2. EXISTING CONDITIONS

The Existing Conditions section describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section does not describe the entire existing environment, but only those environmental resources that would be affected by the alternatives if they were implemented. This section, in conjunction with the description of the "No Action" alternative forms the base line conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

2.1 GENERAL ENVIRONMENTAL SETTING

The TFMCA encompasses approximately 14,000 acres of former floodplain that has been diked and drained for agricultural purposes. There has been no urban development within the immediate project area. Water inflows to TFMCA occur from rainfall and currently drainage occurs to either Canal C-1 to the north or via pumping to Canal C-40 to the west. The TFMCA is currently subdivided by internal levees into three separate parcels that will be interconnected when the project is complete.

Improvements to create pasture and native range for cattle in the northern third of TFMCA have provided partial drainage of the area since the early 1940's. Because of the long-term drainage activities, peat soils in this area have subsided several feet. The middle third of the TFMCA was drained in 1980 and intensively farmed for row-crops until 1985. The SJRWMD acquired this property in 1985 and has maintained it as an isolated rainfall-driven impoundment since that time. A temporary pump station has been used to control water levels. The southern third of the TFMCA was drained in the 1960's and used initially as native pasture and then farmed for row crops beginning in 1980. The property was also purchased by the District in 1985 and maintained as an isolated rainfall-driven impoundment. In 1990, the property was connected to the SJMCA and flooded to enhance project discharge capabilities. In 1992, the area was once again isolated from the marsh. Beginning in 1994, pumping began and water levels have fluctuated in response to seasonal rainfall patterns.

2.2 GEOLOGY AND SOILS

The soils that make up TFMCA and SJMCA are poorly to very poorly drained hydric and facultative soils (Figure 5; USDA 1974). Hydric soils are defined as those soils that are saturated or flooded long enough during the growing season to favor growth and regeneration of wetland vegetation. Hydric soils can be either organic or mineral. Facultative soils are intermediate between hydric and upland soils and sometimes exhibit the characteristics of hydric soils.

Approximately 90% of the area is comprised of hydric soils, primarily Monteverde and Micco peat (Figure 5). Monteverde and Micco peat are poorly drained, highly organic soils that generally occur in freshwater marshes and swamps. Natural water table conditions are generally within a depth of 10 inches of the soil surface for 6 to 12 months a year and between 10 and 40 inches for the rest of the year (USDA 1974). Water can stand on the surface for 6 months each year. Monteverde and Micco peat typically support freshwater marsh vegetation such as maidencane (*Panicum hemitomon*), sawgrass (*Cladium jamaicense*), cattail (*Typha spp.*), arrowhead (*Sagittaria lancifolia*), and buttonbush (*Cephalanthus occidentalis*).

Primary facultative soils occurring in the area are Riviera and Winder loamy sand. Riviera and Winder sand are classified as poorly drained sandy soils that occur on broad low flats and in sloughs, depressions and cypress ponds. Organic content of these soils is generally low. The natural water table is generally within a depth of 10 inches for 1 to 6 months in most years and typically between 10 and 40 inches the rest of the year (USDA 1974). These soils are generally flooded for up to 7 days in 1 to 3 months of each year. Natural vegetation supported by facultative soils include sand cordgrass (*Spartina bakeri*), maidencane, and saw palmetto (*Serenoa repens)*. On low ridges the vegetation is pine (*Pinus spp.)*, live oak (*Quercus viginiana*) and cabbage palm (*Sabal palametto*).

2.3 TOPOGRAPHY

Ground elevations in the TFMCA generally range from 12 to 20 ft NGVD (National Geodetic Vertical Datum) and there is a downward elevation gradient from south to north of approximately 8.5 inches (0.7 ft.) per mile (Figure 6). A comparison of survey data from 1954 and 1998 indicates that soils in the TFMCA have subsided between 2 and 5 ft. This soil loss is due primarily due to the oxidation of the highly organic peat soils that underlie most of the TFMCA after they were drained.

Ground elevations in the adjacent SJMCA generally range from 14 to 23 ft NGVD and there is also a downward slope from south to north of approximately 8.8 inches (0.74 ft.) per mile. The elevation gradient in SJMCA is not evenly sloping but has a relatively steep gradient between the 19-foot and 21-foot contours (Figure 6). This steep gradient occurs in the most constricted portion of the SJMCA where the marsh width spans less than one mile. Ground elevations in TFMCA, on average, are between 2 and 4 ft. lower than ground elevations in the immediately adjacent areas of SJMCA (Figure 6). Differences in ground elevation between the two areas generally increase in a south to north direction.

2.4 PLANT COMMUNITIES

Plant community maps are presented for two dates: pre-project conditions (1986) and existing conditions (1997). Pre-project vegetation maps were analyzed to demonstrate that major vegetation changes have occurred. As a result of the construction of L-74N, water began to impound in the southern two-thirds of the TFMCA and vegetation shifts were observed. Most notable among these changes was that approximately 5,300 acres, which was row crops in 1986, was restored to wetlands by 1997. The restoration of these wetlands should be considered a benefit from project construction.

2.4.1 TFMCA

Plant communities occurring in the TFMCA in 1986 were delineated from 1:24,000 scale, infrared aerial photographs taken in January1986 (Figure 7; Table 2). Although these maps were ground-truthed, the accuracy of the mapping effort was not documented.

2.4.1.1 Northern Section of TFMCA

Plant communities typical of ruderal pasture dominate the majority of this section (Figure 8). The eastern half of the section is dominated by Bahia (*Paspalum notatum*) and other non-native pasture grasses, although a variety of herbaceous wetland plants such as softrush (*Juncus effusus*), arrowhead, pickerelweed (*Pontedaria cordata*) and sand cordgrass occur commonly in more poorly drained areas. This area has experienced a colonization of wax myrtle (*Myrica cerifera*), saw palmetto, and saltbush (*Baccharis halimifolia*) since the discontinuation of grazing. Approximately half of the pastures have been invaded by wax myrtle and are mapped as shrub dominated pasture. The exotic Brazilian pepper (*Schinus terebinthifolius*) occurs throughout this area, primarily in association with remnant farm levees. About 25% of the area that was used as semi-improved pasture is dominated by sand cordgrass (*Spartina bakeri*), and is classified for mapping purposes as wet prairie. Throughout the area there are numerous, small depress ional wetlands that contain a variety of wetland plant species such as maidencane, flat-sedge (*Cyperus odoratus*), and softrush. Approximately one-quarter (1,869 acres) of the northern section supports a dense cover of sawgrass. Nearly all of this sawgrass is located in the northwestern portion of this parcel (Figure 8), and occupies the lowest ground elevations (<15ft NGVD) in TFMCA. Hydric hammock communities located in the southwestern corner of the northern parcel are dominated principally by red maple (*Acer rubrum*).

Table 2. Number of acres and descriptions of major plant communities in TFMCA and SJMCA delineated from 1 to 24,000 scale infrared aerial photographs taken in January 1986.

Community	SJMCA Acres	% of Total	TFMCA Acres	% of Total	Description
Shallow Marsh	9,345.9	77.4	2,366.7	17.2	Herbaceous or graminoid communities dominated by species such as sawgrass, maidencane, cattails, pickerelweed, arrowhead, and other grasses and broad -leaved herbs. Occurs most often on organic soils.
Wet Prairie	18.0	0.2	3,790.7	27.6	Communities of grasses, sedges, rushes, and herbs typically dominated by sand cordgrass, maidencane, or a mixture of species. Usually on mineral soils.
Herbaceous Wetlands	***9,363.9***	***77.6***	***6,157.4***	***44.8***	
Shrub Swamp	1,413.6	11.7	196.8	1.4	Dominated by willows, buttonbush, or similar appearing vegetation.
Transitional Shrub	1,014.2	8.4	297.4	2.2	Dominated by transitional shrubby vegetation at upland margins of water community types or on clear-cut hydric sites. Also develops on wet prairie sites, which have been protected from fire. Wax myrtle (*Myrica cerifera*) and *Baccharis halimnifolia* are typical species.
Shrub Bog			10.8	0.1	Dominated by shrubby vegetation occupying typical bayhead sites (forested wetland dominated by broad-leaved, evergreen bay trees). Often developing in bayheads destroyed by fire or other disturbance.
Shrub Wetlands	***2,427.8***	***20.1***	***505.0***	***3.7***	
Hardwood Swamp	0.5	<0.1	86.9	0.6	Forested wetlands dominated by deciduous hardwood species typically including black gum, red maple, water ash, water elm, and willows. Cypress is often a significant component of this type.
Cypress			22.4	0.2	Forested wetlands dominated by bald cypress or pond cypress (*Taxodium distichum* or *T. ascendens*).
Hydric Hammock			4.3	<0.1	Forested systems dominated by broad-leaved evergreen and deciduous tree species. Cabbage palmetto may be dominant.
Forested Depression			11.5	0.1	Typically pond cypress, pine, deciduous hardwood, bay, or cabbage palm dominated communities occupying shallow depressions in mesic flatwoods sites. Understory vegetation consists of hydrophytic shrubs, grasses, and herbs. Saw palmetto, gallberry and other typical mesic flatwoods species generally absent. Soils usually sandy.
Forested Wetlands	***0.5***	***<0.1***	***125.1***	***0.9***	
Upland	94.3	0.8	6,811.1	49.6	Used for all areas that are not delineated as wetland vegetation. May include drained areas, developed or farmed lands, and pine plantations on hydric soils.
Uplands	***94.3***	***0.8***	***6811.1***	***49.6***	
Open Water	165.5	1.4	103.5	0.8	Unvegetated or sparsely vegetated sites subject to prolonged or semi-permanent flooding. Includes lakes, streams, ponds and other water bodies.
Free Floating	22.6	0.2	27.6	0.2	Communities of free-floating plants (such as water hyacinth, water lettuce, or *Lemna*) or floating mats of rhizomatous species (such as alligator weed or various grasses and sedges).
Open Water	***188.1***	***1.6***	***131.1***	***1.0***	

Table 3. Number of acres and descriptions of major plant communities in TFMCA and SJMCA delineated from 1 to 24,000 scale infrared aerial photographs taken in December 1997.

Community	SJMCA Acres	% of Total	TFMCA Acres	% of Total	Description
Sawgrass	1,711.5	15.2	1,869.9	13.5	Community dominated by sawgrass >70% cover.
Cattail	178.6	1.6	114.1	0.8	Community dominated by cattail >70% cover.
Grass/Sedge Marsh	793.1	7.0	1,787.1	12.9	Shallow marsh dominated by mixed grasses and sedges, including maidencane.
Mixed Herbaceous Marsh	2,708.0	24.1	2,054.1	14.9	Shallow marshes dominated by mixtures of non-woody plants (broad- and narrow-leafed species) where no one species is dominant.
Wet Prairie			842.4	6.1	Herbaceous wetlands where many species occur, esp. grasses and sedges, on primarily mineral soils that are infrequently inundated.
Herbaceous Wetlands	*5,391.2*	*47.9*	*6,667.6*	*48.2*	
Willow Swamp	3,412.3	30.3	318.9	2.3	Shrub swamp with > 70% willow canopy cover.
Primrose Willow			1,495.8	10.8	Shrub swamp with > 70% Ludwigia peruviana cover.
Other Shrub Swamp	1,282.9	11.4	133.3	1.0	Mixed shrub swamps with willow, wax myrtle and other species, sometimes with small trees. Canopy cover of shrubs >70%.
Shrub Wetlands	*4,695.2*	*41.7*	*1,948.0*	*14.1*	
Hydric Hammock	202.1	1.8	355.1	2.6	Forested "islands" in the marsh, dominated by red maple and other flood tolerant species, usually with shrub border and understory.
Forested Wetlands	*202.1*	*1.8*	*355.1*	*2.6*	
Pasture			1,871.6	13.5	Uplands dominated by non-native grasses.
Shrub dominated Pastures			716.3	5.2	Uplands with grass and shrub mixtures. Shrub cover about 20-60%.
Transitional Shrub			884.5	6.4	Community dominated by shrubs, mainly wax myrtle, which tolerates saturated and drier soils.
Levees and Spoil Banks	311.5	2.8	706.9	5.1	Man-made levees and spoil deposits next to canals or drainage ditches.
Uplands	*311.5*	*2.8*	*4,179.3*	*30.3*	
Open Water	631.6	5.6	447.2	3.2	Inundated areas with little or no vegetation as man-made or natural features.
Free Floating	24.8	0.2	224.4	1.6	Water Lettuce, water hyacinth, pennywort and duckweed.
Open Water	*656.4*	*5.8*	*671.6*	*4.8*	
Total	**11,257**		**13,822**		

Table 4. Thematic accuracy estimates for plant community delineation in TFMCA and SJMCA.

Plant Community	TFMCA Groundtruth Points	No. of Correct Points	SJMCA Groundtruth Points	No. of Correct Points
Sawgrass	2	2	7	7
Cattail	1	1	1	1
Grass/Sedge Marsh	5	3	6	5
Mixed Herbaceous Marsh	10	10	29	25
Herbaceous Wetlands	*18*	*16*	*43*	*38*
Willow Swamp	4	3	18	17
Primrose Willow	9	9		
Other Shrub Swamp			11	11
Shrub Wetlands	*13*	*12*	*29*	*28*
Pasture	4	3		
Shrub dominated Pastures	1	1		
Transitional Shrub	1	1		
Uplands	*6*	*5*		
Open Water			1	1
Total	**37**	**33**	**73**	**67**
% Accuracy	**89.2%**		**91.8%**	

2.4.1.1.2 Middle Section of TFMCA

The middle section of the TFMCA is dominated by shrub swamp, primarily primrose willow (*Ludwigia, peruviana*; Figure 8). In places, primrose willow is rooted in a dense floating mat of nutsedge (*Scirpus cubensis*). Other species that occur are arrowhead, pickerelweed, duckweed (*Lemna minor*), *Azolla* (*Azolla caroliniana*), and cattail. The two northeastern sections are blanketed by a complete coverage of primrose willow. Deeper water in the southern half has resulted in the establishment of open water and free floating plant communities dominated by water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*) and surrounded by grass/sedge marsh. At times, the deeper communities are vegetated by aquatic beds, particularly *Hydrilla* (*Hydrilla verticillata*). The northwestern section of this parcel was never farmed for row crops and supports mixed herbaceous marsh with interspersions of grass/sedge marsh. Sawgrass and other native species occur on the northern edge of the property in a small area that was apparently not farmed.

2.4.1.1.3 Southern Section of TFMCA

The southern section of the TFMCA is covered by dense mixed herbaceous marsh intermixed with woody shrubs, primarily willow (*Salix caroliniana*; Figure 8). Herbaceous species include maidencane, giant smartweed (*Polygonum densiflorum*) and cattail. The northeastern corner of the southern section is dominated by cattail. Dog fennel (*Eupatorium capillifolium*) is a weedy pasture species found throughout the property as are a variety of different grasses. The canal located along the eastern border of the southern section is frequently covered with water hyacinth, water lettuce, and *Hydrilla*.

2.4.2 SJMCA

Plant communities occurring in the SJMCA in 1986 were delineated from 1:24,000 scale, infrared aerial photographs taken in January 1986 (Figure 7; Table 2). Plant community classification schemes that were used to generate this map were general because the original purpose of this mapping project was to map wetlands on a District-wide scale. Although these maps were ground-truthed, the accuracy of the mapping effort was not documented.

In 1986, herbaceous wetlands, specifically shallow marshes, were the dominant plant association in the SJMCA covering over three-quarters of the area. The remainder of the area was dominated by shrub wetlands comprised mainly of willow and wax myrtle. Only a small percentage (1.6%) of the area had open water or floating marshes.

Existing plant communities in the SJMCA were delineated from infrared aerial photographs taken in December 1997 (Figure 8: Table 3). This mapping effort utilized more specific plant community classifications than those used in 1986 (e.g. sawgrass and cattail rather than shallow marsh designation). As part of the mapping process, ground-truthing was conducted and the thematic accuracy of plant community delineation was estimated. A set of randomly selected points was ground-truthed in 1999. Thematic accuracy was assessed by locating the designated points in the field and classifying the plant community surrounding that point. A total of 73 points were visited in SJMCA in a variety of plant communities (Table 4). Of the 37 points visited in the field, 67 or 91.8% were delineated correctly.

SJMCA is currently dominated by mixed herbaceous marsh communities, which is a highly diverse mixture of species where no one species is dominant (Figure 8; Table 3). Common species include maidencane, smartweed (*Polygonum spp.*), arrowhead, pickerelweed, cattail, and buttonbush. One-third (1,712 acres) of SJMCA is characterized as a sawgrass community. Although the amount of sawgrass coverage is similar between TFMCA and SJMCA, the stands in SJMCA are generally less dense and exhibit greater floral diversity than those in the TFMCA. Although herbaceous wetlands remain the dominant plant associations in SJMCA, the abundance of this community has declined from 77.6% to 47.9%. A major portion of the marsh has converted to shrub swamp. Shrub swamp, dominated primarily by willow, is still the second most dominant plant community in the SJMCA. However, there has been a marked increase in shrub swamp since 1986, with a two-fold increase in willow coverage. Willow swamp is most abundant immediately north of the levee that delimits the southern border of the SJMCA and, along the main river channel to the north (Figure 8). Cattail dominated-communities cover approximately 2% of the total area of the SJMCA. Nearly 10% of SJMCA is classified as open water, hydric hammock and free-floating vegetation surrounded by project levees and spoil banks. The open water component of SJMCA varies with water level. During prolonged high water periods, open water extends into the marsh from the C-40 canal. The deeper areas adjacent to the canal are sometimes densely vegetated by *Hydrilla*, water hyacinth and water lettuce. An increase in open water communities occurred from 1986 to 1997 and is likely attributable to prolonged flooding adjacent to the C-40 canal caused by the canal plugs.

2.5 FISH AND WILDLIFE RESOURCES

The Upper St. Johns River Basin is a nationally significant biological resource that supports many economically important populations of fish and wildlife and provides important habitat for a number of threatened and endangered species. The importance of the Upper Basin to fish and wildlife resources is obvious when considering that even with the extensive loss of floodplain that has already occurred, the basin still ranks as one of the largest wetland areas in the state (Kushlan 1990). The following discussion is an overview of common fish and wildlife resources found within the immediate project area.

2.5.1 INVERTEBRATES

Macroinvertebrates represent an important component of the Upper St. Johns River basin food web. In aquatic environments, species such as the crayfish (*Procambarus alleni*) and the fresh water shrimp (*Palaemonetes paludosus*) are abundant and provide an important food source for larger fish, amphibians and reptiles, and wading birds. Jordan (1995) reported that in Blue Cypress marshes the average abundance of fresh water shrimp was approximately 94,000 per acre (38,000/ha) while average biomass was approximately 18 lbs. per acre (20 kg/ha). In wet prairie communities, crayfish abundance was approximately 105,000 per acre (42,000/ha) while biomass was nearly 215 lbs. per acre (241 kg/ha). Another important invertebrate is the Florida apple snail (*Pomacea paludosa*), which is the primary food of the endangered snail kite (*Rostrhamus sociabilis plumbeus*). In SJMCA and TFMCA, there are also dozens of other aquatic and terrestrial insect species, in both juvenile and adult phases, which are important in the food chain.

2.5.2 FISHERIES RESOURCES

Within the project area there are a large number of fish species that reside within the natural lakes, marshes, canals, and borrow pits. Important freshwater sport fish include largemouth bass (*Micrpopterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and bluegill (*Lepomis machrochirus*; Table 5). Numerous forage species such as mosquito fish (*Gambusia affinis*), bluefin killifish (*Lucania goodei*), and least killifish (*Heterandria formosa*) are also abundant. Fish are critical components of the food web in

Table 5. List of common fishes of the Upper St. John River basin (McClane 1955).

Florida gar (*Lepisosteus platyrhincus*)	Tilapia (*Tilapia aureus*)
Bowfin (*Amia calva*)	Brook silverside (*Labidesthes sicculus*)
Largemouth bass (*Micropterus salmoides*)	Tailight shiner (*Notropis maculatus*)
Black crappie (*Pomoxis nigromaculatus*)	Golden Shiner (*Notemigonus crysoleucas*)
Chain pickerel (*Esox niger*)	Lake Chubsucker (*Erymizon sucetta*)
Bluegill (*Lepomis machrochirus*)	Tadpole madtom (*Noturus gyrinus*)
Redear sunfish (*Lepomis microlophus*)	Golden topminnow (*Fundulus chrysotus*)
Spotted sunfish (*Lepomis punctatus*)	Seminole killifish (*Fundulus seminolus*)
Warmouth (*Lepomis gulosus*)	Flagfish (*Jordanella floridae*)
Dollar sunfish (*Lepomis marginatus*)	Bluefin killifish (*Lucania goodei*)
Blue spotted sunfish (*Enneacanthus gloriosus*)	Mosquito fish (*Gambusia affinis*)
Everglades pygmy sunfish (*Elassoma evergladei*)	Least killifish (*Heterandria formosa*)
Yellow bullhead (*Ictalurus natalist*)	Sailfin molly (*Poecilia latipinna*)
Brown bullhead (*Ictalurus nebulosus*)	Swamp darter (*Etheostomà fusiforme*)
Gizzard shad (*Dorsoma cepedianum*)	Pirate perch (*Aphredoderus sayanus*)
Threadfin shad (*Dorsaom pretense*)	

the Upper St. Johns River system and serve as the pathway for energy transfer from plankton, algae, invertebrates, and plant material to wading birds, reptile and amphibians, and mammals.

While canals and lakes contain water throughout the year, the marshes tend to experience seasonal drydowns. As a result, fish populations in the marshes vary widely as fishes move from the shallower areas into canals and lakes during the dry periods. Even given this fluctuating environment, fish can be quite abundant in the marsh. Jordan (1995) reported that over a three-year period, average densities of small forage fishes in Blue Cypress wet prairie and slough habitats were 73,000 fish per acre (30,000/ha) and 154,000 fish per acre (62,000/ha), respectively. The gradual recession of water levels from the marsh serves to concentrate forage fishes in small pools and shallow water areas and renders them more susceptible to predators such as wading birds. This is a key component of the ecology of South Florida marshes (DeAngelis and White 1994).

The St. Johns Water Management Area (SJWMA), which discharges into the project area through Structure S-96C , supports a high quality largemouth bass fishery that has received national acclaim (Cox et al. 1991). From February through April 1998 alone, it was estimated anglers spent nearly 59,000 hours fishing the SJWMA and caught nearly 60,000 fish (Eisenhauer et al. 1998). Quality fisheries also occur in Blue Cypress Lake, which is connected by canal to Structure S-96B Lake (Eisenhauer et al. 1997). The canal system in the SJMCA currently supports limited seasonal sport fisheries. During the cooler months of the year, sport fish move downstream into the canals when water is discharged from either the St. Johns Water Management Area or from the Blue Cypress Water Management Area. Fish also probably migrate into the canals from the downstream lakes, although due to the dense *Hydrilla* coverage in the lakes, sport fisheries in these lakes are considered to be generally poor (Eisenhaur et al. 1997). During the summer months, water temperatures in the canals rise dramatically and dissolved oxygen levels fall. Fish kills in the C-40 Canal in the southern end of the SJMCA often occur during this period in association with rainfall events and/or pulse discharges from the structures. To prevent fish kills, operation schedules for S-96B and S-96C have been implemented to will prevent rapid closing of these structures after high discharge events. Sport fishing opportunities in the SJMCA canal system are limited because the canals are generally only accessible by airboat. Existing canals in the TFMCA are stagnant and usually covered with water hyacinth or water lettuce. Species that can survive low dissolved oxygen, such as spotted gar (*Lepisosteus platyrhincus*) and bowfin (*Amia calva*; Loftus and Kushlan 1987), are most common.

2.5.3 REPTILES AND AMPHIBIANS

Common reptiles found within the study area include the American alligator (*Alligator mississippiensis*), as well as turtles, lizards and snakes. Common turtles include the cooter (*Chrysemys floridana*), Florida softshell turtle (*Trionys ferox*), mud turtle (*Kinosternon bauri*), and the snapping turtle (*Chelydra serpentina*). Lizards, such as the green anole (*Anolis carolinensis*), are common and several species of skink occur in the drier habitats. Drier habits also support a number of snakes including the southern ringneck snake (*Diadophis punctatus*), southern black racer (*Coluber constrictor*), the eastern diamondback rattlesnake (*Crotalus adamanteus*), the pygmy rattlesnake (*Sistrurus barbouri*) and the eastern indigo snake (*Drymarchon corais*) a federally listed endangered species. Wetter habitats support more aquatic species such as the water snake (*Natrix sipedon*), Everglades rat snake (*Elaphe obsoleta*) , the green water snake (*N. cyclopion*) and the cottonmouth (*Agkistrodon piscivorous*).

The pig frog (*Rana grylio*) is one of the most important amphibians to occur within the project area because it is considered an important recreational and commercial species. Other important frog species include Florida cricket frog (*Acris gryllus*) and the southern leopard frog (*Rana sphenocephla*). Various tree frogs that inhabit drier habitats include the green tree frog (*Hyla cinerea*), and the squirrel tree frog (*H. squirela).* Other common amphibians include the greater siren (*Siren lancertina*), the dwarf siren (*Pseudobranchus striatus*), and the eastern narrow-mouthed toad (*Gastrophryne carolinensis*).

2.5.4 AVIFAUNA

2.5.4.1 General Bird Use

Stevenson (1986) identified approximately 475 bird species found in Florida either as residents or migratory birds. According to Pranty (1996), approximately 460 species are native to Florida and 11 species are established exotics. The largest category of native species is that consisting of winter residents, which makes Florida unique among the states in this regard (Pranty 1996). This is evidence of the importance of Florida as an integral part of the Atlantic flyway. Over 150 bird species migrate to Florida ecosystems to winter over and another 152 bird species breed in Florida ecosystems (Pranty 1996). Table 6 lists common birds typically found in the habitats that occur within the geographic range of the study area.

2.5.4.2 Colonial Wading Birds

Colonial wading birds are believed to be useful indicators of wetland system health because they are near the top of the trophic pyramid and their populations are quick to respond to environmental change (Hoffman et al. 1994). Wading birds commonly found within the Upper Basin include Great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), wood stork (*Mycteria americana*), cattle egret (*Bulbulcus ibis*), glossy ibis (*Plegadis falcinellus*), green-backed heron (*Butorides striatus*), least bittern (*Ixobrychus exilis*),limpkin (*Aramus guarauna*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), and white ibis (*Eudocimus albus*).
Wading birds are generally abundant throughout the SJMCA and re-flooded portions of the TFMCA. Peak abundance estimates derived for this area from aerial surveys range from 22,000 to 34,000 birds (Table 7). Cattle egrets and white ibis are generally the most abundant species but wood storks, great egrets and glossy ibis are also common. Wading bird abundance estimates presented here are conservative, because they do not include estimates of the numbers of smaller or dark birds that are harder to see during aerial surveys such as limpkins and little blue herons. Numbers of wading birds throughout the basin fluctuate primarily in response to seasonal water level fluctuations.

Table 6. Common resident and migratory birds found within the project area (USACE 1998, Stevenson and Anderson 1994 and SJRWMD, unpub. data 1998).

Arboreal Birds

Blue-gray gnatcatcher (*Polioptila caerulea*) R

Boat-tailed grackle (*Quiscalus major*) R

Common yellowthroat (*Geothlypis trichas*) R

Eastern meadowlark (*Sturnella magna*) R

Fish crow (*Corvus ossifragus*) R

Killdeer (*Charadrius vociferus*) R

Northern cardinal (*Cardinalis cardinalis*) R

Red-winged blackbird (*Agelaius phoeniceus*) R

White-eyed vireo (*Vireo griseus*) R

Carolina wren (*Thryothorus ludovicianus*) R

Marsh wren (*Cistothorus palustris*) M

Sedge wren (*Cistothorus platensis*) M

Eastern phoebe (*Sayornis phoebe*) M

Palm warbler (*Dendroica palmarum*) M

Yellow-rumped warbler (*Dendroica coronata*) M

Savannah sparrow (*Passerculus sandwichensis*) M

Swamp sparrow (*Melospiza georgiana*) M

Wading Birds

Great blue heron (*Ardea herodias*) R

Great egret (*Casmerodius albus*) R

Sandhill crane (*Grus canadensis*) R

Wood stork (*Mycteria americana*) R E*

Black-crowned night heron (*Nycticorax nycticorax*) R

Cattle egret (*Bulbulcus ibis*) R

Glossy ibis (*Plegadis falcinellus*) R

Green-backed heron (*Butorides striatus*) R

King rail (*Rallus elagans*) R
Least bittern (*Ixobrychus exilis*) R

Limpkin (*Aramus guarauna*) R

Little blue heron (*Egretta caerulea*) R

Snowy egret (*Egretta thula*) R

Tricolored heron (*Egretta tricolor*) R

White ibis (*Eudocimus albus*) R

Yellow-crowned night heron (*Nyctanassa violacea*) R

Sora rail (*Porzana carolina*) M

Aerial Feeding Birds

Barn swallow (*Hirundo rustica*) M

Tree swallow (*Tachycineta bicolor*) M

Chimney swift (*Chaetura pelagica*) M

Aerial Searching Birds

Belted kingfisher (*Ceryle alcyon*) R

Ruddy duck (*Oxyura jamaicensis*) R

Black tern (*Chlidonias niger*) M

Raptors and Vultures

American kestrel (*Falco sparverius*) R

Audubon's crested caracara (*Polyborus plancus*) R,T*

Bald eagle (*Haliaeetus leucocephalus*) R, T*

Osprey (*Pandion haliaetus*) R, T

Red-shouldered hawk (*Buteo lineatus*) R

Snail kite (*Rostrhamus sociabilis plumbeus*) R, E*

Turkey vulture (*Cathartes aura*) R

Black vulture (*Coragyps atratus*) R

American swallow-tailed kite (*Elanoides forficatus*) M

Northern harrier (*Circus cyaneus*) M

Peregrine falcon (*Falco peregrinus*) M

Shorebirds

Black-necked stilt (*Himantopus mexicanus*) M

Dunlin (*Calidris alpina*) M

Greater yellowlegs (*Tringa melanoleuca*) M

Lesser yellowlegs (*Tringa flavipes*) M

Least sandpiper (*Calidris minulilla*) M

Stilt sandpiper (*Calidris himantopus*) M

Floating and Diving Birds

Anhinga (*Anhinga anhinga*) R

Common gallinule (*Gallinula chloropus*) R

Purple gallinule (*Porphyrula martinica*) R

Double-crested cormorant (*Phalacrocorax auritas*) R

Pied-billed grebe (*Podilymbus podiceps*) R

American coot (*Fulica americana*) M

Surface Feeding Ducks

Fulvous whistling duck (*Dendrocygna bicolor*) R

Mottled duck (*Ana fulvigula*) R

Blue-winged teal (*Anas discor*) M

Ringed-necked duck (*Aythya collaris*) M

R—Resident M-Migrant E*- Federally Endangered T*-Federally Threatened

Table 7. Population estimates for wading birds surveyed in SJMCA, TFMCA and surrounding areas between L74W and State Road 192.

Species	Peak Number of Birds month observed			
	1993	1994	1995	1998
Great egret	2,440 June	1,486 Mar	2,800 Feb	2,847 June
Great blue heron	40 Jan	60 Mar	80 Jan	100 Jun
Small dark herons (Little blue heron, Tricolored herons)	513 Jan	340 July	767 June	506 Aug
Small White Herons (Cattle egret, Snowy egret, juvenile Little blue herons)	17,607 Sept	7,827 July	14,160 May	20,693 Aug
Wood stork	147 June/Aug	1,140 June	207 Apr	787 Jun
White ibis	4,360 Sept	10,593 Feb	15,793 Feb	2,107 Jun
Glossy ibis	1,167 Jan	73 Jan	613 Mar	467 Apr
TOTAL	26,274	21,519	34,420	27,507

* Data from Hoffman (1996) and Sewell (1999) .

The SJMCA has historically contained several large wading bird breeding colonies (Table 8;
Runde et al. 1991; Hoffman 1996). No colonies have been reported occurring in the TFMCA. Colonies in the SJMCA are typically located in dense shrub thickets bordering both the river channel and the shores of Lake Sawgrass and Lake Hell 'n Blazes.

Table 8. Peak number of wading bird nests counted in the Upper St. Johns River Basin during 1993-1995 and 1998. *

Species	1993		1994		1995		1998	
	#	%	#	%	#	%	#	%
Great Egret	350	5.2	420	7.0	1540	11.6	1410	10.0
Great Blue Heron	31	0.5	49	0.8	57	0.4	111	0.8
Snowy Egret	130	1.9	330	5.5	.1460	11.0	2790	19.8
Cattle Egret	6000	88.6	5000	82.8	9800	73.5	7130	50.7
Small Dark Herons (Little Blue Heron, Tricolored Herons)	150	2.2	150	2.5	180	1.4	1860	13.2
Wood stork	110	1.6	90	1.5	296	2.2	760	5.4
TOTAL	6771		6039		13333		14061	

* Refer to Hoffman (1996) and Sewell (1999).

In 1993, three colonies, each containing more than 1,000 nests, were located in the SJMCA.(Table 8). Cattle egrets were the most abundant species nesting. In 1994, only one active colony was found and it was located in borrow pit along State Road 192. Nesting was reduced 1994 in the SJMCA because water levels in the area were extremely low due to *Hydrilla* control efforts. In 1995 and 1998, nine colonies were located. Most colonies were found in close proximity to open water of some kind (lake, canal, borrow pit, flooded cypress heads).

The total number of nests surveyed in 1995 and 1998 were nearly double the number of nests observed in 1993 and 1994 (Table 8). Cattle egrets comprise a significant proportion of the birds nesting in the basin as a whole. However, the trend from 1993 to 1998 has been a decrease in the importance of cattle egret nests and an increase in the percentage of snowy egret, little blue heron and tricolored heron nests (Table 8). The number of wood storks nesting in the basin has continued to increase although all nests located have been in borrow pits only. White and glossy ibis were found nesting in the basin in small numbers, but most breeding colonies occur in the Indian River Lagoon basin (Runde 1991, Hoffman 1996, Sewell 1999).

2.5.4.3 Waterfowl

Waterfowl have historically been abundant in the Upper Basin (Sincock 1958). Common species include common gallinule (*Gallinula chloropus*), American coot (*Fulica americana*), fulvous whistling duck (*Dendrocygna bicolor*), mottled duck (*Ana fulvigula*), blue-winged teal (*Anas discor*), and ringed-necked duck (*Aythya collaris*). The results of one-day, mid-winter waterfowl surveys conducted by the Florida Game and Wildlife Conservation Commission over the area between L74W and State Road 192 are presented in Table 9. In two of three years, the American coot was the most abundant bird.

Table 9. Number of birds estimated during mid-winter waterfowl surveys in SJMCA, TFMCA and surrounding areas between L74W and State Road 192 (FWC, unpub.).

Common Name	1997		1998		1999	
	#	%	#	%	#	%
American coot	10,240	88	2,070	35	578	49
Blue-winged teal, Green-winged teal	1.291	11	395	7	302	25
Ringed-necked duck	22	<1	3,426	58	200	17
Mottled duck	41	<1	7	<1	101	9
Northern pintail	3	<1	15	<1		
American widgeon	10	<1	15	<1	5	<1
Fulvous whistling-duck			12	<1		
Gadwall			4	<1		
TOTAL	11,607		5,944		1,186	

2.5.5 MAMMALS

Florida has an interesting variety of mammals including terrestrial, freshwater and marine species. Although most have wide geographic ranges, a few of Florida's mammals are found nowhere else in the United States. Brown (1994) identified 65 species of wild mammals currently found in Florida, excluding the 30 species of cetacean mammals inhabiting the Atlantic Ocean or Gulf of Mexico. Approximately one-third (22) of these mammals commonly occur within the study area. Three of these species are non-native. Table 10 lists common mammals typically found in the habitats that occur within the geographic range of the study area.

Table 10. List of common mammals found in the study area (Brown 1994).

Opossum (*Didelphis marsupialis*)	Evening bat (*Nycticeius humeralis*)
Marsh rabbit (*Sylvilagus palustris*)	Gray fox (*Urocyon cinereoargenteus*)
Hispid cotton rat(*Sigmodon hispidus*)	Raccoon (*Prycyon lotor*)
Marsh rice rat (*Oryzomys palustris*)	Striped skunk (*Mephitis mephitis*)
Cotton mouse (*Peromyscus gossypinus*)	Long-tailed weasel (*Mustela frenata*)
Round-tailed muskrat (*Neofiber alleni*)	River otter (*Lutra canadensis*)
Least shrew (*Cryptotis parva*)	Bobcat (*Lynx rufus*)
Eastern mole (*Scalopus aquaticus*)	White-tailed deer (*Odocoileus Virginians*)
Eastern pipistrelle (*Pipistrellus subflavus*)	Nutria (*Myocastor coypus*)
Seminole bat (*Lasiurus borealis*)	Nine-banded armadillo (*Dasypus novemcinctus*)
Northern yellow bat (*Lasiurus intermedius*)	Wild boar (*Sus scrofa)*

2.6 THREATENED AND ENDANGERED SPECIES

We have identified 6 federal and state listed animal species and 1 plant species that may occur within the project area and may be affected by the project.

2.6.1 WOOD STORK

The wood stork (*Mycteria americana)* is listed as an endangered species by both the USFWS and the Florida Fish and Wildlife Commission (FWC). Wood storks forage in freshwater marshes, seasonally flooded ditches, or almost any shallow wetland depression where fish tend to become concentrated as the area dries (Kahl 1964). Wood storks are tactile feeders which capture prey by feeling with their bill in shallow water generally less than 40 cm deep (Kahl 1964). Wood storks nest in colonies located in woody vegetation over standing water or on islands surrounded by a broad expanse of open water (Nesbitt et al. 1982). Nesting success of wood storks varies between locations and years and appears to be directly related to the quality and quantity of suitable foraging sites near the colony. Aerial surveys conducted between 1993 and 1995 documented up to 1300 wood storks and 296 nests in the Upper St. John River Basin (Hoffman 1996). Wood storks nested in three borrow-pit colonies in or near the project area. Wood storks were commonly observed foraging in both SJMCA and TFMCA. Wood storks are threatened by habitat loss and by water management practices that alter both the timing and intensity of historic seasonal water level fluctuations which affects food availability.

2.6.2 SNAIL KITE

The snail kite (*Rostrhamus sociabilis plumbeus*) is a medium sized raptor found only in south and central Florida and is listed as endangered by both the USFWS and the FWC. The snail kite is entirely dependent upon wetlands and feeds almost exclusively on apple snails (*Pomacea paludosa*; Beissinger 1988). Preferred habitat for kites is herbaceous wetlands that have relatively long hydroperiods but are subjected to periodic drying. Foraging habitats for kites generally have an open water to emergent vegetation ratio of 30% to 40% (Bennetts et al. 1994). The presence of emergent vegetation is critical because snails climb vegetation to take in surface air, and thus become vulnerable to predation by kites. Snail kites nest most successfully in woody vegetation interspersed in wet prairie and slough complexes and will select for these conditions when available (Bennetts et al. 1988). In the Upper St. Johns River basin, snail kites are found primarily in the Blue Cypress Water Management Area where up to 100 birds and 60 nests have been documented (Miller et al. 1996). Snail kites are occasionally observed in the marshes of the SJMCA. Snail kites are threatened primarily by habitat loss and by the eutrophication of existing habitats.

2.6.3 WHOOPING CRANE

The whooping crane (*Grus americanus*) is listed as endangered by both the USFWS and the FWC. Historical accounts indicate that the whooping crane occurred in Florida, but was observed infrequently and never in abundance. Whooping cranes occupy some of the same habitats as the sandhill crane (*Grus canadensis* spp.; Chandler 1988). Nesbitt (1996a) reported that the two most frequently used habitats of the Florida sandhill crane were pastures/prairies and emergent palustrine wetlands dominated by pickerelweed and maidencane. Cranes show a preference for transition zones between wetlands and pastures/prairies and forested habitats. Cranes forage in uplands and wetlands during the day, but return to roosting sites that are almost always in standing water at night. Nests are usually constructed over standing water and when nesting marshes become dry most cranes will forego nesting altogether (Nesbitt 1996b). The main threat to the crane is the loss of wetland/upland transition zones and water management practices that cause drawdowns during nesting season. A national attempt to remove this species from endangered status was initiated in 1993 when several birds were released on the Kissimmee Prairie in the Three Lakes Wildlife Management Area (Bishop 1992, Nesbitt 1996b). This nearby location (~20 miles) has resulted in frequent visitation of whooping cranes to the marshes and surrounding agricultural fields in TFMCA and SJMCA.

2.6.4 AUDUBON'S CRESTED CARACARA

The Florida population of this resident non-migratory raptor is listed as threatened by the USFWS and the FWC. The caracara (*Polyborous plancus*) is found throughout central and southern Florida where it commonly occurs in native prairies as well as improved and unimproved pastures. The bulk of the population is now found on large cattle ranches (Layne 1978). Cabbage palms and live oaks are the most often used nesting substrates (Layne 1996). Caracaras are highly opportunistic feeders, eating carrion and a variety of live invertebrate and smaller vertebrate prey. Numbers of caracara have declined because of the loss of its preferred dry prairie habitat and because of direct human-related mortality. Caracara have been observed in improved and unimproved pasture habitats of the TFMCA .

2.6.5 BALD EAGLE

The bald eagle (Haliaeetus leucocephalus) is listed as threatened by both the USFWS and the FWC. Bald eagles are known to occur throughout the Upper Basin Project area in a wide variety of habitats but proximity to water is important. Preferred habitat includes a high amount of water-to-land edge where prey is concentrated (Palmer 1988). Eagles feed primarily on fish, birds, smaller mammals and carrion. Threats to the bald eagle include habitat loss and fragmentation, collisions with cars and power lines and shooting. Bald eagles have been occasionally observed in both the TFMCA and the SJMCA. Since the banning of DDT and other organochlorines, eagle numbers have increased appreciably and bald eagles have been reclassified from endangered to threatened.

2.6.6 EASTERN INDIGO SNAKE

The eastern indigo snake (*Drymarchon corais couperi*), a large black non-venomous snake which occurs throughout the Upper Basin Project, is listed by both the USFWS and the FWC as a threatened species. The eastern indigo snake is generally classified as an upland species, but is found in a variety of habitats including both wet and dry prairies, hardwood hammocks, agricultural fields, and along the margins of freshwater marshes and lakes (Moler 1996). The indigo snake feeds on virtually any small vertebrate it can capture and its prey is usually swallowed alive. The greatest threats to the indigo snake are habitat loss and fragmentation, pesticides, illegal trapping and vehicle mortality. Eastern indigo snakes are occasionally observed in drier habitats or along levees in TFMCA and SJMCA.

2.6.7 CHAFF SEED

Chaff seed (*Schwalbea americana*) is a tall perennial herb in the figwort family that is distinguished by its large, purplish-yellow, tubular flowers (Center for Plant Conservation N.D.). It flowers from April to June and produces long, narrow seeds, enclosed in a loose-fitting sac-like structure that provides the basis for the common name. Peterson (1997) indicated that chaff seed occurs in both terrestrial (sandhills and mesic flatwoods) and palustrine habitats (wet prairie). Chaff seed grows on sandy peat or sandy loam soils that can be found in ecotonal areas between peaty wetlands and xeric sandy soils. Chaffseed is dependent on factors such as fire, mowing, or fluctuating water tables to maintain the crucial open to partly-open conditions it requires

(USFWS 1995). The most serious threats to its continued existence are fire-suppression, conversion of the habitat, and incompatible land uses. There has been confirmed documentation of chaff seed occurring in Brevard County, although Peterson (1997) does not present the habitat or exact location in which it occurred. Wet prairie habitat occurs in TFMCA, but no documented occurrence of chaff seed has been reported in that location.

2.7 CULTURAL RESOURCES AND HISTORIC PROPERTIES

Inspection of the Florida Master Site File revealed that two sites of archeological significance exist within the boundaries of TFMCA. These sites were surveyed in 1984 as part of a larger reconnaissance survey of 50 probability areas for evaluation of the Upper St. Johns River Basin Project. New World Research, Inc. performed the survey for the U.S. Corps of Engineers which was conducted in compliance with the National Historic Preservation Act of 1966, as amended (PL 89-655); the Archeological and Historic Preservation Act, as amended (PL 93-291); and executive order 11593.

Platt mound (8BR244) is located in the southwestern corner of Section 32, T29S, R36E. The mound or midden is less than one acre in size and is vegetated by hackberry and some cabbage palm and maple. The site remains relatively undisturbed. Aboriginal ceramics, lithics and animal bones were recovered from a test excavation. The artifacts included fire-tempered ceramics, as well as St. Johns, Glades and Belle Glades ceramics.

Elder mound (8BR245) is located in the southeastern corner of Section 20, T29S, R36E. The mound or midden is slightly greater than one acre in size and is vegetated by grasses with some hackberry and cabbage palm. There has been minor destruction of the site by bioturbation, dredging, ditching and the installation of a well. Prehistoric artifacts such as aboriginal ceramics, animal bones and shell food remains were recovered from a small test dig. The artifacts included Orange, St. Johns, Glades and Belle Glades pottery. A variety of materials were found at different levels of excavation, indicating intensive utilization during prehistoric periods.

2.8 WATER QUALITY

The Florida Department of Environmental Protection (FDEP) ranks water quality in the upper basin generally as borderline good to fair, with localized areas of poor quality (FDEP 1996). River and canal waters from Lake Washington south are characterized as being highly colored and contain moderate to high concentrations of calcium, sodium, chloride, total iron, and total organic nitrogen (Belanger et al. 1983; FDEP 1996). Increased groundwater inputs to the system due to agricultural management practices have been implicated as causing increased mineralization of surface waters (Mason and Belanger 1979; Leed and Belanger 1981). Total iron concentrations in the system frequently exceed the 300 *u*g/l level established by the FDEP as the minimum standard for waters used for human consumption. Iron levels in the system appear to be regulated by inputs from non-artesian groundwater, complex interacting natural processes, and re-suspension of bottom sediments (Leed and Belanger 1981). Iron concentrations in non-artesian groundwater samples near Lake Washington have been recorded to exceed 4,500 *u*g/l (Leed and Belanger 1981).

Waters within the Upper St. Johns River Basin are naturally eutrophic (Lowe et al. 1984), although increased runoff from lands converted to agriculture throughout the basin have caused nutrient levels, primarily phosphorous, to increase significantly. The ecological significance of higher nutrient levels can be increased primary productivity, loss of water column dissolved oxygen, algal blooms, fish kills, vegetation community shifts, and loss of biodiversity. Increased nutrient levels can ultimately affect recreational use and the value of an area as fish and wildlife habitat. Agricultural runoff has frequently been implicated as a factor contributing to localized dissolved oxygen sags that have resulted in fish kills (Belanger et al. 1983), although dissolved oxygen levels in the basin tends to be naturally low (Hand et al. 1994).

The USJRBP is designed to reduce nutrient loading and improve water quality by segregating and retaining agricultural discharges in water management areas. For instance, retention within the water management areas is expected to reduce total phosphorous loadings to the basin by at least 36 to 48% (Miller et al.1998). However, even with significant reductions in loading rates, nutrient levels may not reach acceptable levels for several years due to the nutrient buildup in the system that has already occurred. Samples taken from several different areas of the USJRBP have revealed that phosphorous accumulation rates in the soils were up to 25 times higher in the 1980's than in the 1920's (Brenner and Schelske 1995). This reservoir of nutrients tied up in the sediments of lakes, canals, and wetlands may continue to impact surface water conditions and effect the system for many years even after external loading rates have been reduced (Friedemann and Hand 1989).

To characterize existing conditions, water quality information is presented for the major inflows to both the TFMCA and the SJMCA, for marshes and canals within the affected project area, and for Lakes Hell 'n Blazes and Sawgrass (Table 11). Monthly measurements collected as part of the SJRWMD ambient water quality monitoring program were summarized and averaged for the five-year period 1995 – 1999 to encompass a wide range of hydrologic and seasonal conditions. Key parameters of concern were nutrients, primarily phosphorous, major mineral concentrations, and dissolved oxygen (Lowe, et. al. 1984; FDEP 1996).

Mean total phosphorous concentrations ranged from 0.11 mg/l upstream of S-96C (the outflow from the BCMCA) to 0.61 mg/l in the southern section of TFMCA (Table 11). Total Kjeldahl nitrogen values at these two sites ranged from 1.3 mg/l to 2.9 mg/l, respectively and also encompassed the entire range of values recorded at all sites. The high nutrient level in the southern section of TFMCA reflects nutrient release from the intermittently flooded soils, as there is no direct water inflow to the area except for rainfall. Levels are elevated because the area was intensively farmed for row-crops prior to being purchased by the District. In 1984, water discharge from this area was also reported to have the highest nutrient levels of any site measured in the basin (Lowe et al. 1984). With more permanent inundation, phosphorous levels in the water column in this area are expected to drop to levels seen in the middle section of TFMCA (0.12 mg/l), an area that was also intensively farmed, but has been subjected to much longer hydroperiods.

For discharges from Blue Cypress Lake and marsh, average total phosphorous and nitrogen levels for the period 1995 to 1999 are similar to averages reported for the period 1979 to 1982 (Lowe et al. 1984). However, phosphorous levels from 1995-1999 in Lake Hell 'n Blazes (0.18 mg/l) and Sawgrass Lake (0.15 mg/l) are nearly 3.5 times higher than the values of 0.04 mg/l for Sawgrass Lake and 0.05 mg/l for Lake Hell 'n Blazes reported in the earlier study. Nitrogen levels between the two periods are similar. A likely cause for increased phosphorous levels is the additional nutrient loading that occurred following construction of large dairy in the basin in1988. Runoff from this dairy drained into the C-40 Canal just upstream of Lake Hell 'n Blazes. In 1998, the Water Management District purchased a conservation easement over lands to the east of the project area that included the dairy, and the cattle were removed. Residual phosphorous from the dairy, however, may continue to be a significant source of loading to the basin for several years.

From the 1950's to the 1980's, chloride concentrations in the Upper Basin lakes tended to increase, presumably as a result of the increased use of groundwater for irrigation. Groundwater in this area is characteristically high in chlorides as a result of the upconing of relict seawater into the aquifer (Toth 1988). Increases in chlorides also tended to be most dramatic during the dry season, when the irrigation demand was the greatest (Lowe et al. 1984). High chloride concentrations are actually more of an economical than ecological problem because levels to date have all been well within the tolerances of freshwater organisms. In 1981 chloride levels in Lake Washington, the principal potable water supply for the city of Melbourne exceeded the 250 mg/l standard established for Class I waters by the FDEP forcing a temporary shutdown of the water treatment facility.

As a result of retention and increased surface water being available for re-use, chloride concentrations in waters discharged of the basin are expected to decrease. These anticipated reductions are already being realized. From 1995 to 1999, average chloride concentrations ranged from 30 mg/l in the outflow from the BCMCA, to 110 mg/l in the outflow from the SJWMA (Table 11). Measured values are not only well below the state Class I standard of 250 mg/l, but where comparable, they are substantially below the chloride concentrations reported previously. For example, average chloride levels in Lake Hell 'n Blazes and Sawgrass from 1995 to 1999 were 66 mg/l and 61 mg/l, respectively. From 1979 to 1982, average chloride values reported for these lakes were 175 mg/l and 152 mg/l, respectively.

Table 11. Mean concentrations of water quality parameters in selected marsh, canal and lake sites, 1995-1999.

Parameter	Inflow from BCMCA	Inflow from SJWMA	SJMCA Canals	SJMCA Marsh	TFMCA Southern Sect.	TFMCA Middle Sect.	Lake Hell 'n Blazes	Sawgrass Lake
Water Temp. (^{0}C)	25.1	24.2	23.4	21.8	24.1	23.7	23.5	23.3
Turbidity (NTU)	3.6	5.0	3.7	5.7	6.9	2.3	3.6	1.9
Conductivity (umhos/cm)	190	704	466	307	468	402	404	364
Dissolved Oxygen (mg/l)	4.6	6.6	2.8	2.2	5.6	3.6	3.4	3.6
PH	6.7	7.9	6.7	6.6	7.4	6.7	6.8	7.0
Color (cpu)	205	100	188	177	110	167	196	188
Total Organic Carbon (mg/l)	22.9	22.5	24.7	24.6	31.8	36.6	26.8	27.2
Suspended Solids (mg/l)	7.8	8.1	9.2	13.3	24.0	5.6	7.7	4.4
Chloride (mg/l)	30	110	87	47	62	75	66	61
Sulfate (mg/l)	4.7	58.9	17.7	10.8	4.0	2.4	19.4	18.3
Alkalinity (mg/l)	33.2	115.1	70.1	56.6	129.7	65.7	66.7	61.4
Hardness (mg/l)	55	213	126	103	162	111	116	104
Magnesium (mg/l)	3.3	13.5	8.7	6.3	8.9	6.2	7.3	6.6
Calcium (mg/l)	16.4	63.0	35.9	26.2	50.1	34.8	34.3	30.8
Potassium (mg/l)	1.9	7.5	4.1	3.6	6.0	10.6	3.9	3.6
Sodium (mg/l)	15.2	52.0	40.2	23.5	29.6	28.2	29.6	27.7
Iron (ug/l)	282	118	340	260	231	215	276	191
Lead (ug/l)	0.110	0.174	0.280	0.112	0.385	0.203	0.428	0.215
Orthophosphate – Total (mg/l)	0.058	0.054	0.121	0.079	0.453	0.065	0.113	0.096
Total Phosphorus – Total (mg/l)	0.112	0.128	0.187	0.133	0.610	0.121	0.179	0.146
Ammonium – Total (mg/l)	0.04	0.06	0.10	0.04	0.13	0.10	0.09	0.08
Nitrate & Nitrite – Total (mg/l)	0.04	0.07	0.04	0.01	0.04	0.02	0.04	0.03
Total Kjeldahl Nitrogen – T (mg/l)	1.3	2.2	1.9	1.8	2.9	2.6	1.9	1.7
Chlorophyll-a (ug/l)	12.6	32.2	8.2	32.1	32.3	13.5	14.1	10.7

2.9 AESTHETIC RESOURCES

Not applicable.

2.10 NAVIGATION

The area is not currently navigable.

2.11 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The preliminary assessment indicated no evidence of hazardous, toxic or radioactive waste (HTRW) on the project lands. During land procurement and project construction further HTRW awareness should be practiced.

2.12 AIR QUALITY

Air quality levels in the TFMCA are within acceptable Florida parameters.

2.13 NOISE

Noise levels in the TFMCA are within acceptable Florida parameters.

2.14 PUBLIC SAFETY

There are no existing public safety issues.

2.15 ENERGY REQUIREMENTS AND CONSERVATION

The pumping operation will not require any additional significant energy investment.

2.16 NATURAL OR DEPLETABLE RESOURCES

The TFMCA exhibits the same properties as habitat as the surrounding plots.

2.17 SCIENTIFIC RESOURCES

Not applicable.

2.18 NATIVE AMERICANS

See Cultural and Historic Properties.

2.19 REUSE AND CONSERVATION POTENTIAL

Not applicable.

2.20 URBAN QUALITY

This is a rural conservation area, however, it receives runoff from the adjoining densely populated areas.

2.21 SOLID WASTE

Solid waste is not known to be deposited in the conservation areas.

2.22 DRINKING WATER

The TFMCA is not a direct source of drinking water. It does exhibit connection with the SJMCA, and ultimately with the St. Johns River.

2.23 CUMMULATIVE IMPACTS

The cumulative impacts of allowing the SJMCA to drain into the TFMCA would result in overdraining of the SJMCA and detrimental impacts to natural wetlands.