A Baseline Study of Wetlands in the St. Johns River Basin: Precursor to Water Withdrawals from the St. Johns River

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Abstract

This study was conducted to present baseline data about wetland sites, between the west portion of Lake Monroe to the south portion of Lake George, that are near a possible surface water withdrawal location. Vegetation type and abundanc and, soil quality parameters were documented for fourteen sites. Wetland types identified included hydric hammocks, hardwood swamps, shrub swamps, shallow marshes, and wet prairies. Vegetation found at each site typically corresponded to the wetland type. Soil quality parameters measured include soil pH, electrical conductivity, and order classification for three depths within the soil profile. The soil pH for all soil depths measured ranged from 4.0 to 6.5, with a typical increase down through the soil profile wit the exception of 2 sites. Soil conductivities also typically increased as soil depth increased, and ranged from 0.1 to 13.8 mmhos/cm down the soil profile. Soil porewater pH values ranged from 4.4 to 6.0 and conductivities from 0.8 to 13.3 mmhos/cm. Twelve of the fourteen sites surveyed were classified as histosols, and the other two as mollisols. Minimum flows and levels for the areas surveyed are also discussed in addition to possible effects on wetland hydrology, vegetation, and soils due to excessive water withdrawals.

Introduction

With increases in agricultural, municipal, and industrial water use occurring worldwide, it is becoming of increased importance to identify alternate water resources to sustain the needs of the population. One water resource of interest in this quest includes surface freshwaters existing in lakes, rivers, and streams. Freshwater only accounts for 2.5% of the total water found on the earth. Of that percentage, 29.9% is located in groundwaters and only 0.26% in surface water (Shiklomanov, 2000). Because of linkages between surface water, groundwater, and areas surrounding surface waters, such as wetlands, it is important to carefully weigh how alterations in hydrologic conditions impacts important ecological functions over time. In the case of withdrawals from surface waters, it is necessary to determine the volume of water that can be extracted without causing detrimental effects to adjacent wetlands, as well environmentas downstream of withdrawals.

Wetlands alone serve as major ecosystems supporting various types of life, including plants, invertebrates, amphibians, reptiles, fish, birds, and mammals (Sheldon, 2005). They function to prevent excess nutrients and heavy metals from run-off waters from being transported into bordering surface waters. Their ability to retain water also makes them beneficial in providing flood protection and reducing erosion. Wetlands connected to groundwaters also serve to recharge these systems, which is vital due to the use of groundwater for drinking water and irrigation needs (Mitsch, 2000).

The purpose of this manuscript is to present baseline data of wetland sites potentially impacted by surface water withdrawals from the St. Johns River. Although there are three areas of the St. Johns River Basin that are identified as possible locations for water withdrawals, this manuscript focuses primarily on wetlands in the middle St. Johns River Basin, near Lake Monroe and north to Lake George (Figure 1). It is important to discuss the possible effects of water withdrawals on wetland vegetative communities due to hydrological alterations in wetland areas of, which in turn neccesitates collection of baseline data. This information is viable to ensure that the effects of withdrawals can be monitored and changes to the soil, wetland functions, and wetland community can immediately be identified and corrected before the wetland function and hydrology is lost.

Figure 1. Study area: Wetlands in the middle St. Johns River Basin, between Lake Monroe and Lake George.

Materials and Methods

Field Data Collection

Fourteen wetland sites, extending from Lake Monroe north to Lakte George, that are adjacent to the St. Johns River were chosen for vegetative surveys and soil analysis. This area was chosen because it is a possible location for water withdrawals. Sites were surveyed from March to August 2008. At each site, plots were established based on the dominant vegetation found. A 10 X 20m plot was used for wetlands consisting mainly of trees. Wetlands consisting of shrubs were set with 10 X 10m plots- and herbaceous areas a 5 X 5m plots. Plots were set up with the longest side running parallel to the river. For each plot, soil characteristics, water quality, and vegetative species were documented. When there was an obvious change in vegetation between the original sites and the river, additional sites were established and the same field analysis conducted.

Soil texture and color, as well as peat depth and depth to water table were measured. The conductivity and pH of the water in the wetland, or water infiltrating into a cored area, were measured using a Hanna conductivity meter and pH probe. Soil samples were collected at the surface, and approximately 0.5 and 1 meter below the surface using an auger, placed in plastic bags, stored on ice and returned to the SJRWMD lab for analysis. Lab soil analysis occurred within one to two days of sampling. Lastly, the vegetative species found in plots were identified and their percent cover, strata, and diameter at breast height for trees over 7.5 cm in diameter documented. All sites were marked using GPS to ensure accurate mapping and for possible sampling if the need arose.

Lab Soil Analysis

Soil samples were analyzed for pH and conductivity. To measure pH, 25mL of deionized water was added to 25g of a soil sample and stirred frequently for 15 minutes. A calibrated pH probe was then inserted into the soil suspension and pH recorded (Tan, 2005). Soil conductivity was analyzed using the saturated past method. A 150mL beaker was filled approximately 2/3 full with soil. Deionized water was then added while stirring until the sample became saturated and the soil paste glistened. The samples were allowed to stand for approximately one hour to ensure that no water became pooled on the surface (Gartley, 1995). The soil paste was then transferred to filter housing with filters in place, and a vacuum applied. The conductivity of the extract was then measured using a calibrated conductivity meter.

Results

Dominant Vegetation and Community Types

The wetland community types identified among the fourteen sites included hydric hammocks, hardwood swamps, shrub swamps, shallow marshes, and wet prairies (Table 1). Hardwood swamps were the most common, accounting for seven of the fourteen sites surveyed. Shallow marshes, wet prairies, and shrub swamps each accounted for two of the fourteen sites, and one site was identified as a hydric hammock (Figure 2).

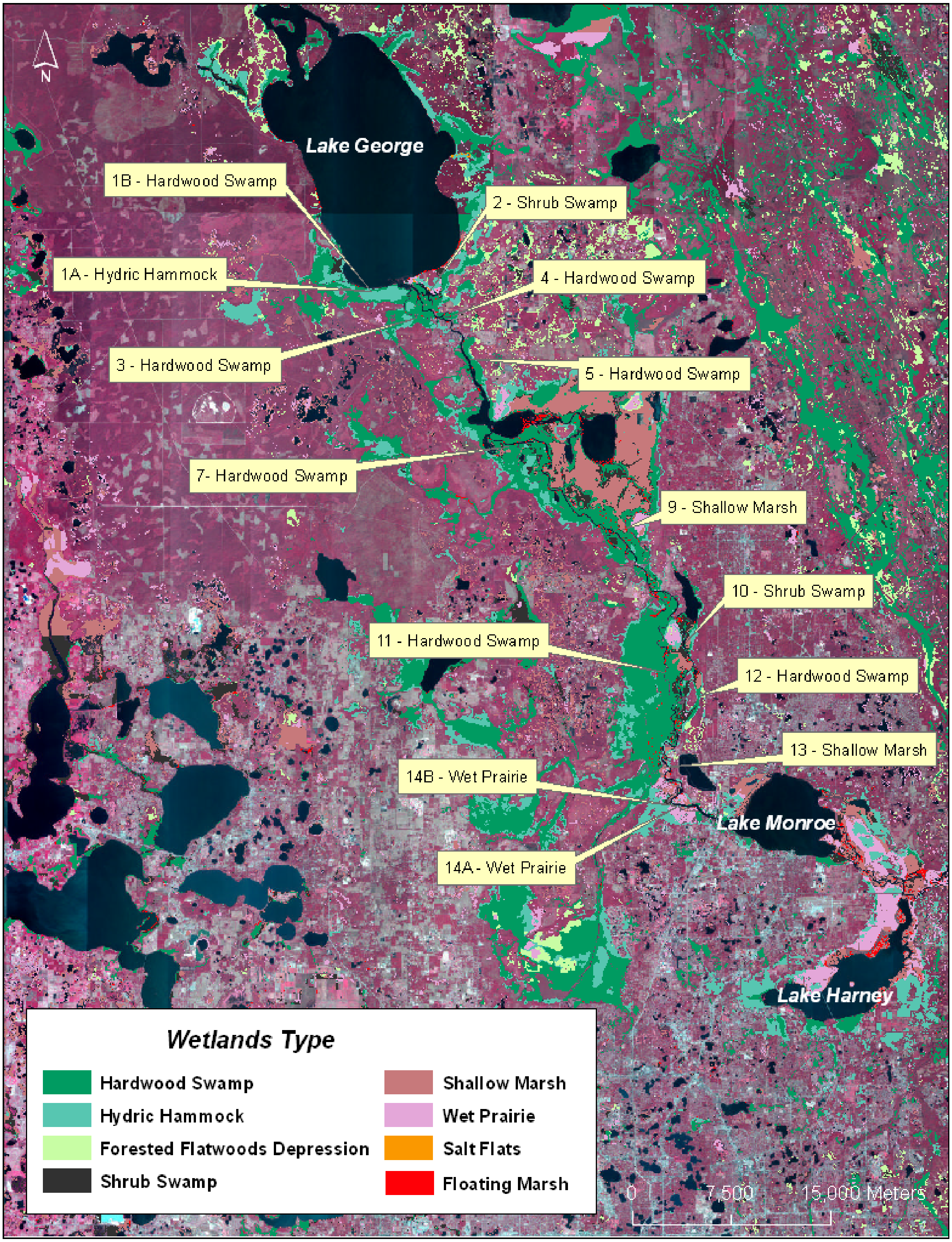

Figure 2. Site locations and wetland type identifications (SJRWMD, 2002).

Fraxinus caroliniana (Carolina Ash) was consistently a dominant species in the hardwood swamp sites, with the exception of site 12, in which *Ulmus Americana* (american elm) and *Acer rubrum* (red maple) were the dominant species. The *Sabal palmetto* (cabbage palm) was a dominant palm species in four of the wetland communities including hardwood swamps, shrub swamps, and hydric hammocks, most of which were non-saline to slightly saline. However, the cabbage palm was a dominant understory species of site 2, a strongly saline site, even though this palm is saline sensitive. It also appeared randomly at a number of other sites. *Hibiscus coccineus* (scarlet rose mallow) and *Alternanthera philoxeroides* (alligator weed) were the dominant species found in abundance in the shallow marshes and wet prairies. Also found dominant in site 14B, a wet prairie, was a *Sesbania* species which was not found at any other site. All vegetative species and their coverage can be found in Appendix A, and the total number of species per site in Figure 3.

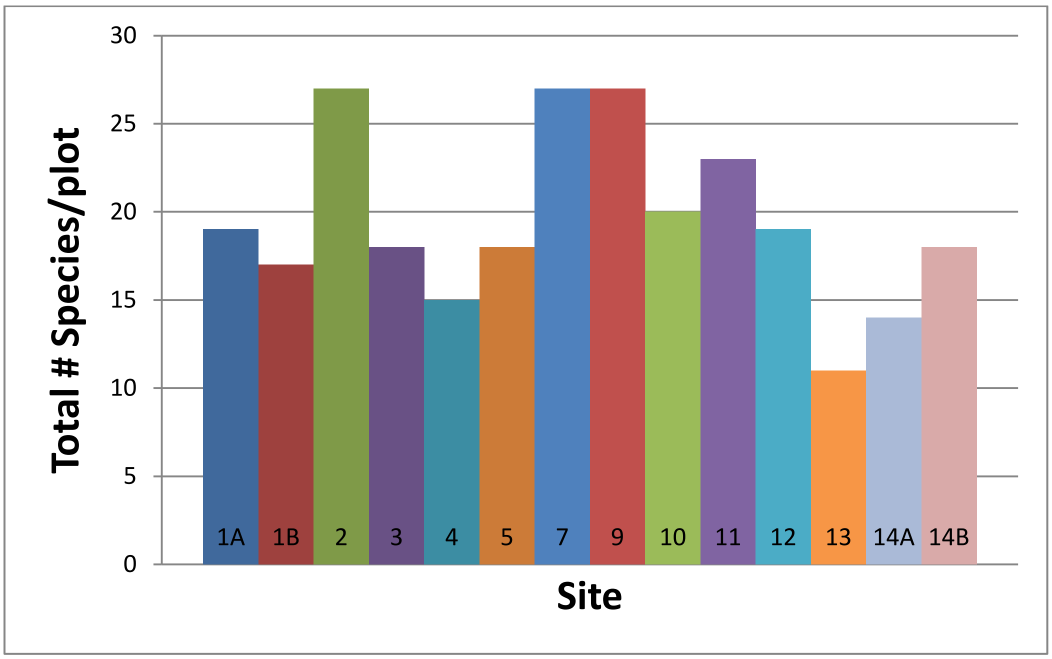

Figure 3. The total number of species identified per plot at each wetland site location.

Soils

Soil series were classified as histosols at 12 of the 14 sites. The two wet prairie sites belonged to the mollisol soil order and consisted of nittaw muck. Terra ceia muck was a common soil series at nine sites. Everglades muck, gator muck, and samsula muck were the soil series at one site each (Table 1).

Table 1. The soil orders, series, and wetland types for 14 sites sampling along the St. Johns River.

Site #	Soil Order	Soil Series	Wetland Type
1a	Histosol	Terra Ceia Muck	Hydric Hammock
1b	Histosol	Terra Ceia Muck	Hardwood Swamp
2	Histosol	Terra Ceia Muck	Shrub Swamp
3	Histosol	Terra Ceia Muck	Hardwood Swamp
4	Histosol	Terra Ceia Muck	Hardwood Swamp
5	Histosol	Terra Ceia Muck	Hardwood Swamp

Site #	Soil Order	Soil Series	Wetland Type
7	Histosol	Terra Ceia Muck	Hardwood Swamp
9	Histosol	Terra Ceia Muck	Shallow Marsh
10	Histosol	Terra Ceia Muck	Shrub Swamp
11	Histosol	Everglades Muck,	Hardwood Swamp
12	Histosol	Gator Muck	Hardwood Swamp
13	Histosol	Samsula Muck	Shallow Marsh
14a	Mollisol	Nittaw Muck	Wet Prairie
14b	Mollisol	Nittaw Muck	Wet Prairie

Analysis of soil pH taken at the surface, 0.5 and 1 meter down from the surface was performed. Results showed an increase in pH as the depth increased for all sites with the exception of sites 11 and 12 (Figure 4). Both of these sites were histosols, but site 11 was an Everglades muck and site 12 was a Gator muck. Surface soil pH for all sites ranged from 4.0 to 5.1. This range was wider at the one meter depth with values ranging from 4.7 to 6.5. Note that there is no data available at the four foot depth for site 3 due to the absence of soil because of the high water table. Data is also lacking for site 14B at this depth because of the inability to auger through the clay layer.

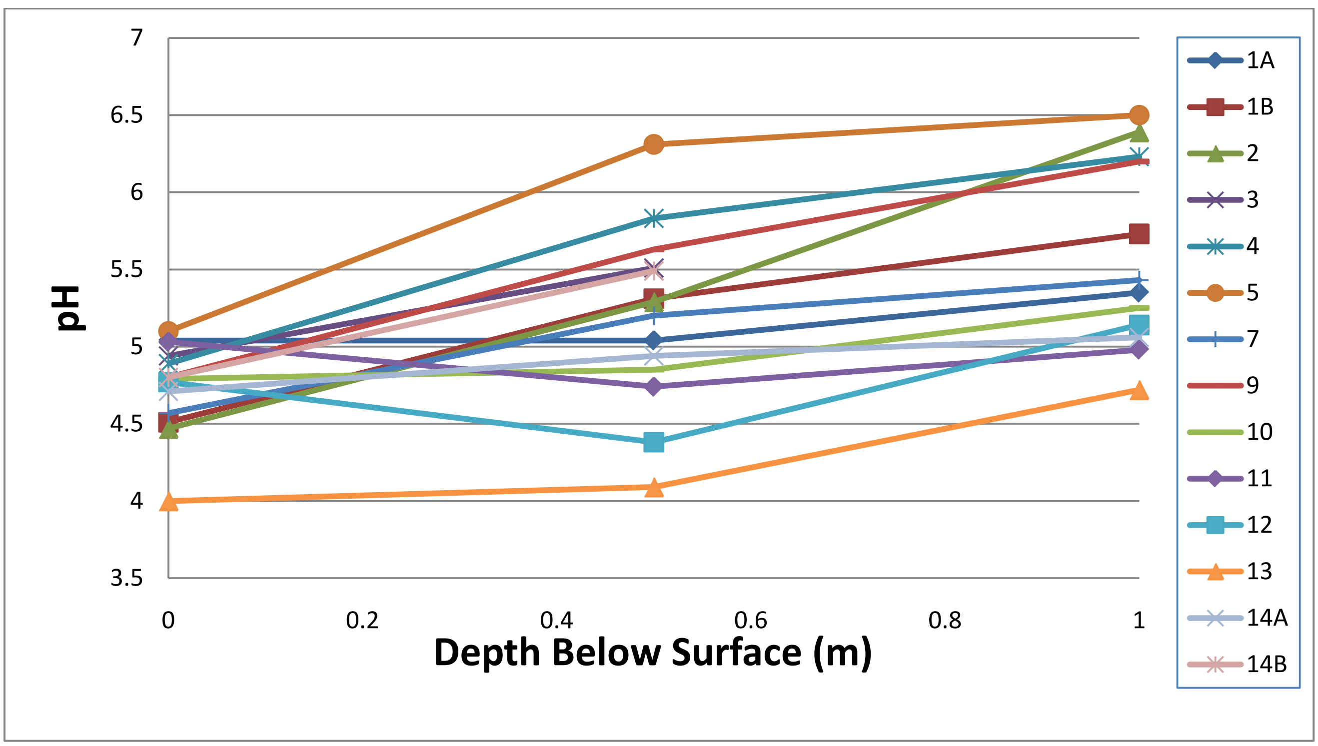

Figure 4. The change in pH through the soil profile for all sites sampled.

In comparison, the soil conductivities also increased as the soil depth increased. Two sites, 4 and 5, were the exceptions. Both sites were histosols of the soil series terra ceia muck. They both also stayed consistently non-saline throughout the soil profile (Table 2) and their conductivities showed little variation from the surface down to four feet. Surface soil conductivities ranged from 0.1 – 4.5 mmhos/cm, and 0.5 –

13.8 mmhos/cm at the four foot depth for all sites (Figure 5). Site2 was the only site that had conductivities in the strongly saline category. All pH and conductivity analysis results can be found in Appendix B.

Table 2. The interpretation of conductivities using the saturated paste method for soluble salts (Dahnke, 1988).

Degree of Salinity	Electrical Conductivity (mmhos/cm)
Non-Saline	0.0 - 2.0
Slightly Saline	2.1 - 4.0
Moderately Saline	4.1 - 8.0
Strongly Saline	8.1 - 16.0
Very Strongly Saline	16.1 +

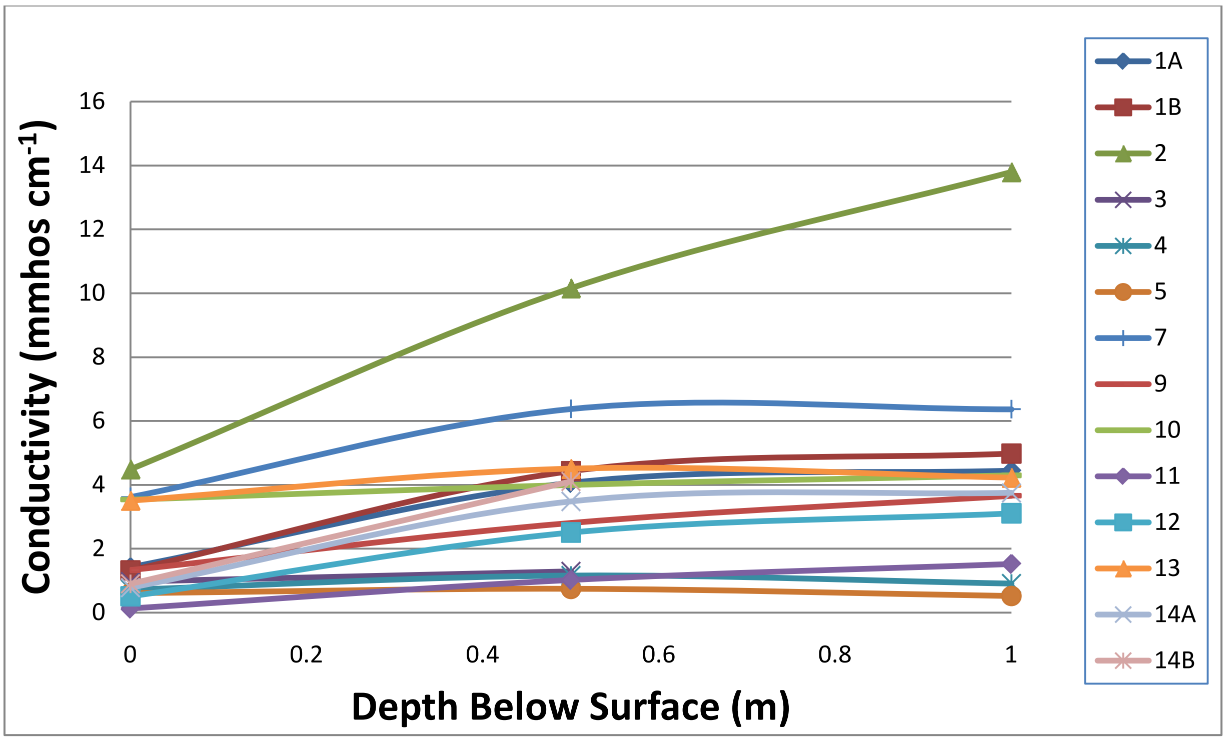

Figure 5. The change in electrical conductivity through the soil profile for all sites sampled.

Measurements of the soil pore water were taken in the field and included conductivity and pH. Soil water pH values for all sites ranged from approximately 4.4 – 6.0. (Figure 6).

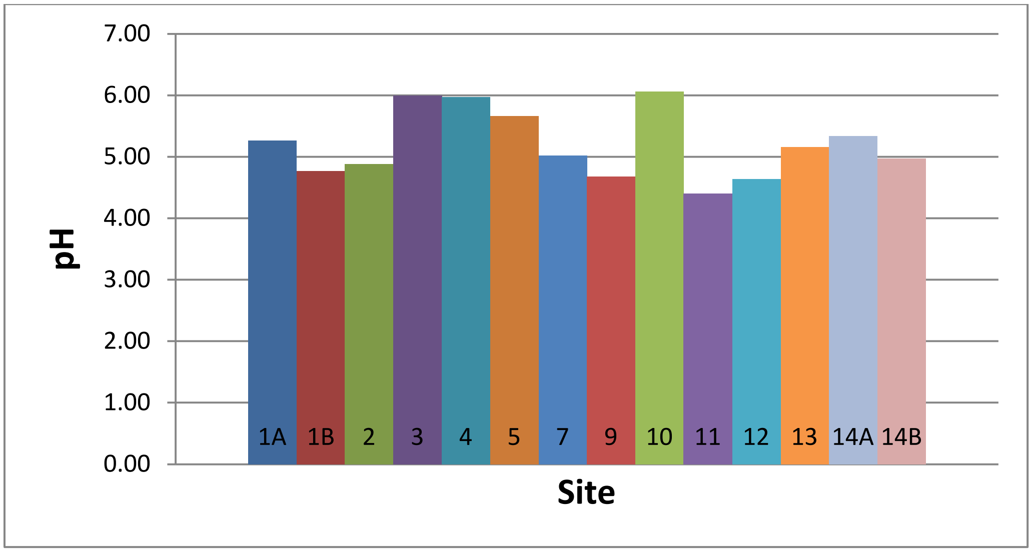

Figure 6. Soil water pH values in porewater for 14 sites along the St. Johns River.

Electrical conductivity values of the soil pore water ranged from 0.8 – 13.3 mmhos/cm (Figure 7).

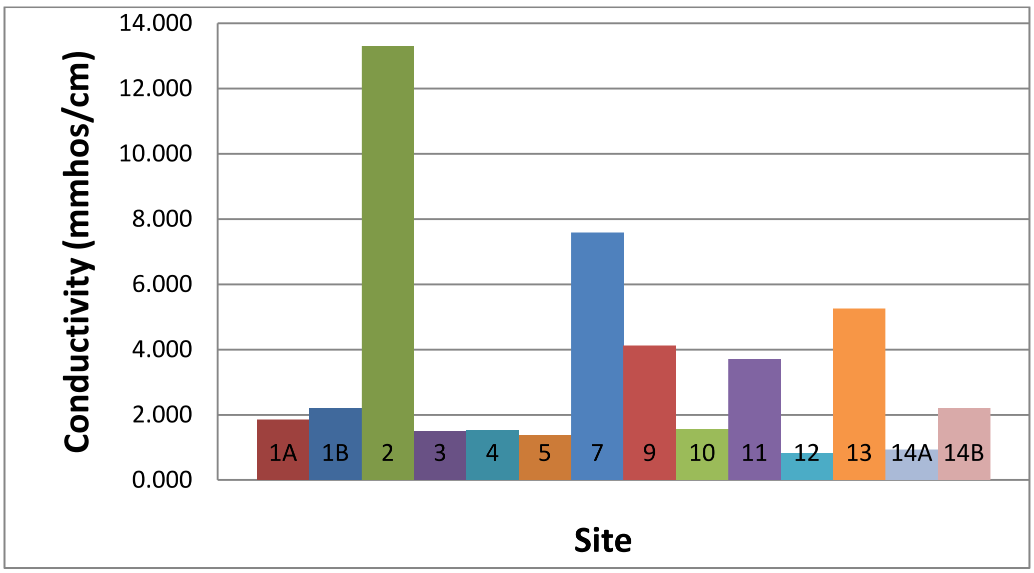

Figure 7. Soil water electrical conductivity values in porewater for 14 sites along the St. Johns River.

Discussion

The dominant species found at each site coincided with the type of wetland community we expected to find based on GIS wetland data layers. Site 1A, the only hydric hammock site, consisted of approximately 80% cabbage palms, which are typical of this type of wetland. Deciduous trees, such as the Carolina ash, were also identified at the site. This area is also rarely flooded, but prone to ponding with poorly drained soils, all typical of a hydric hammock wetland (SJRWMD, 2006).

The shallow marsh sites, 9 and 13, both consisted of a variety of grasses and tall herbaceous plants. Site 13 was described as a mallow marsh and consisting predominantly of herbaceous species. In addition to grasses, site 9 also had a large number of carolina ash and red maples. This discrepancy on what should be expected at this site based on wetland type is most likely due to its shape and location in the floodplain. The site itself lies in what should be a shallow marsh area shaped like a peninsula, surrounded by a hardwood swamp that lies approximately 200 meters away (SJRWMD, 2002). Therefore, there is a possibility that over time species indicative of hardwood swamps colonized this area. Another difference in these 2 sites included soil series, with site 9 identified as terra ceia muck and site 13 as samsula muck. The main difference was the presence of sand at almost 1 meter into the soil profile of samsula muck (NRCS, 2008).

Common characteristics of wet prairies include over 70% herbaceous species, soils with sand or sandy clay, and flooding for a short period during the year (Iowa, 2001). Sites 14A and 14B both consisted of almost 100% herbaceous species, with the rose mallow dominant in 14A and a Sesbania species in 14B. Site 14B was actually created while in the field due to the abrupt break in the rose mallow community between site 14A and the river bank. In addition, both sites were identified as Nittaw muck, a soil series with a typical profile that consists of sandy clay at about 10 inches beneath the soil surface (NRCS, 2008). Based on the vegetation identified at these sites, it was not unexpected that the soils were molisolls, which are typically formed under priaire or grassland vegetation.

Common species of shrub swamps include red maple and buttonbush, both of which were abundant in sites 2 and 10. Site 2 was the most saline site, being bordered by salt marshes on both sides. The high percentage of understory cabbage palms at this site is most likely due to the ability of this species to germinate under these conditions but not survive much past a seedling stage (Perry, 1996). The wetland community that comprised 50% of the sites sampled was the hardwood swamp. Representative species at these sites were the Carolina ash, swamp dogwood, sweetgum, and red maple. The cabbage palm was also commonly found as an overstory species at these sites.

Differences in vegetation in wetlands would most likely be due to differences in soil quality, water regime, water chemistry and location in the environment. Hydrology of wetlands definitely affects wetland vegetation. "The duration and seasonality of flooding and soil saturation, ground-water level, soil type, and drainage characteristics exert a strong influence on the number, type, and distribution of plants and plant communities in wetlands" (Carter, 1997). Vegetation that can tolerate the environmental factors of certain wetlands should be found there. Salt sensitive speices should not be found in saline soils, and vegetation that cannot tolerate standing water typically would not be found in wetlands like sites 14a and 14b, where water is ponded for a long portion of the year.

The difference in soil series between sites is most likely due to how and where these soils were formed, and in some cases the water regime of the wetlands they are found in. The soil series types of the 14 sites change gradually from south to north, until site 10. From this location to site 1, terra ceia muck is the only soil series found. The nittaw muck series, found in sites 14a and b, forms in deposits of clayey sediments and in areas that are subject to flooding or are in standing water for a portion of the year. At the time of sampling, these were the only sites that had standing water, and when soil samples were obtained a clay layer was found approximately half a meter from the surface. Samsula series, indentified at site 13, forms in areas of non-woody plant remains and typically consist of underlying sand. Vegetation at this site had no trees and a sand layer was identified approximately 1m from the surface. The gator series also forms over layers sand or sandy loam, which was found at site 12, about ¾ of a meter from the surface. The everglades and terra ceia muck series, unlike the other three described, are typically not formed over a clay or sand layer, but should consist only of muck or mucky peat. This was consist with soil samples taken from these sites (NRCS, 2008).

The main concerns of water withdrawals in terms of the wetland plant communities and species are shifts in community types/structure, boundaries and composition, changes in biomass or productivity, loss of rare species in the community, and changes in the life cycles and recruitment of species (SJRWMD, 2009). The number of species in a wetland community is dependent on duration, frequency, and timing of saturation, as well as the depth of water in the wetland (Casanova and Brock, 2000). Changes in these factors can affect species very differently, depending on their individual abilities to resist drought. The promotion of the spread of non-native species in a wetland is a possibility when consecutive years of drawdowns are occurring (van der Valk, 1994). Another characteristic of increased drawdowns is a wetland dominated by a very few number of species (Wilcox, 1995). Species with light, small seeds have shown to be better at inhabiting areas that are exposed after drawdowns in comparison to species with heavy, large seeds (Ellison, 1995), which could account for the takeover of a small number of species during these times. Upon extreme withdrawals in a wetland, it would be expected that upland species would eventually move into the once inundated areas.

The salinity of wetlands is an extremely important parameter because changes in soluble salts can indicate shifts in wetland environments. Changes in hydrology especially will influence salinity in wetlands. Fortunately, these changes can be identified over short periods of time, such as from season to season (Seelig, 2006). Monitoring of these data would allow one to know immediately if changes were occurring within a wetland area, therefore permitting an immediate response to those changes possibly allowing a return to normalcy within a shorter amount of time. Soil conductivity measurements for all sites had surface salinities within the non-saline to slightly saline categories, with the exception of site 2, which was expected to have high conductivities due to its location in the landscape. Although there was a general increase in conductivities in about 80% of the sites sampled, degrees of salinity throughout the soil profiles of the sites ranged from non-saline (only slight changes from surface to 1 meter depth) to moderately saline, site 2 being the only site with a strongly saline designation in its profile. Due to the various ranges of conductivities within sites, changes in these values would affect species differently depending on the rooting depth or root zone of the plant.

Soil pH also plays an important role in wetlands due to its ability to affect other soil properties, including uptake of nutrients by plants, microbial activity, and the mobility of pollutants. Therefore, pH is vital in determining what vegetation types are found in wetlands.The removal of water from wetlands will cause a change from an anaerobic environment to an aerobic one. This in turn could lower soil pH due to oxidation of certain minerals (Seelig, 2006). The range of pH for all soils at all depths was between 4.0 -6.5, which would classify all soils as acidic, but values are within the range that most plants and trees prefer for optimal growth, especially more tolerant species that originated in acidic soils (Brady, 2002).

Land subsidence in drained soils could be another possible effect when water levels are decreased. Histosols, in particular, have been studied extensively for these affects especially in the Everglades Agricultural Area where these types of soils are readily found. When these soils are drained, there is potential for a loss of soil organic matter due to oxidation, and an increase in the release of carbon dioxide to the atmosphere (Rojstaczer, 1995). The loss of soil from the organic layer could eventually lead to a reclassification of the soil type. Histosols and mollisols are both characterized by the organic soil material in their horizons. The loss of the organic layer of these soils would no longer classify them as such.

Conclusions

With the undeniable growth in population, the search for alternative water supplies is becoming more common over time. However, it is important to point out that the depletion of groundwater supplies is not only affected by groundwater pumping but can also be seriously altered with surface water withdrawals. Whereas groundwater pumping can cause surface waters to dry up, such as the Santa Cruz River in Arizona, surface water withdrawals can decrease the amount of water available for recharge back into the aquifer as well as affect other biological functions of surrounding environments (Glennon, 2002). Both water resources are linked and should be treated as such.

Too large a decrease in wetland hydroperiod can cause a decline in the natural wetland vegetation and encourage the recruitment of upland vegetation (Glennon, 2002). The shortening of the hydroperiod can also cause land subsidence and alter the major functions that wetlands are known for, such as improved water quality, water storage, and recharge to the aquifer. This proves the importance of minimum flows and levels set for surface waters to avoid these possible effects to adjacent wetlands as well as surface water functions. The basis of this study is to have data available to avoid the examples of extreme water withdrawals and their affects on wetlands. This task is also accomplished by the minimum flows and levels set for these areas of the St. Johns River. The amount of water withdrawals proposed for this study area, based on minimum flows and level calculations, is not expected to exceed or even approach levels that would be harmful or cause change in hydrology or wetland function.

The baseline data presented in this manuscript is only a small portion of the first phase the SJRWMD has conducted on a section of the river. Other factors being studied or that have already been reported on include fish, biogeochemical processes, phytoplankton, zooplankton, and submerged aquatic vegetation (SJRWMD, 2009). Since the collection of this data, the entire length of the St. Johns River has been split into segments to be studied with similar data collection.

Appendix A - Species by Site

All species identified for each plot at each site. Overstory trees with a diameter at breast height greater than 7.5 cm were measured.

Coverage scale:
1 = <1%
2 = 2-5%
3 = 5-25%
4 = 25-50%
5 = 50 – 75%
6 = 75 – 95%
7 = 95 – 100%

Strata:
O = overstory tree
U = understory tree
S = shrub
T = tall herb
L = low herb
G = ground layer

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
1A	Sabal palmetto	Cabbage palm	O	6	91
	Sabal palmetto	Cabbage palm	O	6	89
	Sabal palmetto	Cabbage palm	O	6	106
	Sabal palmetto	Cabbage palm	O	6	86.5
	Sabal palmetto	Cabbage palm	O	6	82
	Sabal palmetto	Cabbage palm	O	6	77
	Sabal palmetto	Cabbage palm	O	6	80
	Sabal palmetto	Cabbage palm	O	6	84.5
	Sabal palmetto	Cabbage palm	O	6	64
	Sabal palmetto	Cabbage palm	O	6	77.5
	Sabal palmetto	Cabbage palm	O	6	85
	Sabal palmetto	Cabbage palm	O	6	85
	Sabal palmetto	Cabbage palm	O	6	90
	Sabal palmetto	Cabbage palm	O	6	84.5
	Sabal palmetto	Cabbage palm	O	6	74
	Sabal palmetto	Cabbage palm	O	6	79
	Sabal palmetto	Cabbage palm	O	6	86
	Sabal palmetto	Cabbage palm	O	6	77.5
	Fraxinus caroliniana	Carolina ash	O	4	20
	Fraxinus caroliniana	Carolina ash	O	4	24
	Fraxinus caroliniana	Carolina ash	O	4	30
	Fraxinus caroliniana	Carolina ash	O	4	43
	Panicum rigidulum	Redtop Panicgrass	L	2	
	Rhus radicans spp.		G	2	
	Sabal palmetto	Cabbage palm	S	2	
	Acer rubrum	Red maple	G	1	
	Boehmeria cylindrica	Small-spike false nettle	L	1	
	Cephalanthus occidentalis	Common buttonbush	L	1	
	Cornus foemina	Swamp dogwood	U	1	
	Cornus foemina	Swamp dogwood	G	1	
	Erechtites hieracifolia	Pilewort	G	1	
	Ilex cassine	Dahoon	U	1	28
	Oak spp.		O	1	177

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Persea palustris	Swamp bay	L	1	
	Phlebodium aureum	Golden polypody	L	1	
	Saururus cernuus	Lizard's tail	L	1	
	Smilax auriculata	Earleaf greenbrier	G	1	
	Thelypteris palustris	Marsh fern	L	1	
	Vittaria lineata	Shoestring fern	G	1	
1B	Boehmeria cylindrica	False nettle	T	4	
	Phanopyrum gymnocarpon	Savannah panicum	T	3	
	Sabal palmetto	Cabbage palm	U	3	
	Sabal palmetto	Cabbage palm	O	3	96
	Sabal palmetto	Cabbage palm	O	3	87
	Sabal palmetto	Cabbage palm	O	3	89
	Sabal palmetto	Cabbage palm	O	3	92
	Sabal palmetto	Cabbage palm	O	3	90
	Acer rubrum	Red maple	O	2	61
	Fraxinus caroliniana	Carolina ash	O	2	35
	Fraxinus caroliniana	Carolina ash	O	2	112
	Fraxinus caroliniana	Carolina ash	O	2	53
	Ilex cassine	Dahoon	U	2	36
	Quercus laurifolia	Laurel oak	O	2	120
	Carex stipata	Owlfruit sedge	G	1	
	Cephalanthus occidentalis	Common buttonbush	U	1	
	Gleditsia aquatica	Water locust	T	1	
	Hydrocotyle umbellata	Marsh pennywort	G	1	
	Leersia spp.		G	1	
	Liquidambar styraciflua	Sweetgum	U	1	
	Nuphar advena	Spatterdock	G	1	
	Pontederia cordata	Pickerelweed	T	1	
	Ptilimnium capillaceum	Mock bishopsweed	G	1	
	Saururus cernuus	Lizard's tail	L	1	
	Vitis rotundifolia	Muscadine	G	1	
2	Acer rubrum	Red maple	O	5	51.5
	Acer rubrum	Red maple	O	5	61.5
	Acer rubrum	Red maple	O	5	96.5
	Acer rubrum	Red maple	O	5	70
	Acer rubrum	Red maple	O	5	96
	Acer rubrum	Red maple	O	5	98
	Acer rubrum	Red maple	O	5	31.5
	Acer rubrum	Red maple	O	5	16.5
	Acer rubrum	Red maple	O	5	44
	Acer rubrum	Red maple	O	5	87
	Acer rubrum	Red maple	O	5	65
	Acer rubrum	Red maple	O	5	33.5

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Acer rubrum	Red maple	O	5	56
	Acer rubrum	Red maple	O	5	52
	Acer rubrum	Red maple	O	5	64
	Hibiscus coccineus	Scarlet rose mallow	T	4	
	Sabal palmetto	Cabbage palm	U	4	
	Cladium mariscoides	Swamp sawgrass	T	3	
	Kosteletzkya virginica	virginia saltmarsh mallow	T	3	
	Fraxinus caroliniana	Carolina ash	U	3	19.5
	Fraxinus caroliniana	Carolina ash	U	3	44
	Polygonum punctatum	Dotted smartweed	L	3	
	Ulmus americana	American elm	O	3	105
	Ulmus americana	American elm	O	3	46
	Ulmus americana	American elm	O	3	43
	Ulmus americana	American elm	O	3	82
	Amorpha fruticosa	False indigo bush	U/L	2	
	Ampelopsis arborea	Peppervine	T	2	
	Crinum americanum	Seven-sisters	L	2	
	Myrica cerifera	Southern bayberry	U	2	34
	Myrica cerifera	Southern bayberry	U	2	16.5
	Myrica cerifera	Southern bayberry	U	2	13
	Myrica cerifera	Southern bayberry	U	2	16
	Myrica cerifera	Southern bayberry	U	2	16
	Myrica cerifera	Southern bayberry	U	2	23
	Persea palustris	Swamp bay	U/O	2	25
	Persea palustris	Swamp bay	U/O	2	47
	Persea palustris	Swamp bay	U/O	2	24.5
	Persea palustris	Swamp bay	U/O	2	37.5
	Phanopyrum gymnocarpon	Savannah panicum	T	2	
	Pontederia cordata	Pickerelweed	T	2	
	Quercus geminata	Sand live oak	O	2	60
	Rhynchospora corniculata	Shortbristle horned beaksedge	T	2	
	Symphyotrichum carolinianum	Climbing aster	T	2	
	Toxicodendron radicans	Eastern poison ivy	G	2	
	Acrostichum danaeifolium	Giant leather fern	T	1	
	Alternanthera philoxeroides	Alligator weed	T	1	
	Baccharis glomeruliflora	Silverling	T	1	
	Cephalanthus occidentalis	Common buttonbush	L	1	
	Fraxinus caroliniana	Carolina ash	L	1	
	Ipomoea sagittata	Saltmarsh morning-glory	G	1	
	Pleopeltis polypodioides	Resurrection fern	G	1	
	Spartina bakeri	Sand cordgrass	T	1	
	Thalia geniculata	Alligator flag	L	1	

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
3	Phanopyrum gymnocarpon	Savannah panicum	L	4	
	Thelypteris interrupta	Hottentot fern	T	4	
	Boehmeria spp.		T	3	
	Cephalanthus occidentalis	Common buttonbush	U/S	3	15
	Cephalanthus occidentalis	Common buttonbush	U/S	3	10.5
	Cephalanthus occidentalis	Common buttonbush	U/S	3	12.5
	Fraxinus caroliniana	Carolina ash	O	3	43
	Fraxinus caroliniana	Carolina ash	O	3	44
	Fraxinus caroliniana	Carolina ash	O	3	33
	Fraxinus caroliniana	Carolina ash	O	3	32
	Fraxinus caroliniana	Carolina ash	O	3	56
	Fraxinus caroliniana	Carolina ash	O	3	154
	Fraxinus caroliniana	Carolina ash	O	3	22
	Fraxinus caroliniana	Carolina ash	O	3	27
	Fraxinus caroliniana	Carolina ash	O	3	45
	Hydrocotyle umbellata	Marsh pennywort	G	3	
	Quercus laurifolia	Laurel oak	O	3	92
	Quercus laurifolia	Laurel oak	O	3	126
	Quercus laurifolia	Laurel oak	O	3	110
	Quercus laurifolia	Laurel oak	O	3	276
	Sabal palmetto	Cabbage palm	S/U	3	
	Toxicodendron radicans	Eastern poison ivy	G	3	
	Acer rubrum	Red maple	O	2	231
	Pontederia cordata	Pickerelweed	T	2	
	Taxodium distichum	Bald cypress	O	2	137
	Taxodium distichum	Bald cypress	O	2	127
	Vitis cinerea	Florida grape	G	2	
	Alternanthera philoxeroides	Alligator weed	G	1	
	Carya aquatica	Water hickory	L	1	
	Ilex cassine	Dahoon	U	1	37
4	Fraxinus caroliniana	Carolina ash	O	4	220
	Fraxinus caroliniana	Carolina ash	O	4	120
	Fraxinus caroliniana	Carolina ash	O	4	24
	Fraxinus caroliniana	Carolina ash	O	4	18
	Fraxinus caroliniana	Carolina ash	O	4	22.5
	Fraxinus caroliniana	Carolina ash	O	4	16
	Fraxinus caroliniana	Carolina ash	O	4	11
	Fraxinus caroliniana	Carolina ash	O	4	75
	Fraxinus caroliniana	Carolina ash	O	4	18
	Fraxinus caroliniana	Carolina ash	O	4	15
	Fraxinus caroliniana	Carolina ash	O	4	88
	Fraxinus caroliniana	Carolina ash	O	4	24
	Acer rubrum	Red maple	O	3	107

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Acer rubrum	Red maple	O	3	95
	Acer rubrum	Red maple	O	3	150
	Cephalanthus occidentalis	Common buttonbush	T/U	3	11.5
	Cephalanthus occidentalis	Common buttonbush	T/U	3	14
	Pontederia cordata	Pickerelweed	T	3	
	Quercus laurifolia	Laurel oak	O	3	25
	Quercus laurifolia	Laurel oak	O	3	19
	Taxodium distichum	Bald cypress	O	3	220
	Echinuchloa spp.		T	2	
	Osmunda regalis	Royal fern	T	2	
	Polygonum glabrum	Denseflower knotweed	L	2	
	Sabal Palmetto	Cabbage palm	O	2	126
	Toxicodendron radicans	Eastern poison ivy	G	2	
	Cornus foemina	Swamp dogwood	U	1	
	Hydrocotyle umbellata	Marsh pennywort	G	1	
	Smilax bona-nox	Saw greenbrier	G	1	
5	Liquidambar styraciflua	Sweetgum	O	4	105
	Liquidambar styraciflua	Sweetgum	O	4	34.5
	Liquidambar styraciflua	Sweetgum	O	4	138
	Liquidambar styraciflua	Sweetgum	O	4	28
	Liquidambar styraciflua	Sweetgum	O	4	19.5
	Liquidambar styraciflua	Sweetgum	O	4	32
	Liquidambar styraciflua	Sweetgum	O	4	37.5
	Woodwardia virginica	Virginia chain fern	U	4	
	Boehmeria cylindrica	False nettle	T	3	
	Cephalanthus occidentalis	Common buttonbush	U	3	12
	Cephalanthus occidentalis	Common buttonbush	U	3	16.5
	Cephalanthus occidentalis	Common buttonbush	U	3	11
	Cephalanthus occidentalis	Common buttonbush	U	3	10
	Cephalanthus occidentalis	Common buttonbush	U	3	9
	Cornus foemina	Swamp dogwood	U	3	19
	Cornus foemina	Swamp dogwood	U	3	16.5
	Cornus foemina	Swamp dogwood	U	3	17
	Cornus foemina	Swamp dogwood	U	3	14
	Fraxinus caroliniana	Carolina ash	O	3	33.5
	Fraxinus caroliniana	Carolina ash	O	3	46
	Fraxinus caroliniana	Carolina ash	O	3	56.5
	Fraxinus caroliniana	Carolina ash	O	3	20.5
	Fraxinus caroliniana	Carolina ash	O	3	17
	Fraxinus caroliniana	Carolina ash	O	3	24.5
	Fraxinus caroliniana	Carolina ash	O	3	15.5
	Fraxinus caroliniana	Carolina ash	O	3	12

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Fraxinus caroliniana	Carolina ash	O	3	32.5
	Fraxinus caroliniana	Carolina ash	O	3	22.5
	Fraxinus caroliniana	Carolina ash	O	3	29.5
	Fraxinus caroliniana	Carolina ash	O	3	84
	Fraxinus caroliniana	Carolina ash	O	3	20
	Leersia virginica	Whitegrass	T	3	
	Phanopyrum gymnocarpon	Savannah panicum	T	3	
	Quercus laurifolia	Laurel oak	O	3	111
	Quercus laurifolia	Laurel oak	O	3	27.3
	Quercus laurifolia	Laurel oak	O	3	70.5
	Ilex cassine	Dahoon	U	2	26
	Polygonum punctatum	Dotted smartweed	U	2	
	Sabal palmetto	Cabbage palm	O	2	67
	Toxicodendron radicans	Eastern poison ivy	G	2	
	Fraxinus caroliniana	Carolina ash	L	1	
	Hydrocotyle umbellata	Marsh pennywort	U	1	
	Pleopeltis polypodioides	Resurrection fern	G	1	
	Pleopeltis polypodioides	Resurrection fern	G	1	
	Pontederia cordata	Pickerelweed	T	1	
	Taxodium spp.		G	1	
7	Sabal palmetto	Cabbage palm	O	5	100
	Sabal palmetto	Cabbage palm	O	5	88.5
	Sabal palmetto	Cabbage palm	O	5	126
	Sabal palmetto	Cabbage palm	O	5	80
	Sabal palmetto	Cabbage palm	O	5	67.5
	Sabal palmetto	Cabbage palm	O	5	87.5
	Sabal palmetto	Cabbage palm	O	5	81
	Sabal palmetto	Cabbage palm	O	5	82.5
	Sabal palmetto	Cabbage palm	O	5	71.5
	Sabal palmetto	Cabbage palm	O	5	140
	Sabal palmetto	Cabbage palm	O	5	102.5
	Sabal palmetto	Cabbage palm	O	5	80
	Sabal palmetto	Cabbage palm	O	5	137.5
	Sabal palmetto	Cabbage palm	O	5	145
	Sabal palmetto	Cabbage palm	O	5	72.5
	Sabal palmetto	Cabbage palm	O	5	85
	Fraxinus caroliniana	Carolina ash	O	4	122
	Fraxinus caroliniana	Carolina ash	O	4	34
	Fraxinus caroliniana	Carolina ash	O	4	46.5
	Fraxinus caroliniana	Carolina ash	O	4	97.5
	Fraxinus caroliniana	Carolina ash	O	4	27.5
	Fraxinus caroliniana	Carolina ash	O	4	53
	Fraxinus caroliniana	Carolina ash	O	4	67.5

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Fraxinus caroliniana	Carolina ash	O	4	67.5
	Fraxinus caroliniana	Carolina ash	O	4	17.5
	Rhus radicans	Eastern poison ivy	G	4	
	Boehmeria cylindrica	False nettle	T	3	
	Centella asiatica	Spade leaf	G	3	
	Dichanthelium commutatum	Variable witchgrass	L	3	
	Hydrocotyle umbellata	Marsh pennywort	G	3	
	Persea borbonia	Red bay	L	3	45
	Persea borbonia	Red bay	L	3	40.5
	Persea borbonia	Red bay	L	3	11.5
	Persea borbonia	Red bay	L	3	17
	Pontederia cordata	Pickerelweed	L	3	
	Ulmus americana	American elm	U	3	23
	Ulmus americana	American elm	U	3	37.5
	Acer rubrum	Red maple	U	2	
	Alternanthera philoxeroides	Alligator weed	L	2	
	Bromeliad		G	2	
	Cephalanthus occidentalis	Common buttonbush	U	2	22.5
	Erechtites hieracifolia	Pilewort	L	2	
	Kosteletzkya pentacarpos	Virginia saltmarsh mallow	T	2	
	Leersia hexandra	Southern cutgrass	L	2	
	Myrica cerifera	Southern bayberry	U	2	15
	Myrica cerifera	Southern bayberry	U	2	11.5
	Myrica cerifera	Southern bayberry	U	2	12.5
	Myrica cerifera	Southern bayberry	U	2	32.5
	Myrica cerifera	Southern bayberry	U	2	21.5
	Panicum dichotomiflorum	Fall panicgrass	T	2	
	Persea borbonia	Red bay	T	2	
	Phanopyrum gymnocarpon	Savannah panicum	T	2	
	Phlebodium aureum	Golden polypody	T	2	
	Pleopeltis polypodioides	Resurrection fern	G	2	
	Rhynchospora corniculata	Shortbristle horned beaksedge	T	2	
	Smilax bona-nox	Saw greenbrier	G	2	
	Thelypteris palustris	Marsh fern	L	2	
	Ilex cassine	Dahoon	U	1	18.5
	Liquidambar styraciflua	Sweetgum	G	1	
9	Acer rubrum	Red maple	O	4	79
	Acer rubrum	Red maple	O	4	67
	Acer rubrum	Red maple	O	4	52
	Acer rubrum	Red maple	O	4	2
	Acer rubrum	Red maple	O	4	54
	Acer rubrum	Red maple	O	4	15

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Acer rubrum	Red maple	O	4	17
	Acer rubrum	Red maple	O	4	15
	Acer rubrum	Red maple	O	4	67
	Acer rubrum	Red maple	O	4	55
	Acer rubrum	Red maple	O	4	25
	Cephalanthus occidentalis	Common buttonbush	L/U	4	14
	Cephalanthus occidentalis	Common buttonbush	L/U	4	11
	Cephalanthus occidentalis	Common buttonbush	L/U	4	8
	Cephalanthus occidentalis	Common buttonbush	L/U	4	8
	Cephalanthus occidentalis	Common buttonbush	L/U	4	8
	Cephalanthus occidentalis	Common buttonbush	L/U	4	17
	Cephalanthus occidentalis	Common buttonbush	L/U	4	8
	Fraxinus caroliniana	Carolina ash	O	4	40
	Fraxinus caroliniana	Carolina ash	O	4	50
	Fraxinus caroliniana	Carolina ash	O	4	74
	Fraxinus caroliniana	Carolina ash	O	4	46
	Fraxinus caroliniana	Carolina ash	O	4	54
	Fraxinus caroliniana	Carolina ash	O	4	34
	Fraxinus caroliniana	Carolina ash	O	4	58
	Fraxinus caroliniana	Carolina ash	O	4	55
	Fraxinus caroliniana	Carolina ash	O	4	20.5
	Fraxinus caroliniana	Carolina ash	O	4	36
	Fraxinus caroliniana	Carolina ash	O	4	34
	Fraxinus caroliniana	Carolina ash	O	4	21
	Fraxinus caroliniana	Carolina ash	O	4	24
	Fraxinus caroliniana	Carolina ash	O	4	37
	Fraxinus caroliniana	Carolina ash	O	4	35
	Fraxinus caroliniana	Carolina ash	O	4	28
	Fraxinus caroliniana	Carolina ash	O	4	86
	Fraxinus caroliniana	Carolina ash	O	4	46
	Fraxinus caroliniana	Carolina ash	O	4	39
	Phanopyrum gymnocarpon	Savannah panicum	T	4	
	Alternanthera philoxeroides	Alligator weed	G	2	
	Commelina diffusa	Common dayflower	G	2	
	Pontederia cordata	Pickerelweed	T	2	
	Rhynchospora inundata	Narrowfruit horned beaksedge	T	2	
	Thalia geniculata	Alligator flag	T	2	
	Amorpha fruticosa	False indigo bush	T	1	
	Ampelopsis arborea	Peppervine	L	1	
	Boehmeria cylindrica	False nettle	T	1	
	Bromeliad		G	1	
	Cicuta maculata	Spotted water hemlock	T	1	
	Eupatorium capillifolium	Dogfennel	L	1	

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Gleditsia aquatica	Water locust	L	1	
	Hibiscus coccineus	Scarlet rose mallow	T	1	
	Hydrocotyle umbellata	Marsh pennywort	G	1	
	Ipomoea spp.		L/G	1	
	Kosteletzkya virginica	Virginia saltmarsh mallow	L	1	
	Mikania spp.		G	1	
	Pleopeltis polypodioides	Resurrection fern	G	1	
	Ptilimnium capillaceum	Mock bishopsweed	L	1	
	Rhus radicans	Eastern poison ivy	G	1	
	Rhynchospora corniculata	Shortbristle horned beaksedge	T	1	
	Symphyotrichum carolinianum	Climbing aster	G	1	
	Ulmus americana	American elm	L	1	
10A	Rhynchospora corniculata	Shortbristle horned beaksedge	T	6	
	Alternanthera philoxeroides	Alligator weed	L	4	
	Acer rubrum	Red maple	O	3	55
	Acer rubrum	Red maple	O	3	18
	Acer rubrum	Red maple	O	3	24
	Acer rubrum	Red maple	O	3	75
	Acer rubrum	Red maple	O	3	26
	Acer rubrum	Red maple	O	3	37
	Acer rubrum	Red maple	O	3	24
	Acer rubrum	Red maple	O	3	28
	Acer rubrum	Red maple	O	3	19
	Acer rubrum	Red maple	O	3	17
	Acer rubrum	Red maple	O	3	11
	Acer rubrum	Red maple	O	3	21
	Acer rubrum	Red maple	O	3	41
	Acer rubrum	Red maple	O	3	10.5
	Acer rubrum	Red maple	O	3	10.5
	Acer rubrum	Red maple	O	3	25
	Acer rubrum	Red maple	O	3	29
	Acer rubrum	Red maple	O	3	39
	Acer rubrum	Red maple	O	3	15.5
	Acer rubrum	Red maple	O	3	47
	Acer rubrum	Red maple	O	3	38
	Acer rubrum	Red maple	O	3	14
	Acer rubrum	Red maple	O	3	15.5
	Acer rubrum	Red maple	O	3	22
	Hibiscus coccineus	Scarlet rose mallow	T	3	
	Salvinia rotundifolia	Butterfly fern	G	3	
	Spartina bakeri	Sand cordgrass	S	3	
	Cephalanthus occidentalis	Common buttonbush	O	2	26

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Hydrocotyle ranunculoides	Floating marsh pennywort	G	2	
	Mikania scandens	Climbing hempvine	G	2	
	Polygonum punctatum	Dotted smartweed	L	2	
	Pontederia cordata	Pickerelweed	L	2	
	Rumex verticillatus	Swamp dock	T	2	
	Thelypteris interrupta	Hottentot fern	T	2	
	Ceratopteris thalictroides	Watersprite	L	1	
	Cyclospermum leptophyllum	Marsh parsley	L	1	
	Erechtites hieracifolia	Pilewort	L	1	
	Eupatorium capillifolium	Dogfennel	L	1	
	Myriophyllum aquaticum	Parrot feather	G	1	
	Phyla nodiflora	Turkey tangle fogfruit	L	1	
	Sacciolepis striata	American cupscale	T	1	
11	Boehmeria cylindrica	False nettle	T	5	
	Mikania spp.		G	4	
	Phanopyrum gymnocarpon	Savannah panicum	T	4	
	Polygonum glabrum	Denseflower knotweed	T	4	
	Cephalanthus occidentalis	Common buttonbush	O	3	13
	Cephalanthus occidentalis	Common buttonbush	O	3	14
	Cephalanthus occidentalis	Common buttonbush	O	3	122
	Cephalanthus occidentalis	Common buttonbush	O	3	130
	Cephalanthus occidentalis	Common buttonbush	O	3	65
	Cephalanthus occidentalis	Common buttonbush	O	3	82
	Cephalanthus occidentalis	Common buttonbush	O	3	62
	Cephalanthus occidentalis	Common buttonbush	O	3	13
	Cephalanthus occidentalis	Common buttonbush	O	3	15
	Fraxinus caroliniana	Carolina ash	O	3	163
	Fraxinus caroliniana	Carolina ash	O	3	93
	Fraxinus caroliniana	Carolina ash	O	3	57
	Fraxinus caroliniana	Carolina ash	O	3	27
	Fraxinus caroliniana	Carolina ash	O	3	53
	Alternanthera philoxeroides	Alligator weed	L	2	
	Eupatorium spp.		T	2	
	Hydrocotyle verticillata	Whorled marshpennywort	L	2	
	Rhynchospora corniculata	Shortbristle horned beaksedge	T	2	
	Taxodium distichum	Bald cypress	L	2	sapling
	Thelypteris interrupta	Hottentot fern	T	2	
	Toxicodendron radicans	Eastern poison ivy	G	2	
	Ulmus americana	American elm	O	2	45
	Acer rubrum	Red maple	O	1	22
	Ampelopsis arborea	Peppervine	L	1	
	Bromeliad spp.		L	1	

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Carex lupuliformis	False hop sedge	T	1	
	Dioda virginiana	Virginia buttonweed	L	1	
	Nyssa sylvatica	Blackgum	O	1	260
	Pontederia cordata	Pickerelweed	T	1	
	Ptilimnium spp.		L	1	
	Teucrium canadense	woodsage	T	1	
12	Acer rubrum	Red Maple	O	5	258
	Acer rubrum	Red Maple	O	5	112
	Ulmus americana	American Elm	O	5	56
	Ulmus americana	American Elm	O	5	79
	Ulmus americana	American Elm	O	5	58
	Ulmus americana	American Elm	O	5	54
	Ulmus americana	American Elm	O	5	126
	Ulmus americana	American Elm	O	5	54
	Ulmus americana	American Elm	O	5	38
	Ulmus americana	American Elm	O	5	45
	Boehmeria cylindrica	Small-spike false nettle	T	4	
	Dichanthelium commutatum	Variable Witchgrass	L	3	
	Liquidambar styraciflua	Sweetgum	U	3	22
	Liquidambar styraciflua	Sweetgum	U	3	16
	Liquidambar styraciflua	Sweetgum	U	3	19
	Liquidambar styraciflua	Sweetgum	U	3	63
	Nyssa aquatica	Water Tupelo	O	3	202
	Quercus laurifolia	Laurel Oak	U	3	9
	Quercus laurifolia	Laurel Oak	U	3	17
	Rhus Radicans	Poison Ivy	G	3	
	Sabal Palmetto	Cabbage Palm	U/O	3	82
	Cephalanthus occidentalis	Common Buttonbush	U	2	17
	Phlebodium aureum	Golden Polypody	T	2	
	Pleopeltis polypodioides	Resurrection Fern	G	2	
	Taxodium distichum	Bald Cypress	U	2	52
	Thelypteris palustris	Marsh Fern	G	2	
	Tillandsia usneoides	Spanish Moss	G	2	
	Carex elliottii	Elliott's Sedge	T	1	
	Eleocharis spp.		L	1	
	Hydrocotyle spp.		G	1	
	Tillandsia setacea	Southern Needleleaf	G	1	
13	Alternanthera philoxeroides	Alligator weed	L	5	
	Carex spp.		T	3	
	Eupatorium spp.		G	3	
	Gallium spp.		G	3	
	Hibiscus coccineus	Scarlet rose mallow	S	3	

Site #	Species Name	Common Name	Stratum	Cover	DBH (cm)
	Scirpus spp.		T	3	
	Mikania scandens	Climbing hempvine	G	2	
	Baccharis glomeruliflora	Silverling	G	1	
	Eupatorium spp.		G	1	
	Hydrocotyle umbellata	Marsh pennywort	G	1	
	Parietaria floridana	Florida pellitory	G	1	
	Phyla nodiflora	Turkey tangle fogfruit	G	1	
14A	Eleocharis spp.		T	4	
	Hibiscus coccineus	Scarlet rose mallow	S	4	
	Alternanthera philoxeroides	Alligator weed	G	3	
	Hydrocotyle Umbellata	Marsh pennywort	G	3	
	Phyla nodiflora	Turkey tangle fogfruit	G	3	
	Carex spp.		T	2	
	Galium tinctorium	Stiff marsh bedstraw	G	2	
	Rhynchospora corniculata	Shortbristle horned beaksedge	T	2	
	Sacciolepis striata	American cupscale	L	2	
	Scirpus spp.		L	2	
	Scirpus spp.		T	2	
	Teucrium canadense	Woodsage	L	2	
14B	Sesbania spp.		S	6	
	Alternanthera philoxeroides	Alligator weed	L	4	
	Carex lupuliformis	False hop sedge	T	3	
	Eleocharis spp.		G	3	
	Hibiscus coccineus	Scarlet rose mallow	S	3	
	Phyla nodiflora	Turkey tangle fogfruit	L	3	
	Scirpus spp.		T	3	
	Carex albolutescens	Greenwhite sedge	L	2	
	Lythraceae spp.		L	2	
	Mikania scandens	Climbing hempvine	G	2	
	Thalia geniculata	Alligator flag	S	2	
	Carex spp.		L	1	
	Echinochloa walteri	Coast cockspur	T	1	
	Eupatorium capillifolium	Dogfennel	G	1	
	Eupatorium spp.		G	1	
	Gallium spp.		G	1	
	Hydrocotyle umbellata	Marsh pennywort	G	1	
	Ludwigia spp.		L	1	
	Sesbania spp.		L	1	

Appendix B – Conductivity by Site and Depth

Site #	Depth	pH (s.u.)	Conductivity (mmhos /cm)	Degree of Salinity
1a	Surface	5.04	1.418	Non-saline
	2 ft.	5.04	4.06	Slightly Saline
	4 ft.	5.35	4.44	Moderately Saline
1b	Surface	4.51	1.324	Non-saline
	2 ft.	5.31	4.43	Moderately Saline
	4 ft.	5.73	4.98	Moderately Saline
2	Surface	4.47	4.49	Moderately Saline
	2 ft.	5.29	10.16	Strongly Saline
	4 ft.	6.39	13.8	Strongly Saline
3	Surface	4.94	0.966	Non-saline
	2 ft.	5.51	1.291	Non-saline
4	Surface	4.89	0.725	Non-saline
	2 ft.	5.83	1.161	Non-saline
	4 ft.	6.23	0.912	Non-saline
5	Surface	5.1	0.608	Non-saline
	2 ft.	6.31	0.744	Non-saline
	4 ft.	6.5	0.522	Non-saline
7	Surface	4.57	3.62	Slightly Saline
	2 ft.	5.2	6.38	Moderately Saline
	4 ft.	5.43	6.37	Moderately Saline
9	Surface	4.8	1.335	Non-saline
	2 ft.	5.63	2.81	Slightly Saline
	4 ft.	6.2	3.66	Slightly Saline
10	Surface	4.79	3.54	Slightly Saline
	2 ft.	4.85	4	Slightly Saline
	4 ft.	5.25	4.3	Moderately Saline
11	Surface	5.03	0.125	Non-saline
	2 ft.	4.74	1.019	Non-saline
	4 ft.	4.98	1.52	Non-saline
12	Surface	4.77	0.51	Non-saline
	2 ft.	4.38	2.51	Slightly Saline
	4 ft.	5.14	3.11	Slightly Saline
13	Surface	4	3.51	Slightly Saline
	2 ft.	4.09	4.51	Moderately Saline
	4 ft.	4.72	4.23	Moderately Saline
14a	Surface	4.71	0.78	Non-saline
	2 ft.	4.94	3.48	Slightly Saline
	4 ft.	5.06	3.75	Slightly Saline
14b	Surface	4.8	0.903	Non-saline
	2 ft.	5.49	4.11	Moderately Saline

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