halted for environmental reasons.

Hydrologic modeling showed that the 1986 project met the original project purpose of flood control and providing conservation storage for dry season water uses. However, this plan was able to accomplish much more.

The District had acquired over 60,000 hectares of the floodplain of the Upper St. Johns River during the 1980s, as a result of the passage of the Save Our Rivers and other conservation land acquisition programs in Florida. This enabled the District to restore substantial areas of floodplain marshes in the four marsh conservation areas. It also restored habitat for a wide range of aquatic and wetland dependent wildlife and resulted in increases in wildlife populations and diversity.

The water management areas not only provided conservation storage and flood control, but these areas were also designed to improve water quality in both the St. Johns River and the Indian River Lagoon. The District had fish stocked in one of the water management areas and this area, which is known by fishermen as the "Stickmarsh" or "Farm 13", is internationally renowned for its fishing opportunities. An ancillary benefit of the project has also been that the large flooded area has a sufficient water surface area to protect citrus groves to the east and southeast of the project from winter freezes. This is the "Indian River" citrus area that is a very significant economic crop in Florida. Before the project was constructed, winter freezes in this region, which are almost always associated with winds from the northwest, caused significant damage to the Indian River citrus crop. After the project, there has been substantially less damage during similar freeze events. It is interesting to note that this unplanned benefit would have more than justified the cost of this water resource restoration project.

The Jane Green Detention Area was initially proposed in the 1962 GDM to be a deep reservoir and this would have resulted in the loss of thousands of acres of forested wetlands. The 1986 project made this area a detention area, where water would only be impounded for a few days or weeks during severe flood events. Studies showed that this short duration flooding would not significantly damage the forested wetlands. This area is also used for deer hunting and public recreation and is known as the Bull Creek Wildlife Management Area.

The Taylor Creek Reservoir was initially going to be a small part of a much larger reservoir. The overall reservoir was determined to have significant negative impacts and the project lands to the south of Taylor Creek Reservoir were returned to the original landowners (except for the Jane Green Detention Area). Taylor Creek Reservoir was designed to provide conservation storage. The agricultural interests adjacent to Taylor Creek Reservoir had not made use of this water supply, but the City of Cocoa obtained a consumptive use permit to pull water from Taylor Creek Reservoir to augment their public water supply system.

So, as described by Sterling (1998), a project which was designed initially in the 1960s for flood control and conservation storage for water supply, but had significant adverse environmental impacts, was modified in the 1980s and now provides flood control, water supply, water quality improvement, wildlife habitat improvement, reduction of inter-basin diversion to the Indian River Lagoon, as well as public recreation and freeze protection benefits. Figure 4 shows the historic loss of floodplain marsh in the Upper St. Johns and the results of the implementation of the 1986 project plan.

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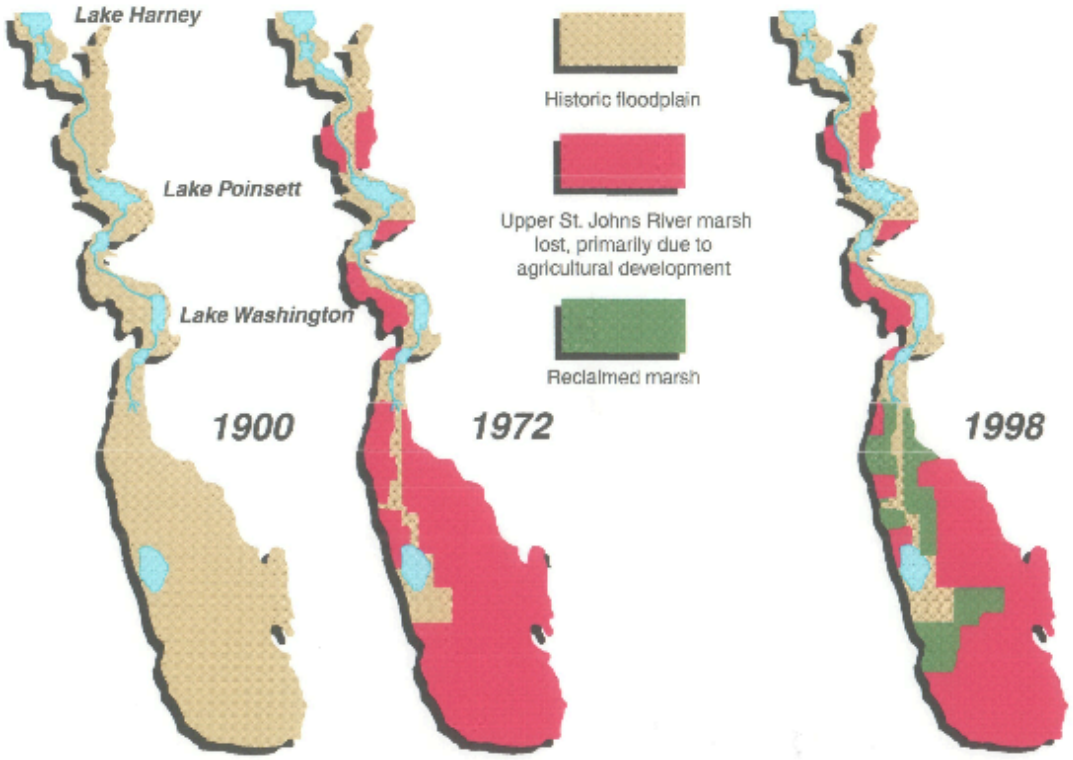

Figure 4 Historic loss and restoration of floodplain wetlands in upper St. Johns

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2.5 Modifications of the Plan

It has been 26 years since the adoption of the 1986 plan. During this time the District has operated the completed portions of the project and monitored the hydrology, water quality, and environmental characteristics of the Upper St. Johns River as described in Miller (1993). Since the operation of the project, the District has recognized several opportunities to improve the benefits of the project by altering the project plan or operations. The following are several of the more significant project modifications to be implemented.

The St. Johns Water Management Area (SJWMA) is a 2,600 hectare reservoir in Indian River County. SJWMA provides irrigation water for citrus, pasture, sod, and other agricultural crops. This reservoir also collects and treats storm water runoff from agricultural lands. In the early operation of the SJRWMA, District scientists were observing that storm water coming into the reservoir from these agricultural lands was short-circuiting to the outfall, reducing the effectiveness of the water treatment provided by the reservoir. The District came up with a plan to construct a berm across the reservoir to act as a baffle and increase the length of the flow path through the reservoir. The Corps reviewed this plan and agreed to implement the change.

The Blue Cypress Water Management Area (BCWMA) is a 4,000 hectare reservoir in Indian River County. BCWMA provides flood storage and water quality treatment of agricultural storm water runoff. BCWMA was also designed to provide irrigation water for citrus and other agricultural crops. In 1989, the District and U.S. Fish and Wildlife Service (USFWS) discovered that BCWMA had become a nesting area for the Everglades Kite, an endangered bird species. The Everglades Kite's primary food is the apple snail. The kite nests in small trees in areas that are flooded, since flooding protects the nests from predators such as raccoons and snakes. During years when drought caused the kites to abandon other nesting habitats in southern Florida, the BCWMA, with its stable water levels and ample population of apple snails, became a significant habitat for the kites. Initially, the USFWS wanted to prohibit all water withdrawals from the BCWMA and also require that the water levels be managed within a very narrow range. District environmental scientists proposed that such management restrictions might have short term benefits for the Everglades Kites, but in the long term the habitat in BCWMA for the kites and many other species would be significantly degraded as discussed in Miller (1996). Also, the District took the position that prohibiting all water withdrawals would be unnecessarily restrictive and harmful to area water users. After a three year long negotiation a plan was agreed to whereby water levels would be managed to support the Everglades Kite habitat, but periodic dry-downs would be allowed and new water withdrawals for irrigation would be prohibited, but withdrawals for freeze protection would be allowed, subject to certain limitations.

During a high water period in the 1990s the neighboring landowners complained that a canal that was conveying drainage water to BCWMA was not functioning. The District engineers investigated this complaint and found that the drainage area involved lands both within the St. Johns River Water Management District and the South Florida Water Management District (SFWMD). Also this area is so flat that water often moves only in response to pumping and many landowners have portable pumps and can move their discharges from one area to another. Also, the flowway in question was not owned by the District. It was determined that several modifications needed to be made. Drainage ditches coming from south Florida were blocked so that drainage from lands in SFWMD would drain into SFWMD canals. A weir was placed in the flowway to prevent backflow from BCWMA and a "cookie cutter" was used to cut a path for flow through the flowway.

Landowners neighboring the Fort Drum Marsh Conservation Area complained that they were experiencing flooding problems. District engineers investigated and determined that an additional drainage channel needed to be provided along the western edge of this area. The Corps agreed to add this feature to the project plan and it was constructed.

During construction of BCWMA there was a flooding event in the basin. Neighboring landowners complained about the high water levels in BCWMA. The District engineers investigated and recommended adding a fixed crest weir along the west side of BCWMA to help control high water levels in the area, which the Corps implemented.

On three occasions in the 1990s a landowner on the west side of the Blue Cypress Marsh Conservation Area experienced flooding of their property, involving the failure of their private levee which separated their land from an area known as Kenansville Lake, a former agricultural property that the District had acquired for restoration purposes. District engineers investigated and found that the Corps had filled in a canal that was a drainage outlet for this rancher and that this may have contributed to the flooding problems. The District negotiated a settlement with the landowner and recommended a drainage plan to the Corps, which involved cutting a new drainage outlet for the neighboring landowner. Although the pre-project drainage canal had been filled by the Corps, the District engineers found that the Corps could move the water 6 kilometers to the north by constructing a 300 meter long channel to an existing borrow pit and then connect the borrow pit to an existing drainage canal on property recently purchased by the District. The Corps agreed to construct this canal and an associated water control structure as a minor modification of the project as shown on Figure 5.

Figure 5 Kenansville Lake outfall canal constructed by Corps

The outfall structure for the Blue Cypress Marsh Conservation Area is designated S-96C. According to Adamus (1997) this structure drains a watershed of 512 square kilometers. The outfall structure for the St. Johns Water Management Area is designated S-96B and this structure drains a watershed area of 208 square kilometers. These two structures are located 450 meters from each other and share the same outfall canal into the St. Johns Marsh Conservation Area. During flooding events when both structures were making designed releases the outfall canal would stage up and restrict the outflow capacity of both structures. The District was forced to restrict operation of these structures and only discharge from one structure at a time. This resulted in high water levels

upstream of one or both structures and caused some flooding of neighboring lands. District engineers evaluated this problem and recommended that the Corps build a levee between these two structures and dredge a separate outfall canal for S-96B that would flow through the Three Forks Marsh Conservation Area. The discharge to the St. Johns Marsh Conservation area from Three Forks Marsh Conservation Area is 16.5 kilometers north of S-96B at a location where the river channel and the water levels are at a lower elevation and therefore better able to accept the combined flow from these water control structures. Figure 6 shows the levee between the two water control structures and the new outfall canal into Three Forks Marsh Conservation Area.

Figure 6 Junction of S-96B and S-96C Outfall Structures

2.6 Additional Restoration Activities in the Basin

In the 26 years since the Upper St. Johns Project was approved by the Corps, the District has found many opportunities to supplement this project and improve on the water resources benefits of the project. During this period the State of Florida created several land acquisition programs, such as P2000 and Florida Forever. As far back as the early 1980s the District Governing Board had made the acquisition of the 10 year floodplain of the Upper St. Johns River its highest priority. Much of this land has since been acquired. The District has also partnered with other agencies that have land acquisition programs such as the Natural Resource Conservation Service (NRCS) of the U.S. Department of Agriculture to purchase some of these flood prone lands. As a result, the District has substantially expanded the overall acreage of restored wetlands in the Upper St. Johns River.

Major restoration projects that have been undertaken in addition to the federal Upper St. Johns Project include:

- Broadmoor Marsh project, 1,100 hectares of marshes managed for waterfowl habitat in partnership with the NRCS, Florida Fish and Wildlife Commission and Ducks Unlimited;
- Six mile creek project, 800 hectares of floodplain wetlands in partnership with NRCS;
- River Lakes Conservation area, 6,400 hectares of floodplain wetlands in partnership with NRCS;
- Canaveral Marshes Conservation area, 1,000+ hectares ;
- Seminole Ranch Conservation area, 8,000 hectares in partnership with The Nature Conservancy;

- Little-Big Econ State Forest, 3,000+ hectares in partnership with Orange County, Seminole County and State of Florida;
- Fellsmere Water Management area, 4,000 hectares in partnership with NRCS; and
- Canal 1 Rediversion Project, modify existing water control structure and install pumps to move water from the C-1 canal into the Sawgrass Lakes Water Management Area in order to return water to the St. Johns River that would otherwise be diverted to the Indian River Lagoon.

In 2008, the District and the Corps were awarded the International Thiess Riverprize for outstanding accomplishment in river restoration for the District's work in the Upper St. Johns River. This award was for the combined efforts of the District and Corps for the Upper St. Johns project as modified and other restoration activities in the basin.

2.7 Fellsmere Water Management Area

In 2002, District environmental scientists determined that the water treatment capability of the existing water management areas was not sufficient to meet regulatory requirements of the Florida Department of Environmental Protection and the U.S. Environmental Protection Agency. This deficit could be made up in several ways. One option would be to require the farmers in the Upper St. Johns to implement measures to reduce the discharge of pollutants into the receiving waters. However, the District had been working with these land owners for many years and there was some concern that additional pollution control measures may not be feasible for the farmers. Another alternative was for the District to construct an additional water management area to provide additional treatment of storm water before discharging this water into the river.

In addition, tropical rainfall events had resulted in high water levels in BCWMA and neighboring landowners had complained that these water levels were dangerously close to damaging their property. The District was therefore interested in pursuing projects that could help to control the high water levels in BCWMA to protect neighboring lands from potential floods.

The District staff developed a conceptual plan for a water management area near the town of Fellsmere and contacted a large landowner to determine if they would be willing to sell the District an area of 1,600 hectares of land to construct a water management area. The land owner was willing to sell and in 2003 the District purchased this land. Later on, the landowner expressed an interest to sell additional lands to the District. The District evaluated various project plan options and developed a partnership with NRCS to pursue a 4,000 hectare water management area project. In 2008 the District acquired the additional lands to bring the total water management area up to 4,000 hectares as shown on Figure 7. In 2010 there was an amendment to this purchase agreement to make a few changes to the property boundary.

The District established a team of engineers and environmental scientists to design the Fellsmere Water Management Area (FWMA). They developed a plan that would create a diverse aquatic habitat that would provide water supply, flood protection, water quality improvement, recreation and which would provide sufficient flood water storage to eliminate the need for inter-basin diversion to the Indian River Lagoon. The construction of levees around FWMA is approximately 80% complete and interim operation could commence as early as summer of 2014.

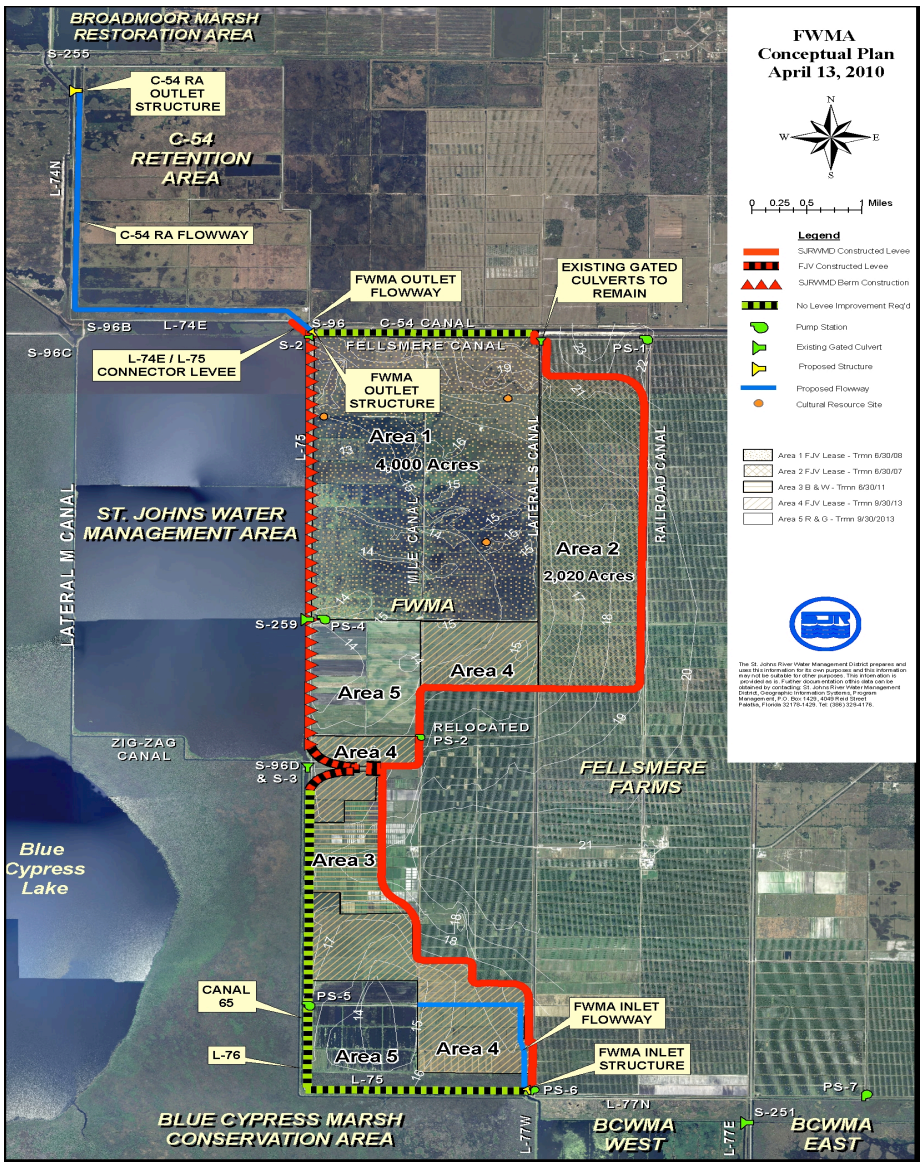

Figure 7 Fellsmere Water Management Area, Indian River County, Florida

3.0 DISCUSSION

The Upper St. Johns Project has evolved over the 60 year period that U.S. and Florida agencies have been addressing the water issues of the Florida peninsula. This evolution has been due to a number of factors including the changing desires of the regions citizens, the improving understanding of hydrologic and environmental issues, development of a multidiscipline project team, the use of adaptive management techniques to operate a project, the organizational structure established at the water management districts and the availability of reliable funding sources. Plus the success of the project can be directly attributed to the leadership provided by key persons at critical times in this evolutionary process.

3.1 Changing Public Desires

In the 1940s, Florida's economy and principal land use was agriculture. But even within the agriculture sector, different agriculture groups have different priorities regarding water resources.

In the 1940s and 1950s the Upper St. Johns River watershed was dominated by cattle grazing and citrus groves, with the citrus being located mainly along the coast. Both of these types of agriculture do not want to see extreme flooding of their lands, although cattle grazing is not harmed as much as citrus by most floods. The citrus industry is more interested in water supply, needing reliable sources of irrigation water during droughts. Also, freeze protection requires a large amount of water in a short period of time, which can be provided by a surface water reservoir.

The ranchers in the Upper St. Johns were not supportive of reservoirs for conservation storage in the 1950s and 1960s. They saw these reservoirs as a way for the public to enter upon their properties for poaching and other mischief. The ranchers would have been satisfied with a project that focused solely upon drainage and flood control. This can be seen in the rancher's opposition to the 1962 plan, and their requests on several occasions for the return of lands acquired by FCD for the project.

In the 1970s the political landscape was changing in Florida. With the advent of Disney World in Orlando, the burgeoning tourist business in the State and a rapidly growing urban population, the public was becoming more concerned about the quality of the environment in Florida. Also, during this period orange juice was very popular and the citrus industry was growing and creating a need for water supply in the Upper St. Johns basin. There was now greater support for environmental restoration and public recreation opportunities for the urban dwellers.

3.2 Improved Understanding of Hydrologic and Environmental Issues

In the 1950s and before unless a surface water body was used as a source of public water supply, not much thought was given to the water quality in rivers and lakes or the environmental benefits of wetlands. Rivers were often viewed as a component of the city sewer system, a transport mechanism to eliminate waste.

In the 1950s the scientific community was simply not aware that hydrologic manipulation on the scale being considered for southern Florida could have such severe impacts. By "engineering" an artificial drainage system that provided for flood control and conservation storage, the Corps opened up vast areas of floodplain wetlands for agricultural development. This extremely intensive agricultural land use, where before there were wetlands, resulted in the discharge of large quantities of nutrients to surface waters and the rapid eutrophication of many water bodies. The mechanisms for this to occur were not well understood at that time.

Over the intervening 50 years much research has been done on the impact of nutrient releases to surface waters. The U.S. Environmental Protection Agency and State of Florida Department of Environmental Protection now have the scientific capability to establish Total Maximum Daily Load (TMDL) targets for water bodies in the state.

3.3 A Multidisciplinary Project Team

The District created a multidisciplinary team to plan and implement the Upper St. Johns restoration project. The team included a project manager whose role involved ensuring that all disciplines on the team were participating in project decisions. It is often the case that a team member on a given project may consider their position to be superior to other members. Sometimes this may be the true. However, it is critical that all voices be heard to ensure that potential problems are not overlooked and that the eventual project plan is the best possible alternative.

3.4 Implementation of Adaptive Management Techniques

As can be seen from the number of project modifications that have been implemented over the years, having a successful project is dependent upon implementation of adaptive management techniques.

The District closely monitors the performance of water resource projects and if the performance is lacking or if an opportunity arises to improve performance, then modifications are considered.

3.5 The Organizational Structure Provided by the Water Management Districts

Over the last forty years the Water Management Districts have built up a staff of engineers, scientists and field staff that is very capable to manage complex hydrologic systems. These staff are commonly solving environmental problems that were not well understood just 20 to 30 years ago. When issues arise in the Upper St. Johns, these District staff identify the problems and work with stakeholders to develop solutions.

The Water Management Districts also have a management structure that starts with a Governing Board that is made up of citizens representative of the public served by the District. The boards act as a collegial body, ensuring that no one sector of the community controls the actions of these agencies. The Districts are also answerable to the State, with the Florida Department of Environmental Protection providing coordination and oversight over the Districts.

3.5 Stable Funding Sources

The Florida Legislature gave the Water Management Districts substantial responsibilities in the 1980s and 1990s, but they also gave the Districts stable funding sources to implement these responsibilities. For land acquisition, the Legislature created Save Our Rivers, P2000 and Florida Forever. For other operating expenses the Legislature, in accordance with the electorate's vote in favor of a Constitutional Amendment, authorized the Districts to collect ad valorem taxes. In addition, from time to time when there was a Legislative priority, there would also be appropriations from the state budget for various water resource projects. The Districts were also able to leverage their funds by partnering with local governments and federal agencies to implement projects where the missions of the agencies coincided. It is safe to say that the Upper St. Johns River restoration would not have been successful if adequate funding had not been provided by the Florida Legislature and the U.S. Congress.

3.6 The Role of Individuals at Key Points in the Project

There are many competent staff working in agencies. However, to move large projects forward requires that there be one or more individuals that have vision and leadership capabilities in positions where they can influence the progress of a project. When project planners run into vexing problems, it is easy for progress to be stalled while the problem is being studied. Likewise it is easy to blame delays on other agencies, politics, the weather, etc. The St. Johns River Water Management District has been fortunate to have a very excellent project team working on the Upper St. Johns Project over the last 30 years and some of the staff have been with the agency during that entire period. Two examples are given.

First, one problem with most federal agencies is that they are bureaucracies with a capital B. In other words, federal agencies are strong on process and weak on individual leadership. There are numerous levels of responsibility in an agency, and every one of these levels discourages staff on lower levels from taking initiative and thereby solving problems. Every decision must be run up an endless command chain and as a result projects often languish for years. Plus if there is a difficult problem to solve, the staff can just study the problem forever, rather than taking a risk by proposing a novel solution. Despite this unfortunate "rule of the nature of federal agencies", the District has been fortunate over the years to have had individuals assigned to their projects that overcame the pull of the bureaucracy and managed to move projects forward. One example was a project manager at the Corps of Engineers and the other was a project manager at the Natural Resource Conservation

Service. As a result, during the time that these individuals worked on projects with the District, many outstanding projects were implemented with very substantial benefits for the public in Florida.

Second, the District has been fortunate to have a number of truly outstanding staff over the last 30 years. As an example consider the District's first Executive Director, a gentleman who was previously a biologist with the Florida Fish and Game Commission. This individual had a very thorough understanding of the issues in the Upper St. Johns River and a vision for how the restoration could occur, even at a time when the agency was just hiring its first staff and had no money. He led the staff and Governing Board to move this vision forward. He may not have been as politically adept as some in this position, but when he was eventually dismissed as Executive Director he stayed on at the District in a position that allowed him to shape the Upper St. Johns Project plan and move the project through the planning process with the Corps.

4.0 CONCLUSIONS

In conclusion, unregulated development of floodplains in central and southern Florida resulted in catastrophic damage and the initial response involved plans that caused additional damage due to a failure to consider environmental consequences. Interdisciplinary planning and adaptive management have resulted in a restoration plan that successfully addressed the major issues in the Upper St. Johns River basin, as well as meeting the changing objectives set forth by the public. It can often take many decades to implement a large water resources project, such as the Upper St. Johns River restoration project discussed in this paper. Over that span of time the project team must consider changing public perspectives on the project, as well as new advances in science related to the project, if the project is to be successful.

ACKNOWLEDGEMENTS

Research funding from the St. Johns River Water Management District is appreciated.

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