SPECIAL PUBLICATION SJ2009-SP13

SUMMARY OF RESULTS WETLAND AUGMENTATION DEMONSTRATION PROGRAM

APPENDIXES

Summary of Results
Wetland Augmentation Demonstration Program
(Special Publication SJ2009 SP-13)

Appendix C - G

The five appendixes included in this document directly support the *Summary of Results Wetland Augmentation Demonstration Program, Special Publication SJ2009 SP-13.*

These appendices are:

- Appendix C - Bennett Swamp Control Weir Operational Conditions: Fifth Annual Report
- Appendix D - City of Port Orange Wellfield: Fifth Annual Hydration Report
- Appendix E - City of Titusville Parkland Wetland Control Weir Operational Conditions: Fifth Annual Report
- Appendix F - Tillman Ridge Wellfield: Fifth Annual Hydration Report
- Appendix G - Assessment of Amphibian Response to Wetlands Augmentation: Final Report

While the summary report will be useful to most, the appendices provide greater details about the St. Johns River Water Management District's Wetland Augmentation Demonstration Program. The details about each project location and the associated amphibian study should be useful in assessing the feasibility of utilizing wetland augmentation projects to avoid undesirable wetland impacts, and in designing and implementing such projects.

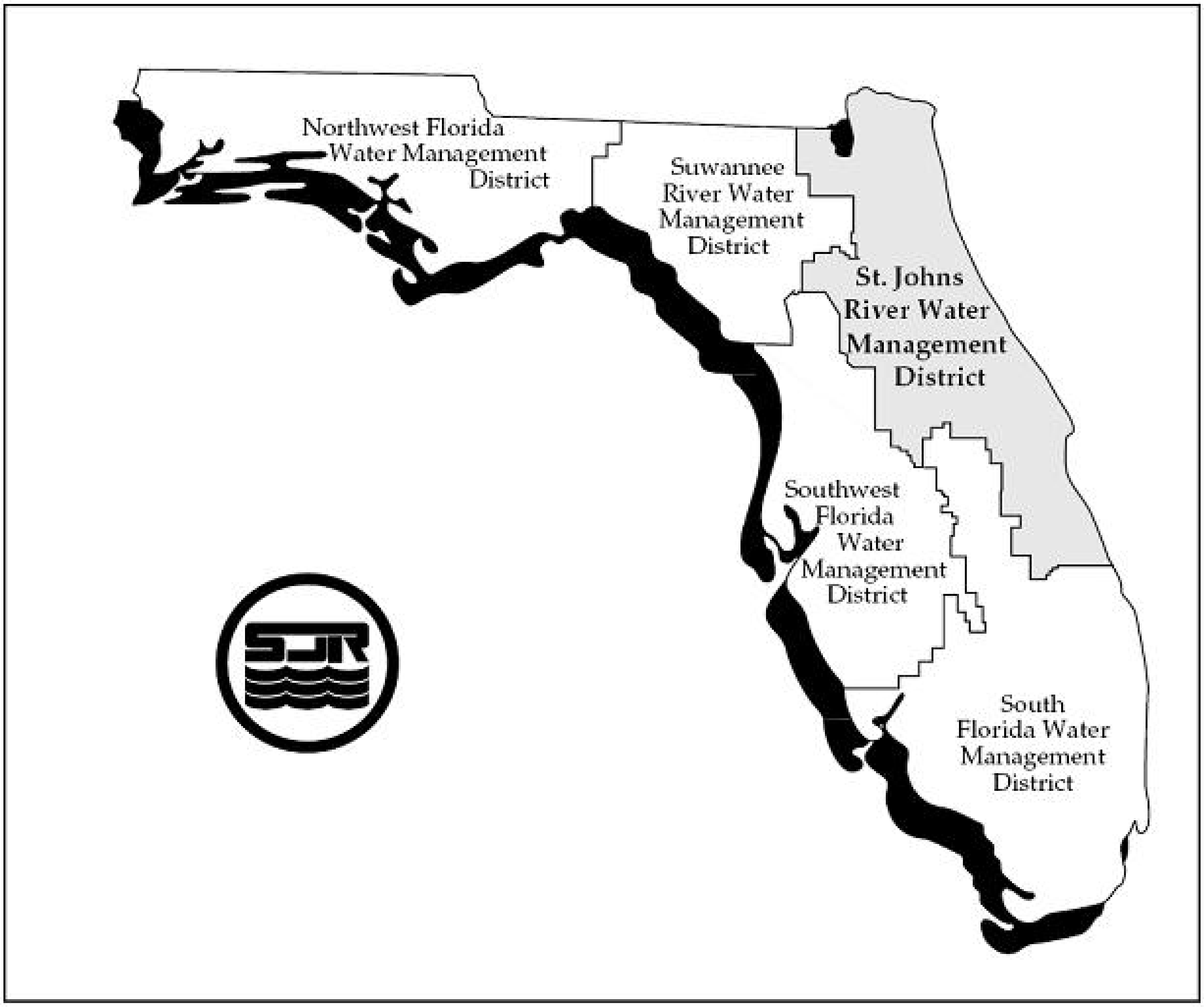
St. Johns River Water Management District
Palatka, Florida

Appendix C - Bennett Swamp Control Weir Operational Conditions: Fifth Annual Report

DEMONSTRATION PROJECT NO. 2, VOLUSIA COUNTY, FLORIDA
BENNETT SWAMP CONTROL WEIR OPERATIONAL CONDITIONS
FIFTH ANNUAL REPORT

St. Johns River Water Management District
Palatka, Florida

August 2009
(Originally prepared September 2008)



The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 18 counties in northeast Florida. The mission of SJRWMD is to ensure the sustainable use and protection of water resources for the benefit of the people of the District and the state of Florida. SJRWMD accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

This document is published to disseminate information collected by SJRWMD in pursuit of its mission. Copies of this document can be obtained from:

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EXECUTIVE SUMMARY

The activities conducted during the Demonstration Project No. 2 – Bennett Swamp Control Weir Operational Conditions are summarized in this report for the period February 2000 through April 2008. The purpose of the demonstration project is to evaluate the potential to avoid ecological impacts from wellfield drawdown by increasing the water storage within the wetland. The baseline period (February 15, 2000, through January 14, 2004) provided background information on the wetland hydrology. The operational period began January 15, 2004, with the completion of the control weir. This report includes all baseline and operational monitoring data as appendices and these represent the most accurate data set to date. Data entry corrections and changes made from year to year, such as a revised approach to summary statistics, or removing the storm-damaged portion of a transect, were not retroactive to previous annual reports. In addition, this fifth annual report (but no previous annual report) has been corrected with a survey datum conversion from National Geodetic Vertical Datum 1929 (NGVD29) to North American Vertical Datum 1988 (NAVD88) for the weir height and target hydrograph; this was needed for direct comparison between these data and all water level and hydrologic indictor data.

This report provides a comparison of the operational hydrological record to the baseline period; and a comparison of the biological community results from the fifth operational period (October 1, 2007 to May 1, 2008) with that of the final year of baseline data (2001-2002). The fifth year was shortened to seven months to allow for preparation of the final report before the program ended on September 30, 2008. The final report is an all-site composite summary.

Bennett Swamp was selected to be part of the demonstration program, *Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District* (SJRWMD), because it corresponds to the program's objective of evaluating the potential effectiveness of several water supply alternatives and approaches for minimizing impacts to wetlands. Cooperative partners on this project include the Volusia County Water Resources and Utility Services, the Florida Division of Forestry, and SJRWMD. (SJRWMD 1999)

The Bennett Swamp rehydration demonstration project is designed to be a passive water detention system. As such, there will be no active augmentation with groundwater (no direct pumping or discharge to the wetland). In January 2004, a weir was constructed by the Volusia County

Water and Utility Services in the Thayer Canal, which drains out of the east side of the wetland. The objective of the weir is to hold back a greater volume of surface water within the swamp for a longer duration by raising the outlet elevation without increasing flooding during major rainfall events.

The three monitoring transects were designated respectively as Thayer Canal, Hammock Field, and Lower Bennett Swamp. Their locations were selected based on property ownership, ease of access, and habitat representative of the wetland. The Thayer Canal Control Weir was positioned approximately 400 meters east of the Thayer Canal monitoring transect because changes in surface and shallow groundwater elevations, and ecological community response, if evident, would most likely observed at the Thayer Canal Transect. For the purpose of this executive summary, only the results from the Thayer Canal Transect are described. Details of all three transects are described in the respective results sections and in the appendixes that follow.

BASELINE PERIOD

The baseline period (February 15, 2000, through January 14, 2004) included the monitoring efforts while the weir was designed and installed. Two shallow groundwater wells (piezometers) were installed at upland and wetland ends of the three vegetation transects. The scope of work called for a one-time baseline-sampling event of the vegetation communities, benthic macroinvertebrates, fish, and water quality. At the time of the first event, however, the water depth was too shallow to sample adequately all of the parameters. Subsequent trips were therefore made until all parameters were sampled. Consequently, some of the baseline parameter data were sampled and characterized more than once to provide additional data points for comparison to the operational period. Ecological monitoring was suspended (except for water depth recording) while the project experienced delays during the design and construction of the weir. Construction of the outlet control weir would have been completed in fall 2003, but high water delayed the completion until January 2004. Four baseline-monitoring events (two in spring and two in fall) were conducted between 2000 and 2004.

Water levels were scheduled to be monitored on 6-hour intervals throughout the study period. However, vandalism and equipment malfunctions resulted in several relatively short gaps in recorded data.

Hydrology and Water Quality

An analysis of the baseline period showed that water levels in Bennett Swamp were above the ground surface 73% of the time. Average daily water level elevations were 26.11 feet NAVD88 (27.24 feet NGVD29) during the 47-month period. The baseline-period rainfall total (average 56 inches) was slightly above the annual average rainfall value for the area (48 to 50 inches). The water quality was typical of a forested wetland in north central Florida. Dissolved oxygen, pH, and conductivity were low, while color was high.

Vegetation

Trees, shrubs, and groundcover vegetation were dominated by facultative and obligate wetland species. Diversity of plant species was low. Tree ages and density, when measured in September 2007, were relatively even within the subcanopy stratum. The herbaceous layer was sparse under dense canopy and shrub layers and limited to open areas. Bennett Swamp appears to be showing the effects of past logging and the effects of ongoing fire suppression.

Animals

Benthic macroinvertebrates were dominated by midge larvae (*Chironomus* sp.) with lentic (water body with low dissolved oxygen water body) species characteristics. No fish were collected during the baseline period because of a lack of surface water and an absence of populations. Amphibian populations were surveyed by University of Florida graduate students under the guidance of Richard Franz. Frog species observed in Bennett Swamp during the baseline period were typical of Florida swamps.

Operational Period

The operational period began with the completion of the outlet control weir in January 2004. It was decided that September 30 would be the annual cut-off for each operational year to synchronize with the amphibian-monitoring season. Consequently, the first operational “year” was nine months in duration, January through September 2004. The second, third, and fourth years were from October 2004 through September 2007. The fifth and final year of operation included only the first seven months, from October 2007 through April 2008, to allow for data analysis and preparation of the final report before the program ended on September 30, 2008.

Hydrology and Water Quality

A target hydrograph was developed for Bennett Swamp using field measurements of vegetative and soil indicators of hydrology that were compared to modeled stage-duration curves for recent (1988) and historical conditions. Biological indicators of current water levels are well below historical levels. The current condition is therefore more adversely affected than suggested by the 1988 simulation. The data indicate that the 2010 stage-duration curve is a more descriptive model for the current conditions. In Bennett Swamp, a 1-foot increase in the stage-exceedence behavior was recommended as an initial rehydration target; therefore, the weir is operating at a control of 26.4 feet NAVD88 (27.5 feet NGVD29).

Stage-exceedence curves were developed for three transect locations in Bennett Swamp: a point near the origin of Thayer Canal; in Bennett Swamp close to Hammock Field; and at US Highway 92 in Lower Bennett Swamp. The modeled points are near the biological sampling transects referred to in this report. The Thayer Canal and Hammock Field Transects are about 1 foot above the Lower Bennett Swamp Transect. The stage-exceedence curves for both the baseline and operational periods were similar to the target historical level at the 50% exceedence value.

Water levels at Thayer Canal Transect remained below the wetland surface during the entire fifth operational period. Water levels fell beneath the Thayer Canal wetland piezometer (21.31 feet NAVD88 [22.44 feet NGVD29]) in September 2007 and remained below that elevation through April 2008. Mean daily water elevation (26.72 feet NAVD88 [27.85 feet NGVD29]) at the wetland recorder during the operational period was 0.61 feet greater than during the baseline period (26.11 feet NAVD88 [27.24 feet NGVD29]). In Year 5 of the operational period, the rainfall total (18.2 inches) was less than the long-term average for the months of October through April for the region. No surface water was present at the time of the scheduled monitoring; consequently, no Year 5 water quality results were available to compare to those of the baseline period.

During the baseline and the first two years of operational monitoring, storm damage, access delays, repeated vandalism, and equipment malfunctions resulted in hydrologic data gaps. To close the gaps in the Thayer Canal transect data, supplemental data from the City of Daytona Beach water level recorder in Thayer Canal were used to assess conditions at the transect location. A regression analysis showed a strong positive correlation (0.979 r-square) between the City's data and CH2M HILL data when the water was above 22.55 feet NAVD88 (23.68 feet NGVD29). During operational Year 3, foresters were able to clear debris from the 2004 and 2005 hurricane seasons that had blocked forest roads, allowing more direct access to the transects. Data from a 46-meter segment (Zone D) of the 230-meter Lower Bennett Swamp transect has been deleted from the data set to allow an undistorted comparison to baseline data. The severe storms in 2004 and 2005 resulted in a significant alteration to this portion of the transect that, if included in the analysis, would overshadow any effect the augmentation may be having on the vegetation.

Vegetation

Vegetation was sampled in spring (March 2008) during the fifth operational period. No apparent differences were observed in the composition of dominant species in the herbaceous layer vegetation between the operational and baseline periods, although percent cover during the monitoring period in 2008 was much lower than during the baseline years. Facultative wetland plant species dominate the herbaceous stratum with the exception of the Hammock Field transect in spring 2007. Percent cover and frequency of herbaceous species continue to be low. The invasive species Japanese climbing fern notably increased in percent cover at the wetland end of the Thayer Canal Transect. Density of shrub species, as of September 2007, was high and diversity low within Bennett Swamp. Canopy and subcanopy dominance and density were reduced from the baseline compared to the last sampling event in September 2007, most likely due to continued losses from the 2004 hurricane season.

Benthic Macroinvertebrates

No surface water was present at the time of the scheduled monitoring; consequently, no fifth period benthic sample results were available to compare to those of the baseline period. Overall, benthic macroinvertebrates density and diversity in previous years were similar to those observed during the baseline period, dominated by midge larvae and tubificid worms. Densities and diversity were generally greater during spring events.

Amphibians

Amphibian surveys were conducted by the Coastal Plains Institute, Inc. (CPI). A full presentation of these survey results is submitted by CPI directly to the SJRWMD. A brief summary of the available CPI survey results (through April 2008) is included in this annual report.

Persistent, dry conditions caused amphibian species richness and abundance to continue to decline through the shortened 2008 sampling period. Three amphibian species and 11 individuals were captured or observed in the 2008 period. Based on the comparison of 2 years of baseline and 4.5 years of operational data, it appears that species diversity of the swamp increased during rainy periods and decreased during drought periods.

Frog calling, frog larva, and evidence of amphibian reproduction were not observed at Bennett Swamp in 2008. These results are likely due to a combination of shortened sampling year and persistent dry conditions in the swamp basin. Rainfall was average for the four-month sampling period; however, it was inadequate for amphibian breeding activity (Means and Meegan 2008).

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FIGURES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
CompQAP	Comprehensive Quality Assurance Plan
CPI	Coastal Plains Institute, Inc.
dbh	diameter at breast height
EPA	U.S. Environmental Protection Agency
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
FDEP	Florida Department of Environment Protection
mg/L	milligrams per liter
µmhos/cm	microhmos per centimeter
MOU	Memorandum of Understanding
NAVD88	North American Vertical Datum 1988
NGVD29	National Geodetic Vertical Datum 1929
OBL	obligate
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
SHWL	seasonal high-water line
SJRWMD	St. Johns River Water Management District
T&E	threatened and endangered
UPL	upland

INTRODUCTION

PROJECT BACKGROUND and RATIONALE

This pilot project is part of Phase 2 of Task E of the *Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District*. The recommended duration of this demonstration project is a 5-year operational period. The study will provide an assessment of the feasibility of avoiding projected impacts to native vegetation and wildlife resulting from the projected increases in groundwater withdrawals. The project is a partnership between the St. Johns River Water Management District (SJRWMD), Florida Division of Forestry, and Volusia County Water Resources and Utility Services. The Bennett Swamp Demonstration Project is one of four projects being conducted by the SJRWMD to test impact avoidance strategies in various ways (CH2M HILL 1997).

Avoiding impacts to wetlands is an approach designed to balance impact and resource development. One impact-avoidance strategy is to compensate for altered hydrology caused by water table decline by indirectly augmenting water levels in the affected wetlands. This project is designed to increase the recharge to the water table by using a control weir in the outlet ditch to reduce the outfall from the wetland. Increases in the average water level and an increase in the duration of inundation/saturation of the wetland are two of the metrics used to assess this augmentation method.

Assessing the environmental impacts of water table declines due to aquifer withdrawals on a regional scale can be difficult and is associated with a high degree of uncertainty. However, developing water supplies without regard for impacts to wetland and aquatic systems and then mitigating later can be a very costly alternative. In comparison to the pump-and-mitigate strategy, impact-avoidance strategies are probably more cost-effective.

At the completion of the 5-year study and presented in a separate report, conclusions about this type of augmentation will be drawn from the data analysis in terms of water quantity, efficiency, ecological responses, cost benefits, and operation and maintenance. Subsequently, better decisions can be made by extrapolating these conclusions to other wetlands systems being assessed for augmentation.

BENNETT SWAMP

Bennett Swamp is a 2,200-acre swamp in the Tomoka River Basin in Volusia County. Approximately 1,490 acres are forested wetland, and the remainder is pine flatwoods (489 acres) and upland (221 acres). The swamp is a broad relict interdunal swale of very flat topography and an average slope of approximately 0.5 foot per mile (SJWRMD 2000). The general direction of flow in the swamp is south toward the Tomoka River, and water exits the swamp either through Thayer Canal (to the east) or through a box culvert under US Highway 92 in lower Bennett Swamp. Water may also flow north under specific flood or high-water conditions (Freeman 2001). Tiger Bay Swamp drains into Bennett Swamp from the west, as shown by the blue arrows in Figure 1.

The Soil Survey of Volusia County (USDA-SCS 1980) shows the main area of Bennett Swamp to be *Samsula Muck*. The soil is described as “very poorly drained nearly level organic soil [that] occurs in broad low flats, small depressions, freshwater marshes, and swamps. Typically, the surface layer is about 9 inches of black muck underlain by 27 inches of dark reddish brown muck…The water table is at or above the soil surface except during extended dry periods.”

Bennett Swamp was selected to be part of the impact-avoidance strategy demonstration program because it is near the City of Daytona Beach wellfield. Groundwater pumping for potable water began in the area in the early 1980s. Since that time, the level of pumping has increased, and the local wellfield has expanded. According to Robert Freeman (SJRWMD 2000), Thayer Canal was constructed on the east side of the wetland prior to 1980 for mosquito control. Subsequently, biological indicators of altered hydrology were observed in Bennett Swamp. For these reasons and the ease in which an outlet control weir could be located in Thayer Canal, Bennett Swamp was selected to be part of the impact-avoidance strategy demonstration program. Volusia County and the Florida Division of Forestry (a co-owner with SJRWMD of Bennett Swamp) are willing participants in the study.

PURPOSE

The results of the 47-month baseline period (February 15, 2000, to January 14, 2004) and the fifth operational period (October 1, 2007, to April 30, 2008) are summarized in this annual report. The report presents an evaluation of the operational effects on water elevations and any changes in flora or fauna.

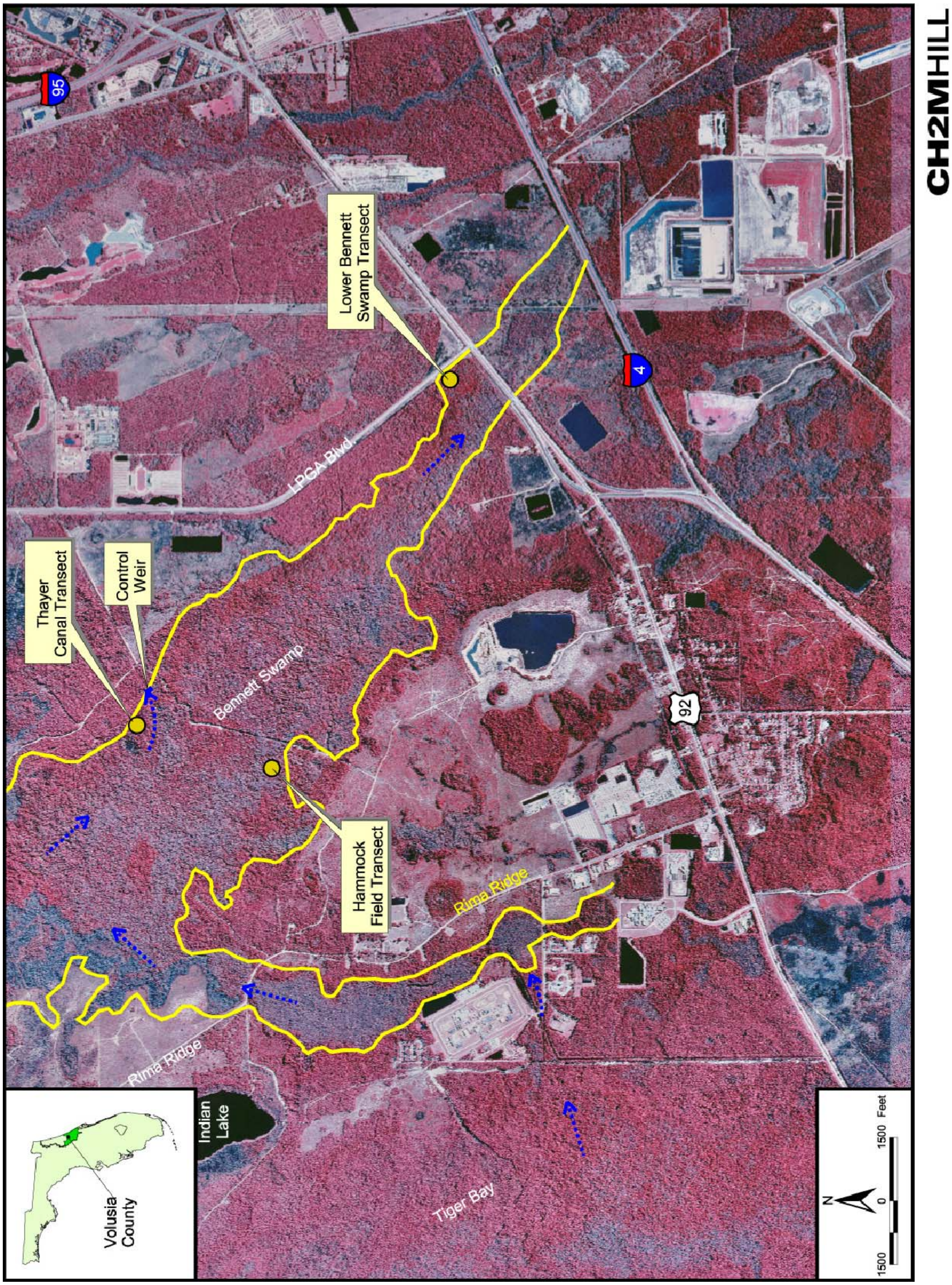


Figure 1.Bennett Swamp project location map, Volusia County

METHODS

OUTLET CONTROL WEIR

The Bennett Swamp rehydration demonstration project is designed to augment seasonal water levels by constructing a control weir in an existing outfall canal. The objective of the weir is to hold more surface water within the system for a longer duration by raising the outlet elevation without increasing flooding from major storm events. This is a passive system, in that; it is rainfall-dependent and does not receive water through a pump and delivery pipe system.

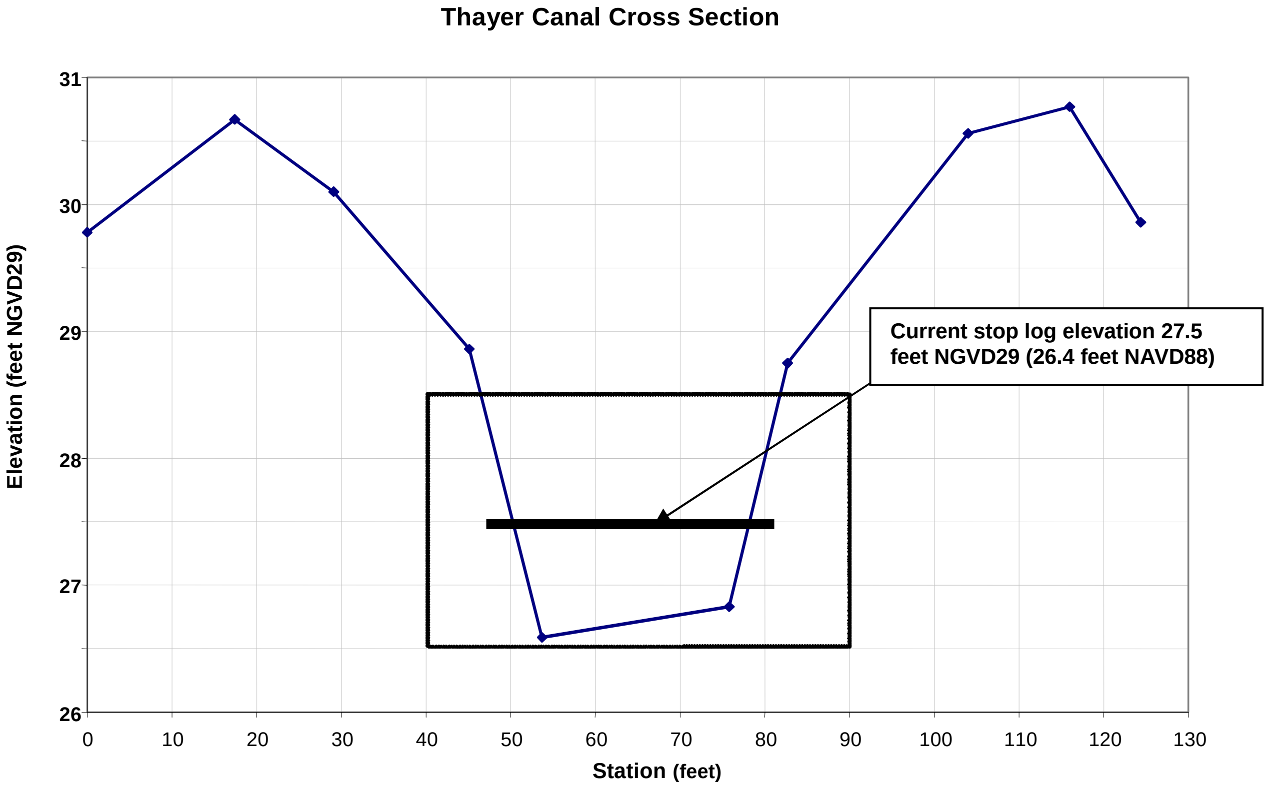
Setting the Control Elevation

Recent and historical hydraulic modeling work was conducted by Robert Freeman of SJRWMD. In 2002, field measurements of vegetative and soil indicators of hydrology were compared to modeled stage-duration curves for recent and historical conditions (CH2M HILL 2002a, included as Appendix A). Elevations of soil and vegetation parameters were collected at all three transects.

Biological parameters were collected, when available, from mature trees of the dominant canopy species, cypress (*Taxodium distichum*) or blackgum (*Nyssa sylvatica*), present at each site. Parameters were divided into short-, moderate-, and long-term indicators. Elevation and thickness of the surficial organic horizon along a gradient of water depth were measured at each transect. The soil elevation data for each transect were regressed against depth. Soil and vegetative indicator elevations were placed on the stage exceedence curves and compared to the expected stage exceedences from the literature, from which an appropriate initial rehydration target was determined.

Construction of the Weir

Former CH2M HILL hydrologist Ron Wycoff designed the conceptual weir and selected the location (Figures 2 and 3). Quentin L. Hampton and Associates, Inc. performed the final design and obtained the construction permits. Volusia County Water Resources and Utility Services constructed the weir. Photographs of the weir under construction, and during low water and flood conditions are shown on Figure 4. The control elevation of the weir is currently set at 26.4 feet North American Vertical Datum 1988 (NAVD88) (27.5 feet National Geodetic Vertical Datum 1929 [NGVD29]). The weir was designed to increase the wetland average seasonal high in 6-inch increments to 2 feet above base flow.



The team selects the weir location west (upstream) of wooden bridge on Thayer Canal.

Thayer Canal from wooden bridge on Slim Pines Road, view east (downstream).

Figure 2. Thayer Canal cross-section and photographs of control weir location, Bennett Swamp

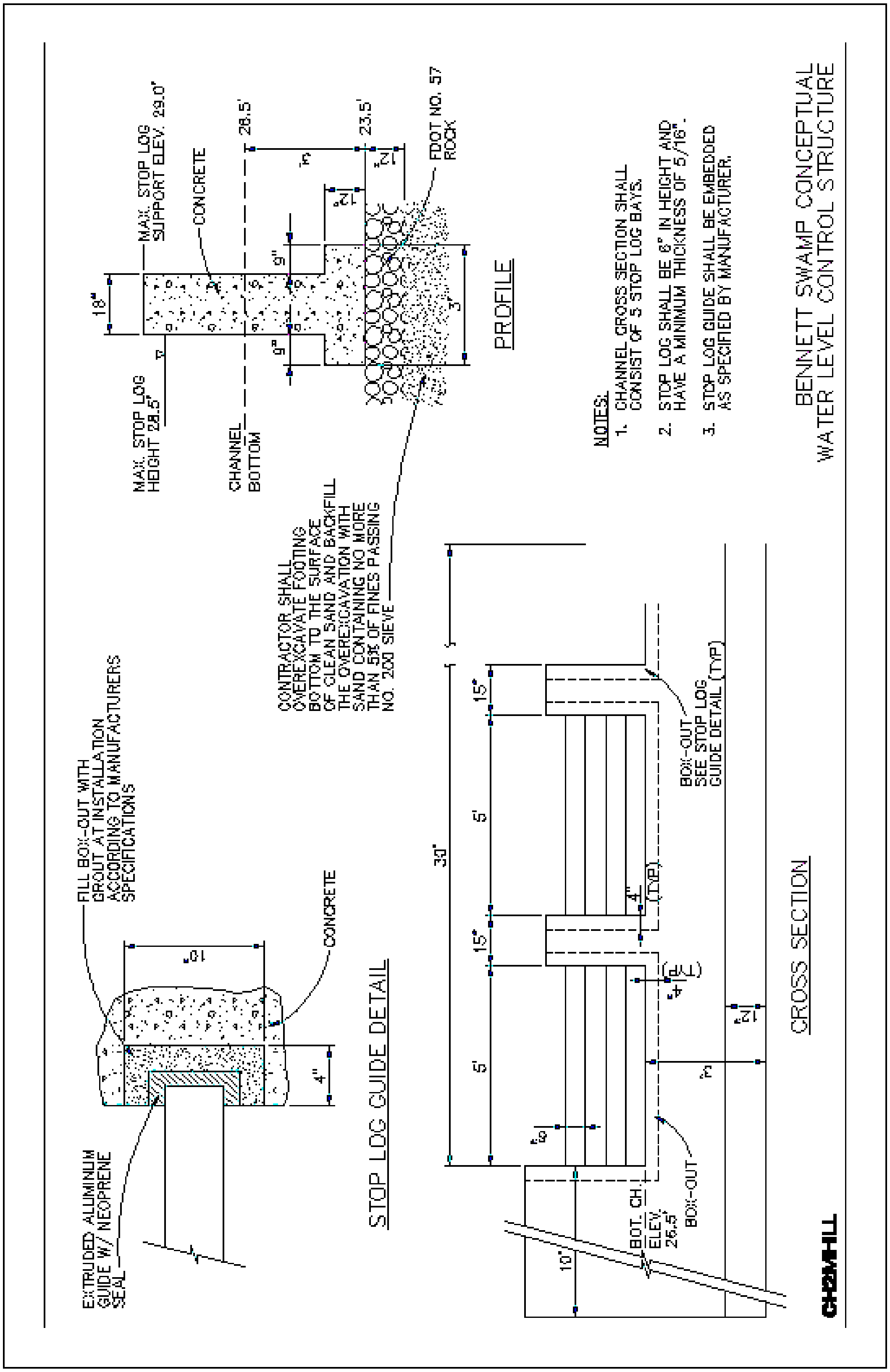


Figure 3. Water level control weir design (elevations in NGVD29 datum), Bennett Swamp

Weir under construction, December2003.

Weir under construction, December 2003.

Weir with newly installed stop-log boards, February 2004.

Another board added to bring weir to correct height, April 2004.

Control weir elevation 26.4 NAVD88 (27.5 feet NGVD29)

Flood water overtops weir, Fall 2004.

Figure 4. Photos of outlet control weir in Thayer Canal

DATA COLLECTION

Data collection for the Bennett Swamp surface water detention demonstration project includes hydrologic, water quality, floral, and faunal sampling. CH2M HILL personnel were responsible for all sampling except that of the amphibian community, which was performed independently by Coastal Plains Institute, Inc. (CPI).

The primary field investigator during this period for all project parameters, except amphibians, was CH2M HILL biologist Steve Eakin, with assistance from Anthony Davanzo. CPI researchers Ryan Means and Rebecca Meegan monitored amphibians. Field investigators during the baseline monitoring included Steve Eakin, Rosanne Prager, Ryan Means, Bill Dunn, Ron Clark, Mandy Parks, and Martha Klein.

Sampling Transect Design

The monitoring transect locations were selected after a site visit in January 2000, based on property ownership, ease of access, and habitat representative of the wetland. The transects were established on February 15, 2000, and the set-up included installation of polyvinyl chloride (PVC) markers, two recording groundwater monitoring wells, and two staff gauges. Figure 5 presents a sketch of the monitoring transect set-up.

One main monitoring transect with two adjacent parallel groundcover transects were set up in the three selected areas. The transects were oriented from the upland edge to an interior deep zone to cover an adequate range of water depths and representative vegetative communities. The transect lengths are: 140 meters at Thayer Canal, 200 meters at Hammock Field, and 230 meters at Lower Bennett Swamp. PVC markers placed over rebar were used to mark the end points and intermediate points on the transects and the corners of each sampling plot (tree, shrub, and groundcover).

Ground surface elevations were surveyed at 3-meter intervals along each main transect. Elevations of staff gauges, top of casing, and ground surface at each piezometer also were surveyed.

Photo Stations

Three photo stations were established along the main transect in the center of each shrub plot. The photographs cover four quadrants (north, south, east, and west) surrounding the station. Photographs were taken at each station in the fall and spring.

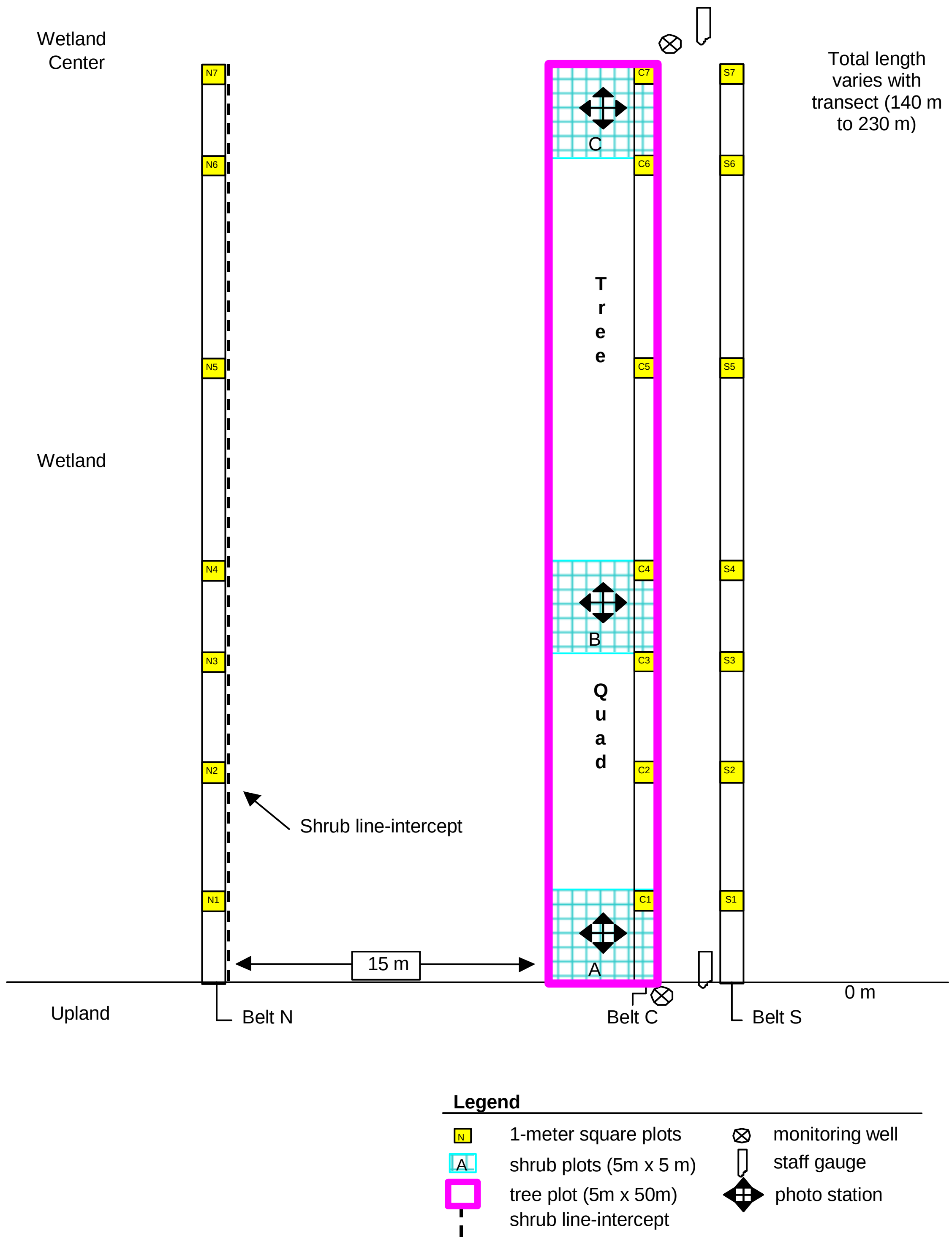


Figure 5. Transect site map – typical, Bennett Swamp

Sampling Schedule

The scope of work required a one-time baseline-sampling event of the vegetation communities, benthic macroinvertebrates, fish, and water quality. At the time of the first event, however, the water depth was too shallow for adequate sampling of all of the parameters. Subsequent trips were made until all parameters were sampled.

The water levels were scheduled to be monitored on 6-hour intervals throughout the study period. Ecological parameters were sampled and characterized in spring and fall seasons. Ecological monitoring was suspended (except for water depth recording) while the project experienced delays during weir design and construction. Construction of the outlet control weir was completed in January 2004. Semiannual sampling was performed during the operational years. The sampling schedule and parameter list, as performed for the project, is presented in Table 1.

Stage and Rainfall

Two recording piezometers and staff gauges (Figure 5) were installed along the main monitoring transect. One set was installed near the upland boundary to serve as a backup to the main set in the wetland interior. The piezometers were set as deep as possible by hand auger, approximately 6 to 8 feet below ground surface.

Each piezometer contains a data logger that is programmed to collect and record water levels at a minimum of two-hour intervals. The data loggers currently associated with the upland and wetland piezometers are Infinities USA Dataloggers and have a scrolling memory for 3,900 readings. Data are downloaded every 8 to 12 weeks. During each site visit, staff gauge measurements are recorded to verify that the data loggers are functioning properly.

Rainfall data were obtained from the National Weather Service from the Tiger Bay State Forest station for the sampling period.

Surface Water Quality Sampling

Analytical samples for surface water quality were collected twice for the baseline period and semiannually during each year of operation. A grab sample was collected from the surface water for analysis for the range of water quality parameters listed in Table 1. Temperature, dissolved oxygen, pH, total depth, and conductivity were measured and recorded during field sampling. Dissolved oxygen and temperature were measured at depths 5 to 8 centimeters below the water surface and within 8 to 10 centimeters of the ground surface.

Table 1. Wetland sampling plan for Bennett Swamp

Parameter	Baseline Period				Operational Period								
	May 00	Sep 00	Oct 01	Apr 02	Mar 04	Jan 05	Mar 05	Sep 05	Mar 06	Sep 06	Apr 07	Sep 07	Apr 08
BIOTA													
Trees (Annual In Fall)		X	X			X		X		X		X	
Herbs	X		X	X	X	X	X	X	X	X	X	X	X
Shrubs (Annual In Fall)		X	X			X		X		X		X	
Benthic Macroinvertebrates	X[a]		X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Fish (Annual in Fall)			[b]			X		X		--[e]		--[e]	
T & E Plant and Animal	X	X	X	X	X	X	X	X	X	X	X	X	X
Amphibians	**Monthly**				**Monthly** [c]		**Monthly Jan through Sep**						
SURFACE WATER SAMPLES													
Alkalinity as $CaCO_3$			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Ammonia (NH_3)			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Color			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Conductivity			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Nitrate plus Nitrite NO_3 + $N0_2$ as N			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Orthophosphate, Low			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Total Dissolved Solids			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Total Kjeldahl Nitrogen			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Total Phosphorus, Low			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Total Suspended Solids			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
FIELD PARAMETERS													
Dissolved Oxygen			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Temperature			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Conductivity			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
pH			X	X	X	X	X	X	X	--[e]	--[e]	--[e]	--[e]
Water Level	**Continuous Recordings**[d]												
Photographs	X		X	X	X	X	X	X	X	X	X	X	X
SUBSTRATE SAMPLES													
Soil Description	X			X									

Note:

[a] Sampled at Thayer Canal Transect only (water too low at other transects).
[b] Sampled but no fish found.
[c] Hurricane flooded traps – no amphibian data in September 2004.
[d] Continuous records except for periods of malfunctions and vandalism.
[e] No water present during sampling; parameter data not available.

T&E = threatened and endangered

Spring event is usually conducted in March and fall in September unless hazardous weather conditions cause the event to be postponed until conditions are safe for field data collection.

All of the samples were kept on ice below 4 degrees Celsius (°C) until arrival at the analytical laboratory. A field blank composed of analyte-free water also was collected and analyzed for all parameters. Specific sample containers, holding times, and preservation techniques are based on the approved quality assurance plan (CH2M HILL 1999).

Quality Assurance and Quality Control

The Quality Assurance and Quality Control (QA / QC) techniques used during monitoring have been approved by the Quality Assurance Section of the Florida Department of Environmental Protection (FDEP). The techniques used are accepted protocol for each type of sampling procedure. CH2M HILL field personnel followed procedures outlined in CH2M HILL's Comprehensive Quality Assurance Plan (CompQAP) No. 910036G for the execution of field activities, proper completion of chain-of-custody forms, sample preservation requirements, proper handling of samples, and certified laboratory analytical services. Strict adherence to holding times for all parameters was observed.

The laboratory analytical work during the baseline period was conducted by Columbia Analytical Services, Inc., according to its CompQAP No.930298G. During the operational period, the water quality samples have been sent to Advanced Environmental Laboratories, Inc., in Jacksonville, Florida. Laboratory personnel followed the procedures outlined in the laboratory's CompQAP for sample kit preparation, tracking and analysis of samples, and data validation.

Approved instrument maintenance and calibration procedures were followed by the field team in accordance with the manufacturer's recommendations and were consistent with standard procedures outlined in the CH2M HILL CompQAP. Calibration results were recorded on the field data sheets. (Columbia 1998) During each sampling event, one field blank was collected.

Soils

Soil profiles were sampled along the main transect when water levels allowed. All strata or horizons within this surficial zone were characterized. These surficial sediments comprise the principal zone of biological activity, where the augmentation efforts are likely to have measurable ecological effects. Soils were excavated by digging a small pit to a depth below the water table or 90 centimeters. The soil horizons and their major subdivisions were identified and a thickness measurement was taken for each horizon or subdivision. Two pits were excavated along the main monitoring transect.

Vegetation Sampling

Sampling was conducted along the transects running from the upland edge to the interior of the wetland. Vegetative community sampling included three main strata:

- Herbaceous groundcover
- Shrubs and saplings
- Canopy / subcanopy

Herbaceous groundcover sampling was conducted semiannually. Canopy / subcanopy and shrub / sapling data collection was conducted annually.

Herbaceous Groundcover. The herbaceous groundcover community included all annual plants, soft-stemmed perennials, and woody seedlings less than 0.3 meter in height. Two sampling methods were used to characterize the herbaceous plant stratum: 21 plots (1 meter by 1 meter) and three 1-meter-wide belt intercept transects (Figure 5).

(1) One-Meter-Square Plots

Groundcover data were recorded along the main transect and along two additional parallel transects, each with seven plots (1 meter by 1 meter). Within each of the 21 plots of 1 square meter, species composition and percent cover of herbaceous species and woody seedlings (< 0.3 meter tall) were determined.

(2) Belt-Intercept Transects

A modified line-intercept technique was used to evaluate herbaceous plant occurrences along the three belt transects (1 meter wide along the length of the main transect). The line-intercept technique was used to monitor changes in aerial cover and zonation of target indicator species along an upland-to-wetland gradient.

Occurrence of selected target species along the belt transect was recorded as the linear distance covered by a species within five intervals of equal length along the belt. For each target species the belt-intercept linear distance of cover was used to generate estimates of percent cover and frequency (number of intervals in which the species occurred), which were converted to relative vegetative cover and relative frequency. The values for each plant species were added and averaged to yield an importance value as shown in Table 2.

Table 2. Plant cover and frequency statistics for herbaceous plant measurements, Bennett Swamp

Statistic		Formula
Linear Cover Distance for Species A	=	Sum of all belt-intercept distances for Species A
Percent Cover	=	(Linear distance of Species A **/** Total transect distance) x 100
Relative Percent Cover	=	(Linear distance of Species A / Total linear distance of all species) x 100
Frequency	=	Number of intervals in which Species A occurred **/** Total number of intervals
Relative Frequency	=	(Frequency of Species A **/** Sum of the frequencies of all species) x 100
Importance Value	=	(Relative percent cover + relative frequency) / 2

Shrubs and Saplings. The shrub / sapling stratum is defined as all woody vascular plant species, as well as sapling trees and sucker shoots of larger trees less than 1 meter high and less than 2.5 centimeters diameter at breast height (dbh). Two sampling methods were used to characterize the shrub / sapling stratum: three plots (5 meters by 5 meters) and one line-intercept transect along the length of the main transect.

(3) 25-Square-Meter Plots

Three plots (each 5 meters by 5 meters) were regularly spaced along the centerline of the main transect. All woody plants within the size class and rooted in or overhanging the plot were identified and recorded. For shrub and sapling species, the percent cover was determined. For sapling species, stem density was determined.

(4) Line Intercept

A line-intercept transect was established along the northern belt transect to monitor the occurrence and percent cover of shrub / sapling strata. A tape measure was placed along the length of the transect, and the linear-intercept distance of each species lying vertically over, under, or touching the tape was recorded. The transect was subdivided into five subintervals for measuring frequency.

For the shrub stratum, the line-intercept linear distance data were used to generate estimates of percent cover and frequency, which are converted to relative vegetative cover and relative frequency. The values for each plant species are summed and averaged to yield an importance value, as described previously, for each species.

Canopy/Subcanopy. One plot, oriented to stretch the length of the transect, was used to characterize the canopy/subcanopy stratum. The width of the plot varies with each transect to include a significant amount of canopy- and subcanopy-size trees. Canopy trees included those greater than or equal to 10.2 centimeters dbh. Subcanopy trees included those greater than or equal to 2.5 centimeters and less than 10.2 centimeters dbh. Trees less than 2.5 centimeters dbh and/or less than 1 meter high were not tagged.

All trees rooted within the tree plot were identified by species, marked with a permanent numbered aluminum tag, and measured for dbh, approximately 1.4 meters above the ground surface. Subsequent measurements were made at the bottom edge of the hanging tags to maintain consistency between annual measurements. The canopy/subcanopy data were collected annually; and included dominant and subdominant hardwood and softwood trees, sapling trees, and larger sucker shoots from the main trunks of trees.

Species composition, density and dominance (basal area), importance value, and stand size structure within each 10-meter interval along the transect can be assessed from the data collected. Long-term monitoring allows for an assessment of the annual growth, recruitment, mortality, and observable changes in health or character of the canopy over a specific period. Importance values for the canopy/subcanopy species were calculated from dominance, density, and frequency data as shown in Table 3.

Table 3. Dominance, density, and frequency statistics for canopy/subcanopy species measurements, Bennett Swamp

Statistic		Formula
Dominance	=	Total basal area of Species A
Relative Dominance	=	(Total basal area of Species A / Total basal area of all species) x 100
Density	=	Number of individuals of Species A
Relative Density	=	(Density of Species A / Total density of all species) x 100
Frequency	=	Number of intervals in which Species A occurred / Total number of intervals
Relative Frequency	=	(Frequency of Species A / Sum of the frequencies of all species) x 100
Importance Value	=	(Relative Dominance + Relative Density + Relative Frequency) / 3

Animals

Benthic Macroinvertebrates. Sampling was conducted within the various habitats found along the monitoring transect. Benthic macroinvertebrate populations were monitored in accordance with the FDEP Standard Operating Procedure BA-7 (7/11/96), which is based on the U.S. Environmental Protection Agency (EPA) rapid bioassessment protocols. The method includes sweep-net sampling of all microhabitats within the sampling area by two field personnel. Sampling is limited to a fixed number of sweeps at each site. All individual organisms collected are sorted and subsequently identified according to species, or the nearest practical taxonomic unit, by a subconsultant.

Fish. During the baseline period, fish populations were sampled near the transect using a 0.94-square-meter Wegner Ring. During the first operational period, access to transects in Bennett Swamp was limited by downed trees from the 2004 hurricane season and private property conflicts. Access issues, to both the Thayer Canal and Hammock Field transects, persisted into Year 2 of operational monitoring. As a result, the fish populations were sampled with a dip net 0.45 meter wide instead of the Wegner Ring. The dip net was swept through the water 10 times in 1-meter-long sweeps, and fish were identified and counted.

Amphibians. During the baseline period, amphibian populations were surveyed by University of Florida biologists L. Richard Franz, Ryan Means, and Steve Johnson. A modest sampling effort was conducted at the site to evaluate the amphibian community.

During the operational period, researchers Means and Meegan of CPI conducted the amphibian surveys at the site. Monitoring was conducted monthly from January through September. Monitoring stations were established around the periphery of the wetland. Each station included a Y-shaped drift fence array with screen funnel traps, cover boards, and PVC pipes to sample the amphibians in the area. Dip-netting and frog-call surveys also were used to detect the presence of amphibian species.

RESULTS

RAINFALL at BENNETT SWAMP

Rainfall data collection began in February 2000. Data from the National Weather Service from the Tiger Bay State Forest station for the period February 2000 to April 2008 are shown in Figure 6. Average annual rainfall during the baseline period from February 2000 through December 2003 was 56 inches, slightly above the annual average rainfall values for the area, which is typically between 48 and 50 inches. Rainfall during the five operational periods was 59.9, 49.9, 34.4, 47.7, and 18.17 inches, respectively. The fifth operational period (October 2007 through April 2008) was slightly below the long-term regional average (22.15 inches) for the seven months.

The peaks in monthly totals are typically associated with hurricane seasons in summer months such as tropical storm Gabrielle (September 2001) and the unusual hurricane season of 2004 with Hurricanes Charley, Frances, Jeanne, and Ivan, which occurred in the first operational period. Monthly rainfall totals collected during the project period from the Tiger Bay State Forest station were compared to average monthly totals from two long-term (1971 to 2000) local data sets. The first data set included records from a nearby station at the Daytona Beach International Airport. The second data set was an average of five regional sites that included data from stations at the Daytona Beach International Airport, Titusville, Sanford, Crescent City, and Deland.

By summing individual monthly departure values from normal values presented from the two data sets, the cumulative departure from normal precipitation was calculated and used to develop trends in precipitation. An increasing trend in cumulative departure from normal rainfall indicates wetter conditions; decreasing trends in cumulative departure from normal rainfall indicate dryer conditions. Figure 7 shows the cumulative departure from the mean monthly rainfall totals from the two long-term data sets.

Through the first 16 months (February 2000 through May 2001) of the baseline period, rainfall at the Tiger Bay State Forest station was below the long-term average of both data sets. During this period, the average monthly rainfall totals between the two data sets remained relatively close. Throughout the rest of the baseline and the first two operational monitoring periods, monthly rainfall totals exceeded the long-term average monthly totals of both data sets. During the third, fourth, and fifth operational periods, monthly rainfall totals were lower than the long-term average monthly totals for both data sets (decreasing values in trend line.).

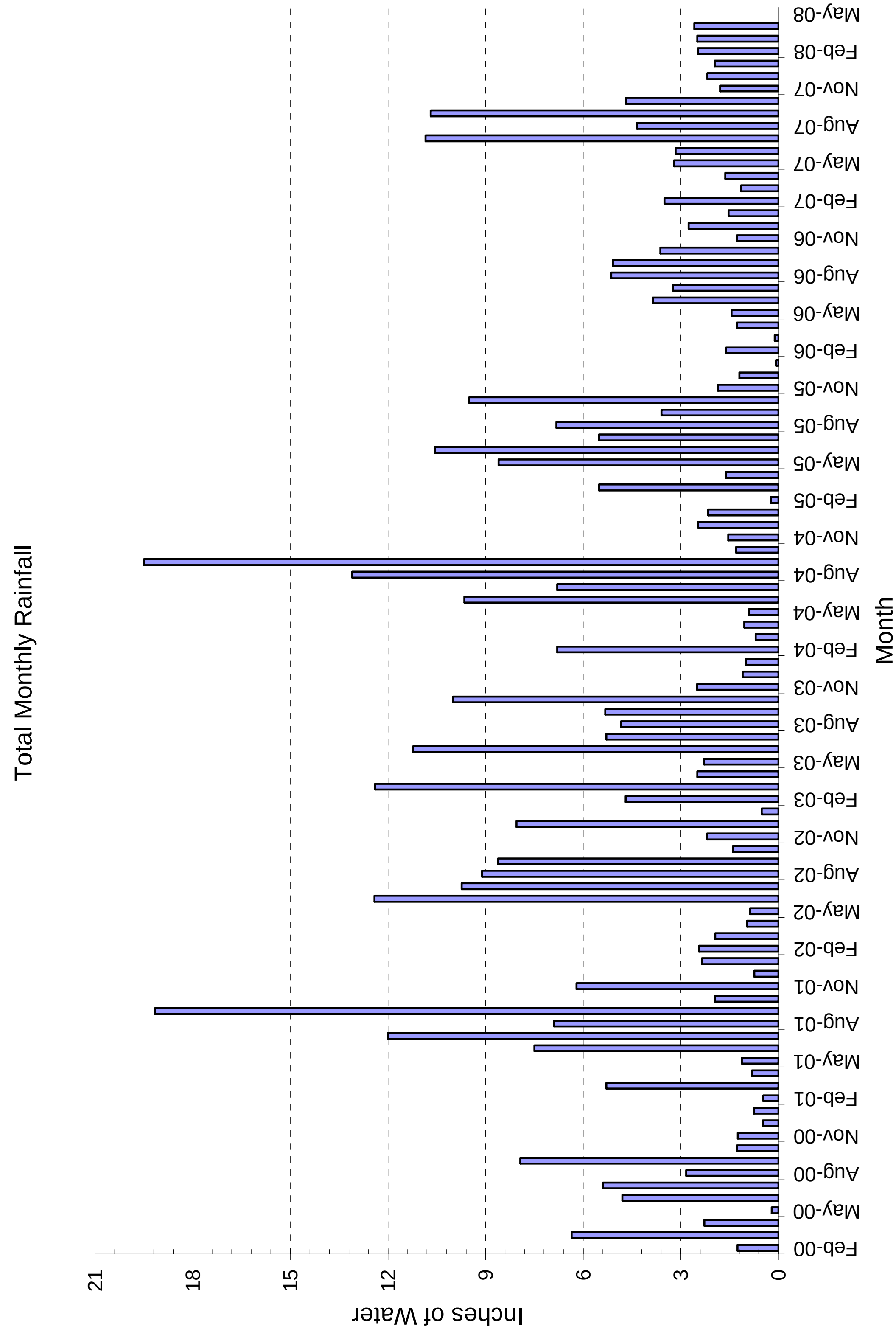


Figure 6. Rainfall at Bennett Swamp

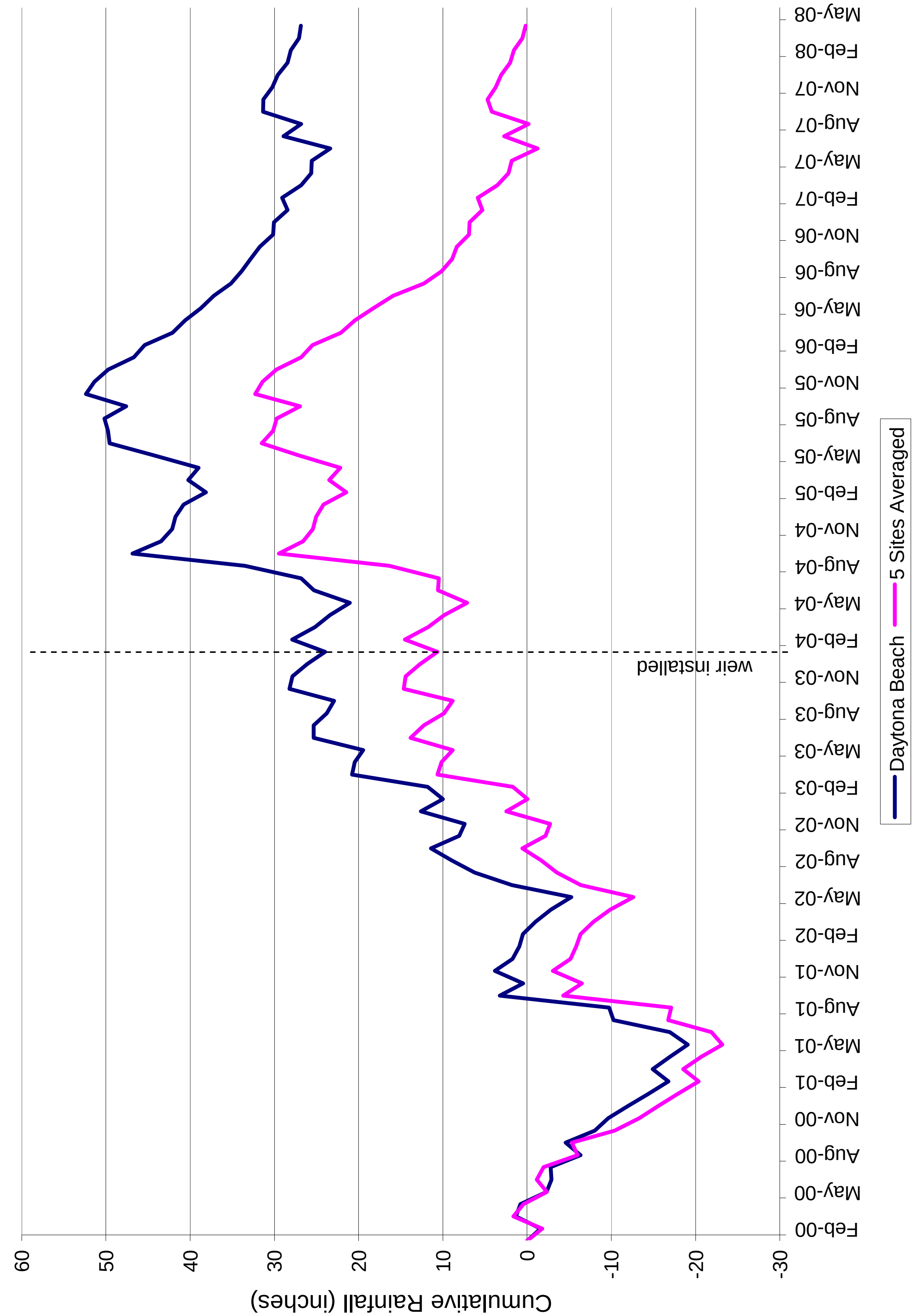


Figure 7. Cumulative departure from long-term average monthly precipitation

Figure 7 shows that the period from June 2002 to September 2005 was wetter than normal, with cumulative rainfall above the average precipitation expected. After September 2005, drier conditions prevailed throughout the third, fourth, and fifth operational periods.

TARGET HYDROGRAPH for BENNETT SWAMP

Field measurements of vegetative and soil indicators of hydrology were compared to modeled stage-duration curves for recent and historical conditions. Appendix A, *Technical Memorandum Hydrologic Goals in Bennett Swamp - Rehydration Water Level Targets Using Biological Indicators* (CH2M HILL 2002a), includes detailed information on the target hydrograph setting. Results from that report are summarized in this report. Biological indicators of current water levels are well below historical levels. Elevations of soil and vegetative indicators were collected at each of three transects.

The lower edge of epiphytic mosses indicate short-term hydrologic changes; lichens are short- to moderate-term indicators; moderate-term indicators are root crowns of fetterbush (*Lyonia lucida*); and long-term indicators include lower and upper tree buttress points. Epiphytic lichens and mosses live on the trunks of trees. Lichens live above the seasonal high-water line (SHWL), while mosses lie below the SHWL. Fetterbush is a shrub whose root crown elevation is also an indicator of SHWL.

Elevation and thickness of the surficial organic horizon along a gradient of water depth were measured and compared to the literature for minimum dry-season water level necessary to maintain the organic soil profile and other wetland functions.

Soil and vegetation data were overlain on the modeled stage-exceedence curve to provide an estimate of the range of the hydrological regime change at the 50 to 60% and 10 to 20% stage-exceedence ranges (Figure 8; analysis details are presented in Appendix A). Figure 8 is representative of Bennett Swamp and not transect-specific; however, exceedence curves generated from transect-specific water-level monitoring data were compared to the modeling results presented in Figure 8.

Historical impacts from surface water alterations and groundwater withdrawal have shifted the stage-duration curve, with the greatest impact in the range of the frequent low to average portions of the curve. Comparison of the simulated historical and 1988 stage curves show that 0.75 foot or more of stage has been lost from the system at the midrange of exceedence percentages (Figure 8: at 50% exceedence, point B minus point C).

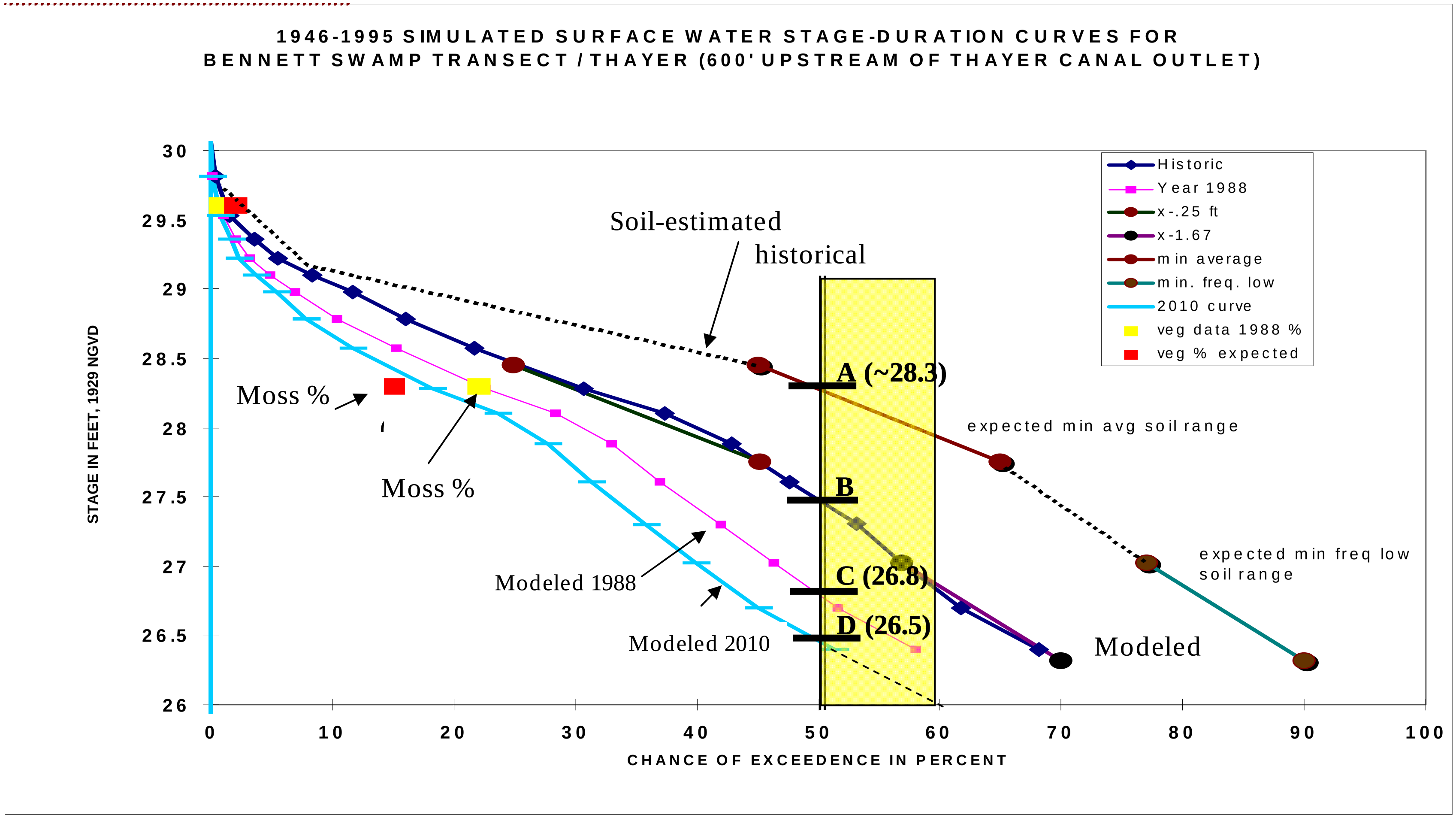


Figure 8. Stage-exceedence diagram with an approximation of the historical condition, Bennett Swamp

Note: Estimation of possible elevation changes between about 15 and 60% stage-exceedence values in Bennett Swamp. Yellow-shaded zone shows the minimum average elevation zone for each curve (estimated from soil, historical, 1988, and 2010). Dotted lines on the curves are projected, not calculated, ranges of a curve.

Analysis of organic soil horizon data also indicates that the modeled historical stage-exceedence curve is lower than the soil-predicted elevations. The historical and 1988 modeled conditions represent conditions already affected by the presence of Thayer Canal. The current condition is more adversely affected than suggested by the 1988 simulation.

This indicates that the Freeman (2001) simulated historical condition is actually an already impacted condition and that the soil oxidation has lagged behind the reduction in stage. The soil-based stage-exceedence estimates suggest a historical elevation different from the modeled 1988 data by about 1.75 feet (Figure 8 shows a 50% exceedence, point A minus point C). Furthermore, the moss lines suggest that the current condition is impacted beyond the modeled 1988 condition, or a possible impact of about 2 feet relative to a pre-disturbance condition (Figure 8 shows a 50% exceedence, point A minus point D).

Despite the variability in the data, there is a sufficiently consistent pattern in the information to draw preliminary conclusions and make a recommendation concerning a rehydration target. The data suggest that the 2010 stage-duration curve is a more descriptive model for the current conditions. In Bennett Swamp, a 1-foot increase in the stage-exceedence behavior was recommended as an initial rehydration target. This will bring the hydrology toward the historical condition without affecting adjacent land uses, such as managed pine plantations, at the edge of the swamp; therefore, the weir is set at elevation 26.4 feet NAVD88 (27.5 feet NGVD29). Appendix B presents the Memorandum of Understanding 2004 on weir operation, maintenance, and performance monitoring (SJRWMD 2004).

AMPHIBIANS

A full presentation of the amphibian survey results, to date, is presented in *Assessment of Amphibian Response to Wetlands Augmentation 6th Annual Report 2008*, Prepared for SJRWMD, Palatka, Florida Coastal Plains Institute and Land Conservancy Tallahassee, Florida submitted by Means and Meegan of CPI directly to the SJRWMD. A summary of the Bennett Swamp monitoring results from the CPI report are included in this annual report.

Species Richness and Relative Abundance

For comparison purposes across sites and years, a controlled capture technique is used (drift fence only). Only those individuals captured by the drift-fence arrays are included in the individual capture totals. Captures and observations made by other techniques are used to assess presence-absence.

Amphibian activity continued to decline through this year. Decreased amphibian abundance in the post-operational period is due to below normal rainfall and a lack of surface water in Bennett Swamp (Means and Meegan 2008).

No state or federally listed species were captured by CPI in 2008. Two species, one individual of each, were captured in drift fence during the shortened monitoring period of 2008. These were the native species pine woods treefrog (*Hyla femoralis*), and the exotic species Cuban treefrog (*Osteopilus septentrionalis*) (Table 4). Nine individuals of one other species, squirrel treefrog (*Hyla squirella*), were observed by other sampling techniques during project year 2008 (Means and Meegan 2008).

Table 4. Amphibian species captured* in drift-fence arrays at Bennett Swamp

Scientific Name	Common Name	Baseline Period	Operational Period				
		1999, 2000	2004	2005	2006	2007	2008
Salamanders							
Eurycea quadridigitata	Dwarf salamander		1	1			
Frogs							
Acris gryllus	Florida cricket frog	25	10	21	4		
Bufo quercicus	Oak toad	5	4	5			
Bufo terrestris	Southern toad	211	1	21	7	3	
Eleutherodactylus planirostris	Greenhouse frog[a]	84	17	8	7	10	
Gastrophryne carolinensis	Eastern narrowmouth	95	15	15	18	3	
Hyla femoralis	Pine woods treefrog	78	24	42	29	2	1
Hyla squirella	Squirrel treefrog	24	20	14	13	2	
Osteopilus septentrionalis	Cuban treefrog [a]		1	1			1
Pseudacris ocularis	Little grass frog	4	3	3			
Rana clamitans	Bronze frog		1				
Rana gryllio	Pig frog			6			
Rana sphenocephala	Southern leopard frog	83	3	38	2	1	
Total number of individuals (abundance)		609	100	175	80	21	2
Total number of species (richness)		9	12	12	7	6	2

Note:

[a] Denotes exotic species

* For comparison purposes across sites and years, a controlled capture technique is used (drift fence only). Only those individual numbers captured by the drift-fence arrays are included in the individual capture totals.

Reproductive Success

No frog calling of any kind was heard at Bennett Swamp in 2008. No larval amphibians were encountered. No evidence of amphibian reproduction was recorded for Bennett Swamp in 2008. These observations were probably the result of a combination of shortened sampling year and persistent, dry conditions in the swamp basin. Rainfall was average for the four-month sampling period; however, it was inadequate for amphibian breeding activity (Means and Meegan 2008).

RESULTS - THAYER CANAL TRANSECT

TOPOGRAPHIC SURVEY

A survey of the topographic relief along the Thayer Canal transect was performed by surveyors on January 2, 2001 (Figures 9 and 10). The transect is situated so the upland end has an elevation of 28.4 feet NAVD88 (29.5 feet NGVD29) and is at the edge of the wetland. The lowest spot along the transect (25.4 feet NAVD88 [30.6 feet NGVD29]) is near the wetland monitoring well and staff gauge, approximately 140 meters from the upland end. The average elevation of the wetland, 27.2 feet NAVD88 (28.3 feet NGVD29), was estimated by averaging all the measurement points shown in Figure 10 plus the natural ground at the recorders and staff gauges. The Thayer Canal Transect drops approximately 3.0 feet in elevation over its length (140 meters).

Figure 9. Thayer Canal Transect, Bennett Swamp, March 2004

PHOTO STATIONS

Photos were taken of the Thayer Canal Transect in Bennett Swamp on three events during the baseline period and nine events during the five operational periods. Photos were taken from the center of the 5-meter by 5-meter shrub plots and are included with this final report.

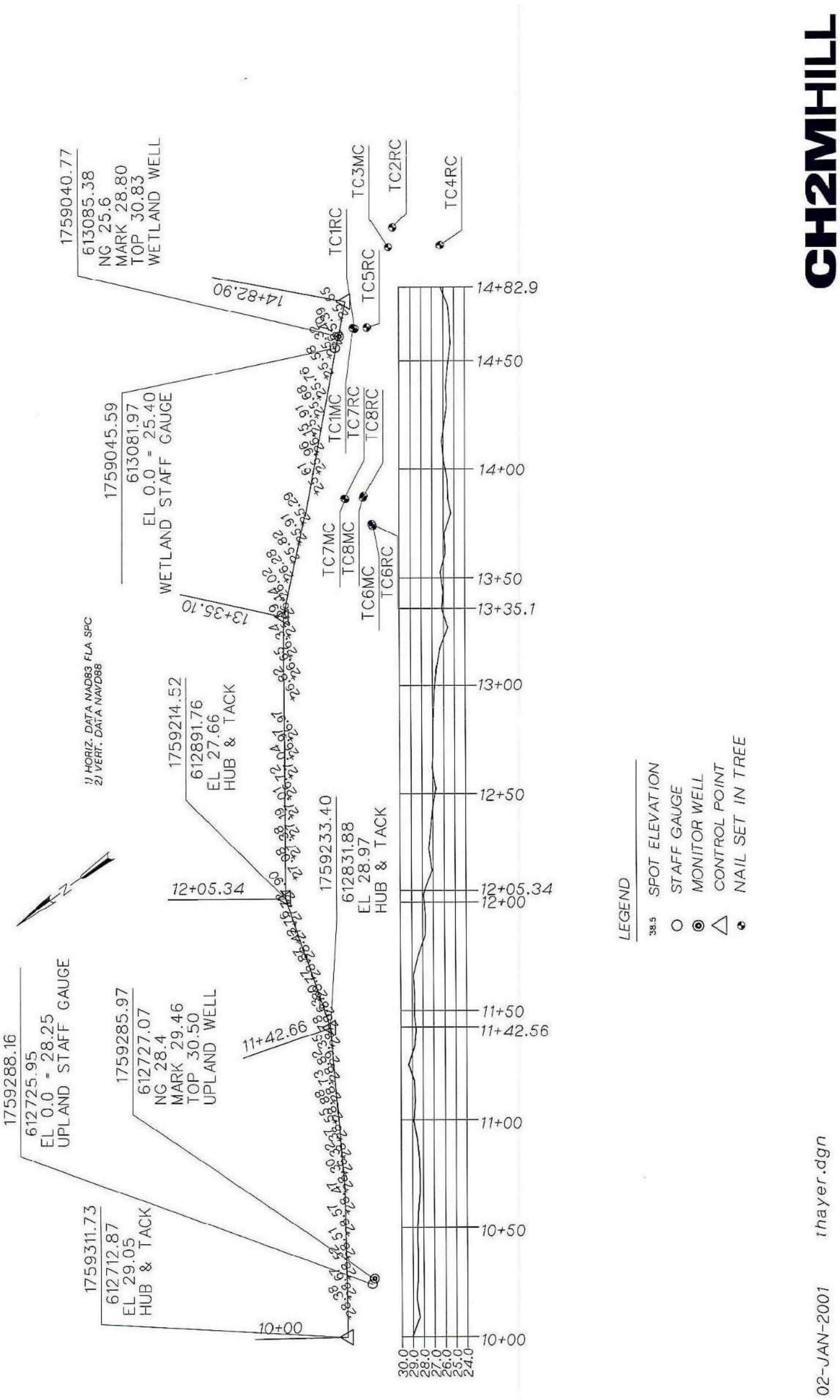


Figure 10. Thayer Canal transect topographic survey (elevations in NAVD88)

GENERAL WILDLIFE OBSERVED

Wildlife within the wetland and using adjacent upland areas were recorded when observed during sampling events. Wildlife observations included green treefrog (*Hyla cinerea*), green anole (*Anoles carolinensis*), pygmy rattlesnake (*Sistrurus miliarius*), red-shouldered hawk (*Buteo lineatus*), osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), northern parula (*Parula americana*), pileated woodpecker (*Dryocopus pileatus*), red-bellied woodpecker (*Melanerpes carolinus*), American robin (*Turdus migratorius*), great egret (*Ardea alba*), and little blue heron (*Egretta caerulea*). Florida black bear (*Ursus americanus floridanus*) scat was observed on the access road near the Thayer Canal Transect on several occasions.

SURFACE WATER ELEVATIONS

Daily Water-Level Elevations

Figure 11 depicts water levels as recorded by upland and wetland data loggers associated with piezometers for the baseline and operational periods. Water-elevation monitoring was initiated in February 2000 and data loggers were set to read on a 6-hour interval. However, several episodes of equipment malfunctions, vandalism, and access limitations resulted in significant data gaps at both upland and wetland ends of the transect. On two occasions, the upland recorder had been removed from the well but not damaged; it was reinstalled each time. The wetland recorder was destroyed and replaced on two separate occasions.

After the 2004 hurricane season, high water and downed trees prevented access to the transect and delayed data downloading from the data loggers. The Thayer Canal Transect was successfully accessed in January 2005, at which time it was discovered that the wetland data logger was missing while the upland recorder was intact. The wetland data logger was replaced in March 2005. During the second operational period, 7 of the 12 months of data were available from the wetland recorder for analysis. These data were supplemented with the City of Daytona Beach water-level data from a nearby station in Thayer Canal. A regression analysis was used to compare the water-level data from the City's recorder with the Thayer Canal Transect data. A strong positive correlation (0.979 r-square) was found when the water was above 22.55 feet NAVD88 (23.68 feet NGVD29), which occurred between August 10, 2004, and February 12, 2005. This captured some of the missing data from the wetter months. Additionally, changes in the frequency of data collection influence the median values for the periods; and because of a small data set, mean values were deemed more accurate than median.

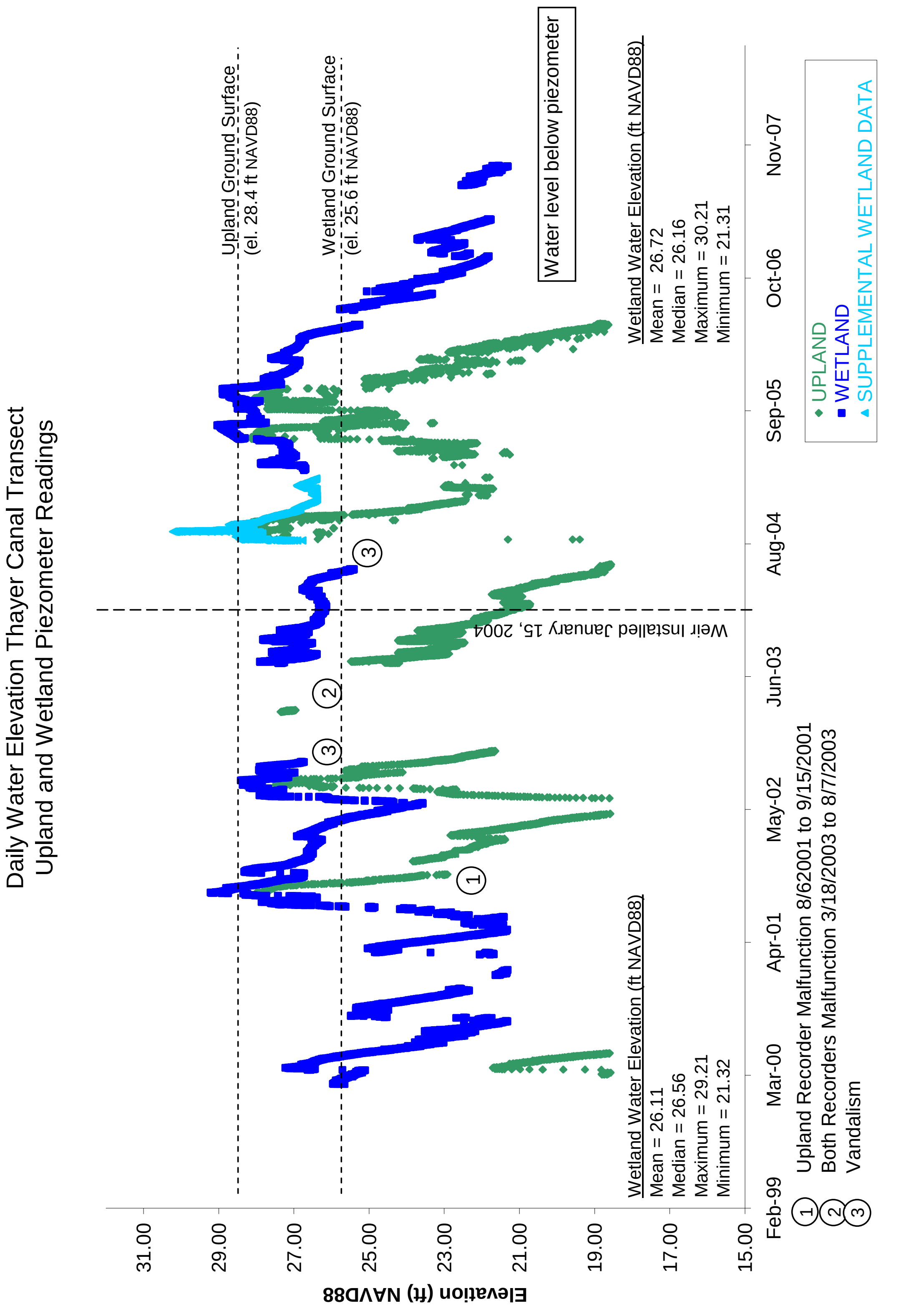


Figure 11. Daily water-level elevations (NAVD88) at Thayer Canal Transect

Since the initial setup of the project through the operational period, the type of water level recorders available has changed. Ultrasonic recorders were used during the baseline period; and this technology was replaced by pressure transducer-type recorders during the operational period. When groundwater fell below the level of the well (21.31 feet NAVD88 [22.44 feet NGVD29]), the ultrasonic recorders would record a “reading” at the bottom of the well; whereas, the pressure transducer recorders do not record this bottom elevation. When averaging the water level data, bottom of the well readings would skew the data toward a higher mean. Basic statistics for daily water-level elevations, with the supplemental data included, are presented in Figure 11. To compare the baseline data accurately to operational data, metrics calculated (mean, median, maximum, and minimum) do not include any values below 21.31 feet NAVD88 (22.44 feet NGVD29). Water levels fell below the bottom of the wetland piezometer from September 2007 through April 2008.

Data show that the mean daily water elevation at the wetland recorder during the operational period (26.72 feet NAVD88 [27.85 feet NGVD29]) was 0.61 foot greater than during the baseline period (26.11 feet NAVD88 [27.24 feet NGVD29]).

Percent Exceedence Level

The percent exceedence curve (amount of time the water is above each elevation) from both the baseline and operational periods is shown in Figure 12. Water levels were above the wetland surface 73% of the time during the 55-month operational period. During the baseline monitoring, water levels were above the wetland surface 76% of the 47-month period.

Figure 12 shows that both baseline and operational period exceedence curves were above the ground surface and the 26.4-foot NAVD88 (27.5-foot NGVD29) target modeled historical level at the 50% exceedence. However, both periods were below the historical soil-estimated curve (27.2 feet NAVD88 (28.3 feet NGVD29]) at the 50% exceedence level (Figure 8). Water levels during the baseline period were above the target modeled historical level by approximately 0.20 foot and below the historical soil-estimated level by approximately 0.60 foot. The operational period was, at 26.7 feet (NAVD88 [27.8 feet NGVD29]) at the 50% exceedence, slightly greater than the baseline period, and above the target level by approximately 0.30 foot. Water levels during the operational period were approximately 0.50 foot below the historical soil-estimated level at the 50% exceedence level. Exceedence values were similar between the baseline and operational periods at the weir elevation (26.4 feet NAVD88 [27.5 feet NGVD29]).

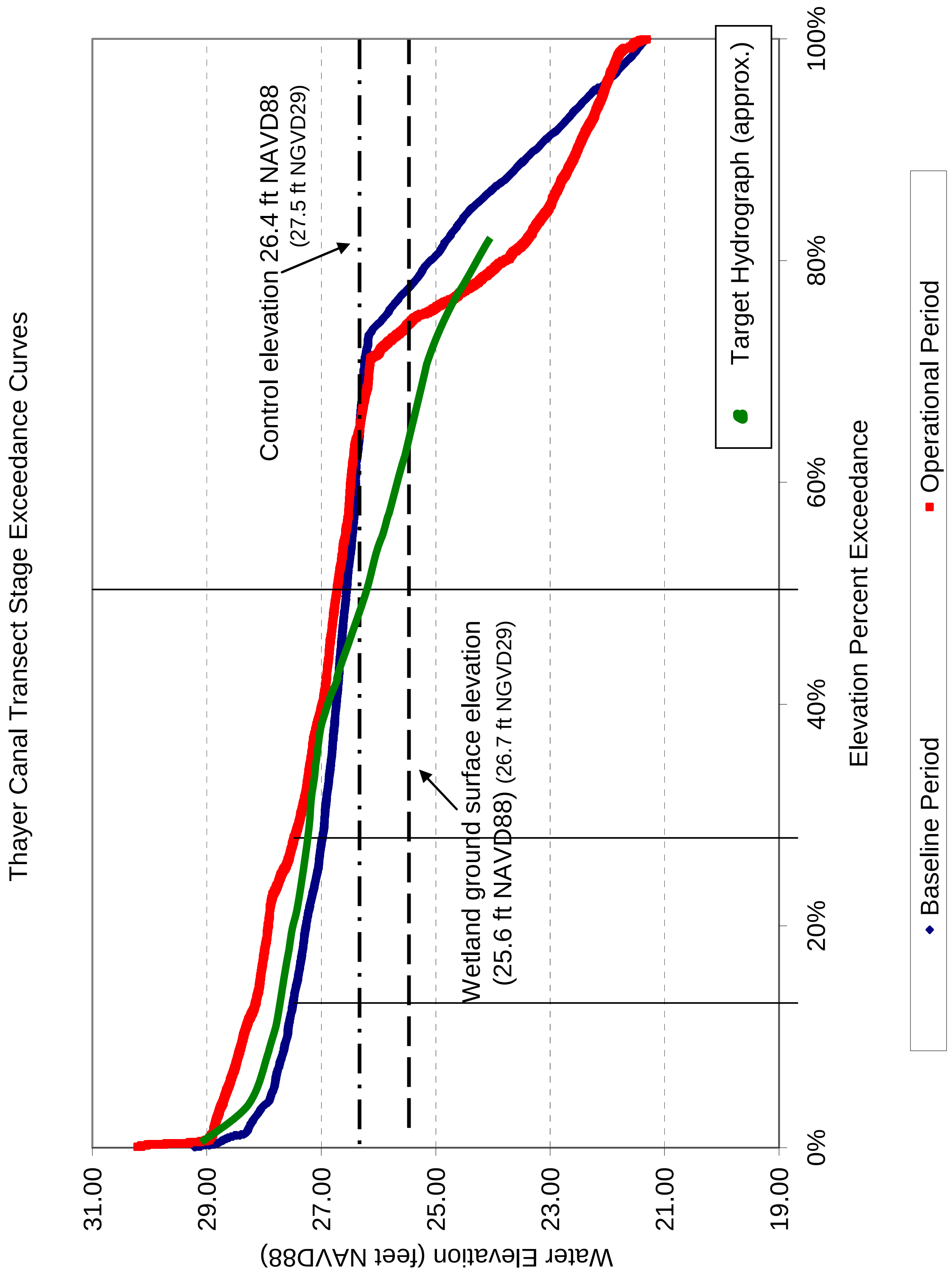


Figure 12. Stage-exceedence curves – Thayer Canal Transect

Exceedence value calculations however are considered somewhat elevated above actual values because many of the low water level elevations are absent from the data set; some due to water levels being below the bottom of the piezometers and some lost due to vandalism or storm damage to the recorders.

The stage curve for the operational period is higher compared to baseline period for water elevations greater than 26.5 feet NAVD88 (27.6 feet NGVD29). The weir setting at 26.4 feet NAVD88 (27.5 feet NGVD29) is just below the elevation where the baseline and operational period exceedence curves begin to diverge. Results above this point are most likely from floodwaters from the 2004 and 2005 hurricane seasons, which overtopped the weir during the operational period. Below an elevation of 26.5 feet NAVD88 (27.6 feet NGVD29) the baseline period exceedence curve is higher than the operational period indicating that the weir had little effect on water levels at the Thayer Canal wetland piezometer.

Based on the target modeled historical levels, the stage at the wetland well should be exceeded 58% of the time once historical conditions are restored. Based on the historical soil-estimated levels, the stage at the wetland well should be exceeded 80% of the time. The soil-estimated historical curve is a predicted water level based on these measured water level indicators. For Bennett Swamp, this curve is shown in Figure 8, previously presented. Although some oxidation of the organic soils has occurred in recent decades, the thickness of the surficial organic horizon along a gradient of water depth still exceeded 1 foot. Enough of the soils remain to find, interpret, and measure the physical evidence of the water-level indicators still present in the soil profile. With regular inundation and enough time, the organic matter will accumulate again and the soil elevation will slowly return to historical levels.

Average Monthly Water-Level Elevations

Average monthly baseline (25.49 feet NAVD88 [26.62 feet NGVD29]) and operational period (25.78 feet NAVD88 [26.91 feet NGVD29]) water elevations differed by a mean value of 0.29 foot (Table 5). Median monthly baseline (26.20 feet NAVD88 [27.33 feet NGVD29]) and operational period (26.59 feet NAVD88 [27.72 feet NGVD29]) water levels differed by a value of 0.39 foot. Average water-level elevations during the operational period were greater than in the baseline period for 6 out of 12 months. Differences in mean water levels between operational and baseline months were greatest during May and June events. Water levels fell below the bottom of the wetland piezometer from September 2007 through April 2008.

Table 5. Average groundwater elevations by month for baseline and operational period, February 2000 through April 2008 – Thayer Canal Transect

	Groundwater Elevation (feet NAVD88)								
	Baseline Period				Operational Period				
Month	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Jan		21.45 ± 0.09	26.57 ± 0.04	[a]--	26.16 ± 0.04	26.67[d] ± 0.17	26.98 ± 0.09	22.83 ± 0.20	[b]--
Feb	25.83 ± 0.07	[b]--	26.40 ± 0.07	[a]--	26.32 ± 0.02	26.54[ad] ± 0.08	27.27 ± 0.19	23.30 ± 0.28	[b]--
Mar	25.48 ± 0.28	23.61 ± 1.31	26.56 ± 0.18	[a]--	26.59 ± 0.09	26.98[a] ± 0.42	26.95 ± 0.12	22.36 ± 0.27	[b]--
Apr	26.64 ± 0.23	24.04 ± 0.60	25.91 ± 0.22	[a]--	26.33 ± 0.11	27.29 ± 0.23	26.66 ± 0.16	21.83 ± 0.03	[b]--
May	25.43 ± 0.56	22.07 ± 0.49	24.77 ± 0.39	[a]--	25.72 ± 0.24	27.22 ± 0.06	25.75 ± 0.29	[b]--	[c]--
Jun	23.61 ± 0.38	21.91 ± 0.27	24.74 ± 0.96	[a]--	[a]--	28.17 ± 0.50	[b]--	[b]--	[c]--
Jul	22.82 ± 0.38	23.01 ± 0.81	27.65 ± 0.35	[a]--	[a]--	28.70 ± 0.28	25.17 ± 0.28	22.21 ± 0.14	[c]--
Aug	21.98 ± 0.38	26.73 ± 0.88	27.95 ± 0.35	27.09 ± 0.42	27.96[ad] ± 0.23	28.01 ± 0.05	24.03 ± 0.39	21.95 ± 0.21	[c]--
Sep	24.50 ± 1.05	28.25 ± 0.83	27.63 ± 0.27	26.96 ± 0.32	28.50[d] ± 0.53	28.27 ± 0.14	24.23 ± 0.29	21.59 ± 0.17	[c]--
Oct	24.55 ± 0.52	27.72 ± 0.50	27.17[a] ± 0.35	27.13 ± 0.40	27.74[d] ± 0.27	28.55 ± 0.26	23.03 ± 0.29	[b]--	[c]--
Nov	22.90 ± 0.36	27.52 ± 0.67	[a]--	26.85 ± 0.27	26.89[d] ± 0.15	28.19 ± 0.57	22.38 ± 0.24	[b]--	[c]--
Dec	[a]--	27.01 ± 0.31	[a]--	26.36 ± 0.05	26.48[d] ± 0.06	27.48 ± 0.17	22.42 ± 0.55	[b]--	[c]--
Mean	**25.49**				**25.78**				
Median	**26.20**				**26.59**				

Note:

[a]-- Data not available or less than a full month of data due to equipment malfunction or vandalism
[b]-- Data not available. Water below bottom of piezometer
[c]-- end of study
[d]-- Supplemental data provided by the City of Daytona Beach water-level station in Thayer Canal

WATER QUALITY

Water quality sampling was conducted twice during the baseline period (October 2001 and April 2002), twice during the first operational period (March 2004 and January 2005), twice during the second operational period (March 2005 and September 2005), and once during the third operational period (March 2006). Surface water at the Thayer Canal Transect was not available during the September 2006, April 2007, September 2007, or April 2008 sampling events. Copies of the laboratory reports and detection limits from the operational and baseline periods are included in Appendix C. Water quality parameter values from the Thayer Canal Transect were similar to those reported from the other monitoring transects during the baseline period, which are described in the Results section for each transect.

The measured water quality parameter values identified during the baseline were similar to the values measured in the operational periods (Table 6).

Table 6. Water quality summary – Thayer Canal Transect

Parameter	Unit	Baseline Period		Operational Period								
		Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006	Apr 2007	Sep 2007	Apr 2008
Dissolved oxygen [a]	mg/L	0.72	3.86	1.53	3.60	1.10	1.37	3.47	--	--	--	--
Temperature [a]	°C	22.7	25.1	14.7	16.09	15.9	23.0	17.5	--	--	--	--
ph [a]	units	3.87	3.81	3.83	3.88	3.91	3.89	3.76	--	--	--	--
Conductivity	µmhos/cm	86	120	90	142	90	63	65	--	--	--	--
Color	units	750	500	450	380	400	600	300	--	--	--	--
Alkalinity as $CaCO_3$	mg/L	U	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--
TSS	mg/L	8	*	7.6	2.0	8.8	2.0	<2.0	--	--	--	--
TDS	mg/L	200	190	120	150	120	37	82	--	--	--	--
Ammonia – N	mg/L	0.48	0.80	0.16	0.52	<0.026	0.13	0.035	--	--	--	--
Total Kjeldahl – N	mg/L	2.1	1.7	1.4	1.6	0.91	1.5	1.3	--	--	--	--
Nitrate + nitrite - N	mg/L	U	< 0.2	<0.027	<0.027	<0.027	<0.027	0.027	--	--	--	--
Total nitrogen	mg/L	2.58	1.8	1.41	1.61	0.92	1.51	1.335	--	--	--	--
Total phosphorus-P	mg/L	0.012	0.032	0.15	<0.043	<0.043	<0.043	<0.043	--	--	--	--
Ortho-phosphate-P	mg/L	U	0.013	<0.013	<0.058	0.013	0.065	<0.013	--	--	--	--

Note:
[a] Measurement taken in field
* Analysis missed
-- Surface water not present at transect during sampling event
U – Undetectable
µmhos/cm – microhmos per centimeter

Surface water at the Thayer Canal Transect exhibits water quality typical of northeast Florida (forested, blackwater swamps with low pH, conductivity, nutrients, and total dissolved solids). Color was also high but typical of Florida wetlands where water has been colored by dissolved organic material resulting from the breakdown of plant detritus within the watershed (Kadlec and Knight 1996). Also typical of these wetland systems is low dissolved oxygen, less than 5 milligrams per liter (mg/L). High inputs of organic matter coupled with long hydraulic residence times create oxygen deficits from the metabolism of microorganisms in wetlands (Mitsch and Gosselink 1993).

SOILS

Soil profiles were characterized from two locations, the upland transitional zone and the wetland center, along the main transect during the baseline period. Each soil characterization pit was limited to a depth of approximately 90 centimeters (35.4 inches) or to the groundwater table and was excavated using a shovel or soil auger. Subsamples were collected from upland and wetland soil horizons for future chemical or physical analyses if needed. A soil profile description (USDA-SCS 1980) along the main transect is included in this section.

The soil characterization pits were dug approximately 20 meters from the beginning and end of the main transect. Groundwater was only observed in the wetland soil pit at a depth of 18 inches from the soil surface.

Upland Soil

Horizon (Depth)	Description
A (0-4 inches):	Very dark gray (10YR3/1) sand with 30% organic matter coated sand grains
E (4-17 inches):	Light gray (10YR7/2) sand
E/B (17-22 inches):	Very dark brown (10YR2/2) sand with 50% organic matter coated sand grains; few fine and medium friable organic matter masses
Bh1 (22-34 inches):	Very dark brown (10YR2/2) sand
Bh2 (34>37 inches):	Dark reddish-brown (5YR2.5/2) sand

Wetland Soil

Horizon (Depth)	Description
Oa (0-18 inches):	Black (10YR2/1) mucky organic soil; charcoal masses present from 0 to 7 inches

VEGETATION

A total of 30 plant species were identified during the baseline period and 25 during the fifth operational period (Table 7). A total of 42 plant species have been identified at the Thayer Canal Transect throughout the entire monitoring period. Twenty-nine of the species were recorded during both the baseline and operational periods. For the purpose of this annual report, herbaceous vegetation data from the fifth operational period are compared to the last year of baseline data (October 2001 and April 2002). These baseline events reflect the conditions of the vegetation in Bennett Swamp just prior to installation of the weir in January 2004.

Shrub and tree monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub and tree monitoring events were conducted at the end of the fourth period, in September 2007. (CH2M HILL 2008) Data from that event is retained in this report for comparison purposes. Detailed data tables for all periods are provided in Appendix D.

Herbaceous Groundcover

One-Square-Meter Plots

Results of the observations of herbaceous groundcover within the 21 plots of 1 square meter for the fifth operational period are presented in Table 8.

During the baseline period, diversity within the plots ranged from zero to six species. Diversity was greater during spring events than during fall events. Percent cover varied between the upland and wetland ends of the transect, and no significant relationship to diversity or cover was observed concerning transect elevation. Fetterbush (*Lyonia lucida)* was the most common groundcover species encountered along all three belts at the Thayer Canal Transect and accounted for an average of 59% of the total relative cover across the baseline monitoring events. Fetterbush is a common shrub species within Bennett Swamp and is considered part of the herbaceous stratum until it grows taller than 0.3 meter.

Table 7. Vegetative species observed at the Thayer Canal Transect

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period			Operational Period								
				May 00	Oct 01	Apr 02	Mar 04	Jan 05	Mar 05	Sep 05	Mar 06	Sep 06	Apr 07	Sep 07	Mar 08
Blue maidencane	*Amphicarpum muhlenbergianum*	Herb	FACW	X	X	X					X	X	X	X	
Broomsedge	*Andropogon virginicus*	Herb	FAC		X	X	X	X			X	X	X	X	X
Swamp fern	*Blechnum serrulatum*	Herb	FACW					X				X		X	
Coinwort	*Centella asiatica*	Herb	FACW	X	X	X									
Buttonbush	*Cephalanthus occidentalis*	Shrub	OBL										X	X	
Sawgrass	*Cladium jamaicense*	Herb	OBL			X	X	X	X	X	X	X			
Three-way sedge	*Dulichium arundinaceum*	Herb	OBL	X	X	X	X	X			X	X	X		
Dogfennel	*Eupatorium capillifolium*	Herb	FAC-FACU								X	X	X	X	X
Loblolly bay	*Gordonia lasianthus*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Dahoon holly	*Ilex cassine*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Virginia willow	*Itea virginica*	Herb	OBL	X	X	X			X	X	X	X	X	X	
Lesser creeping rush	*Juncus repens*	Herb	OBL								X	X			
Redroot	*Lachnanthes caroliana*	Herb	FAC	X	X	X			X	X	X	X	X	X	X
Winged primrosewillow	*Ludwigia alata*	Herb	OBL	X	X	X					X	X	X	X	X
Japanese climbing fern	*Lygodium japonicum*	Vine	FAC										X	X	X
Fetterbush	*Lyonia lucida*	Shrub	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Sweetbay	*Magnolia virginiana*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Wax-myrtle	*Myrica cerifera*	Shrub	FAC	X	X	X	X	X	X	X	X	X	X	X	X
Blackgum	*Nyssa sylvatica*	Tree	OBL						X			X	X	X	X
Cinnamon fern	*Osmunda cinnamomea*	Herb	FACW			X	X					X			
Cypress witchgrass	*Panicum ensifolium*	Herb	OBL-FAC								X	X		X	X
Maidencane	*Panicum hemitomon*	Herb	OBL	X	X	X	X	X		X	X	X	X	X	X
Savannah panicum	*Panicum gymnocarpum*	Herb	OBL											X	
Maidencane	*Panicum spp.*	Herb	OBL-FAC	X	X	X						X		X	

Table 7— *Continued*

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period			Operational Period								
				May 00	Oct 01	Apr 02	Mar 04	Jan 05	Mar 05	Sep 05	Mar 06	Sep 06	Apr 07	Sep 07	Mar 08
Swamp bay	*Persea palustris*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Slash pine	*Pinus elliottii*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Loblolly pine	*Pinus taeda*	Tree	FAC	X	X	X	X	X	X	X	X	X	X	X	X
Camphorweed (rosy)	*Pluchea rosea*	Herb	FACW								X	X	X	X	X
Laurel oak	*Quercus laurifolia*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Blackberry	*Rubus sp.*	Herb	UP-FACW												X
Beaksedge	*Rhynchospora spp.*	Herb	UP-OBL								X	X	X	X	
Cabbage palm	*Sabal palmetto*	Tree	FAC	X	X	X	X	X	X	X	X	X			
Laurel greenbriar	*Smilax laurifolia*	Vine	FACW	X	X	X	X		X	X	X	X			
Sphagnum moss	*Sphagnum*	Herb	OBL	X	X	X		X	X	X		X	X		
Bald cypress	*Taxodium distichum*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Poison ivy	*Toxicodendron radicans*	Herb	FAC	X	X	X	X	X	X	X	X	X	X	X	X
Va. St. John's-Wort	*Triadenum virginicum*	Herb	OBL	X	X	X									X
Cattail, Southern	*Typha domingensis*	Herb	OBL				X	X	X	X					
Highbush blueberry	*Vaccinium corymbosum*	Shrub	FACW				X	X	X	X	X	X			
Muscadine grape	*Vitis rotundifolia*	Vine	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Virginia chain fern	*Woodwardia virginica*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-eyed grass	*Xyris spp.*	Herb	OBL-FACW	X	X	X	X				X	X	X	X	X

Note:

Indicator: UPL = plant almost always occurs in uplands; OBL = plant almost always occurs in wetlands;
FAC = plant equally likely to occur in wetlands 34 to 66% of the time;
FACW = plant usually occurs in wetlands 67 to 99% of the time; NI = no indicator given;
FACU = plant usually occurs in uplands 67 to 99% of the time

[1] Federal indicator, No state indicator given.
Spring event is usually conducted in March and fall in September unless hazardous weather conditions cause the event to be postponed until conditions are safe for field data collection.

Table 8. Summary of herbaceous groundcover in square-meter plots - Thayer Canal Transect

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
October 2001 – Baseline Period									
Andropogon virginicus						8.33		1.19	4.27
Gordonia lasianthus				0.33				0.05	0.17
Lyonia lucida		85.00	31.00	8.00	2.00			18.00	64.51
mosses				1.00				0.14	0.51
Persea palustris		1.00	2.33					0.48	1.71
Upland Grasses	48.33							6.90	24.74
Vitis rotundifolia		2.67	0.67					0.48	1.71
Woodwardia virginica	1.67	0.33	1.67		1.00			0.67	2.39
Total	**50.00**	**89.00**	**35.67**	**9.33**	**3.00**	**8.33**	**0.00**	**27.90**	**100.00**
April 2002 – Baseline Period									
Amphicarpum muhlenbergianum	4.00	0.33						0.62	3.27
Cladium jamaicense							1.67	0.24	1.26
Ludwigia alata						0.33		0.05	0.25
Lyonia lucida		41.67	21.67	5.00	1.67			10.00	52.77
mosses			2.33	6.67	5.00	1.67	2.67	2.62	13.82
Osmunda cinnamomea			0.33				0.33	0.10	0.50
Persea palustris			5.00					0.71	3.77
Toxicodendron radicans						0.33		0.05	0.25
Unknown Grass	1.00							0.14	0.75
Unknown Grass 2	1.00							0.14	0.75
Unknown seedling				0.33	4.00		1.00	0.76	4.02
Vitis rotundifolia		0.67	1.67		0.33			0.29	1.51
Woodwardia virginica	1.00	0.67	0.67	1.67	3.33	1.67	6.67	2.24	11.81
Xyris sp.						0.33	6.67	1.00	5.28
Total	**7.00**	**43.34**	**31.67**	**13.67**	**14.33**	**13.67**	**19.00**	**18.95**	**100.00**
April 2008 – Operational Period 5									
Andropogon virginicus						5.00		0.71	8.29
Eupatorium capillifolium						0.33	1.33	0.24	2.76
Gordonia lasianthus		0.33	0.33	0.33		0.67	0.67	0.33	3.87
Grass sp.							0.67	0.10	1.10
Lygodium japonicum						0.67	35.00	5.10	59.12
Lyonia lucida		0.67	0.67	0.67		0.33		0.33	3.87
Mosses				1.67	0.33	2.67		0.67	7.73

Table 8 — *Continued*

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
Panicum ensifolium						0.67		0.10	1.10
Panicum hemitomon	0.67							0.10	1.10
Persea palustris	0.33	0.33	0.33		0.33	0.33		0.24	2.76
Pluchea rosea						0.33		0.05	0.55
Rubus sp.							0.33	0.05	0.55
Toxicodendron radicans		0.33			0.33		0.33	0.14	1.66
Triadenum virginicum							0.67	0.10	1.10
Vitis rotundifolia		1.00	0.67					0.24	2.76
Woodwardia virginica			0.33		0.67			0.14	1.66
Total	**1.00**	**2.67**	**2.33**	**2.67**	**1.67**	**11.00**	**39.00**	**8.62**	**100.00**

Percent cover was less during the fifth operational period than during the baseline period, but species diversity was slightly greater. During the fifth operational period, the plots had a diversity of zero to six species each, with seven to 11 species along each belt. During the March 2008 event, Plots 6 and 7 recorded the greatest percent cover. Surface water was absent from the Thayer Canal Transect during 2007/2008. Japanese climbing fern (*Lygodium japonicum)* was the most abundant species in the groundcover plots with 59.12 relative percent cover. Broomsedge (*Andropogon virginicus*) and moss were also prevalent, with 8.29% and 7.73% relative cover, respectively.

Japanese climbing fern, a non-native species, occurred along the transect for the first time in April 2007. This species is classified as a Category I Invasive on the Florida Exotic Pest Council's 1999 List of Florida's Most Invasive Species. Category I is defined as species that are invading and disrupting native plant communities in Florida (*Atlas of Florida Vascular Plants* 2000). Japanese climbing fern has increased in percent cover near the wetland end of the monitoring transect since it was first observed in April 2007.

Belt Transects (1-Meter-Wide) Target Species

The species composition along the three 1-meter-wide belt transects was not diverse enough to meet the nine-species goal during initial baseline observations. Rather, three obligate and three facultative species in the herbaceous stratum were found along the transects.

The occurrence of the six target species along the belt transect was recorded as the linear distance covered by a species within five intervals along the belt.

Presence / absence information for each sampling event is provided in Table 9. As shown in Table 9, not all obligate or facultative species have been present during all monitoring events along the belt transect.

Table 9. Presence/absence of indicator herbaceous species along belt transect – Thayer Canal Transect

Species Name	Baseline Period			Operational Period								
	May 2000	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006	Apr 2007	Sep 2007	Mar 2008
Obligate (OBL)												
Ludwigia alata	X								X	X	X	X
Panicum hemitomon	X			X	X		X	X	X	X	X	X
Xyris sp.	X			X					X	X	X	X
Facultative (FAC)												
Lachnanthes caroliana	X		X			X	X	X	X	X	X	X
Toxicodendron radicans	X	X	X	X	X	X		X	X	X	X	X
Vitis rotundifolia	X	X	X	X	X	X	X	X	X	X	X	X

The results of the line-intercept observations for the baseline and fifth operational period are presented in Table 10. The percent cover of target herbaceous species was lower during the fifth operational period compared to baseline events. All target species were recorded along the transect during March 2008. The frequency of occurrence of the target species was slightly greater during the fifth operational period compared to baseline events. Facultative wetland species dominated the herbaceous layer during both the baseline and fifth operational periods. Obligate species were notably absent during the baseline period but were present, although not predominant, during 2008 operational period.

The greatest importance value during both events of the baseline period was reported for the target facultative plant muscadine grape. However, the relationship between the percent cover and frequency of muscadine grape is not likely to correlate with increased water levels because it is a vine and occurs in the wetland canopy. During the March 2008 event, muscadine grape had the greatest importance value along the Thayer Canal Transect followed by poison ivy (49.08 and 23.61, respectively). During the March 2008 event, no standing water was present at any location along the transect, and percent cover plots were not inundated. Detailed herbaceous line-intercept data are presented in Appendix D.

Table 10. Summary of herbaceous groundcover belt transects for target species – Thayer Canal Transect

Species	Indicator	Mean Linear Distance (meters) Belt Transect Zone A	B	C	D	E	Total Mean Linear Distance (m)	Mean Percent Cover Absolute	Mean Percent Cover Relative	Mean Frequency Absolute	Mean Frequency Relative	Importance Value (Percent)
October 2001 – Baseline Period												
Toxicodendron radicans	FAC	0.01				0.50	0.51	0.36	11.08	0.13	25.00	18.04
Vitis rotundifolia	FAC	0.90	0.08	0.08	3.01		4.07	2.90	88.92	0.40	75.00	81.96
Total		**0.91**	**0.08**	**0.08**	**3.01**	**0.50**	**4.57**	**3.27**	**100.00**	**0.53**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	0.91	0.08	0.08	3.01	0.50	4.57	3.27	100.00	0.53	100.00	100.00
	OBL						0.00		0.00		0.00	0.00
Total		**0.91**	**0.08**	**0.08**	**3.01**	**0.50**	**4.57**	**3.27**	**100.00**	**0.53**	**100.00**	**100.00**
April 2002 – Baseline Period												
Lachnanthes caroliana	FAC	0.05	0.23	0.28	0.13	1.93	2.62	1.87	15.88	0.53	44.44	30.16
Toxicodendron radicans	FAC	0.42					0.42	0.30	2.55	0.07	5.56	4.05
Vitis rotundifolia	FAC	4.49	7.79	0.57	0.59		13.44	9.60	81.57	0.60	50.00	65.78
Total		**4.96**	**8.03**	**0.85**	**0.72**	**1.93**	**16.48**	**11.77**	**100.00**	**1.20**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	4.96	8.03	0.85	0.72	1.93	16.48	11.77	100.00	1.20	100.00	100.00
	OBL						0.00		0.00		0.00	0.00
Total		**4.96**	**8.03**	**0.85**	**0.72**	**1.93**	**16.48**	**11.77**	**100.00**	**1.20**	**100.00**	**100.00**
March 2008 - Operational Period 5												
Lachnanthes caroliana	FAC	0.22					0.22	0.16	11.41	0.13	8.70	10.05
Ludwigia alata	OBL				0.04		0.04	0.03	2.04	0.07	4.35	3.20
Panicum hemitomon	OBL				0.03	0.06	0.10	0.07	4.94	0.13	8.70	6.82
Toxicodendron radicans	FAC	0.08	0.03	0.03	0.01	0.10	0.24	0.17	12.44	0.53	34.78	23.61

Table 10 — *Continued*

Species	Indicator	Mean Linear Distance (meters)					Total Mean Linear Distance (m)	Mean Percent Cover		Mean Frequency		Importance Value (Percent)
		Belt Transect Zone										
		A	B	C	D	E		Absolute	Relative	Absolute	Relative	
Vitis rotundifolia	FAC	0.42	0.78		0.03	0.01	1.24	0.89	63.37	0.53	34.78	49.08
Xyris sp.	OBL					0.11	0.11	0.08	5.79	0.13	8.70	7.24
Total		**0.71**	**0.81**	**0.03**	**0.11**	**0.29**	**1.96**	**1.40**	**100.00**	**1.53**	**100.00**	**100.00**
Summary	UPL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FAC	0.50	0.81	0.03	0.08	0.11	1.52	1.22	87.22	1.20	78.26	82.74
	OBL	0.22	0.00	0.00	0.03	0.18	0.43	0.18	12.78	0.33	21.74	17.26
Total		**0.71**	**0.81**	**0.03**	**0.11**	**0.29**	**1.96**	**1.40**	**100.00**	**1.53**	**100.00**	**100.00**

Shrubs/Sapling Community

For the purpose of data analysis and discussion, the canopy species were subdivided into three size classes:

- Shrub/sapling <2.5 centimeters dbh and > 0.3 meter tall
- Subcanopy ≥2.5 centimeters to < 10.0 centimeters dbh
- Canopy ≥10.0 centimeters dbh

Shrub/sapling sampling is conducted annually in the fall in conjunction with canopy/ subcanopy sampling. Data were collected twice during the baseline (September 2000 and October 2001) and four times during operational period (January 2005, and September 2005, 2006, and 2007). Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period. Data from that event is presented for comparison purposes.

25-Square-Meter Shrub/Sapling Plots

Seven shrub species were identified in the 25-square-meter shrub plots during the baseline period. Shrub Plot A (near the upland edge) recorded the highest percent cover during baseline period, and was dominated by loblolly bay (*Gordonia lasianthus*) and fetterbush. Percent cover of shrub species decreased in shrub plots B and C, farther into the wetland (Table 11).

Ten shrub species were identified in the 25-square-meter shrub plots in the operational period, seven of which were previously identified during the baseline period. Shrub Plot C (in the wetland end) recorded the highest percent cover during operational period and was dominated by fetterbush. Shrub Plots A, B, and C have been dominated by the same respective species since the baseline period surveys; loblolly bay (Plot A) and fetterbush (Plots B and C).

Table 11. Shrub/sapling 25-square-meter plot (5-meter by 5-meter) – Thayer Canal Transect

Shrub Plot	Scientific Name	Percent Cover					
		Baseline Period		Operational Period			
		Sep 2000	Oct 2001	Jan 2005	Sep 2005	Sep 2006	Sep 2007*
A	*Gordonia lasianthus*	50	30	10	32	16	12
	Lyonia lucida	50	15				
	Sabal palmetto		2				
	Persea palustris	2	1	3	3	4	2
	Serenoa repens					2	2
	Plot Total	**102**	**48**	**13**	**35**	**22**	**16**

Table 11 — *Continued*

Shrub Plot	Scientific Name	Percent Cover					
		Baseline Period		Operational Period			
		Sep 2000	Oct 2001	Jan 2005	Sep 2005	Sep 2006	Sep 2007*
B	*Gordonia lasianthus*	5	8	7		1	1
	Lyonia lucida	15	10	4	20	16	9
	Ilex cassine		2	2	3		
	Persea palustris	2	1	1			
	Vaccinium corymbosum			1	4	2	
	Plot Total	**22**	**21**	**15**	**27**	**19**	**10**
C	*Itea virginica*	20	20	5		2	1
	Cephalanthus occidentalis					4	1
	Lyonia lucida	20	8	20	10	20	28
	Persea palustris						1
	Taxodium distichum	1	2	2	12	4	1
	Plot Total	**41**	**30**	**27**	**22**	**30**	**32**

* Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007.

Line-Intercept Analysis

Six shrub species were identified along the 140-meter transect during the baseline monitoring event. Importance value (percent cover and frequency) was dominated by fetterbush (51.01%), followed by loblolly bay (21.86%). Contrary to results from the shrub / sapling plots, percent cover was greatest near the wetland end of the monitoring transect.

Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007 (Table 12). Six shrub species were observed along the shrub / sapling line intercept. The highest importance value was recorded for fetterbush (57.45%), followed by loblolly bay (17.87%) (Table 12).

Table 12. Summary of shrub/sapling line-intercept transect - Thayer Canal Transect

Species	Linear Distance (m)					Total Linear Distance	Percent Cover		Frequency		Importance Value
	A	B	C	D	E		Absolute	Relative	Absolute	Relative	
October 2001 – Baseline Period											
Gordonia lasianthus	4.05	3.45	1.99	0.62	1.02	11.13	7.95	17.41	1.00	26.32	21.86
Lyonia lucida	3.63	12.62	2.41	12.78	16.97	48.41	34.58	75.71	1.00	26.32	51.01
Myrica cerifera	0.50			1.03		1.53	1.09	2.39	0.40	10.53	6.46
Persea palustris	0.39					0.39	0.28	0.61	0.20	5.26	2.94
Smilax laurifolia	0.13	0.38	0.61	0.01	1.25	2.38	1.70	3.72	1.00	26.32	15.02
Vaccinium corymbosum				0.10		0.10	0.07	0.16	0.20	5.26	2.71
Total	**8.70**	**16.45**	**5.01**	**14.54**	**19.24**	**63.94**	**45.67**	**100.00**	**3.80**	**100.00**	**100.00**
September 2007 – Operational Period Year 4*											
Gordonia lasianthus	1.55	1.65	0.53	0.21		3.94	2.81	9.08	0.80	26.67	17.87
Lyonia lucida	7.25	4.64	1.20	11.85	10.47	35.41	25.29	81.57	1.00	33.33	57.45
Magnolia virginiana				0.47		0.47	0.34	1.08	0.20	6.67	3.87
Myrica cerifera	1.60					1.60	1.14	3.69	0.20	6.67	5.18
Persea palustris	0.68	0.45	0.11			1.24	0.89	2.86	0.60	20.00	11.43
Sabal palmetto	0.75					0.75	0.54	1.73	0.20	6.67	4.20
Total	**11.83**	**6.74**	**1.84**	**12.53**	**10.47**	**43.41**	**31.01**	**100.00**	**3.00**	**100.00**	**100.00**

Each Interval is approximately 28 meters. “A” is at the upland end, and “E” is at the deep end of the transect.

* Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007

Canopy/Subcanopy

The canopy and subcanopy strata at Thayer Canal Transect, in September 2007, showed evidence of previous impacts from logging and from current fire suppression. Diversity of tree and shrub species was low. Subcanopy densities were high compared to canopy densities; and most specimens were relatively even in age. Changes to the canopy / subcanopy stratum are slow, and it is expected that the effects from hydrologic restoration will be slow to develop.

The canopy / subcanopy strata were sampled during the fall, twice during baseline (September 2000 and October 2001), and four times during the operational period (January 2005, and September 2005, 2006, and 2007). Because of the shortened fifth operational period, the most recent canopy-monitoring event was at the end of the fourth period, in September 2007.

A total of 166 trees from nine species were tagged during the initial plot setup in September 2000 (Appendix D). For the purpose of this annual report, data collected from the most recent monitoring event, September 2007, were compared to the last baseline event (October 2001). During October 2001 (baseline period), 169 trees were identified within the tree plot. Species composition in the subcanopy and canopy was dominated by loblolly bay and swamp bay. The basal area (or dominance) of the canopy trees was 26.17 square meters per hectare (117.7 square feet per acre), and the density was 750.00 individuals per hectare (303.6 individuals per acre). The basal area of the subcanopy trees was 5.90 square meters per hectare (26.5 square feet per acre), and the density was 2,268 individuals per hectare (918.2 individuals per acre). Detailed data for baseline period canopy and subcanopy measurements are provided in Appendix D.

A total of 127 trees were measured during the fourth operational monitoring period, 42 fewer trees than the maximum recorded (169) in October 2001 (Table 13). The dominance of the canopy during the fourth operational period was 34.24 square meters per hectare (152.48 square feet per acre), and density was 821.43 individuals per hectare (332.43 individuals per acre). The dominance of the subcanopy trees was 5.25 square meters per hectare (23.38 square feet per acre), slightly less than recorded during baseline. The density was also less than the baseline events, with a value recorded of 1,446 individuals per hectare (585.19 individuals per acre).

Table 13. Importance values for canopy and subcanopy – Thayer Canal Transect

Species	No.	Dominance (m^2/ha)	Dominance Relative	Density (#/ha)	Density Relative	Frequency Absolute	Frequency Relative	Importance Value (percent)
October 2001 Baseline Period - Canopy								
Gordonia lasianthus	20	12.43	47.50	357.14	47.62	1.00	29.41	41.51
Ilex cassine	3	0.73	2.79	53.57	7.14	0.20	5.88	5.27
Magnolia virginiana	4	1.60	6.13	71.43	9.52	0.20	5.88	7.18
Nyssa sylvatica	2	0.46	1.76	35.71	4.76	0.20	5.88	4.13
Persea palustris	6	1.33	5.07	107.14	14.29	0.80	23.53	14.29
Pinus elliottii	3	2.43	9.30	53.57	7.14	0.40	11.76	9.40
Pinus taeda	1	0.28	1.08	17.86	2.38	0.20	5.88	3.11
Quercus laurifolia	1	4.73	18.09	17.86	2.38	0.20	5.88	8.78
Taxodium distichum	2	2.17	8.29	35.71	4.76	0.20	5.88	6.31
Total	**42**	**26.17**	**100.00**	**750.00**	**100.00**	**3.40**	**100.00**	**100.00**
October 2001 – Baseline Period - Subcanopy								
Gordonia lasianthus	69	3.10	52.64	1232.14	54.33	0.80	23.53	43.50
Ilex cassine	9	0.66	11.16	160.71	7.09	0.20	5.88	8.04
Ilex sp.	1	0.03	0.44	17.86	0.79	0.20	5.88	2.37
Magnolia virginiana	1	0.11	1.80	17.86	0.79	0.20	5.88	2.82
Myrica cerifera	4	0.13	2.20	71.43	3.15	0.60	17.65	7.67
Persea palustris	38	1.71	28.96	678.57	29.92	1.00	29.41	29.43
Pinus elliottii	2	0.08	1.40	35.71	1.57	0.20	5.88	2.95
Taxodium distichum	3	0.08	1.40	53.57	2.36	0.20	5.88	3.22
Total	**127**	**5.90**	**100.00**	**2267.86**	**100.00**	**3.40**	**100.00**	**100.00**
September 2007 – Operational Period Year 4 – Canopy*								
Gordonia lasianthus	26	17.58	51.35	464.29	56.52	1.00	29.41	45.76
Ilex cassine	3	0.94	2.75	53.57	6.52	0.20	5.88	5.05
Magnolia virginica	4	1.43	4.18	71.43	8.70	0.40	11.76	8.21
Nyssa sylvatica	2	0.63	1.84	35.81	4.35	0.20	5.88	4.02
Persea palustris	5	1.33	3.88	89.29	10.87	0.60	17.65	10.80
Pinus elliottii	2	2.55	7.44	35.71	4.35	0.40	11.76	7.85
Pinus taeda	1	0.74	2.15	17.86	2.17	0.20	5.88	3.40
Quercus laurifolia	1	6.87	20.07	17.86	2.17	0.20	5.88	9.37
Taxodium distichum	2	2.17	6.34	35.71	4.35	0.20	5.88	5.52
Total	**46**	**34.24**	**100.00**	**821.43**	**100.00**	**3.40**	**100.00**	**100.00**

Table 13 — *Continued*

Species	No.	Dominance (m^2/ha)	Dominance Relative	Density (#/ha)	Density Relative	Frequency Absolute	Frequency Relative	Importance Value (percent)
September 2007 – Operational Period Year 4 – Subcanopy*								
Gordonia lasianthus	50	2.70	51.51	892.86	61.73	0.80	28.57	47.27
Ilex cassine	9	0.85	16.13	160.71	11.11	0.40	14.29	13.84
Magnolia virginiana	2	0.22	4.23	35.71	2.47	0.40	14.29	7.00
Myrica cerifera	2	0.08	1.54	35.71	2.47	0.20	7.14	3.72
Persea palustris	15	1.04	19.90	267.86	18.52	0.80	28.57	22.33
Taxodium distichum	3	0.35	6.68	53.57	3.70	0.20	7.14	5.84
Total	**81**	**5.25**	**100.00**	**1446.43**	**100.00**	**2.80**	**100.00**	**100.00**

*Canopy was sampled annually in the fall. Because of the shortened fifth operational period, the most recent canopy-monitoring event was at the end of the fourth period, in September 2007.

ANIMALS

Benthic Macroinvertebrates

Samples were collected three times during the baseline period (March 2000, October 2001, and April 2002), twice during the first operational period (April 2004 and January 2005), twice during the second operational period (March 2005 and September 2005), and once during the third operational period (March 2006). No benthic samples were collected in September 2006, April 2007, September 2007, or April 2008 because no surface water was present along the transect. Benthic macroinvertebrate laboratory results are presented in Appendix E. Benthic samples were analyzed to the nearest taxa possible (usually genus) by Pennington and Associates, Inc.

Laboratory results from previous years indicate that overall composition of the benthic macroinvertebrate community was similar between baseline and operational events when surface water was present. Density and taxa richness have fluctuated between events, but these changes are considered normal, as benthic macroinvertebrate communities can be highly variable. Prolonged absence of surface water prior to and during baseline conditions likely reduces the diversity and density of the benthic community. Benthic macroinvertebrate density also decreased after prolonged periods of surface water following the 2004 hurricane season.

Habitat types at the Thayer Canal Transect are diverse and include woody snags, emergent vegetation, and a thick layer of detritus. Most of the identified benthic taxa were of the larvae of the family Chironomidae (midges), classified as highly tolerant of low dissolved oxygen concentrations and low pH values common to mixed hardwood swamp with colored water and low or at times no flow conditions. Midge larvae typically favor organic soils and detritus packs and are important food sources for other invertebrates and fish. Other significant contributing taxa included members of Oligochaeta (worms), Cladocera (water fleas), Isopods, Dytiscidae (predaceous diving beetles), and Ceratopogoniade (no-see-ums).

Fish

The fish community is sampled at the Thayer Canal Transect each fall when surface water is present during the monitoring events. No surface water was present during the September 2000 event; in October 2001, surface water was present, but no fish were collected or observed. During the September 2006 and September 2007 events, no surface water was present along the transect, and no fish samples were collected.

RESULTS - HAMMOCK FIELD TRANSECT

TOPOGRAPHIC SURVEY

A survey of the topographic relief along the Hammock Field Transect (Figures 13 and 14) was performed by CH2M HILL surveying staff on January 2, 2001, using NAVD88. The transect is situated so that the upland end has an elevation of 28.01 feet NAVD88 (29.14 feet NGVD29) and is at the edge of the wetland. The lowest spot along the transect (26.27 feet NAVD88 [27.40 feet NGVD29]) is near the wetland monitoring well and staff gauge, approximately 65 meters from the upland end. The average elevation of the wetland, 27.1 feet NAVD88 (28.23 feet NGVD29), was estimated by averaging all the measurement points shown in Figure 14 and the natural ground at the recorders and staff gauges. The Hammock Field Transect drops approximately 1.1 feet in elevation to its deepest point before rising to 27.39 feet NAVD88 (28.52 feet NGVD29) over its 200 meter-length.

Figure 13. Hammock Field Transect, Bennett Swamp, March 2004

PHOTO STATIONS

Photos of the Hammock Field Transect in Bennett Swamp were taken on three events during the baseline period and on nine events during the five operational periods. Photos were taken from the center of the 5-meter by 5-meter shrub plots and are included with this final report.

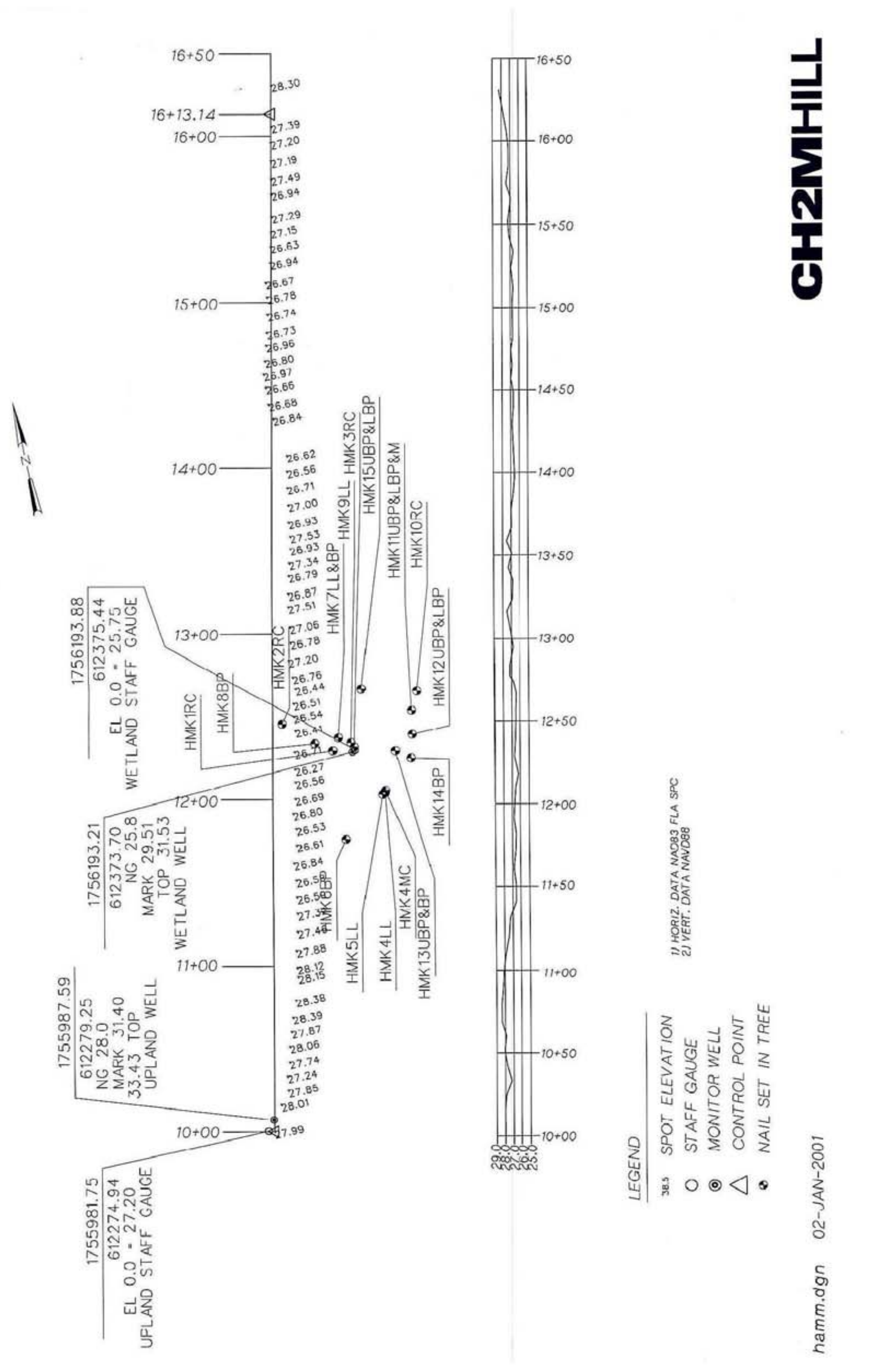


Figure 14. Hammock Field transect topographic survey (elevations in NAVD88)

General Wildlife Observed

Wildlife within the wetland and using adjacent upland areas was recorded as observed during each sampling event. General wildlife observations include green treefrog, bullfrog (*Rana catesbeiana*), green anole, black racer (*Coluber constrictor*), pygmy rattlesnake, rough green snake (*Opheodrys aestivus*), water moccasin (*Agkistridon picivorus*), red-shouldered hawk, barred owl (*Strix varia*), tufted titmouse (*Parus bicolor*), blue-gray gnatcatcher (*Polioptila caerula*), northern parula, Carolina wren (*Thryothorus ludovicianus*), palm warbler (*Dendroica palmarum*), pine warbler (*Dendroica pinus*), pileated woodpecker, red-bellied woodpecker, yellow-bellied sapsucker (*Sphyrapicus varius*), turkey (*Meleagris gallopavo*), great blue heron (*Ardea herodias*), great egret, and wood duck (*Aix sponsa*). Florida black bear scat was observed on the access road near the Hammock Field Transect on several occasions.

Surface Water Elevations

Daily Water-Level Elevations

Figure 15 depicts water levels as recorded by upland and wetland data loggers associated with piezometers for the baseline and operational periods. Water-elevation monitoring was initiated in February 2000 and data loggers were set to record on a 6-hour interval. However, episodes of equipment malfunctions and storm damage have resulted in data gaps.

After the hurricanes in September 2004, high water, downed trees, and adjacent private-property conflict prevented access to the Hammock Field Transect until January 2005. It was at this time that CH2M HILL scientists were able to hike to the transect to assess hurricane damage. The upland recorder was still functioning; however, the wetland recorder was destroyed by a tree fall. The data logger was brought back to the office to attempt to salvage any data that might have been recorded since October 2004.

Consequently, all data recorded by the wetland data logger were unavailable. During the next field visit, on March 11, 2005, the upland recorder was moved to the wetland piezometer, where it collected data until June 12, 2005. After that date, that recorder malfunctioned, and no more data were recorded during the second operational period at this transect.

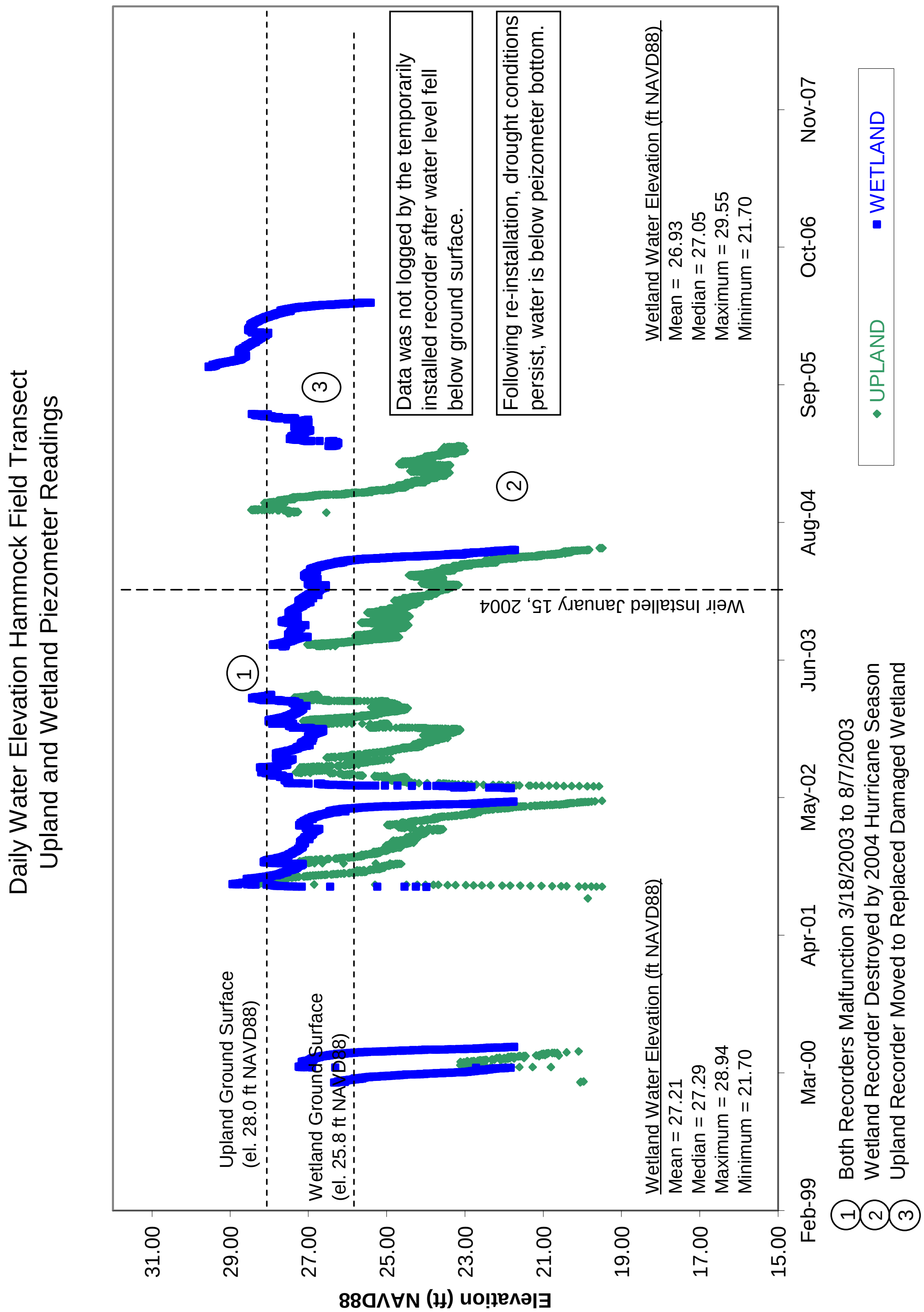


Figure 15. Daily water-level elevations (NAVD88) at Hammock Field Transect

On October 28, 2005, the water-level recorder from the Lower Bennett Swamp upland piezometer was moved to the Hammock Field wetland piezometer, the casing of which had broken off beneath the ground surface during a previous hurricane event and was not able to be repaired. High surface waters prevented excavation of a new piezometer well, in the interim; the relocated water-level recorder was attached to the adjacent staff gage in order to record surface water levels. Water levels stayed above the ground surface during the next two field visits, but fell rapidly throughout April 2006, and fell below the range of the water-level recorder on April 30, 2006. This rapid fall was not discovered until the next field visit (July 5, 2006). At that time, a new piezometer well was excavated, and the recorder was installed immediately adjacent to the original wetland piezometer. Water levels had fallen so quickly, that at the time of the installation, the water level was already below the bottom depth of the new well (21.59 feet NAVD88 [22.72 feet NGVD29]), near the lower limit of the original piezometers well). Data between April 30, 2006 and July 5, 2006 were therefore unavailable. Because of low rainfall, water levels remained beneath the bottom of the wetland well during the remainder of the third, fourth, and fifth operational period. Consequently, no new water-level data are presented for the Hammock Field Transect in this fifth operational period report. The evaluation of water levels at the Hammock Field transect is based on a small data set containing numerous data gaps and should be considered a coarse evaluation.

Basic statistics for daily water-level elevations are presented in Figure 15. Both mean and median values were compared for the baseline and operational periods; however, changes in the frequency of data collection from the data loggers influence the median values for the periods. Because of the low number of data points available for analysis, mean values were deemed more accurate than median for comparison purposes. Preliminary data show that mean water elevations at the wetland recorder during the operational period (26.93 feet NAVD88 [28.06 feet NGVD29]) were slightly less than during the baseline period (27.21 feet NAVD88 [28.34 feet NGVD29]), by 0.28 foot.

Percent Exceedence Level

Due to the small set of data available during the operational period for water levels at the Hammock Field Transect, only limited comparisons to the baseline conditions can be made; therefore, an exceedence curve for Hammock Field Transect will not be generated. Exceedence values are a relative calculation and are significantly affected by the available data. Data from only the dry seasons of the operational period reduce exceedence values, giving the impression that water levels were lower than they actually were.

Average Monthly Water-Level Elevations

Average water-level elevations by month at the Hammock Field transect are presented in Table 14. Because of the low number of data points available at this transect for analysis, mean and median values would be misrepresentative of the actual groundwater levels, therefore are not included in the table.

WATER QUALITY

Water quality sampling was possible twice during the baseline period (October 2001 and April 2002), twice during the first operational period (March 2004 and January 2005), twice during the second operational period (March and September 2005), and once during the third operational period (March 2006). No surface water was available during the September 2006, April 2007, September 2007, and April 2008 events. Copies of the laboratory reports and detection limits from the operational and baseline periods are included in Appendix C. The measured water-quality parameter values from the baseline and operational period are presented in Table 15.

Water-quality parameter values from the Hammock Field Transect were similar to those reported from the Thayer Canal and Lower Bennett Swamp Transects. Surface water at the Hammock Field Transect exhibits water quality typical of Northeast Florida (forested, blackwater swamps with low pH, conductivity, nutrients, and total dissolved solids). Color was also high but typical of Florida wetlands where water has been colored by dissolved organic material resulting from the breakdown of plant detritus within the watershed (Kadlec and Knight 1996). Also typical of these wetland systems is low dissolved oxygen, less than 5 mg/L. High inputs of organic matter coupled with long hydraulic residence times create oxygen deficits from the metabolism of microorganisms in wetlands (Mitsch and Gosselink 1993).

Table 14. Average groundwater elevations by month for baseline and operational period, February 2000 through April 2008 – Hammock Field Transect

Month	Groundwater Elevation (feet NAVD88)								
	Baseline Period				Operational Period				
	2000	2001	2002	2003	2004	2005	2006	2007	2008
Jan		[b]--	27.13 ± 0.06	27.57 ± 0.25	26.77 ± 0.13	[a]--	28.27 ± 0.12	[b]--	[b]--
Feb	25.99[a] ± 0.22	[b]--	26.91 ± 0.09	27.27 ± 0.09	26.94 ± 0.09	[a]--	28.42 ± 0.13	[b]--	[b]--
Mar	23.73 ± 1.29	[b]--	27.04 ± 0.12	28.11 ± 0.21	26.85 ± 0.14	26.61[a] ± 0.41	28.15 ± 0.19	[b]--	[b]--
Apr	27.02 ± 0.14	[b]--	26.14 ± 0.55	[a]--	25.48 ± 1.00	27.22 ± 0.15	27.14 ± 0.57	[b]--	[b]--
May	24.78 ± 1.67	[b]--	22.94 ± 0.86	[a]--	22.50 ± 0.45	27.22 ± 0.15	[b]--	[b]--	[c]--
Jun	[b]--	[b]--	22.88 ± 1.46	[a]--	[a]--	28.08[a] ± 0.21	[b]--	[b]--	[c]--
Jul	[b]--	[b]--	27.50 ± 0.36	[a]--	[a]--	[a]--	[b]--	[b]--	[c]--
Aug	[b]--	[b]--	27.91 ± 0.21	27.54 ± 0.17	[a]--	[a]--	[b]--	[b]--	[c]--
Sep	[b]--	27.51 ± 0.31	27.68 ± 0.12	27.35 ± 0.11	[a]--	[a]--	[b]--	[b]--	[c]--
Oct	[b]--	27.75 ± 0.31	27.22 ± 0.13	27.41 ± 0.14	[a]--	29.44[a] ± 0.05	[b]--	[b]--	[c]--
Nov	[b]--	27.64 ± 0.38	26.93 ± 0.09	27.35 ± 0.08	[a]--	28.93 ± 0.27	[b]--	[b]--	[c]--
Dec	[b]--	27.40 ± 0.15	27.24 ± 0.44	27.12 ± 0.07	[a]--	28.65 ± 0.08	[b]--	[b]--	[c]--

Note:

[a]-- Data not available or less than a full month of data due to equipment malfunction, hurricane, or vandalism
[b]-- Data not available. Water below bottom of piezometer
[c]-- End of study

Table 15. Water quality summary – Hammock Field Transect

		Baseline Period		Operational Period					
Parameter	Unit	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006 - Apr 2008
Dissolved oxygen [a]	mg/L	0.98	1.36	1.55	3.87	2.11	0.82	0.33	--
Temperature [a]	°C	21.8	20.5	14.3	15.0	16.4	22.1	12.79	--
ph [a]	units	3.97	3.83	4.03	4.60	4.08	3.99	4.88	--
Conductivity	µmhos/cm	83	100	62	78	88	53	64	--
Color	units	750	500	500	500	400	500	250	--
ALKALINITY As $CaCO_3$	mg/L	U	<5	<5	<5.0	<5.0	<5.0	<5.0	--
TSS	mg/L	U	*	<2.0	3.0	<2.0	<2.0	<2.0	--
TDS	mg/L	200	180	130	150	140	19	80	--
Ammonia – N	mg/L	0.46	0.88	0.081	0.65	0.39	<0.026	<0.026	--
Total Kjeldahl – N	mg/L	1.9	2.1	1.2	2.2	1.1	1.5	1.2	--
Nitrate + nitrite - N	mg/L	U	<0.2	<0.027	<0.027	0.028	<0.027	0.027	--
Total nitrogen	mg/L	2.36	2.2	1.3	2.3	1.2	1.6	1.3	--
Total phosphorus-P	mg/L	U	0.055	0.13	<0.043	<0.043	<0.043	<0.043	--
Ortho-phosphate-P	mg/L	U	0.010	<0.013	<0.058	<0.013	0.060	<0.013	--

Note:

[a] Measurement taken in field; * Analysis missed; U = Undetected
-- Surface water not present at transect during sampling event
µmhos/cm = microhmos per centimeter

SOILS

Soil profiles were characterized from two locations, the upland transitional zone and the wetland center, along the main transect. The depth of each soil-characterization pit was limited to approximately 90 centimeters (35.4 inches) or to the groundwater table and was excavated using a shovel or soil auger. Subsamples were collected from upland and wetland soil horizons for future chemical or physical analyses if needed. A soil profile description along the main transect is included in this section. The soil characterization pits were dug approximately 20 meters from the beginning and end of the main transect. Groundwater was only observed in the wetland soil pit at a depth of 22 inches from the soil surface.

Upland Soil

Horizon (Depth)	Description
A (0-4 inches):	Black (10YR2/1) sand with 30 to 40% organic matter coated sand grains
E (4-25 inches):	Very pale brown (10YR7/3) sand
E/B (25-30 inches):	Light yellowish-brown (10YR6/4) sand
B (30>38 inches):	Dark brown (10YR3/3) loamy

Wetland Soil

Horizon (Depth)	Description
A (0-12 inches):	Black (10YR2/1) mucky sand with 90% organic matter-coated sand grains
C (12 > 23 inches):	Light gray (10YR7/2) sand with few fine black (10YR2/1) mottles and many fine and medium distinct strong brown (7.5YR4/6) pore linings

VEGETATION

Thirty plant species were identified during the baseline period, 23 during the fifth operational period, and 28 of these species were found during both periods (Table 16). Forty-eight plant species have been identified at the Hammock Field Transect during the entire monitoring period. For the purpose of this annual report, herbaceous vegetation data from the fifth operational period are compared to the last year of baseline data (October 2001 and April 2002). These baseline events reflect conditions of the vegetation in Bennett Swamp just prior to installation of the weir in January 2004.

Shrub and tree monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub and tree monitoring events were conducted at the end of the fourth period, in September 2007. Data from that event is retained in this report for comparison purposes. Detailed data tables for all periods are provided in Appendix D.

Table 16. Vegetative species observed at Hammock Field Transect

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period			Operational Period								
				May 00	Oct 01	Apr 02	Mar 04	Jan 05	Mar 05	Sep 05	Mar 06	Sep 06	Apr 07	Sep 07	Mar 08
Red maple	*Acer rubrum*	Tree	FACW								X	X	X	X	X
Broomsedge	*Andropogon virginicus*	Herb	FAC											X	
Carpetgrass	*Axonopus sp.*	Herb	FAC										X		
Swamp fern	*Blechnum serrulatum*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Bandanna of the Everglades	*Canna flaccida*	Herb	OBL									X			
Sedge	*Carex spp.*	Herb	FACW				X		X			X			
Common buttonbush	*Cephalanthus occidentalis*	Shrub	OBL									X	X	X	
Sawgrass	*Cladium jamaicense*	Herb	OBL		X	X	X		X						
Unidentified Flatsedge	*Cyperus spp.*	Herb	UP-OBL					X							
Three-way sedge	*Dulichium arundinaceum*	Herb	OBL	X	X	X	X		X		X	X	X	X	
Fireweed	*Erechtites hieraciifolius*	Herb	FAC												X
Loblolly bay	*Gordonia lasianthus*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Clustered mille graines	*Hedyotis uniflora*	Herb	FACW									X			
Dahoon holly	*Ilex cassine*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Virginia willow	*Itea virginica*	Herb	OBL	X	X	X	X	X				X			
Redroot	*Lachnanthes caroliana*	Herb	FAC							X	X	X		X	
Cutgrass	*Leersia hexandra*	Herb	OBL		X	X									
Sweetgum	*Liquidambar styraciflua*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Fetterbush	*Lyonia lucida*	Shrub	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Sweetbay	*Magnolia virginiana*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Wax-myrtle	*Myrica cerifera*	Shrub	FAC	X	X	X	X	X	X	X	X	X	X	X	X
Blackgum	*Nyssa sylvatica*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Cinnamon fern	*Osmunda cinnamomea*	Herb	FACW	X	X	X	X	X	X		X		X		
Royal fern	*Osmunda regalis*	Herb	OBL		X	X									
Cypress witchgrass	*Panicum ensifolium*	Herb	OBL								X	X		X	X
Maidencane	*Panicum hemitomon*	Herb	OBL								X	X	X	X	
Maidencane	*Panicum spp.*	Herb	FACU-OBL	X	X	X				X		X			
Swamp bay	*Persea palustris*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X

Table 16 — *Continued*

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period May 00	Oct 01	Apr 02	Operational Period Mar 04	Jan 05	Mar 05	Sep 05	Mar 06	Sep 06	Apr 07	Sep 07	Mar 08
Slash pine	*Pinus elliottii*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Camphorweed	*Pluchea sp.*	Herb	FACW									X		X	
Laurel oak	*Quercus laurifolia*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Water oak	*Quercus nigra*	Tree	FACW	X	X			X	X	X	X	X	X	X	X
Narrowfruit horned beaksedge	*Rhynchospora inundata*	Herb	OBL											X	
Beakrush	*Rhynchospora spp.*	Herb	UP-OBL	X	X	X						X	X		X
Blackberry	*Rubus spp.*	Vine	UP-FACW	X	X	X						X			
Cabbage palm	*Sabal palmetto*	Tree	FAC	X	X	X	X	X	X	X	X	X			
Lizards tail	*Saururus cernuus*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Laurel greenbriar	*Smilax laurifolia*	Vine	FACW	X	X	X	X	X	X	X	X	X	X		
Sphagnum moss	*Sphagnum*	Herb	OBL	X	X	X		X		X	X	X	X	X	X
Bald cypress	*Taxodium distichum*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Poison ivy	*Toxicodendron radicans*	Herb	FAC	X	X	X	X		X	X	X	X	X	X	X
Bladderwort	*Utricularia sp.*	Herb	OBL								X				
Highbush blueberry	*Vaccinium corymbosum*	Shrub	FACW				X	X		X		X		X	
Violet	*Viola spp.*	Herb	FAC- OBL										X		
Muscadine grape	*Vitis rotundifolia*	Vine	FACW	X	X	X			X	X	X	X	X	X	X
Netted chain fern	*Woodwardia areolata*	Herb	OBL	X	X	X	X		X	X	X	X	X	X	X
Virginia chain fern	*Woodwardia virginica*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-eyed grass	*Xyris spp.*	Herb	OBL-FACW			X									

Note:

Indicator: UPL = plant almost always occurs in uplands;
OBL = plant almost always occurs in wetlands;
FAC = plant equally likely to occur in wetlands 34 to 66% of the time;
FACW = Plant usually occurs in wetlands 67 to 99% of the time;
FACU = Plant usually occurs in uplands 67 to 99% of the time
NI = no indicator given;
[1] Federal indicator, No state indicator given.

Herbaceous Groundcover

One-Square-Meter Plots

Results of the observations of herbaceous groundcover within the 21 plots of 1 square meter for the fourth operational period are presented in Table 17.

During the baseline period, diversity within the plots ranged from zero to 10 species. Percent cover varied between the upland and wetland ends of the transect, and no significant relationship to diversity or cover was observed concerning transect elevation. Sphagnum moss was the most common groundcover species encountered along all three belts at the Hammock Field Transect; it accounted for an average of 41% of the total relative cover during each of the baseline monitoring events. Sphagnum moss is a common herb species within Bennett Swamp.

Table 17. Summary of herbaceous groundcover in square-meter plots – Hammock Field Transect

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
October 2001 – Baseline Period									
Blechnum serrulatum					3.33		7.33	1.52	14.00
Cladium jamaicense	1.00							0.14	1.31
Leersia hexandra	1.00							0.14	1.31
Lyonia lucida		2.67			2.67	4.00	5.00	2.05	18.82
mosses	1.00			4.00	1.67	23.33	3.33	4.76	43.76
Myrica cerifera	0.67							0.10	0.88
Osmunda cinnamomea							6.67	0.95	8.75
Osmunda regalis	1.33							0.19	1.75
Persea palustris	0.67	0.17						0.12	1.09
Sabal palmetto	0.67							0.10	0.88
Saururus cernuus	0.17	0.33						0.07	0.66
Unknown	0.33							0.05	0.44
Vitis rotundifolia		0.33						0.05	0.44
Woodwardia areolata		1.67						0.40	3.72
Woodwardia virginica	1.67	0.17					1.00	0.24	2.19
Total	**8.50**	**5.33**	**0.00**	**4.00**	**7.67**	**27.33**	**23.33**	**10.88**	**100.00**
April 2002 – Baseline Period									
Blechnum serrulatum					10.00		14.00	3.43	12.27
Dulichium arundinaceum				0.67				0.10	0.34
Itea virginica							3.33	0.48	1.70
Lyonia lucida		0.33			6.67	13.33	10.00	4.33	15.50
mosses		5.00	13.33	0.33	16.67	23.33	16.67	10.76	38.50
Persea palustris		1.67						0.24	0.85
Sabal palmetto	0.33							0.05	0.17

Table 17 — *Continued*

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
Saururus cernuus	1.67	3.33						0.71	2.56
Toxicodendron radicans				0.33	0.33	1.67	2.67	0.71	2.56
Unknown grass	0.33							0.05	0.17
Unknown herb	2.33							0.33	1.19
Unknown seedling		3.66	1.00	0.66	2.67	0.33		1.19	4.26
Vitis rotundifolia	1.67							0.24	0.85
Woodwardia areolata		1.67						0.24	0.85
Woodwardia virginica	11.67	3.33		7.33	1.67		10.67	4.95	17.72
Xyris sp.	1.00							0.14	0.51
Total	**19.00**	**19.00**	**14.33**	**9.33**	**38.00**	**38.67**	**57.33**	**27.95**	**100.00**
March 2008 – Operational Period 5									
Acer rubrum		0.67						0.10	2.53
Blechnum serrulatum					5.67	0.33	5.33	1.62	43.04
Erechtites hieraciifolius						0.33		0.10	2.53
Gordonia lasianthus				1.00		0.67	0.33	0.33	8.86
Liquidambar styraciflua	0.67	0.33			0.33			0.19	5.06
Lyonia lucida		0.67			0.33	0.33	0.33	0.24	6.33
Magnolia virginiana						0.33		0.05	1.27
mosses							0.33	0.10	2.53
Panicum ensifolium	0.33							0.05	1.27
Persea palustris	0.33	0.33	0.67		0.33		0.67	0.33	8.86
Rhynchospora sp.			0.67					0.10	2.53
Saururus cernuus	0.33	1.67		0.33				0.33	8.86
Toxicodendron radicans			0.33	0.33		0.33		0.14	3.80
Vitis rotundifolia						0.33		0.05	1.27
Woodwardia virginica				0.33				0.05	1.27
Total	**1.67**	**3.67**	**2.67**	**2.00**	**6.67**	**2.67**	**7.00**	**3.76**	**100.00**

Percent cover in March 2008 of the fifth operational period was lower than percent cover observed during the baseline events particularly the April 2002 event. Species composition was similar to that observed during baseline monitoring. Herbaceous cover within all the plots were low during the fifth operational period but was slightly higher towards the wetland end of the transects. During the March 2008 monitoring event, no surface water was present along the transect.

Swamp fern was the most prevalent groundcover observed, accounting for 43.04 relative percent cover in March 2008. No other species dominated the relative percent cover along the Hammock Field transect during March 2008.

Species diversity in the plots varied, from zero species to five species per plot with eight to 11 species per transect.

Belt Transects (1-Meter-Wide) Target Species

The species composition along the three 1-meter-wide belt transects was not diverse enough to meet the nine-species goal during initial baseline observations. Rather, two obligate and two facultative species in the herbaceous stratum were found along the transects.

The occurrence of the four target species along the belt transect was recorded as the linear distance covered by a species within five intervals along the belt. Presence / absence information for each sampling event is provided in Table 18.

Table 18. Presence of indicator herbaceous species along belt transect – Hammock Field Transect

Species Name	Baseline Period			Operational Period								
	May 2000	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006	Apr 2007	Sep 2007	Mar 2008
Obligate (OBL)												
Saururus cernuus	X	X	X	X	X	X	X	X	X	X	X	X
Woodwardia areolata	X	X	X	X	X	X	X	X	X	X	X	X
Facultative (FAC)												
Toxicodendron radicans	X	X	X	X	X	X	X	X	X	X	X	X
Vitis rotundifolia	X	X	X	X	X	X	X	X	X	X	X	X

The results of the line-intercept observations for the baseline and fifth operational monitoring period are presented in Table 19. The percent cover and frequency of occurrence of the target species during the fifth operational period were greater than that observed in the October 2001 baseline-monitoring event but less that that observed in the April 2002 baseline-monitoring event. Both percent cover and frequency were low along all three line-intercept belts during each baseline and operational monitoring events, with 7.07 as the highest absolute percent cover observed during any event, recorded for muscadine grape (*Vitis rotundifolia*) in April 2002. Percent cover was greatest near the upland edge of the Hammock Field Transect during most monitoring events primarily due to surface water inundation in the middle and wetland ends of the transects. During the 2008 event, no surface water was present along the transect and target species percent cover was more evenly distributed along the length of the transects. Detailed herbaceous line-intercept data are presented in Appendix D.

Table 19. Summary of herbaceous groundcover belt transects for target species – Hammock Field Transect

Species	Indicator	Mean Linear Distance (meters) Belt Transect Zone A	B	C	D	E	Total Mean Linear Distance (m)	Mean Percent Cover Absolute	Relative	Mean Frequency Absolute	Relative	Importance Value (Percent)
October 2001 – Baseline Period												
Saururus cernuus	OBL	0.41					0.41	0.21	24.36	0.13	16.67	20.51
Toxicodendron radicans	FAC	0.03	0.19		0.01	0.06	0.29	0.14	17.23	0.27	33.33	25.28
Vitis rotundifolia	FAC	0.52	0.05				0.57	0.29	33.86	0.20	25.00	29.43
Woodwardia areolata	OBL	0.41					0.41	0.21	24.55	0.20	25.00	24.78
Total		**1.37**	**0.24**	**0.00**	**0.01**	**0.06**	**1.68**	**0.84**	**100.00**	**0.80**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	0.55	0.24		0.01	0.06	0.86	0.43	51.09	0.47	58.33	54.71
	OBL	0.82					0.82	0.41	48.91	0.33	41.67	45.29
Total		**1.37**	**0.24**	**0.00**	**0.01**	**0.06**	**1.68**	**0.84**	**100.00**	**0.80**	**100.00**	**100.00**
April 2002 – Baseline Period												
Saururus cernuus	OBL	3.16	0.64	0.22	0.59	0.20	4.81	2.41	20.58	0.53	21.62	21.10
Toxicodendron radicans	FAC	0.47	0.33	0.41	1.13	1.43	3.77	1.89	16.14	0.80	32.43	24.29
Vitis rotundifolia	FAC	6.28	4.54	0.54	2.18	0.59	14.13	7.07	60.46	0.80	32.43	46.45
Woodwardia areolata	OBL	0.49	0.04			0.14	0.66	0.33	2.82	0.33	13.51	8.17
Total		**10.4**	**5.55**	**1.18**	**3.89**	**2.35**	**23.38**	**11.69**	**100.00**	**2.47**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	6.75	4.87	0.95	3.31	2.02	17.91	8.95	76.60	1.60	64.86	70.73
	OBL	3.65	0.68	0.22	0.59	0.33	5.47	2.74	23.40	0.87	35.14	29.27
Total		**10.4**	**5.55**	**1.18**	**3.89**	**2.35**	**23.38**	**11.69**	**100.00**	**2.47**	**100.00**	**100.00**

Table 19 — *Continued*

Species	Indicator	Mean Linear Distance (meters) Belt Transect Zone					Total Mean Linear Distance (m)	Mean Percent Cover		Mean Frequency		Importance Value (Percent)
		A	B	C	D	E		Absolute	Relative	Absolute	Relative	
March 2008 – Operational Period - Year 5												
Saururus cernuus	OBL	0.52	0.07	0.06	0.77	0.28	1.70	0.85	34.76	0.53	26.67	30.71
Toxicodendron radicans	FAC	0.00	0.68	0.21	0.48	0.48	1.85	0.93	37.76	0.80	40.00	38.88
Vitis rotundifolia	FAC	0.50	0.10	0.01	0.58	0.58	1.25	0.62	25.44	0.60	30.00	27.72
Woodwardia areolata	OBL	0.10	0.00	0.00	0.00	0.00	0.10	0.05	2.04	0.07	3.33	2.69
Total		**1.12**	**0.85**	**0.28**	**1.83**	**0.82**	**4.90**	**2.45**	**100.00**	**2.00**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	0.50	0.79	0.22	1.06	0.53	3.10	1.55	63.20	1.40	70.00	66.60
	OBL	0.62	0.07	0.06	0.77	0.28	1.80	0.90	36.80	0.60	30.00	33.40
Total		**1.12**	**0.85**	**0.28**	**1.83**	**0.82**	**4.90**	**2.45**	**100.00**	**2.00**	**100.00**	**100.00**

Facultative wetland species dominated the herbaceous layer during the baseline period and during the fifth operational period. Percent cover and frequency were low during the events and were dominated by poison ivy (38.88 importance value), lizard's tail (30.71 importance value), and muscadine grape (27.72 importance value) during the March 2008 event.

Shrubs/Sapling Community

For the purpose of data analysis and discussion, the canopy species were subdivided into three size classes:

- Shrub/sapling <2.5 centimeters dbh and > 0.3 meter tall
- Subcanopy $\geq$2.5 centimeters to < 10.0 centimeters dbh
- Canopy $\geq$10.0 centimeters dbh

Shrub/sapling sampling is conducted annually in conjunction with canopy/subcanopy sampling. Data were collected twice during the baseline (September 2000 and October 2001), once during each year of the operational period (January 2005, and September 2005, 2006, and 2007). Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007. For the purpose of this annual report, data collected from the fourth operational period were compared to the last baseline event (October 2001).

25-Square-Meter Shrub/Sapling Plots

Four shrub species were identified in the 25-square-meter shrub plots during the baseline-monitoring event (Table 20). Shrub Plot C (near the wetland end of the transect) recorded the highest percent cover during baseline event, followed by Shrub Plot A (near the upland edge of the transect). Both of these shrub plots are at higher elevations along the transect.

Fetterbush (*Lyonia lucida*) was recorded in each of the shrub plots and dominated each plot during the October 2001 event (Table 20). The greatest percent cover of fetterbush (35%) was recorded in Shrub Plot C. During the September 2007 event, three shrub species were identified within the shrub plots. One of these species, bald cypress (*Taxodium distichum*) in Shrub Plot C, was not recorded during the baseline events. Shrub Plot C had the highest percent cover, followed by Shrub Plot B. All shrub plots were dominated by fetterbush.

Table 20. Shrub/sapling 25-square-meter plot (5-meter by 5-meter) – Hammock Field Transect

Shrub Plot	Scientific Name	Percent Cover					
		Baseline Period		Operational Period			
		Sep 2000	Oct 2001	Jan 2005	Sep 2005	Sep 2006	Sep 2007*
A	*Magnolia virginiana*	4	2			9	
	Lyonia lucida	60	25	45	32	10	12
	Persea palustris	1	1				
	Rubus sp.					9	
	Plot Total	**65**	**28**	**45**	**32**	**28**	**12**
B	*Itea virginica*	20	1	4	4	10	
	Lyonia lucida	10	12	25	28	30	16
	Myrica cerifera	1		4			
	Plot Total	**31**	**13**	**33**	**32**	**40**	**16**
C	*Acer rubrum*					6	
	Itea virginica					2	
	Lyonia lucida	1	35	40	32	62	24
	Persea palustris			2	1		
	Taxodium distichum						1
	Vaccinium corymbosum	50					3
	Plot Total	**51**	**35**	**42**	**33**	**70**	**28**

* Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007.

Line-Intercept Analysis

Six shrub and woody vine species were identified along the 200-meter transect during the baseline monitoring event (Table 21). Percent cover and frequency were dominated by fetterbush (55.95% importance value). During the baseline event, percent cover of shrub species was high and was greatest near the middle of the transect.

Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007 (Table 21). Four shrub species were observed along the shrub line intercept. Fetterbush had the highest importance value (59.57%), followed by highbush blueberry (*Vaccinium corymbosum*) (17.97%). Percent cover of shrub species was lower during the fourth operational period than during the baseline event.

Table 21. Summary of shrub/sapling line-intercept transect – Hammock Field Transect

Species	Linear Distance (m)					Total Linear Distance	Percent Cover		Frequency		Importance Value (percent)
	A	B	C	D	E		Absolute	Relative	Absolute	Relative	
October 2001 – Baseline Period											
Gordonia lasianthus		1.22				1.22	0.61	1.43	0.20	5.56	3.49
Itea virginica				0.41		0.41	0.21	0.48	0.20	5.56	3.02
Lyonia lucida	3.19	15.08	28.31	11.11	13.97	71.66	35.83	84.12	1.00	27.78	55.95
Smilax sp.	0.04	0.83	0.19		0.05	1.11	0.53	1.30	0.20	22.22	11.76
Vaccinium corymbosum	1.06		4.26	2.11		7.43	3.72	8.72	0.60	16.67	12.69
Woody Vines	0.25	1.12		1.60	0.39	3.36	1.68	3.94	0.80	22.22	13.08
Total	**4.54**	**18.25**	**32.76**	**15.23**	**14.41**	**85.19**	**42.60**	**100.00**	**3.60**	**100.00**	**100.00**
September 2007 – Operational Period – Year 4*											
Lyonia lucida	7.70	15.75	10.20	16.20	11.00	60.85	30.43	77.47	1.00	41.67	59.57
Myrica cerifera	0.80			1.60		2.40	1.20	3.06	0.40	16.67	9.86
Persea palustris	5.30			1.40		6.70	3.35	8.53	0.40	16.67	12.60
Vaccinium corymbosum	5.00			3.25	0.35	8.60	4.30	10.95	0.60	25.00	17.97
Total	**18.80**	**15.75**	**10.20**	**22.45**	**11.35**	**78.55**	**39.28**	**100.00**	**2.40**	**100.00**	**100.00**

Note:

Each interval is approximately 40 meters. “A” is at the upland end, and “E” is at the deep end of the transect.
* Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007.

Canopy/Subcanopy

The canopy and subcanopy strata at Hammock Field transect, in September 2007, showed evidence of previous impacts from logging and from current fire suppression. Diversity of tree and shrub species was low, and most specimens were relatively even in age. Changes to the canopy / subcanopy stratum are slow, and it is expected that the effects from hydrologic restoration will be slow to develop.

The canopy / subcanopy strata were sampled during the fall, twice during the baseline (September 2000 and October 2001), once each year during the fall of the operational period (January 2005, and September 2005, 2006, and 2007). Seventy-five trees from 10 species were tagged during the initial plot setup in September 2000. For the purpose of this annual report, data collected from the most recent monitoring event, September 2007, were compared only to the last baseline event (October 2001). Detailed data are provided in Appendix D. During October 2001 of the baseline period, 74 trees were identified within the tree plot. Dominant species were blackgum (*Nyssa sylvatica)*, sweetbay (*Magnolia virginiana)*, and swamp bay (*Persea palustris)* in the canopy (28.15, 23.75, and 17.16% importance values, respectively). The dominance of the canopy trees was 33.43 square meters per hectare (145.7 square feet per acre), and density was 800.00 individuals per hectare (323.9 individuals per acre).

The subcanopy was dominated by swamp bay and sweetbay (40.65 and 30.20% importance values, respectively). Blackgum was notably absent from the subcanopy. The basal area of the subcanopy trees (or dominance) was 3.11 square meters per hectare (13.6 square feet per acre). The density was 1,050 individuals per hectare (425.1 individuals per acre).

Fifty-two trees were measured in the fourth operational period, 22 less than in the maximum recorded (74) in October 2001 (Table 22). Dominance of the canopy trees was greater than that recorded in the baseline event. The dominance of the canopy trees was 148.03 square meters per hectare (644.83 square feet per acre), and density was 775.00 individuals per hectare (313.64 individuals per acre), a very slight increase over the October 2001 baseline event. The dominance of the subcanopy trees was 1.68 square meters per hectare (7.32 square feet per acre), a slight decrease since baseline observations. The density of 525.00 individuals per hectare (212.46 individuals per acre) was reduced compared to baseline events.

Table 22. Importance values for canopy and subcanopy – Hammock Field Transect

Species	No.	Dominance (m^2/ha)	Dominance Relative	Density (#/ha)	Density Relative	Frequency Absolute	Frequency Relative	Importance Value (percent)
October 2001 – Baseline Period – Canopy								
Ilex cassine	1	0.45	1.34	25.00	3.13	0.20	6.67	3.71
Liquidambar styraciflua	2	1.71	5.13	50.00	6.25	0.40	13.33	8.24
Magnolia virginiana	8	8.77	26.24	200.00	25.00	0.60	20.00	23.75
Nyssa sylvatica	9	12.14	36.33	225.00	28.13	0.60	20.00	28.15
Persea palustris	7	3.21	9.60	175.00	21.88	0.60	20.00	17.16
Pinus elliottii	1	2.62	7.83	25.00	3.13	0.20	6.67	5.87
Quercus laurifolia	2	0.53	1.60	50.00	6.25	0.20	6.67	4.84
Taxodium distichum	2	3.99	11.94	50.00	6.25	0.20	6.67	8.29
Total	**32**	**33.43**	**100.00**	**800.00**	**100.00**	**3.00**	**100.00**	**100.00**
October 2001 – Baseline Period – Subcanopy								
Ilex cassine	4	0.57	18.40	100.00	9.52	0.20	7.14	11.69
Magnolia virginiana	13	0.97	31.06	325.00	30.95	0.80	28.57	30.20
Myrica cerifera	3	0.09	2.96	75.00	7.14	0.40	14.29	8.13
Persea palustris	19	1.28	41.00	475.00	45.24	1.00	35.71	40.65
Quercus nigra	1	0.14	4.56	25.00	2.38	0.20	7.14	4.69
Taxodium distichum	2	0.06	2.02	50.00	4.76	0.20	7.14	4.64
Total	**42**	**3.11**	**100.00**	**1050.00**	**100.00**	**2.80**	**100.00**	**100.00**
September 2007 Operational Period Year 4 – Canopy*								
Ilex cassine	3	0.98	0.67	75.00	9.68	0.20	5.88	5.41
Liquidambar styraciflua	2	111.89	75.59	50.00	6.45	0.40	11.76	31.27
Magnolia virginiana	6	9.72	6.57	150.00	19.35	0.60	17.65	14.52
Nyssa sylvatica	8	13.33	9.01	200.00	25.81	0.60	17.65	17.49
Persea palustris	6	3.22	2.17	150.00	19.35	0.80	23.53	15.02
Pinus elliottii	1	3.02	2.04	25.00	3.23	0.20	5.88	3.72
Quercus laurifolia	2	0.96	0.65	50.00	6.45	0.20	5.88	4.33
Quercus nigra	1	0.34	0.23	25.00	3.23	0.20	5.88	3.11
Taxodium distichum	2	4.56	3.08	50.00	6.45	0.20	5.88	5.14
Total	**31**	**148.03**	**100.00**	**775.00**	**100.00**	**3.40**	**100.00**	**100.00**
September 2007 – Operational Period Year 4 - Subcanopy*								
Ilex cassine	2	0.22	13.02	50.00	9.52	0.20	9.09	10.54
Magnolia virginiana	9	0.90	53.67	225.00	42.86	0.80	36.36	44.30
Myrica cerifera	1	0.05	3.16	25.00	4.76	0.20	9.09	5.67
Persea palustris	7	0.42	24.68	175.00	33.33	0.80	36.36	31.46
Taxodium distichum	2	0.09	5.48	50.00	9.52	0.20	9.09	8.03
Total	**21**	**1.68**	**100.00**	**525.00**	**100.00**	**2.20**	**100.00**	**100.00**

Note:

Frequency is given as a number of subquadrants in which the species occurs divided by the total number of subquadrants (5).
* Tree monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent tree-monitoring event was at the end of the fourth period, in September 2007.

ANIMALS

Benthic Macroinvertebrates

Samples were collected twice during the baseline period (October 2001 and April 2002), twice during the first operational period (April 2004 and January 2005), twice during the second operational period (March 2005 and September 2005), and once during the third operational period (March 2006). No water was present at the Hammock Field Transect during the initial March 2000 baseline sampling or the September 2006, April 2007, September 2007, and April 2008 events. Benthic macroinvertebrate laboratory results are presented in Appendix E. Benthic samples were analyzed to the nearest taxa possible (usually genus) by Pennington and Associates, Inc.

Overall composition of the benthic macroinvertebrate community was similar between baseline and operational events when surface water was present. Density and taxa richness have fluctuated between events, but these changes are considered normal, as benthic macroinvertebrate communities can be highly variable. Benthic macroinvertebrate samples were the most varied at the Hammock Field Transect compared to the other transects within Bennett Swamp. Prolonged absence of surface water prior to and during baseline conditions likely reduces the diversity and density of the benthic community. Benthic macroinvertebrate density also decreased after prolonged periods of surface water following the 2004 hurricane season.

Habitat types at the Hammock Field Transect are diverse and include woody snags, emergent vegetation, and a thick layer of detritus. Most of the identified benthic taxa were of the larvae of the family Chironomidae (midges), classified as highly tolerant of low dissolved oxygen concentrations and low pH values common to mixed hardwood swamp with colored water and low or at times no flow conditions. Midge larvae typically favor organic soils and detritus packs and are important food sources for other invertebrates and fish. Other significant contributing taxa included members of Oligochaeta (worms), and Isopods.

Fish

The fish community is sampled in the fall at the Hammock Field Transect when surface water is present. No surface water was present during the September 2000, September 2006, and September 2007 events. During the October 2001 event, surface water was present, but no fish were collected or observed.

RESULTS - LOWER BENNETT SWAMP TRANSECT

TOPOGRAPHIC SURVEY

A survey of the topographic relief along the Lower Bennett Swamp Transect (Figures 16 and 17) was performed by CH2M HILL surveying staff on January 2, 2001, using NAVD88. The transect is situated so the upland end has an elevation of 26.7 feet NAVD88 (27.8 feet NGVD29) and is at the edge of the wetland. The lowest spot along the transect (25.7 feet NAVD88 [26.8 feet NGVD29]) is near the wetland monitoring well and staff gauge, approximately 230 meters from the upland end. The average elevation of the wetland, 26.3 feet NAVD88 (27.43 feet NGVD29), was estimated by averaging all the measurement points shown in Figure 17 plus the natural ground at the recorders and staff gauges. The Lower Bennett Swamp Transect drops approximately 1.0 foot in elevation over its length (230 meters).

Figure 16. Lower Bennett Swamp Transect, Bennett Swamp, March 2004

PHOTO STATIONS

Photos of the Lower Bennett Swamp Transect in Bennett Swamp were taken on three events during the baseline period and on nine events during the five operational periods. Photos were taken from the center of the 5-meter by 5-meter shrub plots and are included with this final report.

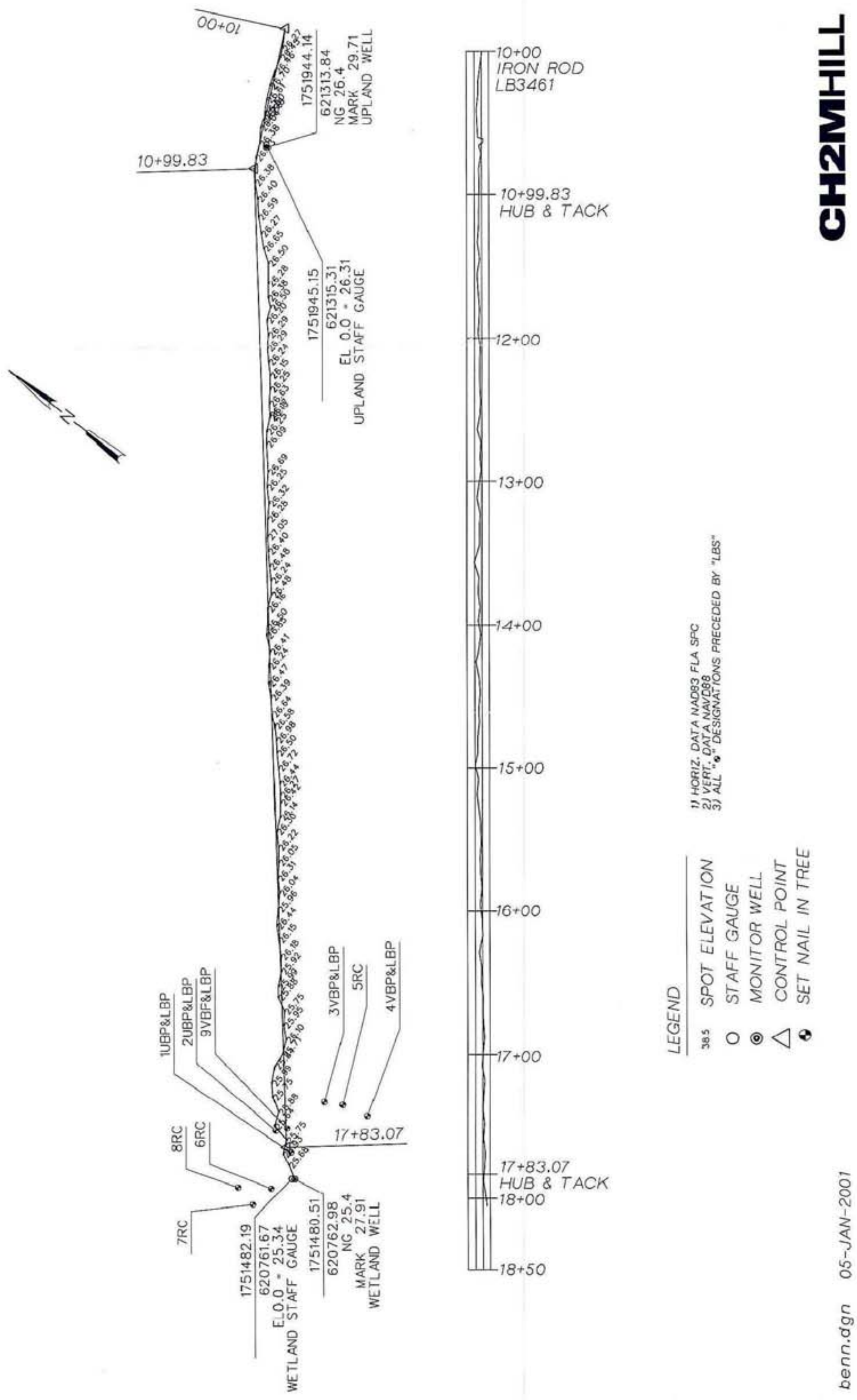


Figure 17. Lower Bennett Swamp transect topographic survey (elevations in NAVD88)

General Wildlife Observed

Wildlife within the wetland and in adjacent upland areas was recorded when observed during sampling events. Wildlife observations include zebra longwing butterfly (*Heliconius charitonius*), green treefrog, pine woods treefrog, little grass frog, Florida chorus frog (*Pseudacris nigrita*), green anole, ground skink (*Scincella lateralis*), garter snake (*Thamnophis sirtalis*), eastern coral snake (*Micrurus fulvius*), red-shouldered hawk, osprey, northern parula, and cattle egret (*Bubulcus ibis*).

Surface Water Elevations

Figure 18 depicts water levels as recorded by upland and wetland data loggers associated with piezometers for the baseline and operational periods. Water elevation monitoring was initiated in February 2000 and data loggers were set to record on a 6-hour interval; however, malfunctions in both the upland and wetland recorders resulted in a gaps in data during baseline and the first operational monitoring period.

Basic statistics for daily water-level elevations are presented in Figure 18. Both mean and median values were compared for the baseline and operational periods; however, changes in the frequency of data collection influences the median values for the periods. Data show that mean water elevations at the wetland recorder during the entire operational period (24.18 feet NAVD88 [25.31 feet NGVD29]) were lower than during the baseline period (25.28 feet NAVD88 [26.41 feet NGVD29]) by 1.1 feet. Median values also were slightly less during the entire operational period (25.47 feet NAVD88 [26.66 feet NGVD29]) than during the baseline (25.64 feet NAVD88 [26.77 feet NGVD29]), a difference of 0.17 foot.

Water levels fell below the bottom of the wetland piezometer (19.34 feet NAVD88 [20.47 feet NGVD29]) in mid-June 2007 and stayed beneath the ground surface through the end of the fifth operational period. Metrics calculated for daily and average monthly water level elevations (mean, median, maximum, and minimum) do not include any values below 19.34 feet NAVD88 [20.47 feet NGVD29].

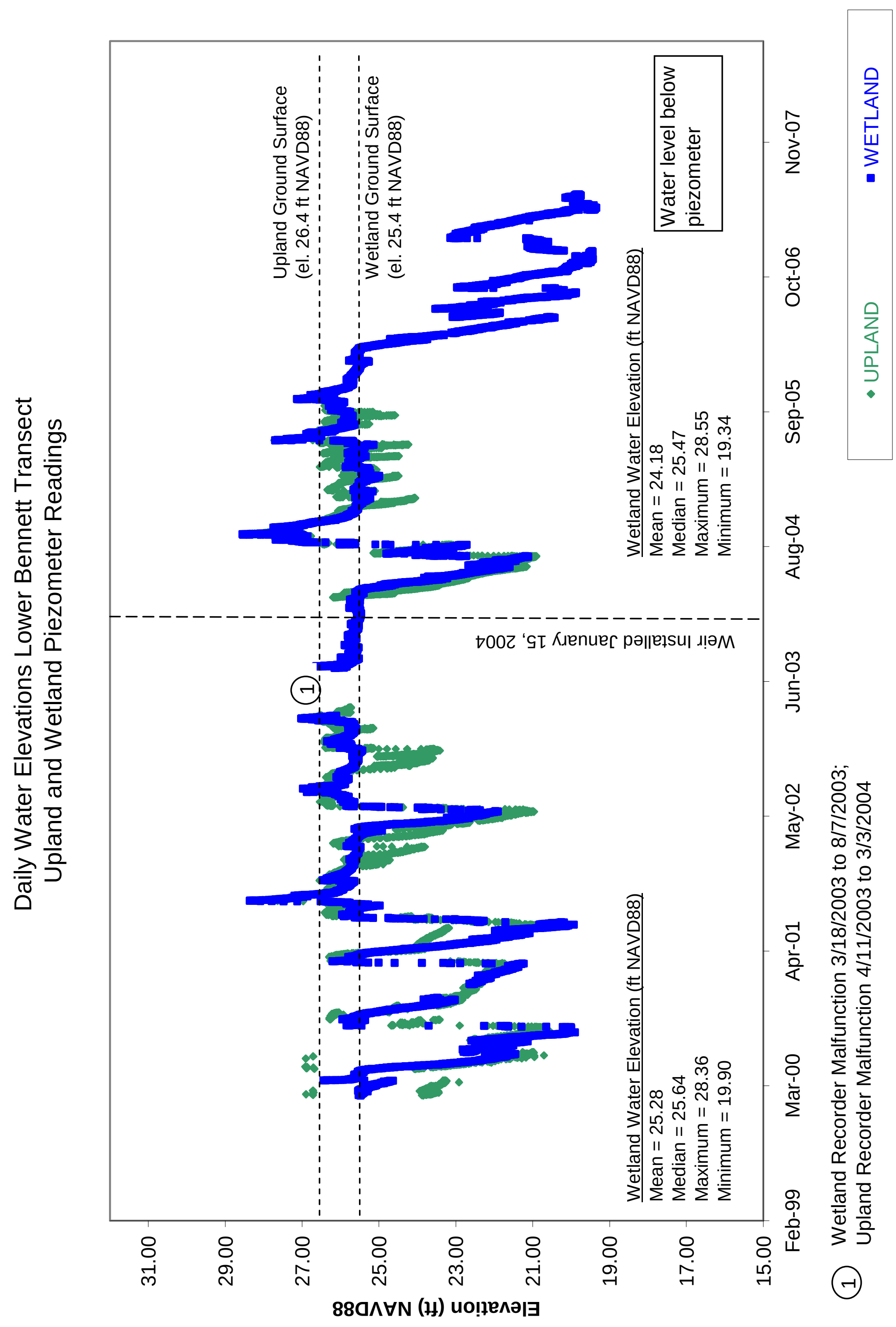


Figure 18. Daily water-level elevations (NAVD88) at Lower Bennett Swamp Transect

Percent Exceedence Level

Water levels at the Lower Bennett Swamp Transect exceeded the wetland surface 53% of the time during the entire operational period (Figure 19). During the baseline monitoring, water levels were above the wetland surface 84% of the 47-month period.

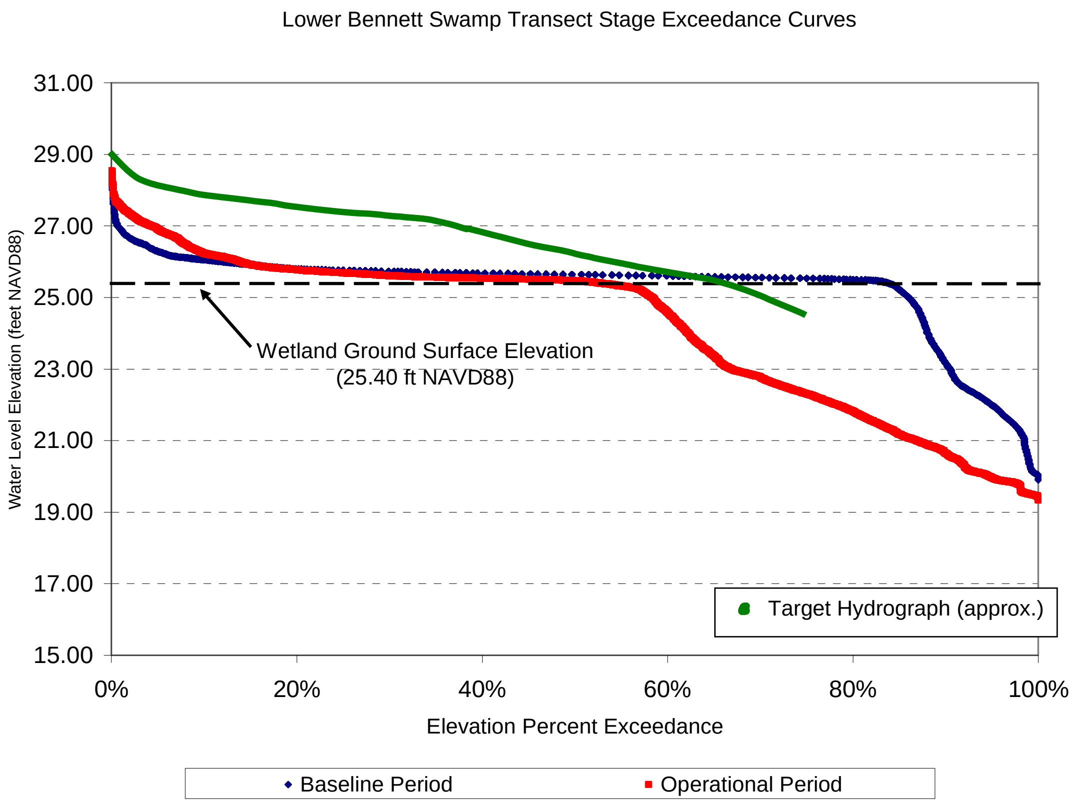


Figure 19. Stage-exceedence curves – Lower Bennett Swamp Transect

Both baseline and operational period exceedence curves were below the 26.4-foot NAVD88 (27.5-foot NGVD29) target (modeled historical level) and the soil-estimated historical curve (27.2 feet NAVD88 [28.3 feet NGVD29]) at the 50% exceedence level. Based on the target hydrograph, the stage at the wetland well should be exceeded 67% of the time once historical conditions are restored.

Average Monthly Water Level Elevations

Average monthly baseline (24.64 feet NAVD88 [25.77 feet NGVD29]) and operational period (23.90 feet NAVD88 [25.03 feet NGVD29]) water elevations differed by a mean value of 0.74 foot (Table 23).

Table 23. Average groundwater elevations by month for baseline and operational period, February 2000 through April 2008 – Lower Bennett Swamp Transect

Month	Groundwater Elevation (feet NAVD88)								
	Baseline Period				Operational Period				
	2000	2001	2002	2003	2004	2005	2006	2007	2008
Jan		22.38[a] ± 0.15	25.66 ± 0.05	25.98 ± 0.19	25.52 ± 0.03	25.50 ± 0.07	25.51 ± 0.06	20.93 ± 0.12	[b]--
Feb	25.45[a] ± 0.05	21.91 ± 0.26	25.58 ± 0.09	25.69 ± 0.06	25.59 ± 0.07	25.31 ± 0.17	25.56 ± 0.09	22.73 ± 0.40	[b]--
Mar	25.18 ± 0.32	23.79 ± 2.05	25.61 ± 0.08	26.45 ± 0.30	25.50 ± 0.08	25.43 ± 0.17	25.21 ± 0.35	21.89 ± 0.38	[b]--
Apr	25.57 ± 0.13	24.95 ± 0.62	25.24 ± 0.26	[a]--	24.27 ± 0.61	25.60 ± 0.09	23.90 ± 0.50	20.55 ± 0.47	[b]--
May	23.76 ± 1.01	22.58 ± 0.56	23.11 ± 0.64	[a]--	22.65 ± 0.58	25.54 ± 0.13	22.08 ± 0.46	19.75 ± 0.16	[c]--
Jun	22.11 ± 0.37	21.29 ± 0.40	23.83 ± 1.49	[a]--	21.95 ± 0.43	26.48 ± 0.63	21.94 ± 0.91	19.90 ± 0.10	[c]--
Jul	21.98 ± 0.43	22.38 ± 2.03	25.89 ± 0.14	[a]--	23.56 ± 0.87	26.17 ± 0.37	22.50 ± 0.39	[b]--	[c]--
Aug	20.66 ± 0.67	25.60 ± 0.20	26.34 ± 0.32	25.90 ± 0.26	26.00 ± 1.66	25.83 ± 0.07	20.53 ± 0.52	[b]--	[c]--
Sep	24.25 ± 2.23	26.70 ± 0.96	25.96 ± 0.08	25.68 ± 0.09	27.46 ± 0.33	26.07 ± 0.15	21.85 ± 0.82	[b]--	[c]--
Oct	25.19 ± 0.40	26.13 ± 0.33	25.67 ± 0.08	25.68 ± 0.07	26.45 ± 0.44	26.41 ± 0.31	20.94 ± 0.51	[b]--	[c]--
Nov	23.59 ± 0.36	26.00 ± 0.26	25.58 ± 0.04	25.65 ± 0.05	25.64 ± 0.08	25.94 ± 0.22	19.92 ± 0.21	[b]--	[c]--
Dec	[a]--	25.79 ± 0.10	25.77 ± 0.22	25.57 ± 0.05	25.46 ± 0.09	25.71 ± 0.06	19.80 ± 0.47	[b]--	[c]--
Mean	24.64				23.90				
Median	24.94				25.31				

[a]-- Data not available or less than a full month of data due to equipment malfunction or vandalism
[b]-- Data not available – water fell below bottom of well
[c]-- end of study

Median monthly baseline (24.94 feet NAVD88 [26.07 feet NGVD29]) and operational period (25.31 feet NAVD88 [26.44 feet NGVD29]) water elevations differed by 0.37 foot. Differences between operational and baseline months were greatest during June and December.

WATER QUALITY

The Lower Bennett Swamp transect is the shallowest of the three monitoring transects at Bennett Swamp and does not hold water for extended periods like the Thayer Canal and Hammock Field transects. Water quality sampling was conducted twice during the baseline period and twice during each operational year when surface water was present. Surface water of sufficient depth for sampling was present only three times: during the baseline monitoring period in October 2001 and April 2002 and during the operational period in September 2005 (Table 24).

Table 24. Water quality summary – Lower Bennett Swamp Transect

Parameter	Unit	Baseline Period			Operational Period				
		May 2000	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006 through April 2008
Dissolved Oxygen [A]	mg/L	--	1.90	1.06	--	--	--	1.45	--
Temperature [A]	°C	--	22.1	23.0	--	--	--	22.0	--
ph [A]	units	--	3.74	3.83	--	--	--	3.96	--
Conductivity	µmhos/cm	--	110	99	--	--	--	89	--
Color	units	--	750	500	--	--	--	750	--
Alkalinity as $CaCO_3$	mg/L	--	U	<5	--	--	--	<5.0	--
TSS	mg/L	--	U	*	--	--	--	<2.0	--
TDS	mg/L	--	220	160	--	--	--	140	--
Ammonia – N	mg/L	--	0.10	<0.1	--	--	--	<0.026	--
Total Kjeldahl – N	mg/L	--	1.8	0.77	--	--	--	1.4	--
Nitrate + Nitrite – N	mg/L	--	U	0.27	--	--	--	<0.027	--
Total Nitrogen	mg/L	--	1.9	1.04	--	--	--	1.5	--
Total Phosphorus-P	mg/L	--	U	0.028	--	--	--	0.078	--
Ortho-Phosphate-P	mg/L	--	0.026	0.016	--	--	--	0.088	--

Note:

[A] Measurement taken in field
-- Surface water not present at transect during sampling event
U Undetected

Surface water at the Lower Bennett Swamp Transect exhibits water quality typical of Northeast Florida (forested, blackwater swamps with low pH, conductivity, nutrients, and total dissolved solids). Color was high but typical of Florida wetlands where water has been colored by dissolved organic material resulting from the breakdown of plant detritus within the watershed (Kadlec and Knight 1996). Also typical of these wetland systems is low dissolved oxygen, less than 5 mg/L. High inputs of organic matter coupled with long hydraulic residence times create oxygen deficits from the metabolism of microorganisms in wetlands (Mitsch and Gosselink 1993). Copies of the laboratory reports and detection limits from the sampling conducted are included in Appendix C.

SOILS

Soil profiles were characterized from two locations, the upland transitional zone and the wetland center, along the main transect. The depth of each soil-characterization pit was limited to approximately 90 cm (35.4 inches) or to the groundwater table and was excavated using a shovel or soil auger. Subsamples were collected from the upland and wetland soil horizons for future chemical or physical analyses if needed. The soil profile description along the main transect is summarized in this section.

The soil-characterization pits were dug approximately 20 meters from the beginning and end of the main transect. Groundwater was only observed in the wetland soil pit at a depth of 5 inches from the soil surface.

Upland Soil

Horizon (Depth)	Description
A (0-3 inches):	Very dark gray (10YR3/1) sand with 50% organic matter-coated sand grains
E1 (3-20 inches):	Pale brown (10YR6/3) sand
E2 (20-28 inches):	Brownish-yellow (10YR6/6) sand with few fine and faint yellowish-brown (10YR5/8) mottles
Bt (28>37 inches):	Brown (10YR5/3) sandy clay loam with many fine and distinct yellowish-brown (10YR5/8) pore linings; common fine and medium roots

Wetland Soil

Horizon (Depth)	Description
Oa (0-14 inches):	Black (10YR2/1) mucky organic soil with many fine roots
C (14 > 20 inches):	Pale brown (10YR6/3) sand

VEGETATION

A total of 26 plant species were identified during the baseline period and 21 during the fifth operational period (Table 25), and 23 of these species were found during both periods. Thirty-four plant species have been identified at the Lower Bennett Swamp Transect throughout the entire monitoring period. For the purpose of this annual report, herbaceous vegetation data from the fifth operational period are compared only to the last year of baseline data (October 2001 and April 2002). These baseline events reflect conditions of the vegetation in Bennett Swamp just prior to the installation of the weir in January 2004.

Shrub and tree monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub and tree monitoring events were conducted at the end of the fourth period, in September 2007. Data from that event is retained in this report for comparison purposes. Detailed data tables for all periods are provided in Appendix D.

Herbaceous Groundcover

One-Square-Meter Plots

Results of the observations of herbaceous groundcover within the 21 plots of 1 square meter for the baseline and the fifth operational period are presented in Table 26.

During the baseline period, diversity within the plots ranged from two to nine species. Diversity was greater during the April 2002 event when compared to the October 2001 event. Percent cover was lowest near the wetland end and increased near the middle and upland edge of the transect. Several species dominated the percent cover of the herbaceous layer during the baseline period. Fetterbush (*Lyonia lucida*) was the most common groundcover, followed by Virginia chain fern *(Woodwardia virginica)*, sphagnum moss, and swamp fern (*Blechnum serrulatum)* (34.1%, 31.8%, 26.3%, and 16.87% average relative cover, respectively). Fetterbush is a common shrub species within Bennett Swamp and is considered part of the herbaceous stratum until it grows taller than 0.3 meter.

Table 25. Vegetative species observed at Lower Bennett Swamp Transect

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period			Operational Period								
				May 2000	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006	Apr 2007	Sep 2007	Mar 2008
Red Maple	*Acer rubrum*	Tree	FACW	X	X	X	X		X	X	X	X	X	X	X
Broomsedge	*Andropogon virginicus*	Herb	FAC									X	X	X	
Swamp fern	*Blechnum serrulatum*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Sedge	*Carex sp.*	Herb	FAC-OBL				X								
Dogfennel	*Eupatorium capillifolium*	Herb	FAC									X	X	X	
Loblolly bay	*Gordonia lasianthus*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Dahoon holly	*Ilex cassine*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Virginia willow	*Itea virginica*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Redroot	*Lachnanthes caroliana*	Herb	FAC						X						
Fetterbush	*Lyonia lucida*	Shrub	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Sweetbay	*Magnolia virginiana*	Tree	OBL	X	X	X	X	X	X	X	X				
Wax-myrtle	*Myrica cerifera*	Shrub	FAC	X	X	X	X	X	X	X	X	X	X	X	X
Blackgum	*Nyssa sylvatica*	Tree	OBL							X	X	X	X	X	X
Cinnamon fern	*Osmunda cinnamomea*	Herb	FACW	X	X	X	X								
Panicum grass	*Panicum ensifolium*	Herb	OBL			X	X		X	X	X	X	X	X	
Swamp bay	*Persea palustris*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Golden polypody	*Phlebodium aureum*	Herb	NI						X	X	X	X	X	X	
Slash pine	*Pinus elliottii*	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Resurrection fern	*Polypodium polypodioides*	Herb	NI											X	
Laurel oak	*Quercus laurifolia*	Tree	FACW	X	X	X	X	X	X	X					X
Water oak	*Quercus nigra*	Tree	FACW	X	X	X									X
Beakrush	*Rhynchospora sp.*	Herb	FAC-OBL	X	X	X						X			
Cabbage palm	*Sabal palmetto*	Tree	FAC	X	X	X	X	X	X	X	X	X	X	X	X

Table 25 — *Continued*

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period			Operational Period								
				May 2000	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006	Apr 2007	Sep 2007	Mar 2008
Lizards tail	*Saururus cernuus*	Herb	OBL	X	X	X	X	X	X		X		X	X	X
Saw palmetto	*Serenoa repens*	Shrub	FACU								X				
Laurel greenbriar	*Smilax laurifolia*	Vine	FACW	X	X	X	X	X	X	X	X	X	X	X	
Sphagnum moss	*Sphagnum*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Bald cypress	*Taxodium distichum*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Poison ivy	*Toxicodendron radicans*	Herb	FAC	X	X	X	X	X	X	X	X	X	X	X	X
Highbush blueberry	*Vaccinium corymbosum*	Shrub	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Muscadine grape	*Vitis rotundifolia*	Vine	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Netted chain fern	*Woodwardia areolata*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Virginia chain fern	*Woodwardia virginica*	Herb	FACW		X	X	X	X	X	X	X	X	X	X	X
Yellow-eyed grass	*Xyris sp.*	Herb	OBL-FACW			X									

Note:

Indicator: UPL = plant almost always occurs in uplands;
OBL = plant almost always occurs in wetlands;
FAC = plant equally likely to occur in wetlands 34 to 66% of the time;
FACW = Plant usually occurs in wetlands 67 to 99% of the time;
FACU = Plant usually occurs in uplands 67 to 99% of the time
NI = no indicator given;
[1] Federal indicator, No state indicator given.

Table 26. Summary of herbaceous groundcover square-meter plots – Lower Bennett Swamp

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
October 2001 – Baseline Period									
Blechnum serrulatum	0.67	0.67		10.00	0.33		1.00	1.81	23.31
Itea virginica	5.67	1.00						0.95	12.27
Lyonia lucida	11.00	0.33	8.33	7.67	0.33		0.67	4.05	52.15
mosses		4.00	0.33		13.33	0.33	1.67	2.81	36.20
Persea palustris	0.33	0.67	1.00	0.33	0.67			0.43	5.52
Vitis rotundifolia	1.67			0.33	0.33			0.33	4.29
Woodwardia areolata		0.17						0.02	0.31
Woodwardia virginica		4.17	8.33	2.67		1.67		2.40	30.98
Total	**19.33**	**11.00**	**18.00**	**21.00**	**15.00**	**2.00**	**3.33**	**12.81**	**100.00**
March 2002 – Baseline Period									
Blechnum serrulatum		1.67		10.00			10.00	3.10	10.43
Itea virginica	2.33	0.67						0.43	1.44
Lyonia lucida	11.67	3.00	9.00	16.00	3.67	0.67	1.67	6.52	21.99
mosses	6.67	4.00	11.67	0.33	6.67	0.67	3.33	4.76	16.05
Panicum ensifolium	0.33							0.05	0.16
Persea palustris					1.67			0.24	0.80
Pinus seedling		1.00						0.14	0.48
Smilax sp.			0.33	0.67			2.33	0.48	1.61
Toxicodendron radicans	5.33				0.67			0.86	2.89
Unknown Carex sp.		0.33						0.05	0.16
Unknown fern sp.					0.67			0.10	0.32
Vitis rotundifolia	0.33	1.67	5.00	4.00	10.67			3.10	10.43
Woodwardia areolata				0.33				0.05	0.16
Woodwardia virginica	0.67	18.33	21.67	21.67		5.00	0.33	9.67	32.58
Xyris sp.	0.33	0.33	0.33					0.14	0.48
Total	**27.67**	**31.00**	**48.00**	**53.00**	**24.00**	**6.33**	**6.33**	**29.67**	**100.00**
March 2008 - Operational Period 5									
Acer rubrum				0.33			0.33	0.10	1.49
Blechnum serrulatum		1.67	2.00	11.00			8.67	3.33	52.24
Gordonia lasianthus	0.33	0.33					0.33	0.14	2.24
Itea virginica	0.33	0.33						0.10	1.49
Lyonia lucida	1.00	0.33	0.33	0.67			0.67	0.43	6.72
mosses			2.00		0.33	0.33		0.38	5.97
Persea palustris			0.33		0.33			0.10	1.49
Toxicodendron radicans				0.33	0.67		0.33	0.19	2.99
Vitis rotundifolia				1.00		3.67	1.00	0.81	12.69
Woodwardia virginica		1.33	1.00	1.33	0.33	1.67		0.81	12.69
Total	**1.67**	**2.67**	**4.67**	**13.33**	**1.33**	**5.67**	**11.33**	**6.38**	**100.00**

Percent cover and species composition during the fifth operational period were less than half of those observed during baseline monitoring. During the fifth operational period, the plots had a diversity of zero to four species each. Total mean percent cover was 6.38. Swamp fern dominated the meter-square plots during the March 2008 sampling event, with 52.24 relative percent cover. Muscadine grape and Virginia chain fern were also important, with 12.69 relative percent cover each. Percent cover was highest in plots near the middle of the Lower Bennett Swamp transect in both the baseline and operational periods.

Belt Transects (1-Meter-Wide) Target Species

The species composition along the three 1-meter-wide belt transects was not diverse enough to meet the nine-species goal during initial baseline observations. Two obligate and two facultative species in the herbaceous stratum were found along the transects. The occurrence of the four target species was recorded as the linear distance covered by a species within five intervals along the belt. Presence/ absence information for each sampling event is provided in Table 27.

Table 27. Presence/absence of indicator herbaceous species along belt transect – Lower Bennett Swamp Transect

Species Name	Baseline Period			Operational Period								
	May 2000	Oct 2001	Apr 2002	Mar 2004	Jan 2005	Mar 2005	Sep 2005	Mar 2006	Sep 2006	Apr 2007	Sep 2007	Apr 2008
Obligate (OBL)												
Saururus cernuus	X	X	X	X	X	X		X		X	X	X
Woodwardia areolata	X	X	X	X	X	X	X	X	X	X	X	X
Facultative (FAC)												
Toxicodendron radicans	X	X	X	X	X	X	X	X	X	X	X	X
Vitis rotundifolia	X	X	X	X	X	X	X	X	X	X	X	X

Percent cover for the target species during the fifth operational period was slightly higher than during the October 2001 baseline event but lower than during the April 2002 baseline event. Frequency of occurrence of the target species was similar between the baseline period and fifth operational period. Facultative wetland species dominated the herbaceous layer during the baseline period and the fifth operational period except in October 2001, when

Virginia chain fern, an obligate species, was co-dominant enough for total obligate species to provide slightly greater percent cover, if lower frequency, than facultative species. The results of the line-intercept observations for the baseline and fifth operational periods are presented in Table 28. The relationship between the percent cover and frequency of muscadine grape is not likely to show a relationship correlated to increased water levels because it is a vine and occurs in the wetland canopy. Detailed herbaceous line intercept data are presented in Appendix D.

Shrubs/Sapling Community

For the purpose of data analysis and discussion, the canopy species were subdivided into three size classes:

- Shrub/sapling <2.5 centimeters dbh and > 0.3 meter tall
- Subcanopy ≥2.5 centimeters to < 10.0 centimeters dbh
- Canopy ≥10.0 centimeters dbh

Shrub/sapling sampling is conducted annually in the fall in conjunction with canopy/subcanopy sampling. Data were collected twice during the baseline (September 2000 and October 2001), and once during each year of the operational period (January 2005, and September 2005, 2006, and 2007). Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007. For the purpose of this annual report, data collected from the fourth operational period were compared only to the last baseline event (October 2001).

25-Square-Meter Shrub/Sapling Plots

Four shrub species were identified in the 25-square-meter shrub plots during the baseline-monitoring event. Shrub Plot A (near the upland edge) had the highest percent cover during baseline and was dominated by the species loblolly bay (*Gordonia lasianthus*). Percent cover of shrub species decreased within Shrub Plot B and Shrub Plot C, near the center and the wetland end of the transect, respectively (Table 29).

Percent cover of shrub species was lower during September 2007 than during the baseline period. Five shrub species were identified in the 25-square-meter shrub plots, one of which, red maple (*Acer rubrum*), was not previously identified during the baseline-monitoring event. Shrub Plot A had the highest percent cover and was dominated by the species swamp bay (*Persea palustris)*.

Table 28. Summary of herbaceous groundcover belt transects for target species – Lower Bennett Swamp Transect

		Mean Linear Distance (meters)					Total Mean Linear Distance (m)	Mean Percent Cover		Mean Frequency		Importance Value (Percent)
		Belt Transect Zone										
Species	**Indicator**	**A**	**B**	**C**	**D***	**E**		**Absolute**	**Relative**	**Absolute**	**Relative**	
Fall 2001 – Baseline Period												
Saururus cernuus	OBL					0.18	0.18	0.09	2.00	0.08	4.35	3.17
Toxicodendron radicans	FAC						0.01		0.08	0.25	13.04	6.56
Vitis rotundifolia	FAC	0.26		1.41		0.97	2.64	1.38	29.88	0.92	47.83	38.85
Woodwardia areolata	OBL	4.19	1.59	0.24			6.02	3.14	68.05	0.67	34.78	51.42
Total		**4.46**	**1.59**	**1.65**		**1.15**	**8.85**	**4.61**	**100.00**	**1.92**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	0.26		1.42		0.97	2.65	1.38	29.95	1.17	60.87	45.41
	OBL	4.19	1.59	0.24		0.18	6.20	3.23	70.05	0.75	39.13	54.59
Total		**4.46**	**1.59**	**1.65**		**1.15**	**8.85**	**4.61**	**100.00**	**1.92**	**100.00**	**100.00**
Spring 2002 – Baseline Period												
Saururus cernuus	OBL					1.83	1.83	0.95	2.75	0.17	5.88	4.32
Toxicodendron radicans	FAC	0.80	0.18	1.13		0.18	2.29	1.19	3.44	1.00	35.29	19.37
Vitis rotundifolia	FAC	13.23	14.6	13.54		10.55	51.93	27.05	77.96	1.00	35.29	56.63
Woodwardia areolata	OBL	6.59	3.41	0.55			10.55	5.50	15.84	0.67	23.53	19.69
Total		**20.62**	**18.2**	**15.22**		**12.57**	**66.61**	**34.69**	**100.00**	**2.83**	**100.00**	**100.00**
Summary	UPL						0.00		0.00		0.00	0.00
	FAC	14.03	14.8	14.66		10.73	54.22	28.24	81.40	2.00	70.59	76.00
	OBL	6.59	3.41	0.55		1.83	12.39	6.45	18.60	0.83	29.41	24.00
Total		**20.62**	**18.2**	**15.22**		**12.57**	**66.61**	**34.69**	**100.00**	**2.83**	**100.00**	**100.00**

Table 28 — *Continued*

Species	Indicator	Mean Linear Distance (meters) Belt Transect Zone A	B	C	D*	E	Total Mean Linear Distance (m)	Mean Percent Cover Absolute	Relative	Mean Frequency Absolute	Relative	Importance Value (Percent)
Spring 2008 - Operational Period 5												
Saururus cernuus	OBL	0.00	0.00	0.00		0.65	0.65	0.35	6.25	0.17	9.09	7.67
Toxicodendron radicans	FAC	0.65	0.15	0.52		0.30	1.62	0.88	15.55	0.75	40.91	28.23
Vitis rotundifolia	FAC	1.32	2.40	2.98		1.00	7.70	4.19	74.09	0.67	36.36	55.23
Woodwardia areolata	OBL	0.37	0.00	0.00		0.06	0.43	0.23	4.10	0.25	13.64	8.87
Total		**2.34**	**2.55**	**3.50**		**2.01**	**10.40**	**5.65**	**100.00**	**1.83**	**100.00**	**100.00**
Summary	UPL	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FAC	1.97	2.55	3.50		1.30	9.32	5.07	89.64	1.42	77.27	83.46
	OBL	0.37	0.00	0.00		0.71	1.08	0.59	10.36	0.42	22.73	16.54
Total		**2.34**	**2.55**	**3.50**		**2.01**	**10.40**	**5.65**	**100.00**	**1.83**	**100.00**	**100.00**

Note:

Each interval is approximately 46 meters. "A" is at the upland end, and "E" is at the deep end of the transect.

*Data from Zone D of the Lower Bennett Swamp transect (a 46-meter segment of the 230-meter transect) has been deleted from the data set to allow an undistorted comparison to baseline data. The severe storms in 2004 and 2005 resulted in a significant alteration to this portion of the transect that, if included in the analysis, would overshadow any effect the augmentation may be having on the vegetation.

Table 29. Shrub/sapling 25-square-meter plot (5-meter by 5-meter) – Lower Bennett Swamp Transect

Shrub Plot	Scientific Name	Percent Cover					
		Baseline Period		Operational Period			
		Sep 2000	Oct 2001	Jan 2005	Sep 2005	Sep 2006	Sep 2007*
A	*Gordonia lasianthus*	15	25	30	50	10	25
	Lyonia lucida	5	10	5	4	4	4
	Itea virginica		1				
	Persea palustris		3	1	4	37	4
	Plot Total	**20**	**39**	**36**	**58**	**51**	33
B	*Acer rubrum*						1
	Gordonia lasianthus	1	15	10	24	10	5
	Persea palustris		1		8	4	1
	Pinus elliottii					1	
	Plot Total	**1**	**16**	**10**	**32**	**15**	7
C	*Gordonia lasianthus*	1	5	1			
	Acer rubrum					1	
	Lyonia lucida	15	12	3	33	10	3
	Vaccinium corymbosum	1		1	4	4	1
	Plot Total	**17**	**17**	**5**	**37**	**15**	4

Note:

* Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period, in September 2007.

Line-Intercept Analysis

Ten shrub and woody vine species were identified along the 230-meter transect during the baseline monitoring event. Percent cover was dominated by loblolly bay and fetterbush (29.21% and 21.25% importance values, respectively). Percent cover was greatest near the upland end of the transect and decreased in the center and the wetland end.

Percent cover was slightly higher during September 2007 compared to the baseline period. Eight species were observed along the shrub / sapling line intercept for the fourth operational period. The highest importance value was recorded for fetterbush, followed by loblolly bay and swamp bay (52.82%, 35.17%, and 22.45% importance values, respectively). Percent cover and frequency of observed species varied along the transect with the highest values in zone A (the most upland end) and zone C (the transect middle). A summary of shrub / sapling line intercept transects is presented in Table 30.

Table 30. Summary of shrub/sapling line-intercept transect - Lower Bennett Swamp Transect

Species	Linear Distance (m)					Total Linear Distance	Percent Cover		Frequency		Importance Value (percent)
	A	B	C	D#	E		Absolute	Relative	Absolute	Relative	
October 2001 – Baseline Period											
Gordonia lasianthus	0.79	3.18	5.94		4.19	14.10	7.34	24.32	1.00	18.18	21.25
Itea virginica	0.28					0.28	0.15	0.48	0.25	4.55	2.51
Lyonia lucida	14.15	1.10	7.37		0.74	23.33	12.15	40.24	1.00	18.18	29.21
Myrica cerifera			0.71			0.71	0.37	1.22	0.25	4.55	2.89
Persea palustris	10.27	1.27				11.54	6.01	19.90	0.50	9.09	14.50
Sabal palmetto	0.68	0.11				0.79	0.41	1.36	0.50	9.09	5.23
Smilax sp.	0.30	5.15			0.02	5.47	2.85	9.43	0.75	13.64	11.54
Vaccinium corymbosum					0.38	0.38	0.20	0.66	0.25	4.55	2.60
Vitis rotundifolia	0.29					0.29	0.15	0.50	0.25	4.55	2.52
Woody Vines		0.45	0.01		0.63	1.09	0.57	1.88	0.75	13.64	7.76
Total	**26.76**	**11.26**	**14.00**		**5.96**	**57.98**	**30.20**	**100.00**	**5.50**	**100.00**	**100.00**
September 2007 – Operational Period – Year 4*											
Gordonia lasianthus	1.15	4.55	17.51		3.89	27.10	14.11	41.77	0.80	28.57	35.17
Ilex cassine					1.40	1.40	0.73	2.16	0.20	7.14	4.65
Lyonia lucida	29.25	0.60	14.25		5.90	50.00	26.04	77.07	0.80	28.57	52.82
Myrica cerifera	0.50					0.50	0.26	0.77	0.20	7.14	3.96
Persea palustris	3.95	1.55	4.00		1.10	10.60	5.52	16.37	0.80	28.57	22.45
Pinus sp.	0.11					0.11	0.06	0.17	0.20	7.14	3.66
Sabal palmetto	1.80	0.60				2.40	1.25	3.70	0.40	14.29	8.99
Smilax laurifolia	1.20				0.07	1.27	0.66	1.96	0.40	14.29	8.12
Total	**36.81**	**2.75**	**18.25**		**7.07**	**64.88**	**33.79**	**100.00**	**2.80**	**100.00**	**100.00**

Note: Each interval is approx. 46 meters. “A” is at the upland end, “E” is at deep end.
#Data from Zone D of transect (a 46-meter segment of the 230-meter transect) has been deleted from the data set to allow an undistorted comparison to baseline data. The severe storms in 2004 and 2005 resulted in a significant alteration to this segment - if included in the analysis, would overshadow any augmentation effect on vegetation.
*Shrub monitoring was performed annually in the fall. Because of the shortened fifth operational period, the most recent shrub-monitoring event was at the end of the fourth period.

Canopy/Subcanopy

The canopy/subcanopy stratum at Lower Bennett Transect showed evidence of previous impacts from logging and from current fire suppression. Diversity of tree and shrub species was low. Subcanopy densities were high compared to canopy densities. Most tree specimens were relatively even in age. Changes to the canopy/subcanopy stratum are slow, and it is expected that the effects from hydrologic restoration will be slow to develop.

The canopy/subcanopy stratum was sampled twice during the baseline (September 2000 and October 2001), once during each year of the operational period (January 2005, and September 2005, 2006, and 2007). Because of the shortened fifth operational period, the most recent canopy-monitoring event was at the end of the fourth period, in September 2007. Ninety-nine trees from nine species were tagged during the initial plot setup in September 2000 (Appendix D). For the purpose of this annual report, data collected from the most recent monitoring event, September 2007, were compared to the last baseline event (October 2001). During October 2001 (baseline event), 98 trees were identified within the tree plot, 1 less than in the previous event (September 2000). Species composition was similar to that observed in the previous baseline event and dominated by swamp bay in both the canopy and subcanopy. The dominance of both the canopy and subcanopy trees increased from September 2000 to October 2001. The dominance of the canopy trees was 58.59 square meters per hectare (255.3 square feet per acre), and density was 1,130 individuals per hectare (457.7 individuals per acre). The basal area of the subcanopy trees (or dominance) was 3.79 square meters per hectare (16.5 square feet per acre). The density was slightly less than that of the previous baseline event, at 1,000 individuals per hectare (404.9 individuals per acre). Detailed data are provided in Appendix D.

Fifty trees were measured during the fourth operational period, 48 fewer than the 98 trees recorded in September 2001 (Table 31). Damage from the 2004 hurricane season was evident at the Lower Bennett Swamp Transect. An area of downed trees began at approximately 160 meters and continued across the entire transect out to about 200 meters. Very few trees were left standing within this area. Some trees were completely wind-thrown, some snapped off midway on the trunk, and some were leaning over or bent below breast height. Both canopy- and subcanopy-size trees of the dominant species loblolly bay were the most affected. Dominance and density were less than those recorded during the October 2001 baseline event. Canopy dominance was 33.42 square meters per hectare (145.58 square feet per acre), and density was 652.17 individuals per hectare (263.93 individuals per acre).

Table 31. Importance values for canopy and subcanopy – Lower Bennett Swamp Transect

Species	No.	Dominance (m^2/ha)	Dominance Relative	Density (#/ha)	Density Relative	Frequency Absolute	Frequency Relative	Importance Value (percent)
October 2001 – Baseline Period - Canopy								
Gordonia lasianthus	32	38.53	65.76	695.65	64.54	1.00	33.33	53.54
Nyssa sylvatica	4	4.13	7.05	86.96	7.69	0.40	13.33	9.36
Persea palustris	4	3.27	5.58	86.96	7.69	0.60	20.00	11.09
Pinus elliottii	1	0.37	0.64	21.74	1.92	0.20	6.67	3.08
Taxodium distichum	11	12.29	20.98	239.13	21.15	0.80	26.67	22.93
Total	**52**	**58.59**	**100.00**	**1130.43**	**100.00**	**3.00**	**100.00**	**100.00**
October 2001 - Baseline Period– Subcanopy								
Acer rubrum	1	0.14	3.65	21.74	2.17	0.20	7.69	4.51
Gordonia lasianthus	37	2.87	75.68	804.35	80.43	1.00	38.46	64.86
Ilex cassine	3	0.27	7.17	65.22	6.52	0.40	15.38	9.69
Magnolia virginiana	1	0.17	4.50	21.74	2.17	0.20	7.69	4.79
Myrica cerifera	1	0.10	2.60	21.74	2.17	0.20	7.69	4.16
Nyssa sylvatica	1	0.10	2.60	21.74	2.17	0.20	7.69	4.16
Persea palustris	1	0.11	2.88	21.74	2.17	0.20	7.69	4.25
Pinus elliottii	1	0.03	0.91	21.74	2.17	0.20	7.69	3.59
Total	**46**	**3.79**	**100.00**	**1000.00**	**100.00**	**2.60**	**100.00**	**100.00**
September 2007 – Operational Period Year 4 – Canopy*								
Gordonia lasianthus	15	17.00	50.88	326.09	50.00	1.00	41.67	47.51
Nyssa sylvatica	2	1.88	5.61	43.48	6.67	0.20	8.33	6.87
Persea palustris	1	0.43	1.28	21.74	3.33	0.20	8.33	4.31
Pinus elliottii	1	0.70	2.08	21.74	3.33	0.20	8.33	4.58
Taxodium distichum	11	13.42	40.15	239.13	36.67	0.80	33.33	36.72
Total	**30**	**33.42**	**100.00**	**652.17**	**100.00**	**2.40**	**100.00**	**100.00**
September 2007 - Operational Period Year 4 – Subcanopy*								
Gordonia lasianthus	18	1.45	86.75	391.30	90.00	0.80	66.67	81.14
Ilex cassine	1	0.07	4.20	21.74	5.00	0.20	16.67	8.62
Nyssa sylvatica	1	0.15	9.05	21.74	5.00	0.20	16.67	10.24
Total	**20**	**1.67**	**100.00**	**434.78**	**100.00**	**1.20**	**100.00**	**100.00**

Note: Frequency is given as a number of subquadrants in which the species occurs divided by the total number of subquadrants (5).
*Canopy was sampled annually in the fall. Because of the shortened fifth operational period, the most recent canopy-monitoring event was at the end of the fourth period, in September 2007.

The dominance of the subcanopy trees was 1.67 square meters per hectare (7.27 square feet per acre), and the density was 434.78 individuals per hectare (175.95 individuals per acre).

ANIMALS

Benthic Macroinvertebrates

The Lower Bennett Swamp Transect was sampled for benthic macroinvertebrates when surface water was present during a monitoring event. Benthic macroinvertebrate samples were collected during the baseline period in October 2001 and April 2002 and during the second operational period in September 2005. No surface water was observed at the Lower Bennett Swamp Transect during interim events (April 2004, January 2005, and March 2005) or subsequent events (March 2006, September 2006, April 2007, September 2007, and April 2008). Benthic macroinvertebrate laboratory results are presented in Appendix E. Benthic samples were analyzed to the nearest taxa possible (usually genus) by Pennington and Associates, Inc.

Overall composition of the benthic macroinvertebrate community was similar between baseline and operational events when surface water was present and samples were collected. Surface water was, when present, occurred only near the wetland end of the monitoring transect and short in duration. Habitat types at the Lower Bennett Swamp Transect are diverse and include woody snags, emergent vegetation, and a thick layer of detritus. Conditions are similar to the other transects in Bennett Swamp with the exception of no deeper pools or channels. Most of the identified benthic taxa were of the larvae of the family Chironomidae (midges), classified as highly tolerant of low dissolved oxygen concentrations and low pH values common to mixed hardwood swamp with colored water and low or at times no flow conditions. Midge larvae typically favor organic soils and detritus packs and are important food sources for other invertebrates and fish. Other significant contributing taxa included members of Oligochaeta (worms), and Isopods. Samples collected from the Lower Bennett Swamp Transect were lower at in density and taxa richness compared to other monitoring transects within Bennett Swamp.

Fish

Four attempts were made to sample the fish community at the Lower Bennett Swamp Transect. During the March 2000 baseline event and January 2005 operational event, no surface water was present. During the October 2001 baseline event and the September 2005 operational event, surface water was present near the wetland recorder, but no fish were sampled or observed. No fish were sampled subsequently because of a lack of surface water along the transect.

No permanent pools or nearby ditches occur near the Lower Bennett Swamp Transect. For a viable fish community to exist at this transect, surface water needs to be present for a longer duration, and be connected to habitats that support wetland fishes year-round. Although water was above the surface of the wetland often during the baseline and operational periods, the shallow topography and fluctuating hydroperiod did not support fish along the transect.

SUMMARY

During the fifth operational period, rainfall across Florida continued to be below average, although not as severe as it was in 2006 and 2007. The region has not recovered from the drought, consequently, no surface water was present in Bennett Swamp throughout the fifth operational period.

Rainfall of 18.2 inches during the fifth operational period was less than the long-term average for the months of October through April for the region. Mean daily water elevations (26.72 feet NAVD88 [27.85 feet NGVD29]) at the Thayer Canal Transect wetland recorder during the operational period were 0.61 feet greater than during the baseline period (26.11 feet NAVD88 [27.24 feet NGVD29]). Water levels fell beneath the Thayer Canal wetland piezometer (21.31 feet NAVD88 [22.44 feet NGVD29]) in September 2007 and remained below that elevation through April 2008. Baseline and Operational period exceedence curves were very similar to the target elevation set from evaluating hydrologic indicators at each of the transects and showed little difference between periods. Water quality samples were not possible during Year 5 of monitoring.

Percent cover of the herbaceous stratum continues to be dominated by facultative (FAC) wetland species, with the exception of the Hammock Field transect in spring 2007. Percent cover and frequency of all herbaceous species continued to be low. The shrub stratum along the transects within Bennett Swamp continued to dominate much of the ground cover. Diversity of the shrub stratum was low. The canopy was evenly aged, relatively, and the subcanopy layer was somewhat dense.

Fish species and benthic community samples were not collected due to the absence of surface water during April 2008. As reported by CPI (Means and Meegan 2008) persistent, dry condition is the reason amphibian-species richness and abundance were lower again in 2008.

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Appendix A
Hydrologic Evaluation and Rehydration Target

Hydrologic Goals In Bennett Swamp — Rehydration Water Level Targets Using Biological Indicators

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Summary

Field measurements of vegetation and soil indicators of hydrology were compared to modeled stage-exceedance curves for simulated historic, recent (1988) and 2010 conditions. Biological indicators of current water levels are well below historic and 1988 simulated levels. Historic impacts from Thayer Canal construction and groundwater withdrawal have shifted stage–exceedance relationships, with the greatest impact in the middle portion of the curve. The surface water simulations used in this study were based on groundwater elevations simulated for three conditions: pre-wellfield hydrology and two levels of groundwater pumping. These simulations suggested that the 1988 elevations at the Thayer Canal were more than ½ feet below the historic stages at the 50 percent exceedance elevations. Vegetation data from the Thayer Canal transect suggested that current stages are at least 1 foot below the historic exceedance elevations at the 15 percent exceedance point, which approximates the Minimum Frequent High water level. Soil-based estimates of historic hydrologic elevations suggested differences of about 1.75 feet. Comparison of modeled curves with hydrologic curves estimated from biological indicators provided a useful tool for impact assessment. A 1-foot increase in the stage-exceedance behavior of the site was recommended as an appropriate initial rehydration target.

Introduction

The St. Johns River Water Management District is evaluating the benefits of augmenting surface water in wetlands for rehydration and recharge. The goal is to avoid or mitigate impacts from groundwater withdrawals. Bennett Swamp was selected as the pilot project site after biological indicators of altered hydrology were observed there. The first step in the Bennett Swamp project is an evaluation of current and historic hydrologic regimes in the swamp.

Bennett Swamp and the surrounding area have been affected by human activity for many years. Thayer Canal was one of many canals in the area constructed for mosquito control prior to 1980. Groundwater pumping for potable water began in the early 1980s. Since that time, the level of pumping has increased and the local wellfield has expanded. For the purposes of this analysis, "historic" refers to the period prior to the initiation of groundwater pumping. The current condition is estimated using simulations of 1988 conditions, and the future is a model of 2010 conditions assuming pumping above the current levels.

This technical memorandum compares modeled stage duration curves and vegetative indicators of hydrology to evaluate recent changes in long-term average stage conditions. The product of this evaluation is a target rehydration elevation for the swamp.

Hydrologic Information

Bennett Swamp is a 2,200-acre swamp located in Volusia County. Approximately 1,490 acres are forested wetland and the remainder is pine flatwood (489 acres) and upland (221 acres) (Figure 1). The swamp is a broad relict interdunal swale, very flat topographically, with an average slope of approximately 0.5 feet per mile (SJWRMD 2000). The general direction of flow in the swamp is south toward the Tomoka River and water exits the swamp either through Thayer Canal (to the east) or through a box culvert under US 92 in lower Bennett Swamp. Water may also flow north under specific flood or high water conditions (Freeman, 2001). The invert of Thayer Canal at the bridge over the upstream end of the canal at the eastern side of Bennett Swamp is about one foot below the estimated average elevation of the swamp (25ft NGVD – Freeman, 2001).

There are no historic water elevations measurements inside Bennett Swamp. This report is based on modeling (CDM 1995, reported in SJRWMD 1999) of hydrologic conditions in Tiger Bay Swamp, which drains into Bennett Swamp from the west. That evaluation focused on the possible placement of a weir to mitigate potential impacts in Tiger Bay and Bennett Swamps. The analysis used local rainfall records, stage data from a point in Thayer Canal east of Bennett Swamp (1982 - 1988 intermittent, unpublished data, and published USGS data from 1988 – 1995), and stage data from Tiger Bay Canal (published data 1978 to the present) (SJRWMD 1999). The groundwater components of the simulations were piezometric levels obtained from a groundwater modeling study of Volusia County (Williams 1997)

Historic surface water simulations were developed from piezometric elevations that simulated pre-wellfield conditions (projections for the period prior to 1982). Simulations of 1988 projections, assumed to be representative of the present, were based on 45 mgd groundwater pumping simulations, and 2010 simulations were based on piezometric elevations projected for 90 mgd pumping (SJRWMD 1999). Additional survey information (Freeman, 2001) were added to improve the accuracy of the simulations and adjusted to the NGVD 1929 datum. The simulations reported in Freeman (2001) were those used for this study, and all elevations reported here are NGVD 1929 datum based.

There are records beginning in 1982 of Thayer Canal elevations and flows for a point downstream of Bennett Swamp. These were included in development of the model. While not directly evaluated, it seems likely that the canal had some impact on the hydrology of the swamp, as the main function of the canal is drainage for mosquito control (SJRWMD 1999).

Stage-exceedance curves were developed for a point near the origin of Thayer Canal, in Bennett Swamp close to Hammock Field, and at US 92 in Lower Bennett Swamp. The modeled points are in close proximity to the Hammock Field, Thayer Canal, and Lower Bennett Swamp biological sampling transects. The Thayer Canal and Hammock Field transects are about 1 foot above the Lower Bennett Swamp transect (NGVD elevation).

Physical and Biological Data

Elevations of soil and vegetation parameters were collected at three transects in the swamp (Figure 1). The transects were established to monitor hydrologic and biological changes in the system with hydrologic augmentation:

- Thayer Canal (a transect near the beginning of the Canal on the east side of the swamp)
- Hammock Field (west and slightly south of the Thayer Canal Transect)
- Lower Bennett Swamp (approximately 2 miles south of the other transects, just north of US 92; the site lies about 1 foot in elevation below the other two sites)

Physical parameter elevations included:

- Ground surface at the wetland staff gauge for the site
- Ground surface for the upland staff adjacent to the site
- Ground surface at the wetland well at the site
- Ground surface at the upland well adjacent to the site
- The highest and lowest ground water level recorded from the wetland well at each site

Short- and Moderate-Term Indicators

Elevations of the following biological parameters were collected, when available, at each of the above points, primarily from mature trees of the dominant canopy species, cypress (*Taxodium distichum*) or black gum (*Nyssa sylvatica*) present at each site. Biological parameters were divided into short-term and long-term indicators as follows:

Short Term Indicators:

- Upper moss limit
- Lichen line

Moderate-Term Indicators:

- Upper adventitious root crown of fetterbush (*Lyonia lucida*)

Epiphytic lichens and mosses live on the trunks of trees. Lichens live above the water, while mosses require regular inundation. Fetterbush is an understory plant that sends out adventitious roots from a portion of its lower stem when regularly inundated. These roots respond much more slowly than the lichens and mosses to changes in water elevations. Thus, they are considered here to be moderate term indicators of water level. Lower limits of lichens, upper limits of mosses, and maximum elevations of fetterbush root crowns are indicators of seasonal high water conditions (Hale 1984, Hull et al 1989). These three sets of plants form an elevation hierarchy that create one approximate indicator of short-term (less than 5 year) wet-seasonal high-water ranges. The elevations of these plants approximate the Minimum Frequent

High (mosses and fetterbush) and Minimum Infrequent High (lichen line). The Minimum Frequent High as defined by SJRWMD is the same value as that defined as the Normal Pool elevation by the South West Florida Water Management District (Hull et al 1989).

Mosses require periods of inundation, and so are more typically located within the typical high water seasonal elevations (approximately 10 to 15 percent stage duration). Lichens have a radial growth rate estimated at 4 to 5 millimeters (mm) per year and will die as a result of prolonged inundation (1 to 2 weeks submergence: Hale 1984). Thus, they occur at the high end of the inundation pattern (Hull et al 1989), in the neighborhood of 5 percent stage exceedance elevations. Fetterbush root crowns reach down to the water and so the top of the root crown may grow above typical wet season inundation levels.

Long-term Indicators

Vegetation

- Lower buttress point
- Upper buttress point

Buttressing is characterized by an enlarged diameter of the base of a tree trunk. The purpose of buttressing in swamp trees is unclear. Buttressing may benefit the ability of the plant to remain standing and growing in the fluctuating water levels and remain upright in the unconsolidated and often inundated soils in which they grow. Alternatively, they may develop as a physiological response to flooding (Hook and Schultens 1978). The elevations of the top or upper (point of continuous circular main trunk) and bottom or lower (point of buttress slope reduction) points of the buttress may be an indicator of very infrequent (less and every 5 years) high water elevations in the swamp (Davis, 1973; Sonny Hall, personal communication 2001). The elevation range for the lower buttress point is expected to approximate the Minimum Frequent High and the upper buttress point is expected to approximate the Minimum Infrequent High.

Soil

The Soil Survey of Volusia County (Baldwin et al. 1980) shows the main area of Bennett Swamp to be Samsula Muck. The soil is described in that document as “very poorly drained nearly level organic soil [that] occurs in broad low flats, small depressions, freshwater marshes, and swamps… Typically the surface layer is about 9 inches of black muck underlain by 27 inches of dark reddish brown muck…The water table is at or above the soil surface except during extended dry periods…”

The field team (Bill Dunn, Robert Epting, and David Stites) measured organic matter surface layer thickness along a gradient of water depth, and converted those depths to elevations based on the elevation collected from the staff gauge at each site.

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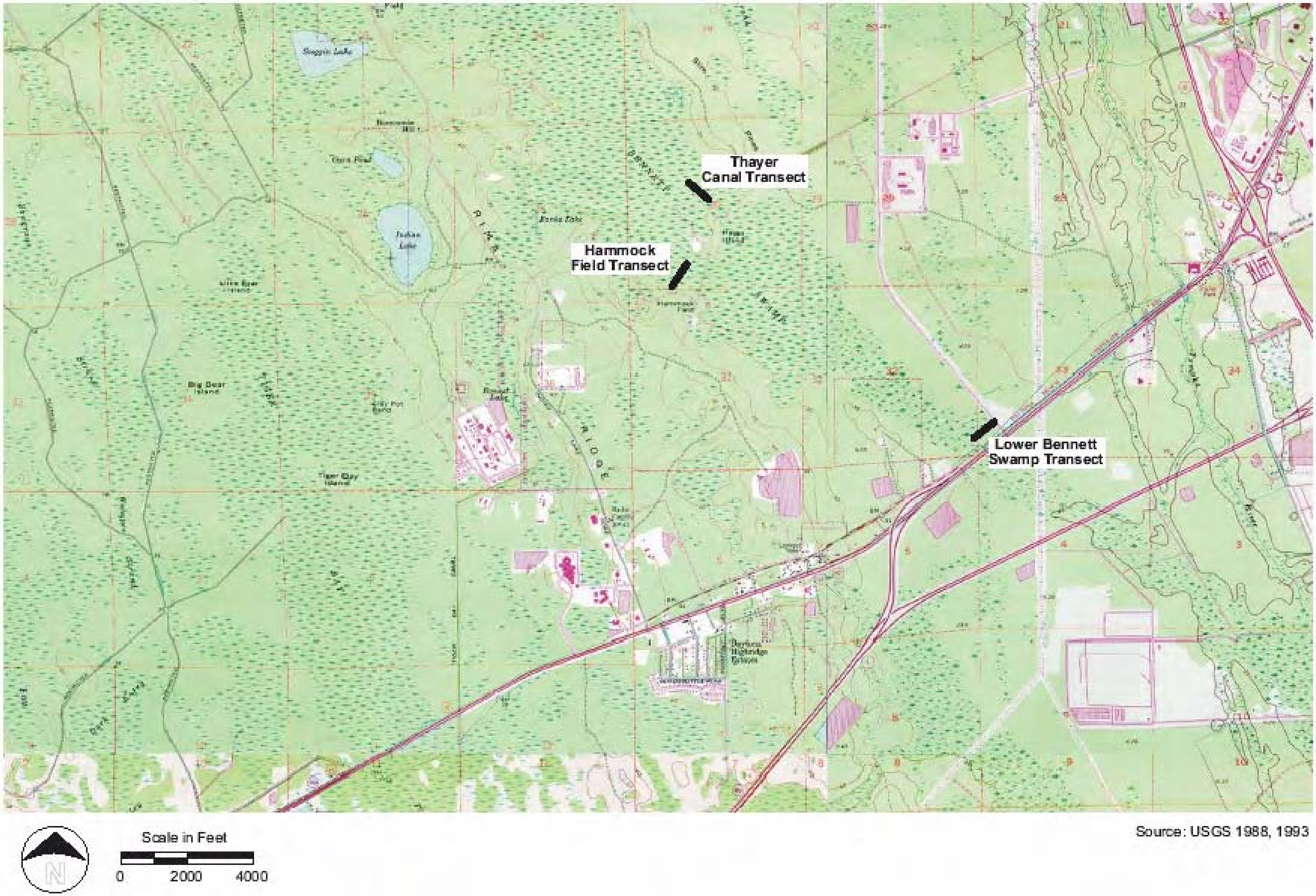

Source: USGS 1988, 1993

Figure 1. Bennett Swamp Project Location, Volusia County, Florida

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Evaluation of Pine Plantation Elevations

The Florida Department of Forestry (DOF) manages pine plantations on the borders of Bennett Swamp and is concerned that changes to the hydrology of Bennett Swamp not damage its plantings. This concern was evaluated by surveying transects located during a meeting with DOF staff directly responsible for the area. The survey transects were specifically identified on the ground by a CH2M HILL wetland scientist, who staked a transect line that traversed the planted pine/wetland edge with the edge of pine specifically marked. Survey points were taken at that stake and at points on either side to establish elevation changes along the survey line (Figure 2). The resulting data were compared to the existing stage duration curve and the historic (target) stage duration curve to assess the likely hydrologic result on the pine plantation area of changing the stage duration curve in Bennett Swamp.

Analysis

Standardized methods for relating hydric soil characteristics to specific points or intervals along the stage-exceedance cure are under development by the Minimum Flows and Levels (MFL) group at SJRWMD (Sonny Hall, personal Communication 2001). The analysis approach employed here is a shortened version of the methods used by SJRWMD for development of Minimum Flows and Levels (e.g. Mace, 2001 to estimate the Minimum Average water elevation and the Minimum Frequent Low water elevation.

The development of a surficial organic horizon along a hydrologic gradient can be used as one indicator of stage duration conditions along that gradient. SJRWMD scientists have correlated characteristics of organic soil horizons to specific hydrologic regimes using long-term hydrologic records. These methods were used to develop a simple model of hydrologic conditions in Bennett Swamp, estimated using the relationship developed between depth of organic horizon and elevation in the swamp:

- Estimate of Minimum Average water level
  - Average of elevations at 8 inches and 16 inches surface organic soil less 0.25 feet
  - Minimum Average (SJRWMD 2001)
  - 55 percent to 60 percent of stage duration curve
- Estimate of Minimum Frequent Low water level
  - Average of elevations at 8 inches and 16 inches surface organic soil less 1.66 feet (SJRWMD unpublished data and professional opinion based on Clayton and Neller 1943, Stephens 1974)

A mean water elevation no lower than 0.25 ft below the mean surface elevation of organic soils has been used to protect peat soils in south Florida (Stephens 1974SJRWMD and professional opinion based on unpublished data). This same depth below the muck surface has been found to correspond to the water elevation exceeded about 50 to 60% of the time (Brooks and Lowe 1984; Hall, 1987). The Minimum Frequent Low elevation was estimated in a similar fashion, as the mean organic soil elevation described above minus 1.67 feet. This is considered a minimum dry season depth necessary to maintain the organic soil profile and other wetland functions and structures (Mace 2001). The minimum Frequent Low has been found to occur at about the 75 to 90% stage exceedence ranges (Sonny Hall, Personal Communication 2001).

Following the SJRWMD Minimum Flows and Levels assessment protocols the mean elevation of the organic soil was estimated as the average of the elevation of the histic epipedon (an organic layer of 8 inches) and the beginning of a true histosol soil (an organic layer of 16 inches in depth). Measured organic soil depths were regressed against their respective elevations to calculate the elevations of exactly 8 and 16 inches of organic horizon. The stage-exceedance percent values related to each of the elevations were then calculated by interpolating stage exceedance data provided by Freeman (2001).

Mean values for the elevations of biological parameters measured at each site were calculated and compared to one another and to stage-exceedance curves provided by Freeman (2001). Stage exceedances for these values were also calculated

The suite of soil and vegetation indicator elevations were placed on the stage exceedence curves and compared to the expected stage exceedances from the literature and the District's other MFL-related investigations. Differences were related to changes in the hydrologic regime in the swamp.

Results and Interpretation

Elevation information from CH2M HILL (2000) describes the basic topographic position of the site. These data were the basis for calculation of elevations of the topographic, vegetative and soil indicators in this technical memorandum (Table 1 and Table 2).

TABLE 1
Physical Elevation Information for Each Sample Site Within Bennett Swamp

			Ground Elevations at Measurement Devices			
Site	**Groundwater Low**	**Groundwater High**	**Wetland Staff**	**Wetland Well**	**Upland Staff**	**Upland Well**
Lower Bennett	21.14	27.24	26.48	26.54	27.45	27.54
Thayer Canal	22.24	28.22	26.54	26.74	29.39	29.54
Hammock	22.44	28.45	26.89	26.94	28.34	29.14

All elevation values are in reference National Geodetic Vertical Survey (NGVD 1929 datum).

Biological Indicators

Average elevations of the biological indicators provided the best measures of the existing and historic conditions in the swamp for the upper end of the stage duration curve (Table 2). Not all indicators were found at each of the three sites. For example, no buttress measurements were made at the Thayer Canal transect location (due to logistic constraints). Buttress data include information from bald cypress and black gum trees the dominant canopy species. The sample size was insufficient to assess any potential differences between the two species' data.

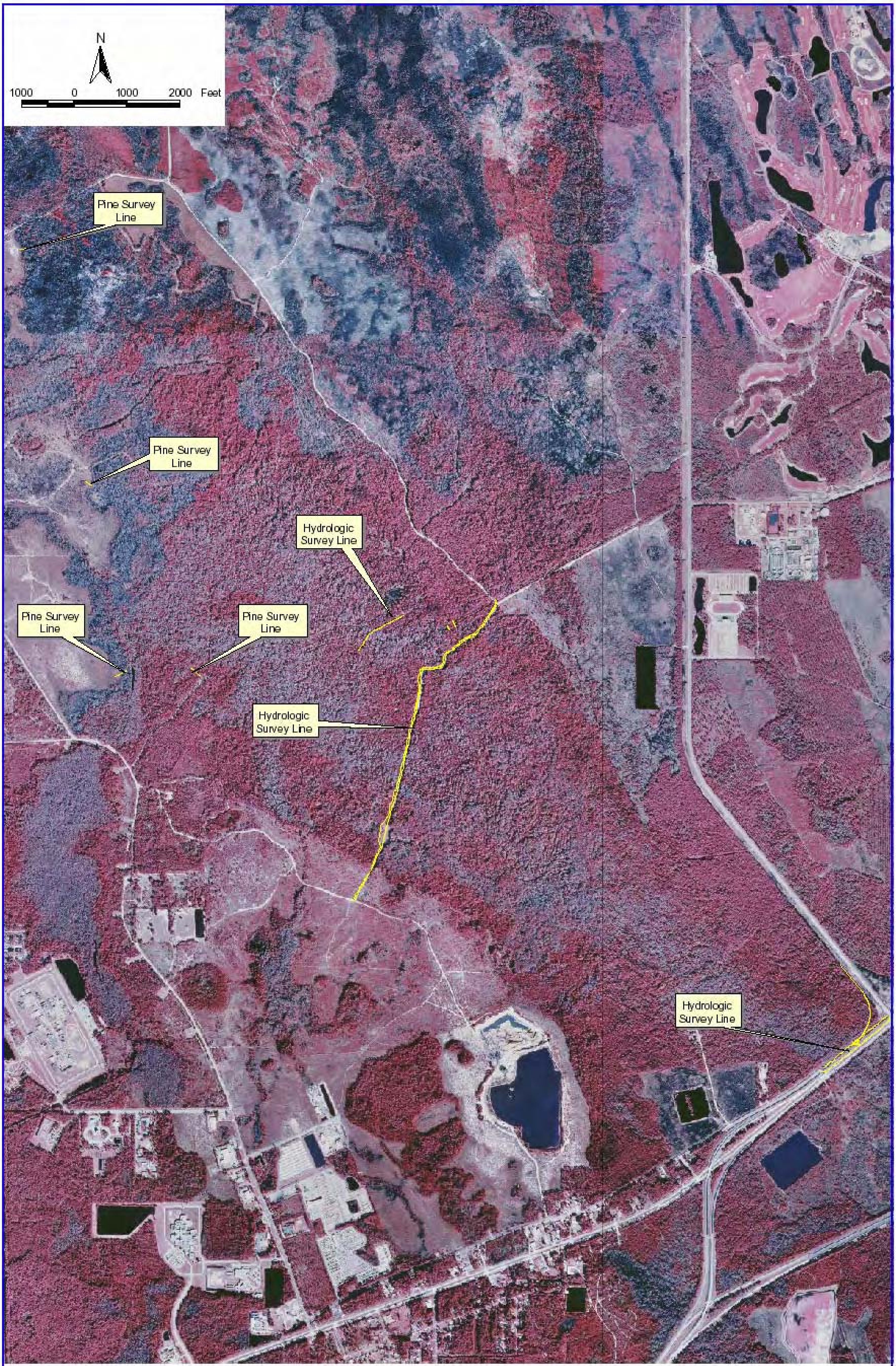


Figure 2
Location of Hydrologic and Pine Plantation Survey Points in Bennett Swamp

TABLE 2
Average Elevation of Biological Indicators for Each Sample Site (NGVD 1929)

	Moss Lower Limit	Lower Lichen Line	Fetterbush Root Crown	Lower Buttress Point	Upper Buttress Point
Lower Bennett	27.4	27.9	28.0	30.1	30.9
Thayer Canal	28.3	29.6	29.8	NA	NA
Hammock Field	28.7	29.6	30.0	32.1	33.1

The raw data are provided as an appendix.
NA indicates that the data were not available for that parameter at that location.

Data was collected from each of the three transects established to assess biological changes (CH2M HILL 2000). The vegetation indicators behaved consistently within a site (Figure 3). Mosses were found at the lowest elevations, followed by lichens and fetterbush. Lichen lines were very close to the minimum elevation of fetterbush root crown tops.

Comparison of all individual elevation data (Figures 3 and 4a, 4b) shows that the data are consistent across sites. The Lower Bennett Swamp transect, about 2 miles downstream from the other two transects is downslope of the other two sites approximately one foot in elevation. This is reflected in the elevation of the indicators. The range of water elevations (maximum water elevation and minimum groundwater elevation) recorded since the initiation of the study includes the moderate and short-term indicators (mosses, lichens, fetterbush root crowns) and suggests that they are within reasonable elevation ranges of one another.

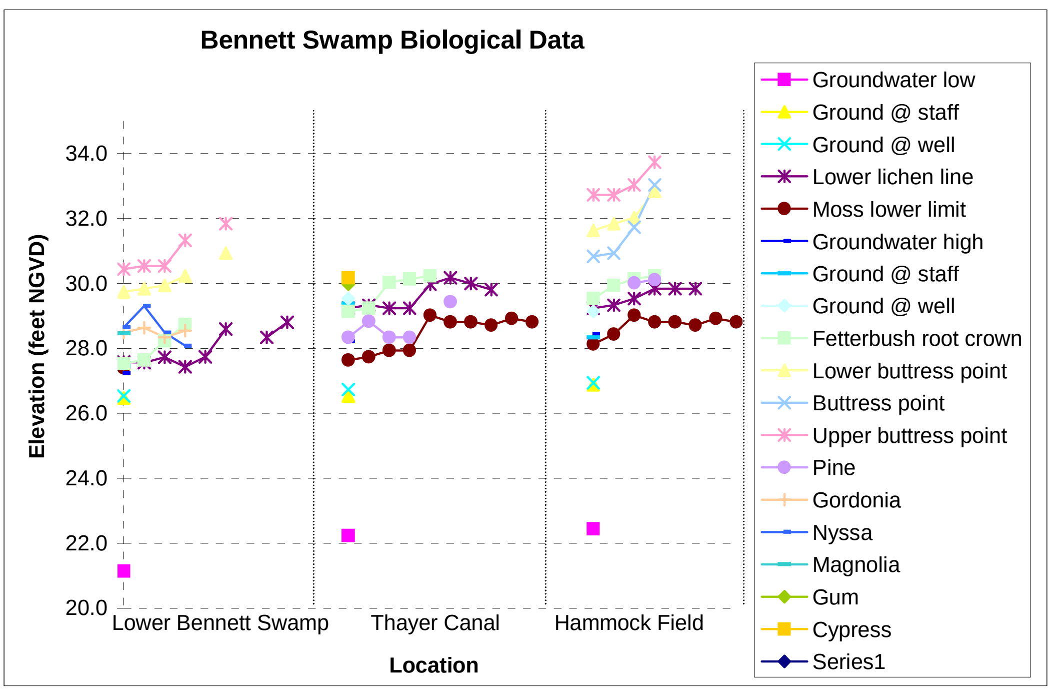


FIGURE 3
Elevations of Biological Indicators Measured at the Three Transects in Bennett Swamp

Comparison of Biological Indicators and Stage Duration Curves

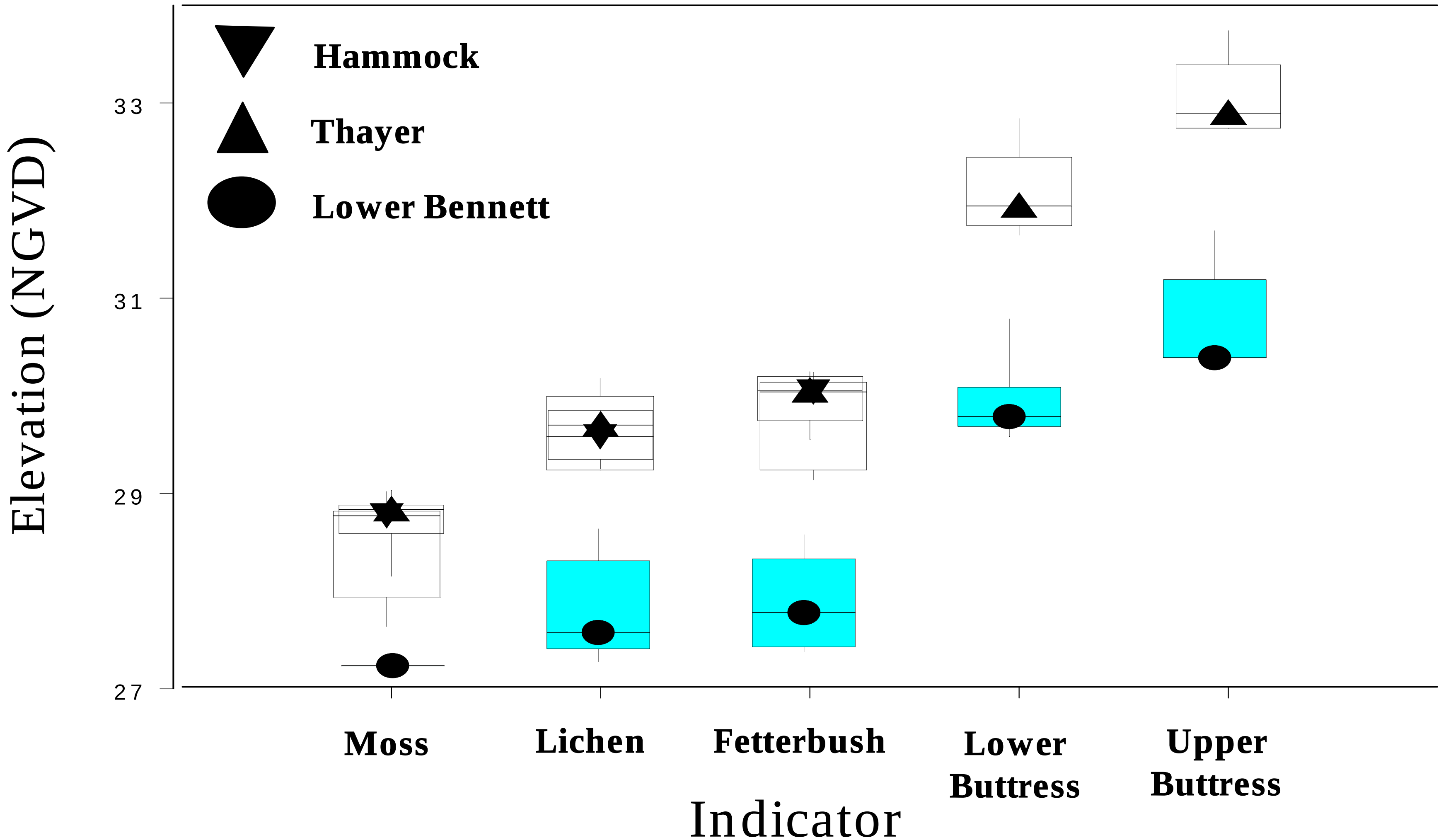
Stage duration curves for each transect (SJRWMD 2001) were simulated for pre-pumping conditions (historic elevation duration curve) and recent conditions (1988 duration curve).

At the Thayer Canal site (Figure 5), the 1988 simulation falls rapidly away from the historic simulation at about 3 percent exceedance, and is about 0.51 feet below the modeled historic elevation at 50 percent exceedance. Comparison of average elevations of biological indicators at each site to their respective stage duration simulations (Figures 5, 6, and 7) suggested that hydrologic impacts had occurred.

- The Thayer Canal Transect results (Figure 5) showed the greatest change in conditions with respect to the historic and 1988 stage simulations. The moss line and lichen lines are expected to lay around the 10 to 15 percent and 1 percent to 5 percent stage exceedances respectively, with fetterbush at a slightly higher elevation than the moss line. The expected elevations are more than 1 foot higher than their present positions on the simulated 1988 hydrograph. Further, the mosses and lichens have shifted relative to the fetterbush, indicating that at least in the short term there has been a reduction in stage-exceedence elevations toward the upper end of the scale.
- Hammock Field data (Figure 6) suggest that water levels are less than a foot lower than elevations provided by the stage simulation, not as great a difference as in the Thayer Canal data.
- The distribution of biological data with respect to the stage duration curve was not consistent for Lower Bennett Swamp (Figure 7). The results suggest that the current stages are greater than either 1988 or historic simulations. Given the visual appearance of the site (hummocked appearance, loss of organic soil layer, etc.) this does not seem likely. The more likely explanation is that the simulated hydrology is inaccurate due to insufficient topographic information on which to base the modeling.
- Buttress elevations suggest that water level maxima have remained similar through time. Buttress elevation ranges are in line with both historic and 1988 simulations.

The overall conclusions based on the plant data are as follows:

- The assumption that the 1988 data are roughly representative of the current condition is not supported for the larger portion of the hydrologic simulations.
- Buttress information suggests that historically, low-frequency events (less than 0.5 percent) typically occur at water elevation in the range of 32 to 33 feet NGVD for the Hammock Field site, and about 1.5 feet below that at the lower Bennett Swamp site.
- The 5 to 10 percent duration elevations for the area associated with Thayer Canal and Hammock Field transects should be at approximately 30 feet NGVD.
- The 5 to 10 percent duration elevations for the area associated with Lower Bennett Swamp should be approximately 28 feet NGVD.



`FIGURE 4A. . Biological indicator data from each site are provided as box and whisker plots, overlapped for comparison. Hammock figure is denoted by a triangle on the median line; Thayer Canal by a rectangle on the median line, and Lower Bennett Swamp with a filled circle on the median line. Slight changes in the shape of the box and whisker plot accompanies the different length width ratio in this figure, and box and whisker plots of indicators from the three transects may not completely overlap due to plotting software.

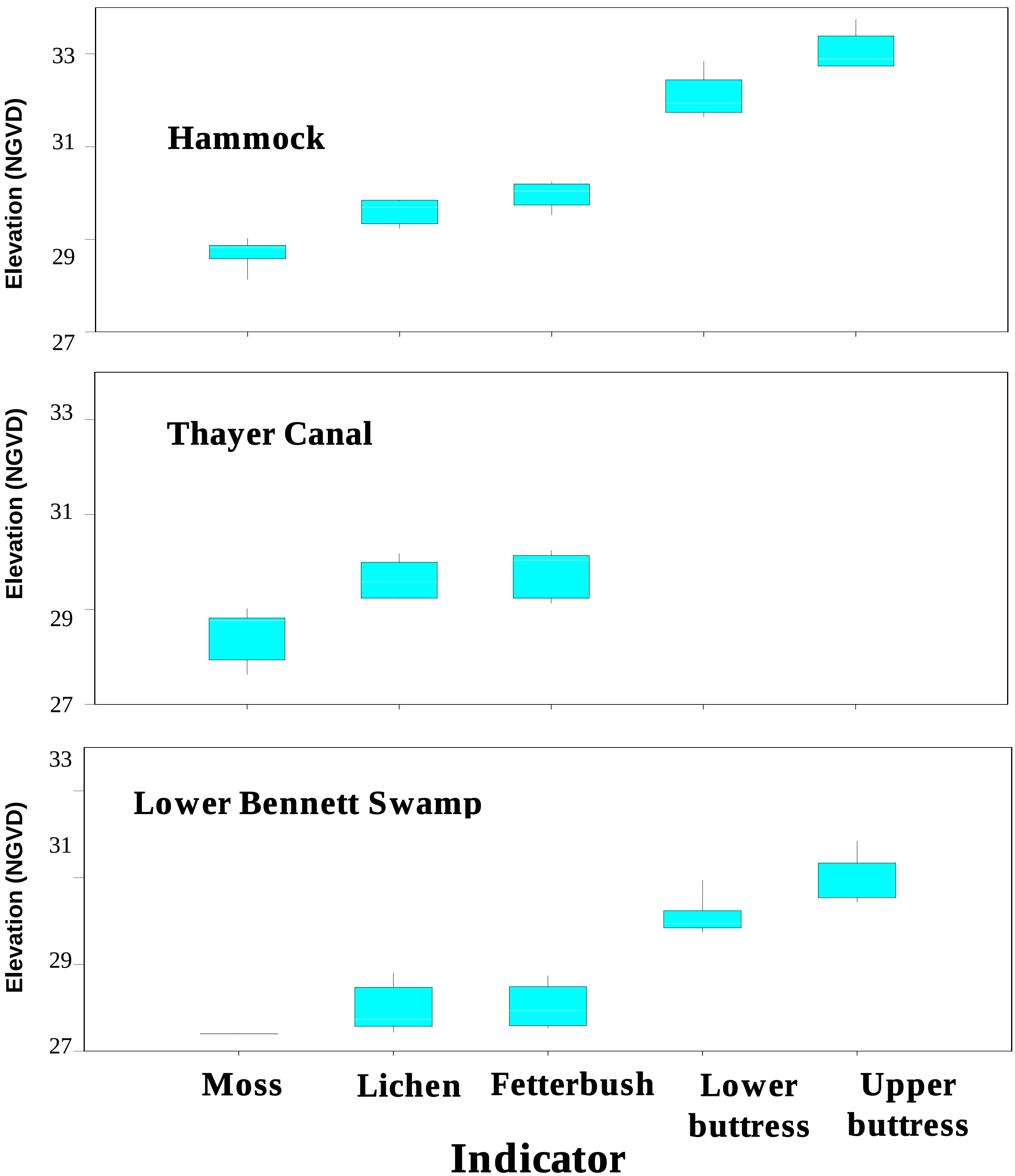


FIGURE 4B

Comparison of Biological Indicator Elevations along Biological Transects in Bennett Swamp

Note: Biological indicator data from each site are provided as box and whisker plots. The white line within boxes indicate the median; the top and bottom of the boxes indicate the first and third quartiles; and the bars on the top and bottom of the boxes indicate maximum and minimum elevations.

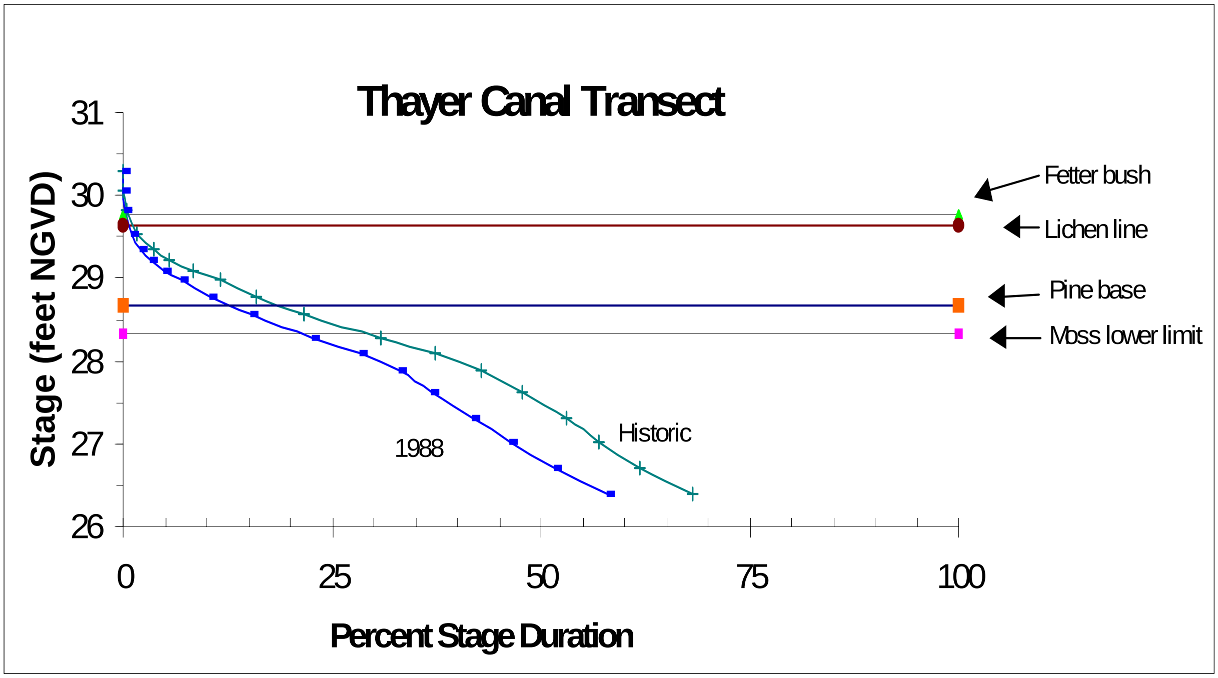


FIGURE 5
Comparison of Simulated Stage Data at Thayer Canal to Biological Indicator Data Ranges

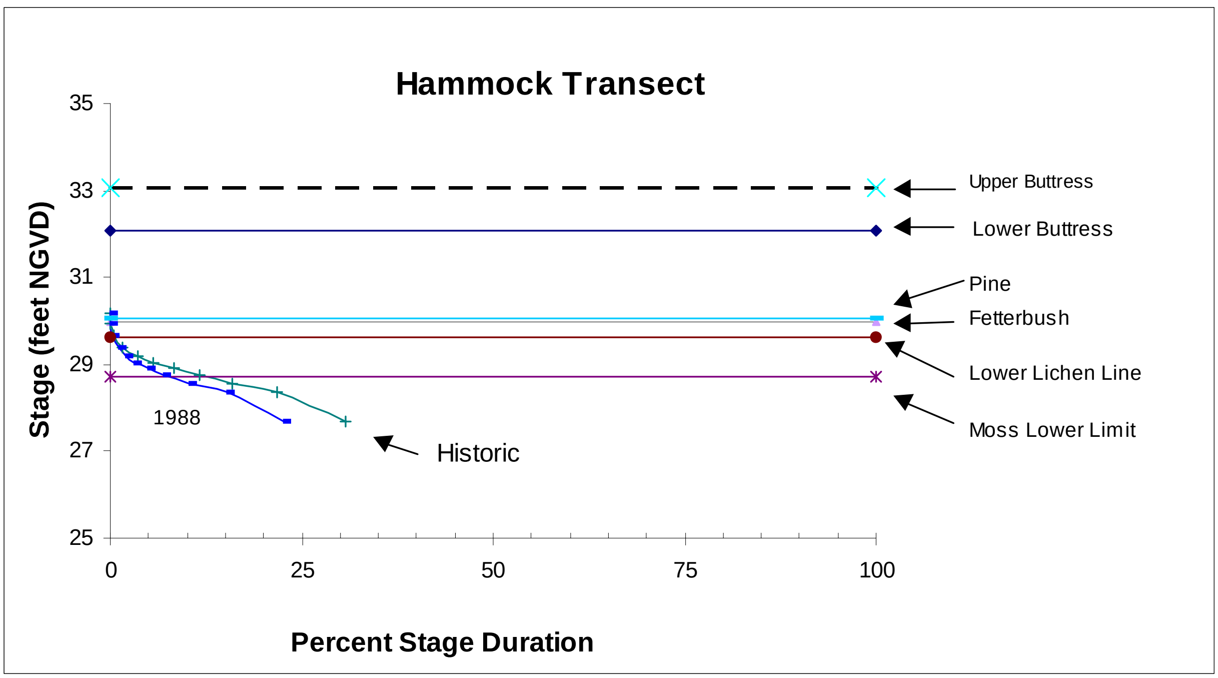


FIGURE 6
Comparison of Simulated Stage Data at the Hammock Field Transect to Biological Indicator Data Ranges

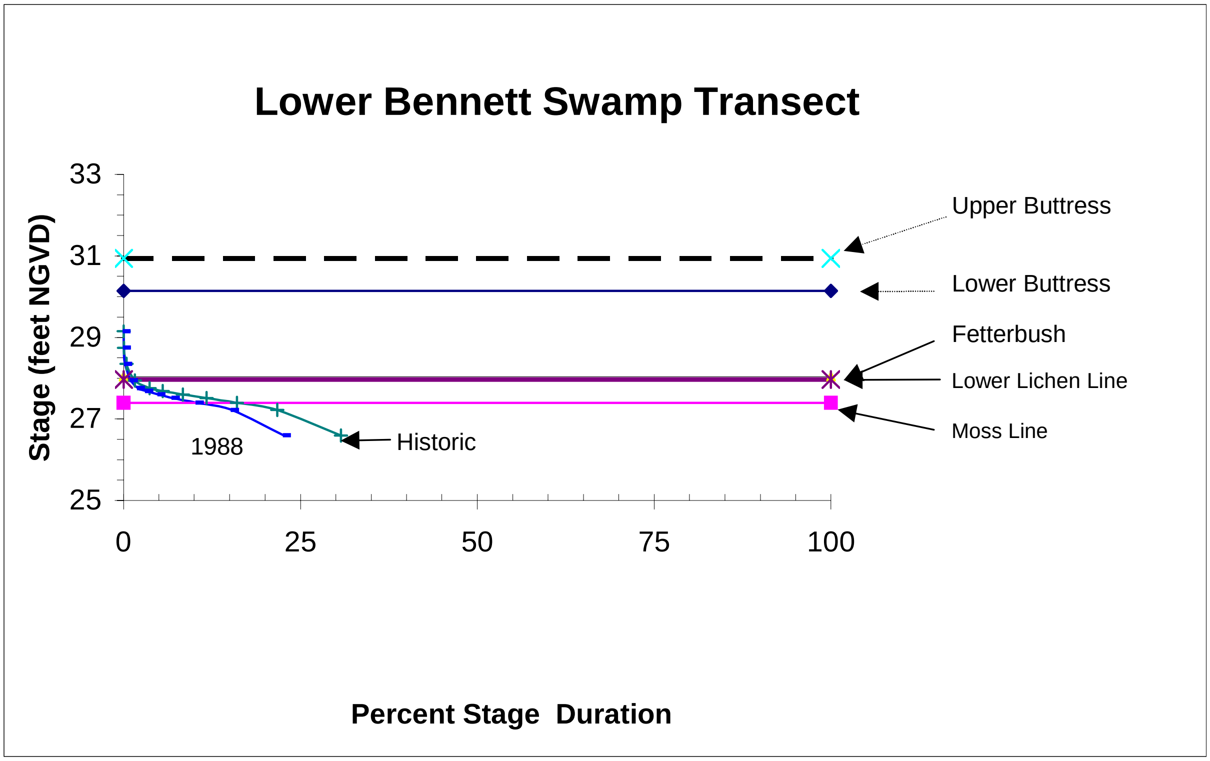


FIGURE 7
Comparison of Simulated Stage Data at the Lower Bennett Swamp Transect to Biological Indicator Data Ranges

Soil Indicators

Depth of the surficial organic soil horizon were measured along the transect line at several points with varying water depths. Those water depths were used to provide a soil surface elevations for each point. The organic layer depths were regressed against the elevations (Table 3A, Figure 8).

Considering that the Thayer canal stage duration curve best reflected biological indicators, the Thayer Canal soil data were used to assess the hydrologic implication of soil organic matter depths along the elevation gradient. The elevations at 0, 8, and 16 inches of surface organic soil layer were estimated from the soil–elevation regression (Table 3). Because surficial topography of the organic and underlying mineral horizons can be uneven, the relationship between the organic horizon depth and elevation may vary considerably from point to point within the swamp. This is particularly apparent for Hammock Field data, which were poorly organized along the transect gradient (Table 3A, Figure 8). Thayer Canal and Lower Bennett Swamp soil depth and elevation data were well modeled.

Analysis of organic soil horizon data suggests that the modeled historic stage exceedance curve is lower than the soil-predicted elevations. The estimated minimum average value of 28.1 feet is 28.4 percent stage exceedance rather than the 50 percent to 60 percent point expected. The minimum frequent low estimate, 26.7 feet, is at the 51.6 percent level rather than near the expected 85 to 90 percent points (Table 3B).

TABLE 3A
Soil Organic Matter Gradients with Elevation in Bennett Swamp (Regression Statistics)

Regression	Thayer	Hammock Field	Lower Bennett
R^2	0.96	0.04	0.93
Slope	-0.84	-0.43	-0.83
Intercept	24.67	13.01	23.00

TABLE 3B

Soil - based hydroperiod elevation estimates for Thayer Canal transect: soil data-based estimates compared to 1988 stage exceedance data

Calculated Elevation of Histosol (16")	Calculated Elevation of Histic Epipedon (8")	Elevation of Minimum Average.	Min Avg. Percent Exceedance (1988)	Elevation of Minimum. Frequent Low	Min Freq. low percent-exceedance (1988)
28.0	28.7	28.1	28.4%	26.7	51.6%

Elevation values are in feet NGVD.

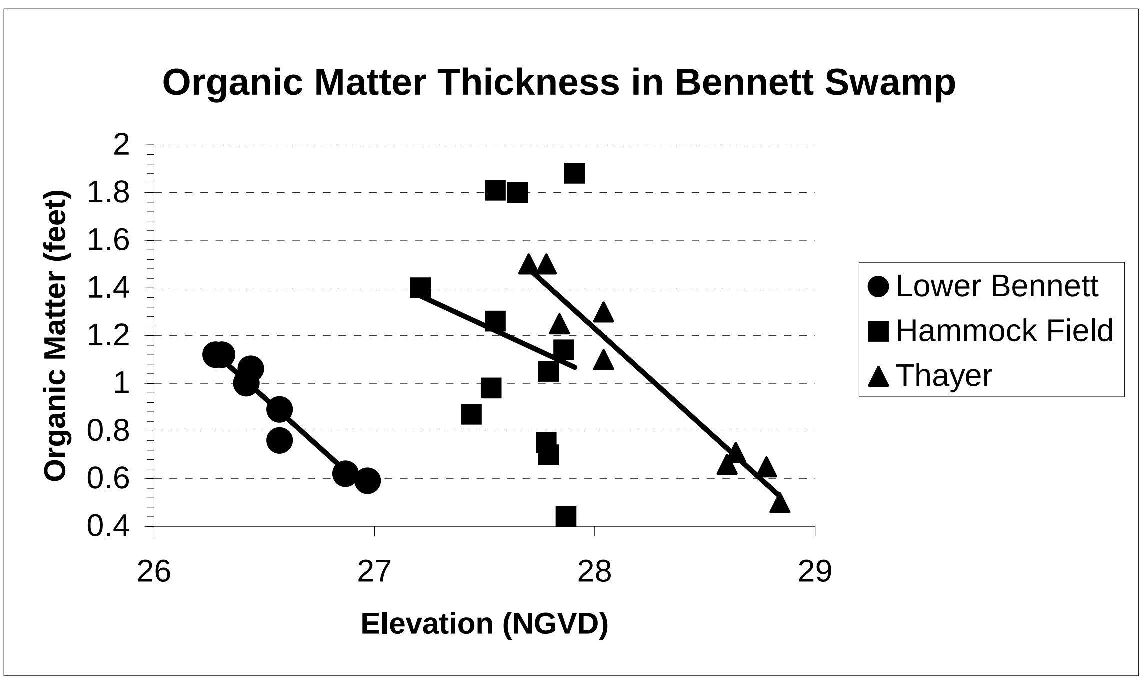


FIGURE 8
Regression of Thickness of Organic Matter and Elevation at Bennett Swamp Transect Sites.
Note: Table 3 provides regression statistics.

Estimation of Elevation Changes in Bennett Swamp

Soil and biological data were overlaid on the stage-exceedance curves to provide an estimate of the range of the change in hydrological regime at the 50% to 60% and 10% to 20 % stage exceedance ranges. We chose the 50% point on the curves for comparison because higher percentage values were not available for the 1988 and 2010 simulations. The estimates were calculated in the following fashion:

Soils

Because we chose to use only the Thayer Canal soil data, and had collected a limited amount of information, we chose to bracket our estimate of the minimum levels by using the elevations of the histic epipedon and histosol rather than the average of the two. From the regression-calculated elevations of the histic epipedon and the histosol soil were subtracted 0.25 ft and 1.67 feet (Table 3). The two resulting values for each set of final values were used to provide a range of values for the minimum average and minimum frequent low. This evaluation assumed that the organic soils exposed by lowered water conditions were oxidizing at a rate that would result in the soils remaining after the hydrologic change had occurred. Therefore, the soils reflect an earlier, more elevated hydrology and not the present condition.

The percent exceedance values for each elevation were calculated by interpolation from the historic stage-exceedance data provided Freeman (2001). These values were then plotted on the historic hydrograph (Figure 9).

We used percent exceedance ranges of 45% - 65% for the Minimum Average stage-exceedance value, and about 75% – 90% for the Minimum Frequent Low as the expected values The histic epipedon and histosol elevations were then projected onto those percent exceedance values to assess where the historic curve might fall (Table 4 and Figure 9: Expected Minimum Average and Expected Minimum Freq. Low). Once the soil indicators for MA and MFL were plotted in the expected positions on the stage exceedance curve an approximation of the historic condition provided by these data was sketched (Figure 9:soil-estimated historic curve).

TABLE 4 Calculated and expected stage exceedance values for soil data-based estimates of minimum frequent low and minimum average
Note that the soil data are expressed as the elevation range from the histic epipedon elevation to the histosol elevation. Stage exceedance data were calculated by interpolation from the historic stage exceedance .v elevation curve provided by B. Freeman, December 2001.

Elevation	Historic % Exceedance	Expected % Exceedance	Comment
Min. Average = X-0.25 ft			
27.75	45.18	65%	Histosol elevation basis
28.45	24.84	45%	Histic epipedon elevation basis
Min. Freq. Low = X- 1.67 ft			
26.33	>70%	75%	Histosol Elevation basis
27.03	56.9%	90%	Histic epipedon elevation basis

Vegetation

Vegetation data for the buttresses, lichens, and fetterbush were in the region of the curves (historic, 1988, 2010) where the stage exceedance curves are quite similar. The data plotted approximately where they might be expected to be observed in terms of percentage exceedance, but we recognize that the curves are simulations; thus these results must be carefully interpreted.

The moss data however are typically located in the region of the stage exceedance curve that is likely affected, and we plotted the data for the vegetation against the 1988 (the curve believed to be closest to the existing condition) and also estimated the expected stage location position of the data (Table 5 and Figure 9: red and yellow points).

TABLE 5. Calculated and expected stage exceedance values for vegetation indicators.
Stage exceedance data were calculated by interpolation from the historic stage exceedance .v elevation curve provided by B. Freeman, December 2001.

		Stage Exceedance		
Vegetation	**Elevation**	**Historic % Exceedance**	**1988 % Exceedance**	**Expected % Exceedance**
Moss lower limit	28.3	30.1	22.0	10% – 15%
Fetterbush root crown	29.6	0.4	0.2	5% - 10%
Lower lichen line	29.8	1.3	0.7	1% - 5%

Evaluation of Pine Plantation Elevations

Pine plantations borders were surveyed at four points on the west side of Bennett Swamp. Figure 2 shows the locations; Table 4 summarizes the results. The survey indicated that the pines are well above the existing flood conditions, and that a stage change of 1 foot in the 5 percent or greater stage exceedance elevations should have no effect on the condition of the pines.

From north to south in Figure 2, the planting edge on each of the four transects is in the less than 1 percent stage frequency exceedance range for both the Thayer Canal and the Hammock Field stage duration curves. The plantation borders are also above the base elevations of pines found along the transects in the swamp (Figures 5 and 6).

TABLE 4
Elevation of Pine Plantation Borders on the West Side of Bennett Swamp See Figure 2 for transect locations in Bennett Swamp.

Transects from North to South	Elevation at Planting Edge	Elevation Range of Survey Line
1	30.05	28.86 – 32.17
2	33.13	32.17 – 34.73
3	30.84	29.66 –31.85
4	30.56	30.12 – 30.84

All values are feet NGVD

Discussion

That there are discrepancies between the biological (soil and plant line) data and the hydrologic simulations is not surprising. As noted in Hydrologic Information (above) there are no stage data for Bennett Swamp and the information used to model historic and 1988 conditions was based on sites upstream and downstream of the system entry and exit flow points. We consider the soil and biological information more accurate in the sense that these indicators are directly reflective of both historic and existing conditions, while the simulations are adjusted estimates of conditions at other points in the larger system. The hydrologic analysis indicated that there was likely impact. The vegetative indicator and soil data support differences in the hydrologic simulations, and suggest that greater impacts have in fact occurred.

The various sources of data suggest a range of possible impacts to the hydrology of Bennett Swamp.

- The hydrologic simulations suggest that 3/4-foot or more has been lost from the system at the midrange of exceedence percentages (Figure 9: Yellow zone B - C). The bottom elevation of Thayer Canal at the eastern side of Bennett Swamp (24 feet NGVD: Freeman, 2001) might contribute to this result.

- The soil data (Figure 9:) suggest that the historic elevation simulation is an impacted condition, given that the soil oxidation has lagged behind the reduction in stage. The soil based expected stage exceedance estimates suggest an historic elevation different from the 1988 data by about 1.75 feet (Figure 9: Yellow zone – A - C)

- The moss lines suggest that the present condition is impacted beyond the 1988 condition, or a possible impact of about 2 feet (Figure 9: Yellow zone: A -D).

  Hull et al (1989) provided elevation relationships for fetterbush, lichen and mosses (elevation relationships in Figures 3b, 4b, 5b, 6b, 7b, 8b of Hull et al. 1989). In that study, lichen lines were higher than upper moss line and Fetterbush root crown by about 0.3 – 0.6 feet. The moss line was close to but slightly lower than Fetterbush.

  In Bennett Swamp, the fetterbush and lichen lines are at approximately the same level. The moss is lower than the other two indicators by between 0.5 and 1.4 feet, if one examines all three transects (Figures 4a and 4b). Since the fetterbush root crown changes up or down on the stem only very slowly compared to moss and lichen edges, it appears that the moss and lichen elevations have moved lower with respect to the fetterbush root crown. The expected percent exceedance for these lines is 10% to 15%, while the percent exceedance for the moss on the 1988 curve is 22.1%. The moss appears closer to the 2010 curve than to the 1988 or historic curves (Figure 9). If the moss elevation is another, independent indicator of hydrologic conditions, the potential reduction in water elevations of the minimum average exceedance is almost 2 feet (Figure 9: yellow zone, A – D).

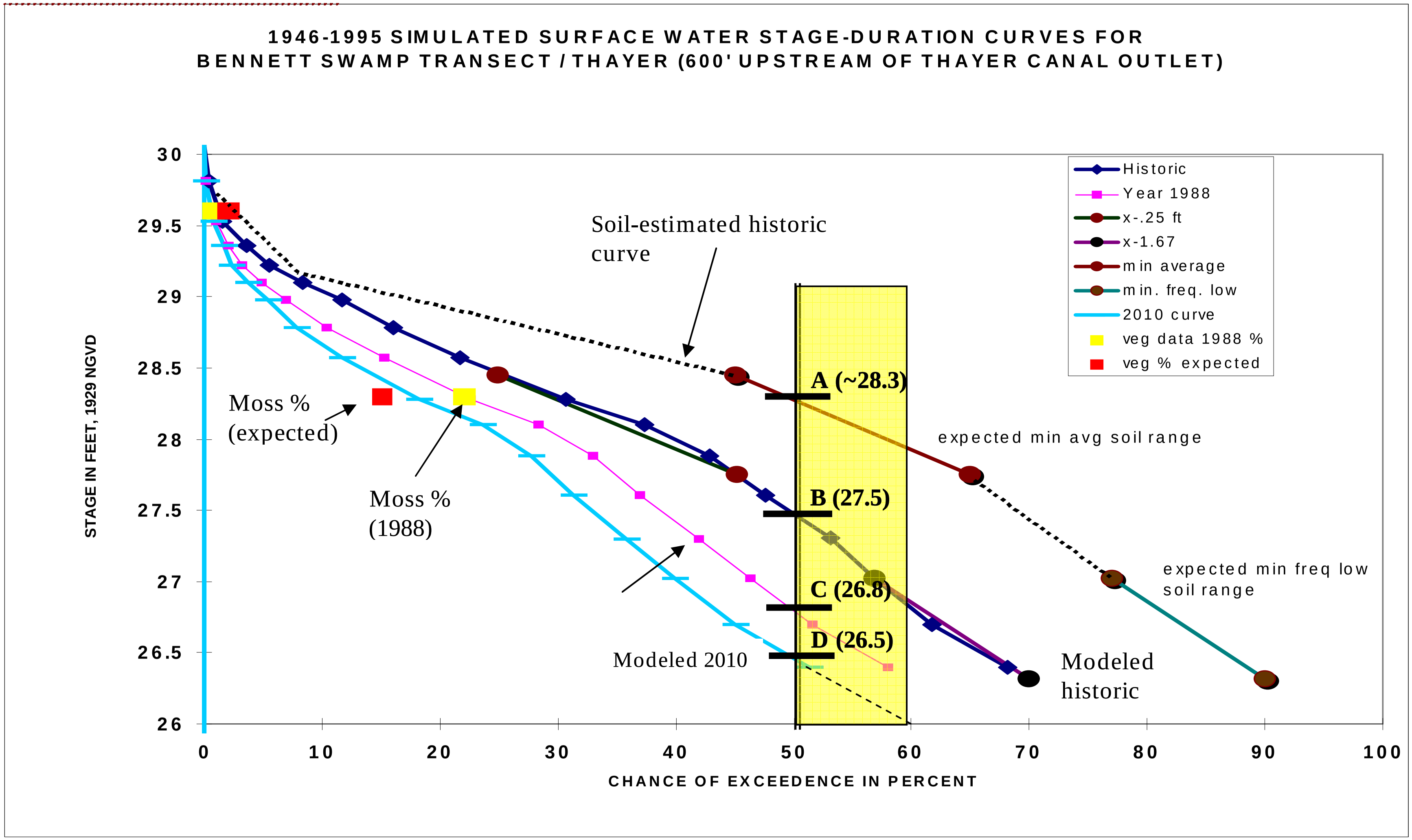


FIGURE 9. Estimation of possible elevation changes between about 15 and 60% stage-exceedance values in Bennett Swamp. Yellow zone shows the minimum average elevation zone for each curve (estimated from soil, historic, 1988, and 2010). Dotted lines on the curves projected, not calculated, ranges of a curve.

Southwest Florida Water Management District studied elevation ranges of biological indicators of high water levels in isolated cypress swamps in the northern Tampa Bay area (SWFWMD 2001). The study supports the proximity of the mean elevation of moss and fetterbush lines reported by Hull et al. (1989), but also suggests that these two indicators should lie close to the lower buttress elevation. The lower buttress points in Bennett Swamp, however, lie considerably higher than the moss and fetterbush lines. This difference may reflect long-term changes, since buttress geometry does not change in response to a reduced stage curve, but the other biological indicators can migrate downward. A note of caution: buttress characteristics may differ between isolated cypress wetland in the Tampa area and a large flow-through wetland system like Bennett Swamp.

Conclusions and Recommendation

Despite the variability in the data, there is a sufficient, consistent pattern in the information to draw preliminary conclusions and make a recommendation concerning a rehydration target. The hydrologic simulations, vegetation, and soil indicators demonstrate that the hydrology of Bennett Swamp has been impacted. Causal factors likely include surface water drainage alterations and ground water withdrawal and changes may have begun prior to the operation of water supply wells.

Using the Thayer Canal information as the most accurate indicator, the following changes can be estimated:

- The hydrologic simulations provided by Freeman showed a reduction of between ½ and 1 foot at the 50 percent to 60 percent stage exceedances for the modeled historic and 1988 conditions. We suggest, however, that the modeled conditions do not represent pre-disturbance and current conditions, respectively, but rather that the historic conditions were already impacted by the presence of Thayer Canal, and that the current condition is more impacted than suggested by the 1988 simulation.
- For the soil data, a stage reduction of 1.75 feet of the minimum average elevation (approximately the 55 to 60 percent stage duration) was estimated as the difference between pre-disturbance, or at least pre-well field and current conditions.
- For the biological data, a stage reduction of about 5% –10% between the modeled 1988 and current conditions was indicated from moss lines, suggesting further that the 2010 stage duration curve was a likely model for these data, and that there has been a reduction in the elevation of the Minimum Frequent High condition.
- The combined data suggest a difference of at least one-foot and more likely between one and 2 feet of stage reduction at exceedances greater than about 15%, comprising the portion of the stage-exceedance curve that brackets the three minimum levels (Minimum Frequent High, Minimum Average, and Minimum Frequent Low) typically addressed in setting an MFL.
- The results suggest an appropriate initial rehydration target: Increasing the stage 1 foot at duration frequencies of 20 percent and greater will bring the hydrology toward the historic condition without harming the pine plantation resources located at the edge of the swamp.

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Appendix B
Memorandum of Understanding (MOU)

SH311AA
FDACS CONTRACT #

008560

MEMORANDUM OF UNDERSTANDING BETWEEN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, THE FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES, DIVISION OF FORESTRY AND VOLUSIA COUNTY, FLORIDA FOR THE OPERATION, MAINTENANCE AND PERFORMANCE MONITORING OF A SURFACE WATER CONTROL STRUCTURE ON THAYER CANAL IN BENNETT SWAMP, VOLUSIA COUNTY, FLORIDA

THIS MEMORANDUM OF UNDERSTANDING (MOU) is made and entered into on this 30th day of April, 2004 by and between the ST. JOHNS RIVER WATER MANAGEMENT DISTRICT (hereinafter "DISTRICT"), whose mailing address is 4049 Reid Street, Palatka, Florida 32177, THE FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES, DIVISION OF FORESTRY (hereinafter "DIVISION") whose address is 3125 Conner Boulevard, Tallahassee, Florida, 32399-1650, and VOLUSIA COUNTY (hereinafter "COUNTY"), whose mailing address is 123 West Indiana Avenue, DeLand, Florida 32720.

WITNESSETH

WHEREAS, DISTRICT and DIVISION are the joint owners of certain lands in Volusia County, Florida, that include an area commonly known as the Bennett Swamp; and

WHEREAS, DISTRICT, DIVISION and COUNTY (THE PARTIES) have under prior agreement caused a surface water control structure (Weir) to be constructed on said lands in the Thayer Canal, an artificial outlet of Bennett Swamp, Volusia County, Florida, for the purpose of controlling surface water levels and thereby detaining surface water in Bennett Swamp; and

WHEREAS, THE PARTIES to this MOU desire to operate, maintain and monitor the performance of the Weir; and

WHEREAS, the DISTRICT, the DIVISION and the COUNTY each have programmatic authority, and the COUNTY has established funding sources for the operation and maintenance of the constructed features of the Project; and

WHEREAS, the DIVISION is responsible for management of the Tiger Bay State Forest, which includes a portion of the Tiger Bay/Bennett Swamp area; and

WHEREAS, the DISTRICT has, through scientific study, established water level targets for rehydrating the wetland named Bennett Swamp, using biological indicators as the basis for Project operations; and

WHEREAS, the COUNTY is a county of the State of Florida and has established a stormwater utility for the purpose of managing stormwater, including the funding of stormwater project maintenance and operations, within its boundaries; and

WHEREAS, Weir operations must be in accordance with direction from the DISTRICT and not interfere with the DIVISION forest management objectives; and

WHEREAS, Weir maintenance must be continued over the life of the structure; and

WHEREAS, DISTRICT has obtained an Environmental Resource Permit (ERP) number 64-171851-005 from the Florida Department of Environmental Protection for the construction and operation of the Weir;

and

WHEREAS, COUNTY assumes responsibility for the continuing operation and maintenance of the Weir by execution of this MOU; and

WHEREAS, in so doing COUNTY will meet the needs and objectives of DISTRICT and DIVISION to provide for water control within the Bennett Swamp, and shall be acting as their agent for purposes of the Weir operations and maintenance and access thereto.

NOW THEREFORE, in consideration of the foregoing premises, which are made a part of this MOU, the DISTRICT, DIVISION and the COUNTY hereby agree to the following:

I. AUTHORITY

This MOU is entered into under the following authority:

A. The DISTRICT enters into this MOU under the authority of Section 373.083, Florida Statutes, which authorizes the Governing Board to enter into agreements with other public agencies to accomplish the directives and goals of Chapter 373.

B. The DIVISION enters into this MOU under the authority of Section 589.28, Florida Statutes, which authorizes county commissions and other municipalities to enter into cooperative agreements with DIVISION for providing assistance in forestry and forest-related knowledge.

C. The COUNTY enters into this MOU under the authority of Sections 125.01 (1)(k) 1 and 125.01(1)(p), Florida Statutes, which authorize the COUNTY to enter into agreements with other public agencies to accomplish goals for providing water service to its customers.

II. EFFECTIVE DATE AND TERMS

A. This MOU shall commence on the date of full execution and shall remain in effect for the life of the Weir, estimated to be thirty (30) years, or until dismantlement of the Weir at an earlier date mutually agreed upon by THE PARTIES.

B. This MOU shall be reviewed as necessary by THE PARTIES and may be amended upon mutual agreement of THE PARTIES. Amendments shall be in writing and approved by all parties.

C. The DISTRICT agrees to fund the environmental monitoring of Bennett Swamp for a period not to exceed five (5) years from the date of this agreement.

D. The COUNTY agrees to fund Weir operations and maintenance for the life of the Weir.

E. The DIVISION agrees to perform monitoring activities related to water surface levels within Bennett Swamp and their relationship to the DIVISION's planted pine tree plantations and other improvements upstream of the Weir.

F. The DISTRICT, DIVISION and COUNTY agree that all work shall be performed in accordance with EXHIBIT "A", STATEMENT OF WORK, entitled, "Operation, Maintenance and Performance Monitoring of a Water Control Structure on Thayer Canal, Bennett Swamp, Volusia County, Florida" attached hereto and incorporated herein.

III. PROJECT MANAGEMENT

A. Project Managers - Each party hereby designates the employee, or their successor, set forth below as its respective Project Manager. Project Managers shall assist with project coordination and shall be the party's primary contact person. Notices or reports shall be sent to the attention of THE PARTIES' Project Manager by U.S. mail, postage paid, to THE PARTIES' addresses as follows:

For the DISTRICT:	For the DIVISION	For the COUNTY:
James Gross, P.G. 4049 Reid Street Palatka, Florida 32177 Tel. (386) 312-2344	Cathy Lowenstein 5458 N. Hwy 17 Deleon Springs, Florida 32130 Tel. (386) 985-7820	Gary Cook 123 W. Indiana Ave. DeLand, Florida 32720-4262 Tel. (386) 943-7027 Ext 2309

IV. CHANGES IN SERVICE REQUIREMENTS

THE PARTIES to this MOU may at any time, by mutual written agreement in the form of an amendment to this MOU, make changes within the general scope of this MOU in the services or work to be provided.

V. TERMINATIONS

This MOU may be terminated for any reason by any party upon thirty (30) days written notice to the other parties.

VI. INDEMNITY AND INSURANCE

A. Each party to the MOU is responsible for all personal injury and property damage attributable to the negligent acts or omissions of that party and the officer, employees and agents thereof. In addition, each party is subject to the provisions of Section 768.28, Florida Statutes (2002). Notwithstanding the aforesaid, the DISTRICT and the DIVISION shall have no indemnity obligation with respect to the COUNTY when the COUNTY acts as the agent of the DISTRICT and DIVISION for any purposes pursuant to this Agreement.

B. If any party fails to comply with any of the terms, conditions, provisions or stipulations of this MOU, any party may avail itself of any or all remedies provided in the MOU and shall have the right and power to proceed in accordance with its provisions.

VII. CIVIL RIGHTS

Pursuant to Chapter 750, Florida Statutes, no party shall discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age, handicap or marital status.

VIII. CANCELLATION

Each party to this MOU reserves the right to unilaterally cancel this MOU for refusal by another party to allow public access to all documents, papers, letters, or other material related to this MOU and subject to the provisions of Chapter 119, Florida Statutes, as amended.

IX. AUDIT: ACCESS TO RECORDS

Each party agrees that the other parties or their duly authorized representatives shall, until the expiration of three (3) years after termination of this MOU, have access to examine any of the other parties documents, papers and records related to this MOU

X. DISPUTE RESOLUTION

Any dispute arising under this MOU which is not disposed of by mutual consent of the Project Managers shall be referred to THE PARTIES legal counsels.

XI. GOVERNING LAW

This MOU shall be construed and interpreted according to the laws of the State of Florida.

XII. ENTIRE MOU

This MOU, upon execution by the ST. JOHNS RIVER WATER MANAGEMENT DISTRICT; FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES, DIVISION of FORESTRY and VOLUSIA COUNTY, constitute the entire MOU of THE PARTIES. THE PARTIES are not bound by any stipulations, representation, agreements, or promises, oral or otherwise, not printed or inserted in this MOU. All parties agree that no representations have been made by any of the other parties to induce any party to enter into this MOU other that as expressly states by this MOU. This MOU cannot be changed orally, nor by any means other than written amendments referencing this MOU and signed by all parties.

IN WITNESS WHEREOF, the following authorized representative of the DISTRICT, DIVISION and the COUNTY has executed this Memorandum of Understanding on the date signed by each party:

Approved as to Form and Legality
DISTRICT Office of General Counsel

By: ______________________
Stanley J. Niego, Sr.
Assistant General Counsel

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

By: ______________________

Printed Name: Kirby G. Green III

Title: Executive Director

Date: 4/30/04

Approved as to Form and Legality
Florida Department of Agriculture
And Consumer Services

By: ______________________

FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

By: ______________________

Printed Name: Mike Gresham

Title: Director, Division of Administration

Date: January 30, 2004

Approved as to Form and Legality
Volusia COUNTY

Office of the COUNTY Attorney

By: [signature]

VOLUSIA COUNTY

By: [signature]

Printed Name: Dwight D. Lewis

Title: Chair

Date: 4/1/04

EXHIBIT A
STATEMENT OF WORK

OPERATION, MAINTENANCE AND PERFORMANCE MONITORING OF A SURFACE WATER CONTROL STRUCTURE ON THAYER CANAL, BENNETT SWAMP, VOLUSIA COUNTY, FLORIDA

I. INTRODUCTION/BACKGROUND

The St. Johns River Water Management District (DISTRICT) has initiated a Wetland Augmentation Demonstration Program to gain operational experience in wetland impact avoidance through water level augmentation in wetlands. One of the demonstration project sites selected is Bennett Swamp, located in Volusia County, Florida (COUNTY), an important regional water resource that has been impacted by surface water flow pattern alteration and groundwater withdrawal resulting in lowered water levels within the swamp. The swamp provides recharge to the Floridan aquifer, which in turn provides water supply to utilities within the region. The primary objective of this project is the upward adjustment of water levels within Bennett Swamp to better approximate natural conditions.

Recent DISTRICT hydrological and ecological investigations of Bennett Swamp indicate a base water level decline on the order of 0.5 feet to 1.75 feet, relative to natural pre-development conditions. Hydrologic simulation indicates a base water level decline on the order of about 0.5 feet; vegetation data suggest a decline of at least one foot, and soil-based estimates indicate a decline on the order of 1.75 feet. DISTRICT desires to assess the feasibility of restoring the swamp to a more natural condition by retaining additional surface water within the swamp by use of a water level control structure (Weir) located on Thayer Canal. The retained surface water should increase base water levels in Bennett Swamp, increase the potential for groundwater recharge and reduce the volume of freshwater discharges to tide.

II. OBJECTIVE

The objective of this Memorandum (MOU) is to establish responsibilities among the three parties for the operation and maintenance of the Weir, monitoring of upstream impacts on planted pine plantations or other improvements, and monitoring of Bennett Swamp itself to determine environmental changes due to the Weir and possible changes in Weir operating parameters.

III. SCOPE OF WORK

The COUNTY is to maintain the Weir in good operating condition and operate the Weir in accordance with written instructions from the DISTRICT.

The DISTRICT is to implement a 5-year ecological and hydrologic monitoring program, develop a management plan for the Weir, including Weir operation schedule and guidelines, transmit Weir operation schedule and guidelines to COUNTY, oversee Weir operation, maintenance and schedule, and prepare a brief annual progress report for five years.

The Florida Department of Agriculture and Consumer Services, Division of Forestry, (DIVISION) will conduct routine assessments of State forest resources to determine if the Weir operations have resulted in conditions that are, or clearly will be, significantly adverse to the management objectives and responsibilities of the DIVISION.

IV. TASK IDENTIFICATION

DISTRICT responsibilities:

1. Develop a management plan for the Weir and coordinate with COUNTY and DIVISION on implementation of the plan.
2. Collect ecological and hydrologic monitoring data along three transects previously established under the Wetland Augmentation Demonstration Program, Project #2, Bennett Swamp, Volusia County, for the five (5)-year study period.
3. Develop an annual assessment of net change in quantitative wetland ecological functions. Provide a monitoring report package to the DIVISION and COUNTY. The report will include copies of field data sheets and photographs, analysis and discussion of data collected, and conclusions and recommendations.
4. Jointly determine with the DIVISION and COUNTY, at the end of the planned five (5)-year study period, the need for long-term operation of the Weir. A decision will be made to continue operation, to maintain the Weir in standby mode, or to dismantle the Weir.
5. Share in the cost to place the Weir in standby mode or dismantle the Weir.
6. Establish the COUNTY as an "agent" of the DISTRICT for use of an access easement crossing property owned by Consolidated-Tomoka Land Company by execution of this MOU or other legal mechanism.

DIVISION responsibilities:

1. Conduct routine assessments of State forest resources, including, but not limited to, trees and other plant communities, roads and general access, stream and wetland crossings, to determine if the Weir operations have resulted in conditions that are, or clearly will be, significantly adverse to the management objectives and responsibilities of the DIVISION. Provide pertinent information from these assessments to the DISTRICT to facilitate the responsibilities of the DISTRICT and COUNTY.
2. Participate with the DISTRICT in the preparation of an annual assessment of the net change in quantitative wetland ecological functions.
3. Participate with the DISTRICT and COUNTY in assessing the need for long-term operation of the Weir.

COUNTY responsibilities:

1. Maintain the Weir in good operating condition, including but not limited to, clearing of debris, repair or replacement of Weir components that deteriorate due to environmental or human actions; storage of extra Weir stop log sections; and periodic work on access road to maintain reasonable access for light standard utility vehicles (SUVs) and service truck-type vehicles.
2. Operate the Weir in accordance with the DISTRICT management plan. Under emergency circumstances, the COUNTY may temporarily diverge from the DISTRICT management plan to avoid flooding of DIVISION State forest resources or other upstream improvements, notifying the DISTRICT and DIVISION within 24 hours.
3. Assume operation and maintenance responsibilities in accordance with the conditions of ERP#64-171851-005 for the life of the Weir structure or until THE PARITES agree to Weir dismantlement.

V. COST ALLOCATION

The COUNTY agrees to the operation and maintenance of the Weir and other responsibilities described above, without compensation from the DISTRICT or DIVISION, including the Weir as a part of the COUNTY stormwater utility.

The DIVISION agrees to perform the monitoring and participation responsibilities described above, without compensation from the DISTRICT or COUNTY.

The DISTRICT agrees to perform its responsibilities as described above, without compensation from the DIVISION or COUNTY.

Should cost estimates developed by the DISTRICT at the end of the first five (5)-years of the MOU indicate that Weir operation or standby costs will exceed $5,000 per year, or Weir dismantlement costs will exceed $10,000, the DISTRICT and COUNTY may negotiate an appropriate cost-sharing arrangement.

Appendix C
Water Quality Laboratory Data

ACCREDITED IN ACCORDANCE WITH nelac

Columbia Analytical Services INC.
An Employee-Owned Company

November 02, 2001

Service Request No. J2103243

Bill Dunn
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Project No.: 147556.IA.BS
Project Name: Bennett Swamp

Dear Bill Dunn:

Enclosed are the results of the samples(s) submitted to our laboratory on October 12, 2001. For your reference, these analyses have been assigned our service request number: J2103243.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in the entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Paul Gunsaulies

Paul Gunsaulies
Project Manager

CAS Jacksonville is NELAC-accredited by the State of Florida (E82502). Other state accreditations include: LA, AI 30759; MA, M-FL937; NH, 2942; NC, 527; SC, 96021; WA, C278.

8540 Baycenter Rd. • Jacksonville, FL 32256 • (904) 739-2277 • 800-695-7222 • Fax (904) 739-2011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill
Project:	Bennett Swamp/147556.IA.BS
Sample Matrix:	Surface Water

Service Request:	J2103243
Date Collected:	10/11/01
Date Received:	10/12/01
Date Extracted:	NA

Inorganic Parameters

Analyte	Units	EPA Method	MRL	Date/Time Analyzed	Sample Name: Thay-1 Lab Code: J2103243-001	Sample Name: LBS-1 Lab Code: J2103243-002	Sample Name: Ham-1 Lab Code: J2103243-003
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	10/19/01 0830	U	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	10/18/01 1030	0.48	0.10	0.46
Color	Color Units	110.2	5	10/12/01 1625	750	750	750
Conductivity	uMHOS/cm	120.1	2	10/15/01 1145	86	110	83
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	10/12/01	U	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	10/12/01 1428	U	0.026	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	10/17/01 1500	0.012	U	U
Solids, Total Dissolved	mg/L (ppm)	160.1	10	10/15/01 1400	200	220	200
Solids, Total Suspended	mg/L (ppm)	160.2	5	10/17/01 1100	8	U	U
TKN	mg/L (ppm)	351.4	0.5	10/15/01 1400	2.1	1.8	1.9

U Not detected at or above the MRL.

Approved By: Paul Gonsalves Date: 11/2/01

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill
Project:	Bennett Swamp/147556.IA.BS
Sample Matrix:	QC Water

Service Request:	J2103243
Date Collected:	10/11/01
Date Received:	10/12/01
Date Extracted:	NA

Inorganic Parameters

Analyte	Units	EPA Method	MRL	Date/Time Analyzed	FB-1	Method Blank
				Sample Name:	FB-1	Method Blank
				Lab Code:	J2103243-004	J211012-MB
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	10/19/01 0830	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	10/18/01 1030	U	U
Color	Color Units	110.2	5	10/12/01 1625	U	U
Conductivity	uMHOS/cm	120.1	2	10/15/01 1145	U	U
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	10/12/01	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	10/12/01 1428	U	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	10/17/01 1500	U	U
Solids, Total Dissolved	mg/L (ppm)	160.1	10	10/15/01 1400	U	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	10/17/01 1100	U	U
TKN	mg/L (ppm)	351.4	0.5	10/15/01 1400	U	U

U Not detected at or above the MRL.

Approved By: Paul Hurvaules Date: 11/2/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Bennett Swamp/147556.IA.BS
Sample Matrix: Surface Water

Service Request: J2103243
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 10/12-19/01

Duplicate Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	Units	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	U	U	U	<1
Ammonia as N	mg/L (ppm)	350.3	0.1	U	U	U	<1
Color	Color Units	110.2	5	750	750	750	<1
Conductivity	uMHOS/cm	120.1	2	86.1	86.3	86.2	<1
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	5.08	5.01	5.04	1
Orthophosphate as P	mg/L (ppm)	365.3	0.01	U	U	U	<1
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	U	U	U	<1
Solids, Total Dissolved	mg/L (ppm)	160.1	10	198	197	198	1
Solids, Total Suspended	mg/L (ppm)	160.2	5	U	U	U	<1
TKN	mg/L (ppm)	351.4	0.5	1.66	1.52	1.59	9

U Not detected at or above the MRL.

Approved By: Paul [signature] Date: 11/2/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Bennett Swamp/147556.IA.BS
Sample Matrix: Surface Water

Service Request: J2103243
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 10/12-19/01

Matrix Spike Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	Units	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	52.3	U	40	76	75-125
Ammonia as N	mg/L (ppm)	350.3	0.1	20	U	17.7	89	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.01	0.5	U	0.465	93	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	1.0	U	0.912	91	75-125
TKN	mg/L (ppm)	351.4	0.5	10	1.66	12.2	105	75-125

U Not detected at or above the MRL.

Approved By: Paul Hanoulos Date: 11/2/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Bennett Swamp/147556.IA.BS
Sample Matrix: Water

Service Request: J2103243
Date Collected: NA
Date Received: NA
Date Analyzed: 10/12-19/01

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	Units	EPA Method	TRUE Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	51.6	54	105	75-125
Ammonia as N	mg/L (ppm)	350.3	10	9.88	99	75-125
Color	Color Units	110.2	25	25	100	75-125
Conductivity	uMHOS/cm	120.1	168	165	98	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.495	99	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.5	0.462	92	75-125
Solids, Total Dissolved	mg/L (ppm)	160.1	300	324	108	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	82	103	75-125
TKN	mg/L (ppm)	351.4	10	11.1	111	75-125

Approved By: Paul Harousles Date: 11/2/01

Cooler Receipt and Preservation Form

Project/Client: Bennett Swamp/CH2M Hill **SR Number:** ____________

Cooler received on 10/12/01 by: SS

Courier: CAS ☐ UPS ☐ FEDEX ☒
CLIENT ☐ CD&L ☐ OTHER ☐

	Yes	No	N/A
1. Were custody seals on the outside of the cooler?	☒	☐	☐
2. Were custody seals intact?	☒	☐	☐
3. Were custody papers properly filled out(ink, singed, ect.)?	☒	☐	☐
4. Did all bottles arrive in good condition(unbroken)?	☒	☐	☐
5. Did any VOA vials contain significant air bubbles?	☐	☐	☒
6. Were ice or ice packs present?	☒	☐	☐
7. Did all samples arrive within appropriate holding times?	☒	☐	☐

8. Where did the bottles originate? CAS/JAX ☒ CLIENT ☐

9. Temperature of cooler(s) upon receipt/within 0-6C?:

	Temp.	Yes	No	N/A		Temp.	Yes	No	N/A
Cooler 1:	4.3	☒	☐	☐	Cooler 3:		☐	☐	☐
Cooler 2:		☐	☐	☐	Cooler 4:		☐	☐	☐

Date/Time Temperature Taken: 10/12/01 10:45 **If No/NA, Explain** ____________

Thermometer ID: 2618380101-0015 ☐ Temp Blank: ☐ Cooler Temp.: ☐
15-078-J-4 ☐ Sample Bottle: ☐ IR Gun: ☒

If out of temperature, client approval to run samples ____________

Cooler Breakdown: Date: 10/12/01 By: SS

	Yes	No	N/A
1. Were all the bottle labels complete(i.e. analysis, preservation, ect.)	☒	☐	☐
2. Did all bottle labels and tags agree with custody papers?	☒	☐	☐
3. Were correct containers used for the test indicated?	☒	☐	☐

4. Air samples: Cassettes/Tubes Intact: ☐ Tedlar Bags Inflated: ☐
Canisters Pressurized: ☐ NA: ☒

Explain any discrepancies ____________

		Yes	No	Sample ID	Reagent	Volume Added
pH	Reagent					
>12	NaOH					
>9	NaOH+ZnAc					
<2	HNO3					
<2	H2SO4	X				
<2	HCl					
5-9*	P/PCB (608 Only)					

* If pH adjustment is required, use NaOH/or H2SO4 PM OK to adjust pH______

YES= All samples OK NO=Samples were preserved at lab as listed

VOC Vial pH Verification(Tested after Analysis) Following Samples Exhibited pH >2				

Other Comments: ____________

Cooler Receipt and Preservation Form

Project/Client: Bennett Swamp/CH2M Hill **SR Number:**

Cooler received on 10/12/01 by: SS

Courier: CAS ☐ UPS ☐ FEDEX ☒

CLIENT ☐ CD&L ☐ OTHER ☐

	Yes	No	N/A
1. Were custody seals on the outside of the cooler?	☒	☐	☐
2. Were custody seals intact?	☒	☐	☐
3. Were custody papers properly filled out(ink, singed, ect.)?	☒	☐	☐
4. Did all bottles arrive in good condition(unbroken)?	☒	☐	☐
5. Did any VOA vials contain significant air bubbles?	☐	☐	☒
6. Were ice or ice packs present?	☒	☐	☐
7. Did all samples arrive within appropriate holding times?	☒	☐	☐
8. Where did the bottles originate? CAS/JAX	☒	CLIENT	☐

9. Temperature of cooler(s) upon receipt/within 0-6C?:

	Temp.	Yes	No	N/A		Temp.	Yes	No	N/A
Cooler 1:	4.3	☒	☐	☐	Cooler 3:		☐	☐	☐
Cooler 2:		☐	☐	☐	Cooler 4:		☐	☐	☐

Date/Time Temperature Taken: 10/12/01 10:45 **If No/NA, Explain**

Thermometer ID: 2618380101-0015 ☐ Temp Blank: ☐ Cooler Temp.: ☐

15-078-J-4 ☐ Sample Bottle: ☐ IR. Gun: ☒

If out of temperature, client approval to run samples

Cooler Breakdown: Date: 10/12/01 By: SS

	Yes	No	N/A
1. Were all the bottle labels complete(i.e. analysis, preservation, ect.)	☒	☐	☐
2. Did all bottle labels and tags agree with custody papers?	☒	☐	☐
3. Were correct containers used for the test indicated?	☒	☐	☐

4. Air samples: Cassettes/Tubes Intact: ☐ Tedlar Bags Inflated: ☐

Canisters Pressurized: ☐ NA: ☒

Explain any discrepancies

		Yes	No	Sample ID	Reagent	Volume Added
pH	Reagent					
>12	NaOH					
>9	NaOH+ZnAc					
<2	HNO3					
<2	H2SO4	X				
<2	HCl					
5-9*	P/PCB (608 Only)					

* If pH adjustment is required, use NaOH/or H2SO4 PM OK to adjust pH

YES= All samples OK NO=Samples were preserved at lab as listed

VOC Vial pH Verification(Tested after Analysis) Following Samples Exhibited pH >2				

Other Comments:

Analytical Services, Inc. An Employee-Owned Company www.caslab.com
8540 Baycenter Rd. • Jacksonville, FL 32256 • (904) 739-2277 • 800-695-7222 x06 • FAX (904) 739-2011

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

PAGE 1 OF 1 | SR# 3243 | CAS Contact

Project Name: Bennett Swamp	Project Number: 147556.IA.BS
Project Manager: Bill Dunn	Report CC: Stan Eakin
Company/Address: CH2M HILL, 3011 SW Williston Rd., Gainesville, FL 32608	
Phone #: (352) 335-7991	FAX#: (352) 335-2857
Sampler's Signature: S.B.E.	Sampler's Printed Name: Steven B. Eakin

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

CLIENT SAMPLE ID	LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NUMBER OF CONTAINERS	Alk, Color, NH3	Cond, NO2, NO3	Ortho P, TDS, TKN	TP, TSS	REMARKS/ ALTERNATE DESCRIPTION
Thoy-1		10/11/01	1100	WTR	3	X	X	X	X	
LBS-1		↓	1200	↓	↓	X	X	X	X	
Ham-1		↓	1000	↓	↓	X	X	X	X	
FB-1		↓	1000	↓	↓	X	X	X	X	

Preservative Key
0. NONE
1. HCL
2. HNO_3
3. H_2SO_4
4. NaOH
5. Zn. Acetate
6. MeOH
7. $NaHSO_4$
8. Other ____

SPECIAL INSTRUCTIONS/COMMENTS

See QAPP ☐

TURNAROUND REQUIREMENTS
___ RUSH (SURCHARGES APPLY)
✓ STANDARD
REQUESTED FAX DATE ____
REQUESTED REPORT DATE ____

REPORT REQUIREMENTS
___ I. Results Only
✓ II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
___ III. Results + QC and Calibration Summaries
___ IV. Data Validation Report with Raw Data
___ V. Specialized Forms / Custom Report
Edata ___ Yes ___ No

INVOICE INFORMATION
PO#
BILL TO:

SAMPLE RECEIPT: CONDITION/COOLER TEMP: 4.3°C   CUSTODY SEALS: Y N

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature: Steven B. Eakin	Signature: S Smith	Signature	Signature	Signature	Signature
Printed Name: CH2M HILL	Printed Name: CAS	Printed Name	Printed Name	Printed Name	Printed Name
Firm: 10/11/01 1530	Firm: 10/12/01 1045	Firm	Firm	Firm	Firm
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - Return to Originator; Yellow - Lab Copy; Pink - Retained by Client

SCOC-1000-07

May 08, 2002

Service Request No. J2201279

Steve Eakin
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Test Report for
Project No.: 147556.IA.BS
Project Name: Bennett Swamp

Dear Steve Eakin:

Enclosed are the results of the samples(s) submitted to our laboratory on April 19, 2002. For your reference, these analyses have been assigned our service request number: J2201279.

All analyses were performed according to our laboratory's quality assurance program. NELAP requirements were met unless footnotes in each sample report indicate otherwise. Estimates regarding the degree of uncertainty in measurements can be inferred from the accuracy limits in the laboratory QA manual. However, these limits do not account for possible matrix effects. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Paul Gunsaulies

Paul Gunsaulies
Project Manager

CAS Jacksonville is NELAC-accredited by the State of Florida (E82502). Other state accreditations include: LA, AI 30759; MA, M-FL937; NC, 527; SC, 96021; WA, C278.

8540 Baycenter Rd. ▪ Jacksonville, FL 32256 ▪ (904) 739-2277 ▪ Fax (904) 739-2011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2201279
Project:	Bennett Swamp/147556.IA.BS	**Date Collected:**	4/18/02
Sample Matrix:	Water	**Date Received:**	4/19/02
		Date Extracted:	NA

Inorganic Parameters

				Sample Name:	**LBS**	**Ham F**	**Thay C**
				Lab Code:	J2201279-001	J2201279-002	J2201279-003
Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**			
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	4/29/02 0900	U	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	5/3/02 0900	U	0.88	0.80
Color	Color Units	110.2	5	4/23/02 1910	500	500	500
Conductivity	uMHOS/cm	120.1	2	5/2/02	99	100	120
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	4/19/02 1832	0.27	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	4/19/02 1300	0.016	0.010	0.013
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	5/6/02 1300	0.028	0.055	0.032
Solids, Total Dissolved	mg/L (ppm)	160.1	10	4/25/02 1920	160	180	190
Solids, Total Suspended	mg/L (ppm)	160.2	5	4/24/02 1600	14	U	6.5
TKN	mg/L (ppm)	351.4	0.5	5/1/02 1415	0.77	2.1	1.7

U Not detected at or above the MRL.

Approved By: Paul Gonzales Date: 5/9/02

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2201279
Project:	Bennett Swamp/147556.IA.BS	**Date Collected:**	4/18/02
Sample Matrix:	Water	**Date Received:**	4/19/02
		Date Extracted:	NA

Inorganic Parameters

Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**	Sample Name: **FB** Lab Code: J2201279-004	**Method Blank** J220419-MB
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	4/29/02 0900	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	5/3/02 0900	U	U
Color	Color Units	110.2	5	4/23/02 1910	U	U
Conductivity	uMHOS/cm	120.1	2	5/2/02	U	U
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	4/19/02 1832	0.38	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	4/19/02 1300	U	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	5/6/02 1300	U	U
Solids, Total Dissolved	mg/L (ppm)	160.1	10	4/25/02 1920	U	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	4/24/02 1600	U	U
TKN	mg/L (ppm)	351.4	0.5	5/1/02 1415	U	U

U Not detected at or above the MRL.

Approved By: Paul Jurisaukis Date: 5/9/02

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Bennett Swamp/147556.IA.BS
Sample Matrix: Water

Service Request: J2201279
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 4/19-5/6/02

Duplicate Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: J2201260-001

Analyte	Units	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	326	322	324	1
Ammonia as N	mg/L (ppm)	350.3	0.1	0.798	0.748	0.773	6(a)
Color	Color Units	110.2	5	500	500	500	<1(b)
Conductivity	uMHOS/cm	120.1	2	13830	13810	13820	<1
Orthophosphate as P	mg/L (ppm)	365.3	0.01	U	U	U	<1(c)
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	0.028	0.030	0.029	7(b)
Solids, Total Dissolved	mg/L (ppm)	160.1	10	324	308	316	5(d)
Solids, Total Suspended	mg/L (ppm)	160.2	5	U	U	U	<1ed)
TKN	mg/L (ppm)	351.4	0.5	U	U	U	<1(c)

U Not detected at or above the MRL.
a Analysis performed on J2201279-003.
b Analysis performed on J2201279-001.
c Analysis performed on J2201279-004.
d Analysis performed on J220425-LCSD.
e Analysis performed on J2201317-001.

Approved By: Paul Gurzaulis Date: 5/9/02

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill
Project:	Bennett Swamp/147556.IA.BS
Sample Matrix:	Water

Service Request:	J2201279
Date Collected:	NA
Date Received:	NA
Date Extracted:	NA
Date Analyzed:	4/19-5/6/02

Matrix Spike Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: J2201260-001

Analyte	Units	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	35.2	326	360	97	75-125
Ammonia as N	mg/L (ppm)	350.3	0.1	20	0.798	21.4	103(a)	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.01	0.5	U	0.489	98(b)	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	0.5	0.028	0.512	97(c)	75-125
TKN	mg/L (ppm)	351.4	0.5	10	U	9.00	90(b)	75-125

U Not detected at or above the MRL.
a Analysis performed on J2201279-003.
b Analysis performed on J2201279-004.
c Analysis performed on J2201279-001.

Approved By: Paul Gunsaulis Date: 5/9/02

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2201279
Project:	Bennett Swamp/147556.IA.BS	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	4/19-5/6/02

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	**Units**	**EPA Method**	**TRUE Value**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	35.2	36	102	75-125
Ammonia as N	mg/L (ppm)	350.3	10.0	10.3	103	75-125
Color	Color Units	110.2	25	25	100	75-125
Conductivity	uMHOS/cm	120.1	168	161	96	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.494	99	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.5	0.492	98	75-125
Solids, Total Dissolved	mg/L (ppm)	160.1	300	324	108	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	74	93	75-125
TKN	mg/L (ppm)	351.4	10	8.38	84	75-125

Approved By: Paul Gurosaulis Date: 5/9/02

Columbia Analytical Services

JACKSONVILLE LABORATORY
CONDITION UPON RECEIPT FORM

Client: CH2M Hill

Date received: 4/19/02 10^00

Received by: agf

Project name: Bennett Swamp

Service request number: J2201279

CUR completed by: agf

Cooler/Shipping Information:

Courier: ☐ CAS ☐ Client ☐ UPS ☐ Airborne ☑ FedEx ☐ Other (describe):

Type: ☑ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	7.1				
Temp taken from	☐ Temp blank ☑ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any "NO" responses or discrepancies should be explained in the "Comments" section below or an NCM if so required. If an NCM was initiated, write the NCM number in the appropriate space.

CHECKLIST	YES	NO	NA	NCM #
1. Were custody seals on shipping container(s) intact? If "No", NCM required.	✓			—
2. Were custody papers properly included with samples?	✓			
3. Were custody papers properly filled out (ink, signed, match labels)?	✓			
4. Did all bottles arrive in good condition (unbroken)?	✓			
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓			
6. Did the sample labels agree with the chain of custody?	✓			
7. Were correct bottles used for the tests indicated?	✓			
8. Were proper sample preservation techniques indicated on the label?	✓			
9. Were samples received within holding times? If "No," NCM required.	✓			—
10. Were all VOA vials checked for the presence of air bubbles? If "No", NCM required.			✓	—
11. Were there air bubbles present in the VOA vials? If "Yes", NCM required.			✓	—
12. Were samples in direct contact with wet ice? If "No," check one: ☑ NO ICE ☐ BLUE ICE		✓		
13. Was the cooler temperature less than 6°C?		✓		
14. Were sample pHs checked and recorded by Sample control? Checks are on reverse side of form. *NOTE: VOA samples are checked by laboratory analysts.*	✓			
15. Were the sample containers provided by CAS?	✓			
16. Were samples accepted into the laboratory?	✓			

Comments:

12 all ice had melted

Columbia Analytical Services

JACKSONVILLE LABORATORY
CONDITION UPON RECEIPT - SAMPLE pH

SR #: J2201279 Date: 4/19/02 Initials: [illegible]

A check mark (✓) in any space under the appropriate column headings for the selected sample indicates that the pH was checked and met the required pH criterion listed in the column heading.

	Bottle Code																	
	A	C	O	P	Q	R	S	T	U	V	W	X	Y	E	F			
Container	40-mL	125-mL	250-mL	500-mL	1-L	1-L	250-mL	500-mL	1-L	250-mL	250-mL	1.75-L	500-mL	/	/			
	G	P	P	P	G	G	P	P	P	G	P	P	P					
Pres.	HCl	HNO_3	H_2SO_4	H_2SO_4	H_2SO_4	H_2SO_4	HNO_3	HNO_3	HNO_3	HNO_3	NaOH	NaOH	Zn Acetate NaOH					
Req. pH	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	> 12	>12	>9					
Sple #	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-001				|										|	|			
-002				|										|	|			
-003				|										|	|			
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-030																		
-031																		
-032																		
-033																		
-034																		
-035																		
-036																		
-037																		
-038																		
-039																		
-040																		
-041																		
-042																		

For aqueous samples with multiple containers, only 1 bottle is checked for pH
NOTE: VOA pH checks are performed by the analytical area, not sample control

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J041205
Project Name:	Bennett Swamp	**Date Sampled:**	3/1/04
Project Number:		**Date Received:**	3/2/04 09:30
		Date Reported:	3/17/04

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Bennett Swamp

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J041205
Date/Time Received: 3/2/04 09:30

Lab Code: J041205-01
Client Sample ID: Thayer
Site: Thayer Canal Transect
Matrix: Water
Date/Time Sampled: 3/1/04 11:30
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.026	**0.16**	mg/L		E350.1		*T*
* **Color**	10	5.0	50	**450**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**69**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.013	**0.013**	mg/L	U	E365.1		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.048	**1.4**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.043	**0.15**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**7.6**	mg/L		E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.027	**0.027**	mg/L	U	E353.2		*J*

TDS

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**120**	mg/L		E160.1		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Color -- Color pH = 3.92

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J041205
Project Name: Bennett Swamp **Date/Time Received:** 3/2/04 09:30

Lab Code: J041205-02 **Date/Time Sampled:** 3/1/04 10:30
Client Sample ID: Hammock **Shipping Method:** Fed Ex
Site: Hammock Field Transect **Sampled By:** Steve Eakin
Matrix: Water **Sampling Method:** G

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.026	**0.081**	mg/L	i	E350.1		*T*
* **Color**	20	5.0	100	**500**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**62**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.013	**0.013**	mg/L	U	E365.1		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.048	**1.2**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.043	**0.13**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.027	**0.027**	mg/L	U	E353.2		*J*

TDS

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**130**	mg/L		E160.1		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Color -- Color pH = 3.75

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp

Report No.: J041205
Date/Time Received: 3/2/04 09:30

Sample Cross Reference Information

Lab Code: J041205-01 **Site: Thayer Canal Transect**
Client Sample Number: Thayer **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct031204nh3-1	3/12/04	09:00	SS		
Color	E110.2	NONE	WCJ-030304-COL	3/3/04	10:00	AA		
Conductivity	SW9050A	NONE	WCJ-031004-COND	3/10/04	09:00	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-030304-N	3/3/04	10:50	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-030304-OP	3/3/04	09:30	KDC		
TDS	E160.1	NONE	WCJ-030404-TDS1	3/4/04	07:30	AGF		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-030804-ALK	3/8/04	10:00	AA		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT031504TKN3	3/15/04	11:12	CLB	PB030904TPTKN	3/9/04
Total Phosphorus (as P)	E365.4	NONE	wct031504tp1	3/15/04	13:16	CLB	PB030904TPTKN	3/9/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-030804-TSS1	3/8/04	08:45	AGF		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J041205-02 **Site: Hammock Field Transect**
Client Sample Number: Hammock **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct031204nh3-1	3/12/04	09:00	SS		
Color	E110.2	NONE	WCJ-030304-COL	3/3/04	10:00	AA		
Conductivity	SW9050A	NONE	WCJ-031004-COND	3/10/04	09:00	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-030304-N	3/3/04	10:50	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-030304-OP	3/3/04	09:30	KDC		
TDS	E160.1	NONE	WCJ-030404-TDS1	3/4/04	07:30	AGF		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-030804-ALK	3/8/04	10:00	AA		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT031504TKN3	3/15/04	11:12	CLB	PB030904TPTKN	3/9/04
Total Phosphorus (as P)	E365.4	NONE	wct031504tp1	3/15/04	13:16	CLB	PB030904TPTKN	3/9/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-030804-TSS1	3/8/04	08:45	AGF		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J041205

Project Name: Bennett Swamp **Date/Time Received:** 3/2/04 09:30

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030304-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030304-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030304-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030404-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030804-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030804-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct031204nh3-1	Ammonia (as N)	Method Blank	E350.1	0.019	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT031504TKN3	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct031504tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill **Project name:** Bennett Swamp

Date/Time Rcvd: 3/2/04 0930 **Log-In request number:** J041205

Received by: AM **Completed by:** AM

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ Other (describe): ____

Type: ☒ Cooler ☐ Box ☐ Other (describe) ____

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	3.6				
Temp taken from	☐ Temp blank ☒ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*	✓		
15. Were the sample containers provided by AEL?	✓		
16. Were samples accepted into the laboratory?	✓		
17. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J041205
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J041205-01	Thayer	Total Phosphorus (T)	Water	3/1/04	11:30	3/2/04 9:30	**3/16/04**		250mL Poly	
J041205-01	Thayer	TKN (T)	Water	3/1/04	11:30	3/2/04 9:30	**3/16/04**		250mL Poly	
J041205-01	Thayer	Ammonia (T)	Water	3/1/04	11:30	3/2/04 9:30	**3/16/04**		250mL Poly	
J041205-02	Hammock	Total Phosphorus (T)	Water	3/1/04	10:30	3/2/04 9:30	**3/16/04**		250mL Poly	
J041205-02	Hammock	TKN (T)	Water	3/1/04	10:30	3/2/04 9:30	**3/16/04**		250mL Poly	
J041205-02	Hammock	Ammonia (T)	Water	3/1/04	10:30	3/2/04 9:30	**3/16/04**		250mL Poly	

Jacksonville Relinquisher: PMachols
Shipping Relinquisher: PE

Shipping Receiver: PE
Tampa Receiver: Ajaye

Date/Time: 3/2/04 10:03:08 AM
Date/Time: 3/3/04 800

Advanced Environmental Laboratories, Inc.

- ☐ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
- ☐ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
- ☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

J041205

1

CLIENT NAME: CH2M ~~Hill~~	PROJECT NAME: Bennett Swamp
ADDRESS: ~~3011 SW~~ Williston Rd. Gainesville, FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.BS
PHONE: (352) 335-5877 FAX:	PROJECT LOCATION: Volusia County, FL
CONTACT: S. Eaton	SAMPLED BY: SBE

TURN AROUND TIME: ☑ STANDARD ☐ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alkalinity, Ammonia, Color | Cond, NO2+NO3, ortho P | TDS, TKN, TP, TSS

LAB NUMBER

WW= waste water **SW**=surface water **GW**=ground water **DW**=drinking water **OIL** **A**=air **SO**=soil **SL**=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Alkalinity, Ammonia, Color	Cond, NO2+NO3, ortho P	TDS, TKN, TP, TSS							LAB NUMBER
Preserv							.									
Thayer	Thayer Canal Transect	Grab	3/1/04	1130	SW	4	X	X	X							
Hammock	Hammock Field Transect	Grab	3/1/04	1030	SW	4	X	X	X							

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB____	D/T____
		AB____	D/T____
Ret: / /	Via: ____	Trip Bl. ☐ ☐	

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SBE	3/1/04	1200	FedEx		
2	FedEx			Dnichols	3/2/04	0930
3						
4						

Received on ice: ☐ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced
Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J050078
Project Name:	Bennett Swamp	**Date Sampled:**	1/4/05
Project Number:	147556.03.BS	**Date Received:**	1/5/05 09:15
		Date Reported:	1/17/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Bennett Swamp

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J050078
Date/Time Received: 1/5/05 09:15

Lab Code: J050078-01
Client Sample ID: 1
Site: Hammock Field Transect
Matrix: Water
Date/Time Sampled: 1/4/05 10:30
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.65**	mg/L		E350.1		*T*
* **Color**	25	130	130	**500**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**78**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.058	0.23	**0.058**	mg/L	U	E300.0		*T*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**2.2**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**3.0**	mg/L		E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**150**	mg/L		E160.1		*J*

U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 3.95

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J050078
Date/Time Received: 1/5/05 09:15

Lab Code: J050078-02
Client Sample ID: 2
Site: Thayer Canal Transect
Matrix: Water
Date/Time Sampled: 1/4/05 13:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.52**	mg/L		E350.1		T
* Color	25	130	130	**380**	Color Units		E110.2		J
Conductivity	1	2.0	2.0	**85**	umhos/cm		SW9050A		J
Ortho-phosphate (as P)	1	0.058	0.23	**0.058**	mg/L	U	E300.0		T
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		J
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.6**	mg/L		E351.2		T
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		T
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		J

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		J

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**150**	mg/L		E160.1		J

U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 3.85

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp

Report No.: J050078
Date/Time Received: 1/5/05 09:15

Sample Cross Reference Information

Lab Code: J050078-01 **Site: Hammock Field Transect**
Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct010605nh3-3	1/6/05	13:03	JH		
Color	E110.2	NONE	WCJ-010505-COL	1/5/05	13:30	LM		
Conductivity	SW9050A	NONE	WCJ-010504-COND	1/5/05	14:40	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-011205-N	1/12/05	11:34	KDC		
Ortho-phosphate (as P)	E300.0	NONE	wct010605flop	1/6/05	11:57	AJ		
TDS	E160.1	NONE	wcj-011005-tds	1/10/05	10:40	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-010505-ALK	1/5/05	14:10	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct011105tkn1	1/11/05	12:22	AJ	pb011005tptkn	1/10/05 11:35:00
Total Phosphorus (as P)	E365.4	NONE	wct011105tp1	1/11/05	09:44	AJ	pb011005tptkn	1/10/05 11:35:00
Total Suspended Solids (TSS)	E160.2	NONE	wcj-010505-tss2	1/5/05	14:35	AK		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J050078-02 **Site: Thayer Canal Transect**
Client Sample Number: 2 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct010605nh3-3	1/6/05	13:03	JH		
Color	E110.2	NONE	WCJ-010505-COL	1/5/05	13:30	LM		
Conductivity	SW9050A	NONE	WCJ-010504-COND	1/5/05	14:40	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-011205-N	1/12/05	11:34	KDC		
Ortho-phosphate (as P)	E300.0	NONE	wct010605flop	1/6/05	11:57	AJ		
Ortho-phosphate (as P)	E365.1	NONE			11:57			
TDS	E160.1	NONE	WCJ-011105-TDS	1/11/05	15:30	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-010505-ALK	1/5/05	14:10	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct011105tkn1	1/11/05	12:22	AJ	pb011005tptkn	1/10/05 11:35:00
Total Phosphorus (as P)	E365.4	NONE	wct011105tp1	1/11/05	09:44	AJ	pb011005tptkn	1/10/05 11:35:00
Total Suspended Solids (TSS)	E160.2	NONE	wcj-010505-tss2	1/5/05	14:35	AK		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J050078

Project Name: Bennett Swamp **Date/Time Received:** 1/5/05 09:15

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-010504-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	umhos/cm	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-010505-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-010505-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-010505-tss2	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-011105-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-011205-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct010605nh3-3	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct011105tkn1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct011105tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill

Project name: Bennett Swamp

Date/Time Rcvd: 1/5/04

Log-In request number: J050078

Received by: WS

Completed by: WS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ AES ☐ ASAP ☐ Other (describe):

Type: ☒ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	1°				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J050078
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J050078-01	1	Ortho-Phosphate (T)	Water	01/04/2005	10:30	1/5/05 09:15	**01/10/2005**		
J050078-01	1	Total Phosphorus (T)	Water	01/04/2005	10:30	1/5/05 09:15	**01/10/2005**		250mL Poly
J050078-01	1	TKN (T)	Water	01/04/2005	10:30	1/5/05 09:15	**01/10/2005**		250mL Poly
J050078-01	1	Ammonia (T)	Water	01/04/2005	10:30	1/5/05 09:15	**01/10/2005**		250mL Poly
J050078-02	2	Ortho-Phosphate (T)	Water	01/04/2005	13:00	1/5/05 09:15	**01/10/2005**		
J050078-02	2	Total Phosphorus (T)	Water	01/04/2005	13:00	1/5/05 09:15	**01/10/2005**		250mL Poly
J050078-02	2	TKN (T)	Water	01/04/2005	13:00	1/5/05 09:15	**01/10/2005**		250mL Poly
J050078-02	2	Ammonia (T)	Water	01/04/2005	13:00	1/5/05 09:15	**01/10/2005**		250mL Poly

Jacksonville Relinquisher: W. Salter
Shipping Receiver: AEC ~~Pony Express~~
Date/Time: 01/05/2005 17:01:09

Shipping Relinquisher: AEC
Tampa Receiver: [illegible]
Date/Time: ~~1/7/05~~ 930
1/6/05 wrong date

Advanced Environmental Laboratories, Inc.
- ❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
- ❑ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
- ❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
- ❑ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

LA

J050078

CLIENT NAME: CH2M HILL	PROJECT NAME: Bennett Swamp
ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.BS
PHONE: (352) 335-7991 FAX:	PROJECT LOCATION: Volusia, County, FL
CONTACT: Steve Eakin	SAMPLED BY: S. Eakin
TURN AROUND TIME: ✓ STANDARD ❑ RUSH ______	REMARKS / SPECIAL INSTRUCTIONS: * Please check against previous tests (0

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Ortho P | NO2 + NO3 | Alk, NH3, TKN, TP | Color, Cond, TDS, TSS

LAB NUMBER

WW= waste water **SW**=surface water **GW**=ground water **DW**=drinking water **OIL** **A**=air **SO**=soil **SL**=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Ortho P	NO2 + NO3	Alk, NH3, TKN, TP	Color, Cond, TDS, TSS					LAB NUMBER
Hammock Field	Wetland	Grab	1/4/5	1030	SW	4	X	X	X	X					
Thayer Canal	Wetland	↓	↓	1300	SW	4	X	X	X	X					

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler # ______		Relinquished by:	Date	Time	Received by:	Date	Time
Out: / /	Via: ____	RB ______	D/T ______	1				Fed Ex		
		AB ______	D/T ______	2	Fed Ex	1/5/04	0915	W. Salter	1/5/04	0915
Ret: / /	Via: ____	Trip Bl. ❑	❑	3						
				4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

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Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J051956
Project Name:	Bennett Swamp	**Date Sampled:**	3/22/05
Project Number:	147556.03.BS	**Date Received:**	3/23/05 09:15
		Date Reported:	4/8/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Bennett Swamp

Approved By: Paul Gunsaulies 2005.04.08 08:11:00 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 6 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J051956
Date/Time Received: 3/23/05 09:15

Lab Code: J051956-01
Client Sample ID: 1
Site: Hammock Field Transect
Matrix: Water
Date/Time Sampled: 3/22/05 11:00
Shipping Method: UPS
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.39**	mg/L	, Y	E350.1		*T*
* Color	10	50	50	**400**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**88**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.1**	mg/L	, Y	E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U , Y	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.028**	mg/L	i	E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**140**	mg/L		E160.1		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
Y The laboratory analysis was from an unpreserved or improperly preserved sample.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 4.05

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J051956
Date/Time Received: 3/23/05 09:15

Lab Code: J051956-02
Client Sample ID: 2
Site: Thayer Canal Transect
Matrix: Water
Date/Time Sampled: 3/22/05 13:00
Shipping Method: UPS
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U , Y	E350.1		*T*
* Color	10	50	50	**400**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**90**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.91**	mg/L	, Y	E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U , Y	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**8.8**	mg/L		E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**120**	mg/L		E160.1		*J*

U The compound was analyzed for but not detected.
Y The laboratory analysis was from an unpreserved or improperly preserved sample.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 4.09

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Bennett Swamp

Report No.: J051956

Date/Time Received: 3/23/05 09:15

Sample Cross Reference Information

Lab Code: J051956-01 **Site: Hammock Field Transect**

Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct040405nh3-1	4/4/05	08:53	AJ		
Color	E110.2	NONE	WCJ-032405-COL	3/24/05	09:20	AA		
Conductivity	SW9050A	NONE	WCJ-032905-COND	3/29/05	09:45	LM		
Nitrate + Nitrite	E353.2	NONE	WCJ-032305-N1	3/23/05	14:09	AA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-032405-OP	3/24/05	10:27	AA		
TDS	E160.1	NONE	WCJ-032405-TDS	3/24/05	13:30	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-032405-ALK	3/24/05	15:25	MS		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct040405tkn1	4/4/05	14:51	AJ	pb040105tptkn	4/1/05
Total Phosphorus (as P)	E365.4	METHOD	wct040405tp1	4/4/05	12:55	AJ	pb040105tptkn	4/1/05
Total Suspended Solids (TSS)	E160.2	NONE	wcj-032505-tss1	3/25/05	09:45	LM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J051956-02 **Site: Thayer Canal Transect**

Client Sample Number: 2 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct040405nh3-1	4/4/05	08:53	AJ		
Color	E110.2	NONE	WCJ-032405-COL	3/24/05	09:20	AA		
Conductivity	SW9050A	NONE	WCJ-032905-COND	3/29/05	09:45	LM		
Nitrate + Nitrite	E353.2	NONE	WCJ-032305-N1	3/23/05	14:09	AA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-032405-OP	3/24/05	10:27	AA		
TDS	E160.1	NONE	WCJ-032405-TDS	3/24/05	13:30	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-032405-ALK	3/24/05	15:25	MS		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct040505tkn1	4/5/05	16:03	AJ	pb040505tptkn	4/5/05 04:15:00
Total Phosphorus (as P)	E365.4	METHOD	wct040505tp1	4/5/05	09:51	AJ	pb040505tptkn	4/5/05 04:15:00
Total Suspended Solids (TSS)	E160.2	NONE	wcj-032505-tss1	3/25/05	09:45	LM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J051956
Date/Time Received: 3/23/05 09:15

Quality Assurance Report

Method Blanks

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032305-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032405-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032405-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032405-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032405-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-032505-tss1	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032905-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	umhos/cm	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct040405nh3-1	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct040405tkn1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct040405tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct040505tkn1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct040505tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach

Client: CH2M Hill **Report No.:** J051956

Project Name: Bennett Swamp **Date/Time Received:** 3/23/05 09:15

Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill
Project name: 147556.03 BS
Date/Time Rcvd: 3/23/05 0915
Log-In request number: J051956
Received by: DS
Completed by: DS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☒ UPS ☐ Pony Express ☐ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ______

Type: ☒ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	5°				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J051956
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J051956-01	1	Total Phosphorus (T)	Water	03/22/2005	11:00	3/23/05 09:15	**04/06/2005**		250mL Poly
J051956-01	1	TKN (T)	Water	03/22/2005	11:00	3/23/05 09:15	**04/06/2005**		250mL Poly
J051956-01	1	Ammonia (T)	Water	03/22/2005	11:00	3/23/05 09:15	**04/06/2005**		250mL Poly
J051956-02	2	Total Phosphorus (T)	Water	03/22/2005	13:00	3/23/05 09:15	**04/06/2005**		250mL Poly
J051956-02	2	TKN (T)	Water	03/22/2005	13:00	3/23/05 09:15	**04/06/2005**		250mL Poly
J051956-02	2	Ammonia (T)	Water	03/22/2005	13:00	3/23/05 09:15	**04/06/2005**		250mL Poly

Jacksonville Relinquisher: D. Vatter J.D
Shipping Receiver: FedEx ~~Pony Express~~
Date/Time: 3/23/05 1700 ~~03/23/2005~~ 16:17:01 DS

Shipping Relinquisher: FedEx
Tampa Receiver: A. Staley
Date/Time: 3-24-05 1600

Advanced Environmental Laboratories, Inc.
Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
❑ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

J051956

178

CLIENT NAME: CHam HILL

PROJECT NAME: 147556.03.BS

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL

P.O. NUMBER / PROJECT NUMBER: Bennett Swamp

PHONE: (352) 335-7991 FAX:

PROJECT LOCATION: Volusia County, FL

CONTACT: Steven Eakin

SAMPLED BY: [signature]

TURN AROUND TIME:
☑ STANDARD
❑ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alk, NH3, TKN, TP | Color, Cond, TDS, TSS | Ortho P, NO2+NO3

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Preserv	Alk, NH3, TKN, TP	Color, Cond, TDS, TSS	Ortho P, NO2+NO3						LAB NUMBER
Hammock	Surface Water Sample	Grab	3/22/05	11:00	SW	4		X	X	X						01
Thayer	" "	" "	↓	13:00	SW	4		X	X	X						02

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB____	D/T____
		AB____	D/T____
Ret: / /	Via: ____	Trip Bl. ❑	❑

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	3/22/05	1500	~~FedEx~~ UPS		
2	~~FED~~ UPS	3/23/05	0915	D. Salter	3/23/05	0915
3						
4						

Received on ice: ☑ yes ❑ no QC ❑ sent ❑ received

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J056099
Project Name:	Bennett Swamp	**Date Sampled:**	9/12/05
Project Number:	147556.03.BS	**Date Received:**	9/13/05 09:30
		Date Reported:	9/26/05
Attention:	Steve Eakin		
Phone Number:	3523357991		
Address:	3011 SW Williston Road		
	Gainesville, FL 32608		

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Bennett Swamp

Approved By: Paul Gunsaulies 2005.09.26 13:20:22 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J056099
Date/Time Received: 9/13/05 09:30

Lab Code: J056099-01
Client Sample ID: 1
Site: Lower Bennett Swamp, Wetland
Matrix: Water
Date/Time Sampled: 9/12/05 10:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	25	130	130	**750**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**89**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.088**	mg/L		E365.2		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Dissolved Solids	1	10	10	**140**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.4**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.078**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- The pH is 3.63.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J056099

Project Name: Bennett Swamp **Date/Time Received:** 9/13/05 09:30

Sample Cross Reference Information

Lab Code: J056099-01 **Site: Lower Bennett Swamp, W**

Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct091905nh3-1	9/19/05	15:29	AJ		
Color	E110.2	NONE	WCJ-091305-COL	9/13/05	12:00	MSA		
Conductivity	SW9050A	NONE	WCJ-091905-COND	9/19/05	13:30	AA		
Nitrate + Nitrite	E353.2	NONE	WCJ-091505-N2	9/15/05	12:23	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-091405-OPHO	9/14/05	09:45	MSA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-091505-ALK	9/15/05	15:20	AA		
Total Dissolved Solids	E160.1	NONE	WCJ-091605-TDS	9/16/05	15:25	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct092105tkn-1	9/21/05	12:58	AJK	PB092005TPTKN	9/20/05
Total Phosphorus (as P)	E365.4	METHOD	wct092105tp-1	9/21/05	10:18	AJK	PB092005TPTKN	9/20/05
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-091505-TSS3	9/15/05	16:00	JS		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J056099

Project Name: Bennett Swamp **Date/Time Received:** 9/13/05 09:30

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-091305-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-091505-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-091505-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-091605-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-091905-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	umhos/cm	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct091905nh3-1	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct092105tkn-1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct092105tp-1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M
Project name: Bennett Swamp
Date/Time Rcvd: 9/13/05 0930
Log-In request number: J056099
Received by: DS
Completed by: I.B. 9/13/05

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ AES ☐ ASAP ☐ Other (describe):

Type: ☒ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	0				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:
Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?	✓		
11. Were there air bubbles present in the VOA vials?		✓	
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J056099

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J056099-01	1	Total Phosphorus (T)	Water	09/12/2005	10:00	9/13/05 09:30	**09/20/2005**		250mL Poly	
J056099-01	1	TKN (T)	Water	09/12/2005	10:00	9/13/05 09:30	**09/20/2005**		250mL Poly	
J056099-01	1	Ammonia (T)	Water	09/12/2005	10:00	9/13/05 09:30	**09/20/2005**		250mL Poly	

Jacksonville Relinquisher: W. Salter **Shipping Receiver:** ~~Pony Express~~ B/S **Date/Time:** 09/14/2005 16:27:30

Shipping Relinquisher: B/S **Tampa Receiver:** K. Mandelle **Date/Time:** 9-15-05 9:10

Advanced Environmental Laboratories, Inc.
☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

LAB

J056099
projectlabels_200509/06/2005

CLIENT NAME: CH2M HILL	PROJECT NAME: Bennett Swamp
ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.BS
PHONE: (352) 335-7991 FAX:	PROJECT LOCATION: Volusia County, FL
CONTACT: Steven B. Eden	SAMPLED BY: Steven B. Eden
TURN AROUND TIME: ☑ STANDARD ☐ RUSH ____	REMARKS / SPECIAL INSTRUCTIONS: 0°

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Ortho P, NO2+NO3 | Alk, NH3, TKN, TP, | Color, Cond, TDS, TSS

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Ortho P, NO2+NO3	Alk, NH3, TKN, TP	Color, Cond, TDS, TSS						LAB NUMBER
Lower Bennett Swamp	Surface Water - Wetland	Grab	9/12/05	1000	SW	4	X	X	X						01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB____	D/T____
		AB____	D/T____
Ret: / /	Via: ____	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SBE	9/12/05	1200	FedEx		
2	FEDEX	9/13/05	0930	D. Salter	9/13/05	0930
3						
4						

Received on ice: ☒ yes ☐ no QC ☐ sent ☐ received

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J055947
Project Name:	Bennett Swamp	**Date Sampled:**	9/6/05
Project Number:	147556.03.BS	**Date Received:**	9/7/05 09:50
		Date Reported:	9/20/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Bennett Swamp

Approved By: Paul Gunsaulies 2005.09.20 10:48:49 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J055947
Project Name: Bennett Swamp **Date/Time Received:** 9/7/05 09:50

Lab Code: J055947-01 **Date/Time Sampled:** 9/6/05 12:00
Client Sample ID: 1 **Shipping Method:** Fed Ex
Site: Hammock **Sampled By:** Steve Eakin
Matrix: Water **Sampling Method:** G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	20	100	100	**500**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**53**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.060**	mg/L	i	E365.2		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Dissolved Solids	1	10	10	**19**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.5**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- The pH is 3.93.

Lab Code: J055947-02 **Date/Time Sampled:** 9/6/05 18:00
Client Sample ID: 2 **Shipping Method:** Fed Ex
Site: Thayer Canal Transect **Sampled By:** Steve Eakin
Matrix: Water **Sampling Method:** G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.13**	mg/L		E350.1		*T*
* Color	20	100	100	**600**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**63**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.065**	mg/L	i	E365.2		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Dissolved Solids	1	10	10	**37**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.5**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- The pH is 3.83.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp

Report No.: J055947
Date/Time Received: 9/7/05 09:50

Sample Cross Reference Information

Lab Code: J055947-01 **Site: Hammock**
Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct091205nh3-4	9/12/05 15:22	AJK		
Color	E110.2	NONE	WCJ-090705-COL	9/7/05 11:00	MSA		
Conductivity	SW9050A	NONE	WCJ-091905-COND	9/19/05 13:30	AA		
Nitrate + Nitrite	E353.2	NONE	WCJ-090905-N3	9/9/05 15:49	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-090805-O1	9/8/05 10:22	MSA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-091505-ALK	9/15/05 15:20	AA		
Total Dissolved Solids	E160.1	NONE	WCJ-090705-TDS	9/1/69 11:00	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct091305tkn-6	9/13/05 11:57	AJK	PB091105TPTKN	9/11/05
Total Phosphorus (as P)	E365.4	METHOD	wct091405tp6	9/14/05 18:37	AJK	PB091105TPTKN	9/11/05
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-091205-TSS2	9/12/05 13:00	LM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J055947-02 **Site: Thayer Canal Transect**
Client Sample Number: 2 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct091205nh3-4	9/12/05 15:22	AJK		
Color	E110.2	NONE	WCJ-090705-COL	9/7/05 11:00	MSA		
Conductivity	SW9050A	NONE	WCJ-091905-COND	9/19/05 13:30	AA		
Nitrate + Nitrite	E353.2	NONE	WCJ-090905-N3	9/9/05 15:49	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-090805-O1	9/8/05 10:22	MSA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-091505-ALK	9/15/05 15:20	AA		
Total Dissolved Solids	E160.1	NONE	WCJ-090705-TDS	9/1/69 11:00	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct091305tkn-6	9/13/05 11:57	AJK	PB091105TPTKN	9/11/05
Total Phosphorus (as P)	E365.4	METHOD	wct091405tp6	9/14/05 18:37	AJK	PB091105TPTKN	9/11/05
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-091205-TSS2	9/12/05 13:00	LM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J055947

Project Name: Bennett Swamp **Date/Time Received:** 9/7/05 09:50

Quality Assurance Report

Method Blanks

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
Miscellaneous Analytes							
WCJ-090705-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U
Miscellaneous Analytes							
WCJ-090705-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U
Nitrate + Nitrite							
WCJ-090905-N3	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U
Miscellaneous Analytes							
WCJ-091205-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U
Miscellaneous Analytes							
WCJ-091505-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U
Miscellaneous Analytes							
WCJ-091905-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	umhos/cm	U
Miscellaneous Analytes							
wct091205nh3-4	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U
Miscellaneous Analytes							
wct091305tkn-6	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U
Miscellaneous Analytes							
wct091405tp6	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

La

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill
Date/Time Rcvd: 9/7/05 0950
Received by: DS
Project name: Bennett Swamp
Log-In request number: J055947
Completed by: DS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ____________

Type: ☒ Cooler ☐ Box ☐ Other (describe) ____________

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	0				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J055947

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J055947-01 ✓	1	Total Phosphorus (T)	Water	09/06/2005	12:00	9/7/05 09:50	09/14/2005	____	250mL Poly
J055947-01	1	TKN (T)	Water	09/06/2005	12:00	9/7/05 09:50	09/14/2005	____	250mL Poly
J055947-01	1	Ammonia (T)	Water	09/06/2005	12:00	9/7/05 09:50	09/14/2005	____	250mL Poly
J055947-02 ✓	2	Total Phosphorus (T)	Water	09/06/2005	18:00	9/7/05 09:50	09/14/2005	____	250mL Poly
J055947-02	2	TKN (T)	Water	09/06/2005	18:00	9/7/05 09:50	09/14/2005	____	250mL Poly
J055947-02	2	Ammonia (T)	Water	09/06/2005	18:00	9/7/05 09:50	09/14/2005	____	250mL Poly

Jacksonville Relinquisher: D. Salter
Shipping Receiver: B/S ~~Pony Express~~
Date/Time:)9/07/2005 15:11:34

Shipping Relinquisher: B/S
Tampa Receiver: [illegible signature]
Date/Time: 9-8-05 9:ω

Advanced Environmental Laboratories, Inc.

CHAIN OF CUSTODY RECORD

☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

LAB NUMBER: J055947

192

CLIENT NAME: CH2M HILL

PROJECT NAME: 147556.03.BS Bennett Swamp

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608

P.O. NUMBER / PROJECT NUMBER:

PROJECT LOCATION: Volusia County, Florida

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eckich

SAMPLED BY: [signature]

TURN AROUND TIME:
☑ STANDARD
☐ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:

WW=waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Preserv	Alk, NH3, TKN, TP	Ortho P, NO2+NO3	Color, Cond, TDS, TSS					LAB NUMBER
Hammock	Surface Water	Grab	9/6/05	1200	SW	4		X	X	X					
Thayer	↓	↓	↓	1800	SW	4		X	X	X					

BOTTLE SIZE & TYPE / ANALYSIS REQUIRED

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via:	RB ______	D/T ______
		AB ______	D/T ______
Ret: 9/ /	Via:	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	9/6/05	1500	FedEx		
2	FedEx	9/7/05	0950	D. Salter	9/7/05	0950
3						
4						

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J062144
Project Name:	Bennett Swamp	**Date Sampled:**	3/27/06
Project Number:	147556.03.BS	**Date Received:**	3/28/06 15:00
		Date Reported:	4/18/06

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Bennett Swamp

Approved By: Paul Gunsaulies 2006.04.18 10:49:00 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp
Report No.: J062144
Date/Time Received: 3/28/06 15:00

Lab Code: J062144-01
Client Sample ID: 1
Site: Hammock Wetland Surface Water
Matrix: Water
Date/Time Sampled: 3/27/06 11:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		T
* Color	10	50	50	**250**	Color Units		E110.2		J
Conductivity	1	1.0	1.0	**64**	umhos/cm		SW9050A		J
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		J
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		J
Total Dissolved Solids	1	10	10	**80**	mg/L		E160.1		J
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.2**	mg/L		E351.2		T
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		T
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		J

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	i	E353.2		J

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 3.91.

Lab Code: J062144-02
Client Sample ID: 2
Site: Thayer Wetland Surface Water
Matrix: Water
Date/Time Sampled: 3/27/06 13:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.035**	mg/L	i	E350.1		T
* Color	10	50	50	**300**	Color Units		E110.2		J
Conductivity	1	1.0	1.0	**65**	umhos/cm		SW9050A		J
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		J
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		J
Total Dissolved Solids	1	10	10	**82**	mg/L		E160.1		J
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.3**	mg/L		E351.2		T
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		T
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		J

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	i	E353.2		J

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 3.81.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Bennett Swamp

Report No.: J062144

Date/Time Received: 3/28/06 15:00

Sample Cross Reference Information

Lab Code: J062144-01 **Site: Hammock Wetland Surfac**

Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE			15:36			
Color	E110.2	NONE	WCJ-032806-COL	3/28/06	12:32	MSA		
Conductivity	SW9050A	NONE	WCJ-040606-COND	4/6/06	15:13	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-033006-N1	3/30/06	09:45	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-032906-O1	3/29/06	10:46	MSA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-033006-ALK	3/30/06	14:00	AA		
Total Dissolved Solids	E160.1	NONE	wcj-040306-tds	4/3/06	15:30	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD			09:05			
Total Phosphorus (as P)	E365.4	METHOD			13:58			
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-033106-TSS2	3/31/06	13:15	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J062144-02 **Site: Thayer Wetland Surface**

Client Sample Number: 2 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE			15:36			
Color	E110.2	NONE	WCJ-032806-COL	3/28/06	12:32	MSA		
Conductivity	SW9050A	NONE	WCJ-040606-COND	4/6/06	15:13	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-033006-N1	3/30/06	09:45	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-032906-O1	3/29/06	10:46	MSA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-033006-ALK	3/30/06	14:00	AA		
Total Dissolved Solids	E160.1	NONE	wcj-040306-tds	4/3/06	15:30	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD			09:05			
Total Phosphorus (as P)	E365.4	METHOD			13:58			
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-033106-TSS2	3/31/06	13:15	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Bennett Swamp

Report No.: J062144
Date/Time Received: 3/28/06 15:00

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032806-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032906-O1	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033006-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033006-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033106-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-040306-tds	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040606-CO	Conductivity	Method Blank	SW9050A	2.0	1.0	umhos/cm	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

La

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill

Project name: Bennett Swamp

Date/Time Rcvd: 03/28/06 15:00

Log-In request number: J062144

Received by: [signature]

Completed by: [signature]

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☑ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ______

Type: ☑ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	0°				
Temp taken from	☐ Sample Bottle ☑ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J062144

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J062144-01	1	Total Phosphorus (T)	Water	03/27/2006	11:00	3/28/06 15:00	**04/11/2006**		250mL Poly
J062144-01	1	TKN (T)	Water	03/27/2006	11:00	3/28/06 15:00	**04/11/2006**		250mL Poly
J062144-01	1	Ammonia (T)	Water	03/27/2006	11:00	3/28/06 15:00	**04/11/2006**		250mL Poly
J062144-02	2	Total Phosphorus (T)	Water	03/27/2006	13:00	3/28/06 15:00	**04/11/2006**		250mL Poly
J062144-02	2	TKN (T)	Water	03/27/2006	13:00	3/28/06 15:00	**04/11/2006**		250mL Poly
J062144-02	2	Ammonia (T)	Water	03/27/2006	13:00	3/28/06 15:00	**04/11/2006**		250mL Poly

Jacksonville Relinquisher: ____________

Shipping Relinquisher: ____________

Shipping Receiver: ~~Pony Express~~ BJS

Tampa Receiver: K. Mann

Date/Time: 03/29/2006 ~~15:53:49~~ 17:00

Date/Time: 3/30/06 09:

Advanced Environmental Laboratories, Inc.

☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 3
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-15

CHAIN OF CUSTODY

J062144

R:

Page 1 of 1

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd. Gainesville FL 32608

PHONE: (352)335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Bennett Swamp

P.O. NUMBER / PROJECT NUMBER: 147556.03BS

PROJECT LOCATION: Volusia County

SAMPLED BY: S. Eakin

TURN AROUND TIME: ☑ STANDARD ☐ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS: * Ortho phosphate not filtered in field.

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alk, NH3, Color | Cond, NO2+NO3, | Ortho P, TDS, TKN | TP, TSS

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Preserv	Alk, NH3, Color	Cond, NO2+NO3,	Ortho P, TDS, TKN	TP, TSS					LAB NUMBER
Hammock	Wetland Surface Water	Grab	3/27/06	11:00	SW	4			X	X						01
Thayer	" "	" "	↓	13:00	SW	4		X	X	X						02

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB____	D/T____
		AB____	D/T____
Ret: / /	Via: ____	Trip Bl.	

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	3/27/06	1600	Fed-Ex		
2	[signature] FedEx	3/28/06	15:00	[signature]	3/28/06	15:00
3						
4						

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Appendix D
Detailed Vegetation Data

Baseline - Detailed Vegetation Data

Table D-1
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect- March 16, 2000

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Gordonia lasianthus	Percent Cover							Cover	
Ilex sp.	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Amphicarpum muhlenbergianum	10							1.43	9.43
Centella asiatica	1							0.14	0.94
Dulichium arundinaceum							2	0.29	1.89
Ilex cassine							1	0.14	0.94
Itea virginica							1	0.14	0.94
Lachnanthes caroliniana							3	0.43	2.83
Lyonia lucida		25	20	2	3			7.14	47.17
Panicum hemitomon	15							2.14	14.15
Persea palustris		2	1					0.43	2.83
Sphagnum	1	1		3	1	7		1.86	12.26
Triadenum sp.							1	0.14	0.94
Woodwardia virginica					1		1	0.29	1.89
Xyris sp.						1		0.14	0.94
Seedlings	1					1	1	0.43	2.83
Total	28	28	21	5	5	9	10	15.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Amphicarpum muhlenbergianum							2	0.29	2.47
Dulichium arundinaceum		1						0.14	1.23
Gordonia lasianthus					2			0.29	2.47
Ludwigia alata	8	2						1.43	12.35
Lyonia lucida				1	7	10		2.57	22.22
Myrica cerifera							2	0.29	2.47
Panicum hemitomon							8	1.14	9.88
Sphagnum			20				2	3.14	27.16
Vitis sp.					3	1		0.57	4.94
Woodwardia virginica				1				0.14	1.23
Xyris sp.		1						0.14	1.23
Seedlings		1	1	1				0.43	3.70
Unknown Grasses		6	1					1.00	8.64
Total	8	11	22	3	12	11	14	11.57	100.00

Table D-1
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect- March 16, 2000

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Gordonia lasianthus				2				0.29	1.92
Lyonia lucida		10	20	3	1	15	1	7.14	48.08
Panicum hemitomon	1							0.14	0.96
Persea palustris			1					0.14	0.96
Sphagnum		1	1	2		15		2.71	18.27
Toxicodendron radicans					1			0.14	0.96
Vitis sp.			1					0.14	0.96
Woodwardia virginica			2		25		1	4.00	26.92
Seedlings						1		0.14	0.96
Total	1	11	25	7	27	31	2	14.86	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum	3.33						0.67	0.57	4.12
Centella asiatica	0.33							0.05	0.34
Dulichium arundinaceum		0.33					0.67	0.14	1.03
Gordonia lasianthus				0.67	0.67			0.19	1.37
Ilex cassine							0.33	0.05	0.34
Itea virginica							0.33	0.05	0.34
Lachnanthes caroliniana							1.00	0.14	1.03
Ludwigia alata	2.67	0.67						0.48	3.44
Lyonia lucida		11.67	13.33	2.00	3.67	8.33	0.33	5.62	40.55
Myrica cerifera							0.67	0.10	0.69
Panicum hemitomon	5.33						2.67	1.14	8.25
Persea palustris		0.67	0.67					0.19	1.37
Sphagnum	0.33	0.67	7.00	1.67	0.33	7.33	0.67	2.57	18.56
Toxicodendron radicans					0.33			0.05	0.34
Triadenum sp.							0.33	0.05	0.34
Vitis sp.			0.33		1.00	0.33		0.24	1.72
Woodwardia virginica			0.67	0.33	8.67		0.67	1.48	10.65
Xyris sp.		0.33				0.33		0.10	0.69
Seedlings	0.33	0.33	0.33	0.33		0.67	0.33	0.33	2.41
Unknown Grasses		2.00	0.33					0.33	2.41
Total	12.33	16.67	22.67	5.00	14.67	17.00	8.67	13.86	100.00

Table D-2
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect- October 10, 2001

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Gordonia lasianthus	**Percent Cover**							**Cover**	
Ilex sp.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lyonia lucida		50	5	3	1			8.43	42.75
Mosses				3				0.43	2.17
Persea borbonia		3	2					0.71	3.62
Upland Grasses	70							10.00	50.72
Vitis rotundifolia			1					0.14	0.72
Total	70	53	8	6	1	0	0	19.71	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							**Cover**	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus						25		3.57	19.84
Lyonia lucida		20	6		1			3.86	21.43
Persea borbonia			5					0.71	3.97
Upland Grasses	60							8.57	47.62
Vitis rotundifolia		8	1					1.29	7.14
Total	60	28	12	0	1	25	0	18.00	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							**Cover**	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus				1				0.14	1.37
Lyonia lucida		15	20	5				5.71	54.79
Mosses				3				0.43	4.11
Upland Grasses	15							2.14	20.55
Woodwardia virginica	5	1	5		3			2.00	19.18
Total	20	16	25	9	3	0	0	10.43	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							**Cover**	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus						8.33		1.19	4.27
Gordonia lasianthus				0.33				0.05	0.17
Lyonia lucida		85.00	31.00	8.00	2.00			18.00	64.51
Mosses				1.00				0.14	0.51
Persea borbonia		1.00	2.33					0.48	1.71
Upland Grasses	48.33							6.90	24.74
Vitis rotundifolia		2.67	0.67					0.48	1.71
Woodwardia virginica	1.67	0.33	1.67		1.00			0.67	2.39
Total	50.00	89.00	35.67	9.33	3.00	8.33	0.00	27.90	100.00

Table D-3
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect- April 17, 2002

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Gordonia lasianthus	**Percent Cover**							**Cover**	
Ilex sp.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	*5*							0.71	2.72
Lyonia lucida		90	15	5				15.71	59.78
Mosses			2	5			5	1.71	6.52
Osmunda cinnamomea			1				1	0.29	1.09
Persea palustris			5					0.71	2.72
Toxicodendron radicans						1		0.14	0.54
Unknown seedling					5		3	1.14	4.35
Vitis rotundifolia		<1	5					0.71	2.72
Woodwardia virginica					10		5	2.14	8.15
Xyris sp.						1	20	3.00	11.41
Total	5	90	28	10	15	2	34	26.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							**Cover**	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	2							0.29	2.15
Ludwigia alata						1		0.14	1.08
Lyonia lucida		30	25					7.86	59.14
Mosses					10			1.43	10.75
Persea palustris			10					1.43	10.75
Unknown grass 2	3							0.43	3.23
Unknown seedling				1	5			0.86	6.45
Vitis rotundifolia					1			0.14	1.08
Woodwardia virginica				5				0.71	5.38
Total	5	30	35	6	16	1	0	13.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							**Cover**	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	5	1						0.86	4.96
Cladium jamaicense							5	0.71	4.13
Lyonia lucida		5	25	10	5			6.43	37.19
Mosses			5	15	5	5	3	4.71	27.27
Unknown grass	3							0.43	2.48
Unknown seedling					2			0.29	1.65
Woodwardia virginica	3	2	2			5	15	3.86	22.31
Total	11	8	32	25	12	10	23	17.29	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							**Cover**	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	4.00	0.33						0.62	3.27
Cladium jamaicense							1.67	0.24	1.26
Ludwigia alata						0.33		0.05	0.25
Lyonia lucida		41.67	21.67	5.00	1.67			10.00	52.77
Mosses			2.33	6.67	5.00	1.67	2.67	2.62	13.82
Osmunda cinnamomea			0.33				0.33	0.10	0.50
Persea palustris			5.00					0.71	3.77
Toxicodendron radicans						0.33		0.05	0.25
Unknown grass	1.00							0.14	0.75
Unknown grass 2	1.00							0.14	0.75
Unknown seedling				0.33	4.00		1.00	0.76	4.02
Vitis rotundifolia		<1	1.67		0.33			0.29	1.51
Woodwardia virginica	1.00	0.67	0.67	1.67	3.33	1.67	6.67	2.24	11.81
Xyris sp.						0.33	6.67	1.00	5.28
Total	7.00	42.67	31.67	13.67	14.33	4.33	19.00	18.95	100.00

Table D-4
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal- March 16, 2000

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Gordonia lasianthus Ilex sp.	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Lachnanthes caroliniana	FAC				1.97	0.02	1.99	1.42	13.98	0.40	16.67	15.33
Ludwigia alata	OBL				0.52		0.52	0.37	3.65	0.20	8.33	5.99
Panicum hemitomon	OBL	5.90					5.90	4.21	41.46	0.20	8.33	24.90
Toxicodendron radicans	FAC	1.04				3.41	4.45	3.18	31.27	0.40	16.67	23.97
Vitis rotundifolia	FAC	0.41	0.15	0.20	0.23		0.99	0.71	6.96	0.80	33.33	20.15
Xyris sp.	OBL				0.04	0.34	0.38	0.27	2.67	0.40	16.67	9.67
Total		7.35	0.15	0.20	2.76	3.77	14.23	10.16	100.00	2.40	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Lachnanthes caroliniana	FAC				0.04		0.04	0.03	0.09	0.20	8.33	4.21
Ludwigia alata	OBL				1.24	24.10	25.34	18.10	58.88	0.40	16.67	37.77
Panicum hemitomon	OBL	2.91					2.91	2.08	6.76	0.20	8.33	7.55
Toxicodendron radicans	FAC	0.22	0.31				0.53	0.38	1.23	0.40	16.67	8.95
Vitis rotundifolia	FAC	4.74	2.32		1.22		8.28	5.91	19.24	0.60	25.00	22.12
Xyris sp.	OBL			0.01	0.06	5.87	5.94	4.24	13.80	0.60	25.00	19.40
Total		7.87	2.63	0.01	2.56	29.97	43.04	30.74	100.00	2.40	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Ludwigia alata	OBL					4.70	4.70	3.36	44.01	0.20	11.11	27.56
Panicum hemitomon	OBL	0.65					0.65	0.46	6.09	0.20	11.11	8.60
Toxicodendron radicans	FAC	2.36	0.50		0.40		3.26	2.33	30.52	0.60	33.33	31.93
Vitis rotundifolia	FAC			0.20	0.12		0.32	0.23	3.00	0.40	22.22	12.61
Xyris sp.	OBL				0.23	1.52	1.75	1.25	16.39	0.40	22.22	19.30
Total		3.01	0.50	0.20	0.75	6.22	10.68	7.63	100.00	1.80	100.00	100.00

Table D-5
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - October 10, 2001

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Gordonia lasianthus		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Ilex sp.	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC					1.50	1.50	1.07	12.55	0.20	25.00	18.78
Vitis rotundifolia	FAC	1.24	0.19		9.02		10.45	7.46	87.45	0.60	75.00	81.23
Total		1.24	0.19	0.00	9.02	1.50	11.95	8.54	100.00	0.80	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Vitis rotundifolia	FAC	1.46	0.05				1.51	1.08	100.00	0.40	100.00	100.00
Total		1.46	0.05	0.00	0.00	0.00	1.51	1.08	100.00	0.40	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.02					0.02	0.01	7.69	0.20	50.00	28.85
Vitis rotundifolia	FAC			0.24			0.24	0.17	92.31	0.20	50.00	71.16
Total		0.02	0.00	0.24	0.00	0.00	0.26	0.19	100.00	0.40	100.00	100.00

Table D-6
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - April 17, 2002

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Gordonia lasianthus		**Linear Distance (m)**					**Total Linear**	**Cover**		**Frequency**		**Importance**
Ilex sp.	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Lachnanthes caroliniana	FAC				0.39	5.73	6.12	4.37	67.11	0.40	40.00	53.56
Vitis rotundifolia	FAC	0.04	1.26		1.70		3.00	2.14	32.89	0.60	60.00	46.44
Total		0.04	1.26	0.00	2.09	5.73	9.12	6.51	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total **Total Linear**	**Cover**		**Frequency**		**Importance**
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Lachnanthes caroliniana	FAC	0.14	0.7	0.33	0.01	0.05	1.23	0.88	3.61	1	62.5	33.06
Vitis rotundifolia	FAC	13.36	19.40		0.06		32.82	23.44	96.39	0.60	37.50	66.94
Total		13.50	20.10	0.33	0.07	0.00	34.05	24.32	100.00	1.60	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total **Total Linear**	**Cover**		**Frequency**		**Importance**
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Lachnanthes caroliniana	FAC			0.50			0.50	0.36	7.99	0.20	20.00	13.99
Toxicodendron radicans	FAC	1.26					1.26	0.90	20.13	0.20	20.00	20.06
Vitis rotundifolia	FAC	0.07	2.72	1.71			4.50	3.21	71.88	0.60	60.00	65.94
Total		1.33	2.72	2.21	0.00	0.00	6.26	4.47	100.00	1.00	100.00	100.00

Table D-7
Summary of Shrubs on one 140-m Line Intercept Transect for Thayer Canal - September 25, 2000

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Gordonia lasianthus	5.25	3.00				8.25	5.89	9.20	0.40	15.38	12.29
Ilex sp.					2.10	2.10	1.50	2.34	0.20	7.69	5.02
Itea virginica					6.80	6.80	4.86	7.58	0.20	7.69	7.64
Lyonia lucida	3.56	20.12	6.32	16.61	22.70	69.31	49.51	77.26	1.00	38.46	57.86
Myrica cerifera	0.65			0.70		1.35	0.96	1.50	0.40	15.38	8.44
Persea borbonia	1.10				0.80	1.90	1.36	2.12	0.40	15.38	8.75
Total	10.56	23.12	6.32	17.31	32.40	89.71	64.08	100.00	2.60	100.00	100.00

Summary of Shrubs on one 140-m Line Intercept Transect for Thayer Canal - October 2001

	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	Distance	Percent	Relative	Absolute	Relative	Value
Gordonia lasianthus	4.05	3.45	1.99	0.62	1.02	11.13	7.95	17.41	1.00	26.32	21.86
Lyonia lucida	3.63	12.62	2.41	12.78	16.97	48.41	34.58	75.71	1.00	26.32	51.01
Myrica cerifera	0.50			1.03		1.53	1.09	2.39	0.40	10.53	6.46
Persea borbonia	0.39					0.39	0.28	0.61	0.20	5.26	2.94
Smilax sp.	0.13	0.38	0.61	0.01	1.25	2.38	1.70	3.72	1.00	26.32	15.02
Vaccinium elliotti				0.10		0.10	0.07	0.16	0.20	5.26	2.71
Total	8.70	16.45	5.01	14.54	19.24	63.94	45.67	100.00	3.80	100.00	100.00

Table D-8
Summary of Canopy and Subcanopy Tree Importance Values for Thayer Canal Transect - September 25, 2000

Canopy Species

Gordonia lasianthus	**No.**	**Dominance (m^2/ha)**	**Relative Dominance**	**Density (#/ha)**	**Relative Density**	**Frequency (***)**	**Relative Frequency**	**Importance Value**
Ilex sp.	19	11.22	46.94	339.29	48.72	1.00	31.25	42.30
Ilex cassine	3	0.70	2.93	53.57	7.69	0.20	6.25	5.62
Magnolia virginica	4	1.61	6.76	71.43	10.26	0.20	6.25	7.75
Nyssa sylvatica	2	0.44	1.84	35.71	5.13	0.20	6.25	4.41
Persea palustris	4	0.99	4.14	71.43	10.26	0.60	18.75	11.05
Pinus elliottii	3	2.18	9.12	53.57	7.69	0.40	12.50	9.77
Pinus taeda	1	0.22	0.92	17.86	2.56	0.20	6.25	3.24
Quercus laurifolia	1	4.45	18.63	17.86	2.56	0.20	6.25	9.15
Taxodium distichum	2	2.09	8.73	35.71	5.13	0.20	6.25	6.70
Total	39	23.90	100.00	696.43	100.00	3.20	100.00	100.00

Subcanopy Species

Species	**No.**	**Dominance (m^2/ha)**	**Relative Dominance**	**Density (#/ha)**	**Relative Density**	**Frequency (***)**	**Relative Frequency**	**Importance Value**
Gordonia lasianthus	66	2.76	50.25	1178.57	51.97	0.80	22.22	51.48
Ilex cassine	9	0.65	11.82	1.60.71	7.09	0.20	5.56	8.15
Ilex sp.	1	0.03	0.60	17.86	0.79	0.20	5.56	2.31
Magnolia virginica	1	0.13	2.31	17.86	0.79	0.20	5.56	2.88
Myrica cerifera	4	0.11	2.00	71.43	3.15	0.60	16.67	7.27
Persea palustris	40	1.69	30.80	714.29	31.50	1.00	27.78	30.02
Pinus elliottii	3	0.08	1.45	53.57	2.36	0.40	11.11	4.97
Taxodium distichum	3	0.04	0.78	53.57	2.36	0.20	5.56	2.90
Total	127	5.49	100.00	2267.86	100.00	3.60	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-9
Summary of Canopy and Subcanopy Tree Importance Values for Thayer Canal Transect - October 10, 2001

Canopy Species

Gordonia lasianthus	**No.**	**Dominance (m^2/ha)**	**Relative Dominance**	**Density (#/ha)**	**Relative Density**	**Frequency (***)**	**Relative Frequency**	**Importance Value**
Ilex sp.	20	12.43	47.50	357.14	47.62	1.00	29.41	41.51
Ilex cassine	3	0.73	2.79	53.57	7.14	0.20	5.88	5.27
Magnolia virginica	4	1.60	6.13	71.43	9.52	0.20	5.88	7.18
Nyssa sylvatica	2	0.46	1.76	35.71	4.76	0.20	5.88	4.13
Persea palustris	6	1.33	5.07	107.14	14.29	0.80	23.53	14.29
Pinus elliottii	3	2.43	9.30	53.57	7.14	0.40	11.76	9.40
Pinus taeda	1	0.28	1.08	17.86	2.38	0.20	5.88	3.11
Quercus laurifolia	1	4.73	18.09	17.86	2.38	0.20	5.88	8.78
Taxodium distichum	2	2.17	8.29	35.71	4.76	0.20	5.88	6.31
Total	42	26.17	100.00	750.00	100.00	3.40	100.00	100.00

Subcanopy Species

Species	**No.**	**Dominance (m^2/ha)**	**Relative Dominance**	**Density (#/ha)**	**Relative Density**	**Frequency (***)**	**Relative Frequency**	**Importance Value**
Gordonia lasianthus	69	3.10	52.64	1232.14	54.33	0.80	23.53	43.50
Ilex cassine	9	0.66	11.16	160.71	7.09	0.20	5.88	8.04
Ilex sp.	1	0.03	0.44	17.86	0.79	0.20	5.88	2.37
Magnolia virginica	1	0.11	1.80	17.86	0.79	0.20	5.88	2.82
Myrica cerifera	4	0.13	2.20	71.43	3.15	0.60	17.65	7.67
Persea palustris	38	1.71	28.96	678.57	29.92	1.00	29.41	29.43
Pinus elliottii	2	0.08	1.40	35.71	1.57	0.20	5.88	2.95
Taxodium distichum	3	0.08	1.40	53.57	2.36	0.20	5.88	3.22
Total	127	5.90	100.00	2267.86	100.00	3.40	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-10
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect- March 16, 2000

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**Percent**	**Relative**
Blechnum serrulatum							8	1.14	13.56
Itea virginica		1		2				0.43	5.08
Lyonia lucida		10				1	10	3.00	35.59
Osmunda cinnamomea							2	0.29	3.39
Panicum sp.	1							0.14	1.69
Rhynchospora sp.	1							0.14	1.69
Saururus cernuus	1	1						0.29	3.39
Seedlings	1							0.14	1.69
Smilax laurifolia		1		1				0.29	3.39
Sphagnum		1	1	1	1	1	5	1.43	16.95
Toxicodendron radicans							1	0.14	1.69
Woodwardia virginica	2	1		2	2			1.00	11.86
Total	6	15	1	6	3	2	26	8.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**Percent**	**Relative**
Blechnum serrulatum	10							1.43	7.87
Lycopus rubellus							1	0.14	0.79
Lyonia lucida		2				1		0.43	2.36
Myrica cerifera							2	0.29	1.57
Panicum sp.							1	0.14	0.79
Persea palustris							2	0.29	1.57
Rhynchospora sp.				1			1	0.29	1.57
Saururus cernuus			2			1	1	0.57	3.15
Seedlings	1				1	1	1	0.57	3.15
Sphagnum	5	78		1		1	3	12.57	69.29
Toxicodendron radicans		1					1	0.29	1.57
Vitis rotundifolia						1		0.14	0.79
Woodwardia virginica	3			3			1	1.00	5.51
Total	19	81	2	5	1	5	14	18.14	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**Percent**	**Relative**
Blechnum serrulatum				2	5			1.00	14.58
Dulichium arundinaceum				1				0.14	2.08
Lyonia lucida				2	10	2		2.00	29.17
Myrica cerifera	1							0.14	2.08
Persea palustris							2	0.29	4.17
Rhynchospora sp.								0.00	0.00
Rubus sp.		1						0.14	2.08
Seedlings	1		1	1				0.43	6.25
Sphagnum				5	5			1.43	20.83
Vitis rotundifolia		1						0.14	2.08
Woodwardia areolata		2						0.29	4.17
Woodwardia virginica	2						4	0.86	12.50
Total	4	4	1	11	20	2	6	6.86	100.00

Table D-10
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect- March 16, 2000

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum	3.33			0.67	1.67		2.67	1.19	10.68
Dulichium arundinaceum				0.33				0.05	0.43
Itea virginica		0.33		0.67				0.14	1.28
Lycopus rubellus							0.33	0.05	0.43
Lyonia lucida		4.00		0.67	3.33	1.33	3.33	1.81	16.24
Myrica cerifera	0.33						0.67	0.14	1.28
Osmunda cinnamomea							0.67	0.10	0.85
Panicum sp.	0.33						0.33	0.10	0.85
Persea palustris							1.33	0.19	1.71
Rhynchospora sp.	0.33			0.33			0.33	0.14	1.28
Rubus sp.		0.33						0.05	0.43
Saururus cernuus	0.33	0.33	0.67			0.33	0.33	0.29	2.56
Seedlings	1.00		0.33	0.33	0.33	0.33	0.33	0.38	3.42
Smilax laurifolia		0.33		0.33				0.10	0.85
Sphagnum	1.67	26.33	0.33	2.33	2.00	0.67	2.67	5.14	46.15
Toxicodendron radicans		0.33					0.67	0.14	1.28
Vitis rotundifolia		0.33				0.33		0.10	0.85
Woodwardia areolata		0.67						0.10	0.85
Woodwardia virginica	2.33	0.33		1.67	0.67		1.67	0.95	8.55
Total	9.67	33.33	1.33	7.33	8.00	3.00	15.33	11.14	100.00

Table D-11
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect- October 10, 2001

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum							10	1.43	16.53
Cladium jamaicense	1							0.14	1.65
Leersia hexandra	2							0.29	3.31
Lyonia lucida		4					15	2.71	31.40
Mosses				2				0.29	3.31
Osmunda cinnamomea							20	2.86	33.06
Sabal palmetto	2							0.29	3.31
Unknown	1							0.14	1.65
Vitis rotundifolia		1						0.14	1.65
Woodwardia virginica	2	0.5						0.36	4.13
Total	8	5.5	0	2	0	0	45	8.64	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum							12	1.71	11.01
Cladium jamaicense	2							0.29	1.83
Leersia hexandra	1							0.14	0.92
Lyonia lucida						2		0.29	1.83
Mosses	3			10		60	10	11.86	76.15
Myrica cerifera	2							0.29	1.83
Persea borbonia	2	0.5						0.36	2.29
Saururus cernuus	0.5	1						0.21	1.38
Woodwardia virginica							3	0.43	2.75
Total	10.5	1.5	0	10	0	62	25	15.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum					10			1.43	16.95
Lyonia lucida		4			8	10		3.14	37.29
Mosses					5	10		2.14	25.42
Osmunda regalis	4							0.57	6.78
Woodwardia areolata		5						0.71	8.47
Woodwardia virginica	3							0.43	5.08
Total	7	9	0	0	23	20	0	8.43	100.00

Table D-11
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect- October 10, 2001

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					3.33		7.33	1.52	14.00
Cladium jamaicense	1.00							0.14	1.31
Leersia hexandra	1.00							0.14	1.31
Lyonia lucida		2.67			2.67	4.00	5.00	2.05	18.82
Mosses	1.00			4.00	1.67	23.33	3.33	4.76	43.76
Myrica cerifera	0.67							0.10	0.88
Osmunda cinnamomea							6.67	0.95	8.75
Osmunda regalis	1.33							0.19	1.75
Persea borbonia	0.67	0.17						0.12	1.09
Sabal palmetto	0.67							0.10	0.88
Saururus cernuus	0.17	0.33						0.07	0.66
Unknown	0.33							0.05	0.44
Vitis rotundifolia		0.33						0.05	0.44
Woodwardia virginica	1.67	0.17					1.00	0.40	3.72
Woodwardia areolata		1.67						0.24	2.19
Total	8.50	5.33	0.00	4.00	7.67	27.33	23.33	10.88	100.00

Table D-12
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect- April 17, 2002

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum Serrulatum							40	5.71	15.44
Lyonia sp.							30	4.29	11.58
Mosses		10	30	1	20		50	15.86	42.86
Sabal palmeto	1							0.14	0.39
Saururus cernuus	*5*							0.71	1.93
Seedling		1	2	1	5			1.29	3.47
Toxicodendron radicans							2	0.29	0.77
Unknown grass	1							0.14	0.39
Vitis sp.	5							0.71	1.93
Woodwardia virginica	5	10		7	5		25	7.43	20.08
Xyris sp.	3							0.43	1.16
Total	20	21	32	9	30	0	147	37.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Itea virginica							10	1.43	5.88
Lyonia sp.		1				20		3.00	12.35
Mosses		5	10			60		10.71	44.12
Persea borbonia		5						0.71	2.94
Saururus cernuus		10						1.43	5.88
Toxicodendron radicans							5	0.71	2.94
Unknown seedling		5	1	1	1	1		1.29	5.29
Woodwardia virginica	20			10			5	5.00	20.59
Total	20	26	11	11	1	81	20	24.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum					30		2	4.57	20.25
Dulichium arundinaceum				2				0.29	1.27
Lyonia sp.					20	20		5.71	25.32
Mosses					30	10		5.71	25.32
Toxicodendron radicans				1	1	5	1	1.14	5.06
Unknown herb	7							1.00	4.43
Unknown seedling		5			2			1.00	4.43
Woodwardia areolata		5						0.71	3.16
Woodwardia virginica	10			5			2	2.43	10.76
Total	17	10	0	8	83	35	5	22.57	100.00

Table D-12
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect- April 17, 2002

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum					10.00		14.00	3.43	12.27
Dulichium arundinaceum				0.67				0.10	0.34
Itea virginica							3.33	0.48	1.70
Lyonia sp.		0.33			6.67	13.33	10.00	4.33	15.50
Mosses		5.00	13.33	0.33	16.67	23.33	16.67	10.76	38.50
Persea borbonia		1.67						0.24	0.85
Sabal palmeto	0.33							0.05	0.17
Saururus cernuus	1.67	3.33						0.71	2.56
Seedling		0.33	0.67	0.33	1.67			0.43	1.53
Toxicodendron radicans				0.33	0.33	1.67	2.67	0.71	2.56
Unknown grass	0.33							0.05	0.17
Unknown herb	2.33							0.33	1.19
Unknown seedling		3.33	0.33	0.33	1.00	0.33		0.76	2.73
Vitis sp.	1.67							0.24	0.85
Woodwardia areolata		1.67						0.24	0.85
Woodwardia virginica	11.67	3.33		7.33	1.67		10.67	4.95	17.72
Xyris sp.	1.00							0.14	0.51
Total	19.00	19.00	14.33	9.33	38.00	38.67	57.33	27.95	100.00

Table D-13
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - March 16, 2000

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	FAC	3.66					3.66	1.83	20.61	0.20	10.00	15.30
Toxicodendron radicans	OBL	0.02	1.21		1.73	0.22	3.18	1.59	17.91	0.80	40.00	28.95
Vitis rotundifolia	OBL	10.31	0.20			0.01	10.52	5.26	59.23	0.60	30.00	44.62
Woodwardia areolata	FAC	0.10			0.30		0.40	0.20	2.25	0.40	20.00	11.13
Total		14.09	1.41	0.00	2.03	0.23	17.76	8.88	100.00	2.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

							Total					
		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	FAC	3.22	3.00	0.30	2.62	0.20	9.34	4.67	52.21	1.00	33.33	42.77
Toxicodendron radicans	OBL	0.51	1.20	1.70	0.50	2.10	6.01	3.00	33.59	1.00	33.33	33.46
Vitis rotundifolia	OBL	0.93	0.80		0.70		2.43	1.21	13.58	0.60	20.00	16.79
Woodwardia areolata	FAC	0.01			0.10		0.11	0.05	0.61	0.40	13.33	6.97
Total		4.67	5.00	2.00	3.92	2.30	17.89	8.94	100.00	3.00	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

							Total					
		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	FAC	0.02		0.33		1.70	2.05	1.03	12.04	0.60	21.43	16.74
Toxicodendron radicans	OBL	0.66	1.20	1.53	3.10	4.01	10.50	5.25	61.69	1.00	35.71	48.70
Vitis rotundifolia	OBL	1.39	0.04		0.90	0.90	3.23	1.62	18.98	0.80	28.57	23.77
Woodwardia areolata	FAC	0.64				0.60	1.24	0.62	7.29	0.40	14.29	10.79
Total		2.71	1.24	1.86	4.00	7.21	17.02	8.51	100.00	2.80	100.00	100.00

Table D-14
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - October 10, 2001

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	1.04					1.04	0.52	44.44	0.20	20.00	32.22
Toxicodendron radicans	FAC				0.04		0.04	0.02	1.71	0.20	20.00	10.85
Vitis rotundifolia	FAC	0.95	0.14				1.09	0.55	46.58	0.40	40.00	43.29
Woodwardia areolata	OBL	0.17					0.17	0.09	7.26	0.20	20.00	13.63
Total		1.04	0.14	0.00	0.45	0.00	1.63	1.17	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Total

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	0.19					0.19	0.10	19.00	0.20	33.33	26.17
Toxicodendron radicans	FAC		0.58				0.58	0.29	58.00	0.20	33.33	45.67
Woodwardia areolata	OBL	0.23					0.23	0.12	23.00	0.20	33.33	28.17
Total		0.42	0.58	0.00	0.00	0.00	1.00	0.50	100.00	0.60	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Total

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.08				0.17	0.25	0.12	14.62	0.40	50.00	32.31
Vitis rotundifolia	FAC	0.62					0.62	0.31	36.26	0.20	25.00	30.63
Woodwardia areolata	OBL	0.84					0.84	0.42	49.12	0.20	25.00	37.06
Total		1.54	0.00	0.00	0.00	0.17	1.71	0.85	100.00	0.80	100.00	100.00

Table D-15
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - April 17, 2002

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	5.60					5.60	2.80	44.30	0.20	11.11	27.71
Toxicodendron radicans	FAC	0.50			1.28	0.61	2.39	1.19	18.91	0.60	33.33	26.12
Vitis rotundifolia	FAC	1.80	0.17	0.06		1.77	3.80	1.90	30.06	0.80	44.44	37.25
Woodwardia areolata	OBL	0.85					0.85	0.43	6.72	0.20	11.11	8.92
Total		8.75	0.17	0.06	1.28	2.38	12.64	6.32	100.00	1.80	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	3.41	1.93	0	1.76	0.11	7.21	3.6	16.06	0.8	26.67	21.36
Toxicodendron radicans	FAC	0.32	0.99	1.22	1.61	1.48	5.62	2.81	12.52	1	33.33	22.93
Vitis rotundifolia	FAC	13.72	11.33	0.46	6.24		31.75	15.88	70.71	0.8	26.67	48.69
Woodwardia areolata	OBL	0.21	0.11				0.32	0.16	0.71	0.40	13.33	7.02
Total		17.66	14.36	1.68	9.61	1.59	44.90	22.45	100.00	3.00	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.47		0.67		0.48	1.62	0.81	12.87	0.60	23.08	17.97
Toxicodendron radicans	FAC	0.60		0.01	0.50	2.20	3.31	1.66	26.29	0.80	30.77	28.53
Vitis rotundifolia	FAC	3.32	2.13	1.11	0.29		6.85	3.43	54.41	0.80	30.77	42.59
Woodwardia areolata	OBL	0.40				0.41	0.81	0.41	6.43	0.40	15.38	10.91
Total		4.79	2.13	1.79	0.79	3.09	12.59	6.30	100.00	2.60	100.00	100.00

Table D-16

Summary of Shrubs on one 200-meter Line Intercept Transect for Hammock Field - September 26, 2000

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus		0.70				0.70	0.35	0.68	0.20	6.67	3.67
Ilex sp.		1.20				1.20	0.60	1.16	0.20	6.67	3.91
Itea virginica		0.30				0.30	0.15	0.29	0.20	6.67	3.48
Lyonia lucida	7.70	13.20	29.51	15.45	18.52	84.38	42.19	81.61	1.00	33.33	57.47
Myrica cerifera	2.70			0.70		3.40	1.70	3.29	0.40	13.33	8.31
Persea borbonia	1.00	1.70				2.70	1.35	2.61	0.40	13.33	7.97
Rubus sp.				1.80		1.80	0.90	1.74	0.20	6.67	4.20
Vaccinium corymbosum	1.60			7.31		8.91	4.46	8.62	0.40	13.33	10.98
Total	13.00	17.10	29.51	25.26	18.52	103.39	51.70	100.00	3.00	100.00	100.00

Summary of Shrub on one 200-meter Line Transect for Hammock Field - October 2001

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus		1.22				1.22	0.61	1.43	0.20	5.56	3.49
Itea virginica				0.41		0.41	0.21	0.48	0.20	5.56	3.02
Lyonia lucida	3.19	15.08	28.31	11.11	13.97	71.66	35.83	84.12	1.00	27.78	55.95
Smilax sp.	0.04	0.83	0.19		0.05	1.11	0.56	1.30	0.80	22.22	11.76
Vaccinium elliotti	1.06		4.26	2.11		7.43	3.72	8.72	0.60	16.67	12.69
Woody vines	0.25	1.12		1.60	0.39	3.36	1.68	3.94	0.80	22.22	13.08
Total	4.54	18.25	32.76	15.23	14.41	85.19	42.60	100.00	3.60	100.00	100.00

Table D-17

Summary of Canopy and Subcanopy Tree Importance Values for Hammock Field Transect - September 26, 2000

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	1	0.43	1.34	25.00	3.23	0.20	6.67	3.74
Liquidambar styraciflua	2	1.52	4.71	50.00	6.45	0.40	13.33	8.16
Magnolia virginica	7	8.36	25.93	175.00	22.58	0.60	20.00	22.84
Nyssa sylvatica	9	12.00	37.21	225.00	29.03	0.60	20.00	28.75
Persea palustris	7	2.99	9.27	175.00	22.58	0.60	20.00	17.28
Pinus elliottii	1	2.54	7.88	25.00	3.23	0.20	6.67	5.92
Quercus laurifolia	2	0.43	1.33	50.00	6.45	0.20	6.67	4.82
Taxodium distichum	2	3.98	12.33	50.00	6.45	0.20	6.67	8.48
Total	31	32.25	100.00	775	100.00	3.00	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	4	0.53	17.63	100.00	9.09	0.20	7.14	11.29
Magnolia virginica	14	1.14	38.13	350.00	31.82	0.80	28.57	32.84
Myrica cerifera	3	0.08	2.53	75.00	6.82	0.40	14.29	7.88
Persea palustris	20	1.09	36.22	500.00	45.45	1.00	35.71	39.13
Quercus nigra	1	0.12	3.93	25.00	2.27	0.20	7.14	4.45
Taxodium distichum	2	0.05	1.57	50.00	4.55	0.20	7.14	4.42
Total	44	3.00	100.00	1100.00	100.00	2.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-18
Summary of Canopy and Subcanopy Tree Importance Values for Hammock Field Transect - October 10, 2001

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	1	0.45	1.34	25.00	3.13	0.20	6.67	3.71
Liquidambar styraciflua	2	1.71	5.13	50.00	6.25	0.40	13.33	8.24
Magnolia virginica	8	8.77	26.24	200.00	25.00	0.60	20.00	23.75
Nyssa sylvatica	9	12.14	36.33	225.00	28.13	0.60	20.00	28.15
Persea palustris	7	3.21	9.60	175.00	21.88	0.60	20.00	17.16
Pinus elliottii	1	2.62	7.83	25.00	3.13	0.20	6.67	5.87
Quercus laurifolia	2	0.53	1.60	50.00	6.25	0.20	6.67	4.84
Taxodium distichum	2	3.99	11.94	50.00	6.25	0.20	6.67	8.29
Total	32	33.43	100.00	800.00	100.00	3.00	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	4	0.57	18.40	100.00	9.52	0.20	7.14	11.69
Magnolia virginica	13	0.97	31.06	325.00	30.95	0.80	28.57	30.20
Myrica cerifera	3	0.09	2.96	75.00	7.14	0.40	14.29	8.13
Persea palustris	19	1.28	41.00	475.00	45.24	1.00	35.71	40.65
Quercus nigra	1	0.14	4.56	25.00	2.38	0.20	7.14	4.69
Taxodium distichum	2	0.06	2.02	50.00	4.76	0.20	7.14	4.64
	42	3.11	100.00	1050.00	100.00	2.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-19
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect- March 16, 2000

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Blechnum serrulatum				12			2	2.00	15.22
Lyonia lucida	10		15	5				4.29	32.61
Persea palustris			1	1				0.29	2.17
Saururus cernuus							1	0.14	1.09
Seedlings		1			1	6	1	1.29	9.78
Sphagnum			10	1	1	2		2.00	15.22
Toxicodendron radicans	1							0.14	1.09
Vitis rotundifolia		3	1	5				1.29	9.78
Woodwardia areolata		1						0.14	1.09
Woodwardia virginica		1	1	5	2	2		1.57	11.96
Total	11	6	28	29	4	10	4	13.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Blechnum serrulatum				5			2	1.00	9.21
Lyonia lucida	10			5		1	10	3.71	34.21
Osmunda cinnamomea					5			0.71	6.58
Persea palustris					1			0.14	1.32
Seedlings		1	1					0.29	2.63
Sphagnum	5	1	5	5	5			3.00	27.63
Toxicodendron radicans				1		1		0.29	2.63
Unknown Grass						1		0.14	1.32
Vitis rotundifolia							1	0.14	1.32
Woodwardia areolata			1	1	1		1	0.57	5.26
Woodwardia virginica		3		3				0.86	7.89
Total	15	5	7	20	12	3	14	10.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Itea virginica	1	1						0.29	2.00
Lyonia lucida	5				5		5	2.14	15.00
Quercus sp.			1		1	1		0.43	3.00
Rhynchospora sp.		1						0.14	1.00
Saururus cernuus		1						0.14	1.00
Seedlings		1	1	1			1	0.57	4.00
Sphagnum			5		1		25	4.43	31.00
Toxicodendron radicans	1				5			0.86	6.00
Vitis rotundifolia	1	1		1	12			2.14	15.00
Woodwardia areolata	1							0.14	1.00
Woodwardia virginica		1	20					3.00	21.00
Total	9	6	27	2	24	1	31	14.29	100.00

Table D-19
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect- March 16, 2000

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum				5.67			1.33	1.00	7.84
Itea virginica	0.33	0.33						0.10	0.75
Lyonia lucida	8.33		5.00	3.33	1.67	0.33	5.00	3.38	26.49
Osmunda cinnamomea					1.67			0.24	1.87
Persea palustris			0.33	0.33	0.33			0.14	1.12
Quercus sp.			0.33		0.33	0.33		0.14	1.12
Rhynchospora sp.		0.33						0.05	0.37
Saururus cernuus		0.33					0.33	0.10	0.75
Seedlings		1.00	0.67	0.33	0.33	2.00	0.67	0.71	5.60
Sphagnum	1.67	0.33	6.67	2.00	2.33	0.67	8.33	3.14	24.63
Toxicodendron radicans	0.67			0.33	1.67	0.33		0.43	3.36
Unknown Grass						0.33		0.05	0.37
Vitis rotundifolia	0.33	1.33	0.33	2.00	4.00		0.33	1.19	9.33
Woodwardia areolata	0.33	0.33	0.33	0.33	0.33		0.33	0.29	2.24
Woodwardia virginica		1.67	7.00	2.67	0.67	0.67		1.81	14.18
Total	11.67	5.67	20.67	17.00	13.33	4.67	16.33	12.76	100.00

Table D-20
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect- October 10, 2001

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum				10			3	1.86	18.31
Lyonia lucida	8		25	10				6.14	60.56
Itea virginica	2							0.29	2.82
Mosses		2						0.29	2.82
Persea palustris		2	1					0.43	4.23
Vitis rotundifolia				1				0.14	1.41
Woodwardia areolata		0.5						0.07	0.70
Woodwardia virginica		0.5	3			3		0.93	9.15
Total	10	5	29	11	0	3	0	10.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum	2			20	1			3.29	15.54
Lyonia lucida	15	1		12			2	4.29	20.27
Mosses		10	1		40		5	8.00	37.84
Persea palustris	1		2					0.43	2.03
Vitis rotundifolia	5							0.71	3.38
Woodwardia areolata								0.00	0.00
Woodwardia virginica		6	15	8		2		4.43	20.95
Total	23	17	18	40	41	2	7	21.14	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum		2						0.29	4.00
Itea virginica	15	3						2.57	36.00
Lyonia lucida	10			1	1			1.71	24.00
Mosses						1		0.14	2.00
Persea palustris				1	2			0.43	6.00
Vitis rotundifolia					1			0.14	2.00
Woodwardia virginica		6	7					1.86	26.00
Total	25	11	7	2	4	1	0	7.14	100.00

Table D-20
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect- October 10, 2001

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum	0.67	0.67		10.00	0.33		1.00	1.81	14.13
Itea virginica	5.67	1.00						0.95	7.43
Lyonia lucida	11.00	0.33	8.33	7.67	0.33		0.67	4.05	31.60
Mosses		4.00	0.33		13.33	0.33	1.67	2.81	21.93
Persea palustris	0.33	0.67	1.00	0.33	0.67			0.43	3.35
Vitis rotundifolia	1.67			0.33	0.33			0.33	2.60
Woodwardia areolata		0.17						0.02	0.19
Woodwardia virginica		4.17	8.33	2.67		1.67		2.40	18.77
Total	19.33	11.00	18.00	21.00	15.00	2.00	3.33	12.81	100.00

Table D-21
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect- April 17, 2002

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum		5						0.71	3.52
Itea virginica	5	1						0.86	4.23
Lyonia lucida	10	3	1	3	5			3.14	15.49
Mosses							10	1.43	7.04
Persea palustris	1		2		5			0.43	2.11
Pinus seedling		1						0.14	0.70
Toxicodendron radicans	15				2			2.43	11.97
Unknown Carex		1						0.14	0.70
Vitis rotundifolia				2	7			1.29	6.34
Woodwardia virginica		30	30					8.57	42.25
Xyris sp.	1	1	1					0.43	2.11
Total	32	42	34	5	19	0	10	20.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum				15				2.14	5.73
Itea virginica	2							0.29	0.76
Lyonia lucida	15	5	1	30	1	2	5	8.43	22.52
Mosses	20	10	5		20	2		8.14	21.76
Panicum ensifolium								0.00	0.00
Pinus seedling		1						0.14	0.38
Smilax sp.							7	1.00	2.67
Unknown Fern					2			0.29	0.76
Vitis rotundifolia					20			2.86	7.63
Woodwardia areolata				1				0.14	0.38
Woodwardia virginica	2	25	25	40		5	1	14.00	37.40
Total	39	41	31	86	43	9	13	37.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum				15			30	6.43	20.27
Itea virginica		1						0.14	0.45
Lyonia lucida	10	1	25	15	5			8.00	25.23
Mosses		2	30	1				4.71	14.86
Panicum ensifolium	1							0.14	0.45
Persea palustris								0.00	0.00
Pinus seedling		1						0.14	0.45
Smilax sp.			1	2				0.43	1.35
Toxicodendron radicans	1							0.14	0.45
Vitis rotundifolia	1	5	15	10	5			5.14	16.22
Woodwardia areolata								0.00	0.00
Woodwardia virginica			10	25		10		6.43	20.27
Total	13	10	81	68	10	10	30	31.71	100.00

Table D-21
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect- April 17, 2002

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum		1.67		10.00			10.00	3.10	10.43
Itea virginica	2.33	0.67						0.43	1.44
Lyonia lucida	11.67	3.00	9.00	16.00	3.67	0.67	1.67	6.52	21.99
Mosses	6.67	4.00	11.67	0.33	6.67	0.67	3.33	4.76	16.05
Panicum ensifolium	0.33							0.05	0.16
Persea palustris					1.67			0.24	0.80
Pinus seedling		1.00						0.14	0.48
Smilax sp.			0.33	0.67			2.33	0.48	1.61
Toxicodendron radicans	5.33				0.67			0.86	2.89
Unknown Carex		0.33						0.05	0.16
Unknown Fern					0.67			0.10	0.32
Vitis rotundifolia	0.33	1.67	5.00	4.00	10.67			3.10	10.43
Woodwardia areolata				0.33				0.05	0.16
Woodwardia virginica	0.67	18.33	21.67	21.67		5.00	0.33	9.67	32.58
Xyris sp.	0.33	0.33	0.33					0.14	0.48
Total	27.67	31.00	48.00	53.00	24.00	6.33	17.67	29.67	100.00

Table D-22
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - March 16, 2000

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					0.90	0.90	0.47	2.85	0.25	9.09	5.97
Toxicodendron radicans	FAC	1.11	1.11	0.70		0.50	3.42	1.78	10.84	1.00	36.36	23.60
Vitis rotundifolia	FAC	5.50	1.10	7.92		5.50	20.02	10.43	63.45	1.00	36.36	49.91
Woodwardia areolata	OBL	6.91	0.30				7.21	3.76	22.85	0.50	18.18	20.52
Total		13.52	2.51	8.62		6.90	39.56	16.43	100.00	2.75	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					0.60	0.60	0.31	2.13	0.25	9.09	5.61
Toxicodendron radicans	FAC	0.74	0.92	1.00			2.66	1.39	9.44	0.75	27.27	18.35
Vitis rotundifolia	FAC	0.61	4.70	8.01		0.90	14.22	7.41	50.44	1.00	36.36	43.40
Woodwardia areolata	OBL	7.81	2.00	0.90			10.71	5.58	37.99	0.75	27.27	32.63
Total		9.16	7.62	9.91		1.50	28.19	14.68	100.00	2.75	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					2.31	2.31	1.20	8.86	0.25	9.09	8.98
Toxicodendron radicans	FAC	1.25	0.03	0.82		0.10	2.20	1.15	8.44	1.00	36.36	22.40
Vitis rotundifolia	FAC		5.64	5.47		0.84	11.95	6.22	45.86	0.75	27.27	36.56
Woodwardia areolata	OBL	7.20	1.99	0.41			9.60	5.00	36.84	0.75	27.27	32.06
Total		8.45	7.66	6.70		3.25	26.06	13.57	100.00	2.75	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-23
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - October 10, 2001

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.01					0.01	0.005	0.10	0.25	0.14	0.12
Vitis rotundifolia	FAC	0.13		0.37		1.45	1.95	1.02	18.61	0.75	0.43	9.52
Woodwardia areolata	OBL	7.18	1.24	0.10			8.52	4.44	81.30	0.75	0.43	40.86
Total		7.32	1.24	0.47		1.45	10.48	5.46	100.00	1.75	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					0.53	0.53	0.28	5.03	0.25	12.50	8.76
Toxicodendron radicans	FAC			0.01			0.01	0.01	0.09	0.25	12.50	6.30
Vitis rotundifolia	FAC	0.38		2.07		1.46	3.91	2.04	37.10	0.75	37.50	37.30
Woodwardia areolata	OBL	3.84	1.64	0.61			6.09	3.17	57.78	0.75	37.50	47.64
Total		4.22	1.64	2.69		1.99	10.54	5.49	100.00	2.00	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Vitis rotundifolia	FAC	0.27		1.80			2.07	1.08	37.50	0.50	50.00	43.75
Woodwardia areolata	OBL	1.56	1.89				3.45	1.80	62.50	0.50	50.00	56.25
Total		1.83	1.89	1.80		0.00	5.52	2.88	100.00	1.00	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-24
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - April 17, 2002

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					1.97	1.97	1.026	6.49	0.25	9.09	7.79
Toxicodendron radicans	FAC	1.55	0.40	0.52		0.38	3.06	1.594	10.09	1.00	36.36	23.22
Vitis rotundifolia	FAC	5.19	0.95	4.61		6.15	16.90	8.80	55.70	1.00	36.36	46.03
Woodwardia areolata	OBL	4.97	3.44				8.41	4.38	27.72	0.50	18.18	22.95
Total		11.71	4.79	5.13		8.50	30.34	15.80	100.00	2.75	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.75		2.34			3.09	1.61	7.79	0.50	22.22	15.00
Vitis rotundifolia	FAC	3.76	1.69	12.29		1.97	19.71	10.27	49.67	1.00	44.44	47.06
Woodwardia areolata	OBL	11.29	4.59	1.00			16.88	8.79	42.54	0.75	33.33	37.94
Total		15.80	6.28	15.63		1.97	39.68	20.67	100.00	2.25	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					3.53	3.53	1.84	2.71	0.25	8.33	5.52
Toxicodendron radicans	FAC	0.10	0.15	0.52		0.17	0.94	0.49	0.72	1.00	33.33	17.03
Vitis rotundifolia	FAC	30.74	41.20	23.71		23.53	119.18	62.07	91.66	1.00	33.33	62.50
Woodwardia areolata	OBL	3.52	2.19	0.66			6.37	3.32	4.90	0.75	25.00	14.95
Total		34.36	43.54	24.89		27.23	130.02	67.72	100.00	3.00	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-25
Summary of Shrubs on one 196-meter Line Intercept Transect for Lower Bennett Swamp - September 25, 2000

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	1.20	5.90	4.10		3.70	14.90	7.60	42.32	1.00	23.53	32.92
Ilex sp.		1.30				1.30	0.66	3.69	0.25	5.88	4.79
Itea virginica	0.20					0.20	0.10	0.57	0.25	5.88	3.23
Lyonia lucida	9.90	2.81	1.50		1.10	15.31	7.81	43.48	1.00	23.53	33.51
Magnolia virginica	0.50	0.90				1.40	0.71	3.98	0.50	11.76	7.87
Myrica cerifera			0.10			0.10	0.05	0.28	0.25	5.88	3.08
Persea borbonia	0.40					0.40	0.20	1.14	0.25	5.88	3.51
Serenoa repens	0.30					0.30	0.15	0.85	0.25	5.88	3.37
Vaccinium corymbosum	0.90				0.40	1.30	0.66	3.69	0.50	11.76	7.73
Total	13.40	10.91	5.70		5.20	35.21	17.96	100.00	4.25	100.00	100.00

Summary of Shrub on one 196-meter Line Transect for Lower Bennett Swamp - October 2001

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	0.79	3.18	5.94		4.19	14.10	7.34	24.32	1.00	18.18	21.25
Itea virginica	0.28					0.28	0.15	0.48	0.25	4.55	2.51
Lyonia lucida	14.15	1.10	7.34		0.74	23.33	12.15	40.24	1.00	18.18	29.21
Myrica cerifera			0.71			0.71	0.37	1.22	0.25	4.55	2.89
Persea borbonia	10.27	1.27				11.54	6.01	19.90	0.50	9.09	14.50
Sabal palmetto	0.68	0.11				0.79	0.41	1.36	0.50	9.09	5.23
Smilax sp.	0.30	5.15			0.02	5.47	2.85	9.43	0.75	13.64	11.54
Vaccinium elliottii					0.38	0.38	0.20	0.66	0.25	4.55	2.60
Vitis rotundifolia	0.29					0.29	0.15	0.50	0.25	4.55	2.52
woody vine		0.45	0.01		0.63	1.09	0.57	1.88	0.75	13.64	7.76
Total	26.76	11.26	14.00		5.96	57.98	30.20	100.00	5.50	100.00	100.00

Table D-26
Summary of Canopy and Subcanopy Tree Importance Values for Lower Bennett Swamp Transect - September 25, 2000

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	20	38.37	63.86	543.48	52.63	1.00	30.77	49.09
Nyssa sylvatica	2	2.10	3.49	54.35	5.26	0.25	7.69	5.48
Persea palustris	4	4.07	6.78	108.70	10.53	0.75	23.08	13.46
Pinus elliottii	1	0.37	0.62	21.17	2.63	0.25	7.69	3.65
Taxodium distichum	11	15.17	25.25	298.91	28.95	1.00	30.77	28.32
Total	38	60.07	100.00	1032.61	100.00	3.25	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	35	3.00	76.12	951.09	81.40	1.00	36.36	64.63
Ilex cassine	3	0.33	8.34	81.52	6.98	0.50	18.18	11.17
Magnolia virginica	1	0.21	5.41	27.17	2.33	0.25	9.09	5.61
Myrica cerifera	1	0.12	2.96	27.17	2.33	0.25	9.09	4.79
Nyssa sylvatica	1	0.11	2.81	27.17	2.33	0.25	9.09	4.74
Persea palustris	1	0.14	3.45	27.17	2.33	0.25	9.09	4.95
Pinus elliottii	1	0.04	0.91	27.17	2.33	0.25	9.09	4.11
Total	43	3.94	100.00	1168.48	100.00	2.75	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (4)

Table D-27
Summary of Canopy and Subcanopy Tree Importance Values for Lower Bennett Swamp Transect - October 9, 2001

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	21	40.09	64.55	570.65	53.85	1.00	30.77	49.72
Nyssa sylvatica	2	2.10	3.38	54.35	5.13	0.25	7.69	5.40
Persea palustris	4	40.08	6.58	108.70	10.26	0.75	23.08	13.30
Pinus elliottii	1	0.47	0.75	27.17	2.56	0.25	7.69	3.67
Taxodium distichum	11	15.36	24.74	298.91	28.21	1.00	30.77	27.91
Total	39	62.10	100.00	1059.78	100.00	3.25	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	34	3.13	76.14	923.91	80.95	1.00	36.36	64.48
Ilex cassine	3	0.34	8.28	81.52	7.14	0.50	18.18	11.20
Magnolia virginica	1	0.21	5.20	27.17	2.38	0.25	9.09	5.56
Myrica cerifera	1	0.12	3.00	27.17	2.38	0.25	9.09	4.83
Nyssa sylvatica	1	0.12	3.00	27.17	2.38	0.25	9.09	4.83
Persea palustris	1	0.14	3.33	27.17	2.38	0.25	9.09	4.93
Pinus elliottii	1	0.04	1.05	27.17	2.38	0.25	9.09	4.17
Total	42	4.10	100.00	1141.30	100.00	2.75	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (4)

Operational Year 1 - Detailed Vegetation Data

Table D-28
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - March 4, 2004

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Relative
Green algae						15		2.14	26.79
Lyonia lucida		20	2	2	1			3.57	44.64
Moss			1	3	1			0.71	8.93
Panicum hemotomon	1							0.14	1.79
Persea palustris		2	2					0.57	7.14
Unknown seedling				1	1			0.29	3.57
Vitis rotundifolia			2					0.29	3.57
Woodwardia virginica							1	0.14	1.79
Xyris sp.							1	0.14	1.79
Total	1	22	7	6	3	15	2	8.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Relative
Lyonia lucida		15	3					2.57	75.00
Moss					2			0.29	8.33
Myrica cerifera	1							0.14	4.17
Panicum hemitomon	1							0.14	4.17
Persea palustris			1					0.14	4.17
Unknown seedling				1				0.14	4.17
Total	2	15	4	1	2	0	0	3.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Relative
Gordonia lasianthus				1				0.14	2.94
Lyonia lucida		8	6	3	1	1		2.71	55.88
Moss			2	3		2		1.00	20.59
Osmunda cinnamomea			1					0.14	2.94
Smilax laurifolia				1				0.14	2.94
Unknown seedling					1			0.14	2.94
Vitis rotundifolia	2							0.29	5.88
Woodwardia virginica					1		1	0.29	5.88
Total	2	8	9	8	3	3	1	4.86	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Relative
Gordonia lasianthus				0.33				0.05	0.88
Green algae						5.00		0.71	13.16
Lyonia lucida		14.33	3.67	1.67	0.67	0.33		2.95	54.39
Moss			1.00	2.00	1.00	0.67		0.67	12.28
Myrica cerifera	0.33							0.05	0.88
Osmunda cinnamomea		0.33						0.05	0.88
Panicum hemotomon	0.67							0.10	1.75
Persea palustris		0.67	1.00					0.24	4.39
Smilax laurifolia				0.33				0.05	0.88
Unknown seedling				0.67	0.67			0.19	3.51
Vitis rotundifolia	0.67		0.67					0.19	3.51
Woodwardia virginica					0.33		0.67	0.14	2.63
Xyris sp.							0.33	0.05	0.88
Total	1.67	15.33	6.33	5.00	2.67	6.00	1.00	5.43	100.00

Table D-29
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - January 5, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus				1	1			0.29	33.33
Lyonia lucida		1	1	1				0.43	50.00
Persea palustris			1					0.14	16.67
Total	0	1	2	2	1	0	0	0.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus					1			0.14	10.00
Lyonia lucida		4	1					0.71	50.00
Panicum hemitomon	1							0.14	10.00
Vitis rotundifolia			1	1				0.29	20.00
Woodwardia virginica				1				0.14	10.00
Total	1	4	2	2	1	0	0	1.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lyonia lucida		1	2	1				0.57	66.67
Vitis rotundifolia	1		1					0.29	33.33
Total	1	1	3	1	0	0	0	0.86	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus				0.33	0.67			0.14	14.29
Lyonia lucida		2.00	1.33	0.67				0.57	57.14
Panicum hemitomon	0.33							0.05	4.76
Persea palustris			0.33					0.05	4.76
Vitis rotundifolia			0.67	0.33				0.14	14.29
Woodwardia virginica				0.33				0.05	4.76
Total	0.33	2.00	2.33	1.67	0.67	0.00	0.00	1.00	100.00

Table D-30
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal- March 3, 2004

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Panicum hemitomon	OBL	0.01					0.01	0.01	1.75	0.20	20.00	10.88
Toxicodendron radicans	FAC	0.02	0.06				0.08	0.06	14.04	0.40	40.00	27.02
Vitis rotundifolia	FAC		0.16				0.16	0.11	28.07	0.20	20.00	24.04
Xyris sp.	OBL					0.32	0.32	0.23	56.14	0.20	20.00	38.07
Total		0.03	0.22	0.00	0.00	0.32	0.57	0.41	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Panicum hemitomon	OBL	0.04					0.04	0.03	13.79	0.20	25.00	19.40
Vitis rotundifolia	FAC	0.07	0.16				0.23	0.16	79.31	0.40	50.00	64.66
Xyris sp.	OBL					0.02	0.02	0.01	6.90	0.20	25.00	15.95
Total		0.11	0.16	0.00	0.00	0.02	0.29	0.21	100.00	0.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Panicum hemitomon	OBL	0.02					0.02	0.01	6.45	0.20	16.67	11.56
Toxicodendron radicans	FAC	0.08	0.06	0.02			0.16	0.11	51.61	0.60	50.00	50.81
Vitis rotundifolia	FAC	0.06	0.07				0.13	0.09	41.94	0.40	33.33	37.63
Total		0.16	0.13	0.02	0.00	0.00	0.31	0.22	100.00	1.20	100.00	100.00

Table D-31
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - January 5, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.02					0.02	0.01	100.00	0.20	100.00	100.00
Total		0.02	0.00	0.00	0.00	0.00	0.02	0.01	100.00	0.20	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Vitis rotundifolia	FAC	0.17	0.03				0.20	0.14	100.00	0.40	100.00	100.00
Total		0.17	0.03	0.00	0.00	0.00	0.20	0.14	100.00	0.40	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Panicum hemitomon	OBL	0.30					0.30	0.21	53.57	0.20	33.33	43.45
Vitis rotundifolia	FAC	0.19	0.07				0.26	0.19	46.43	0.40	66.67	56.55
Total		0.49	0.07	0.00	0.00	0.00	0.56	0.40	100.00	0.60	100.00	100.00

Table D-32
Summary of Shrubs on one 140-m Line Intercept Transect for Thayer Canal - January 5, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	0.88	2.73	1.30			4.91	3.51	34.38	0.60	37.50	35.94
Lyonia lucida	3.16	2.67	1.16	1.75		8.74	6.24	61.20	0.80	50.00	55.60
Vaccinium elliottii			0.63			0.63	0.45	4.41	0.20	12.50	8.46
Total	4.04	5.40	3.09	1.75	0.00	14.28	10.20	100.00	1.60	100.00	100.00

Table D-33
Summary of Canopy and Subcanopy Tree Importance Values for Thayer Canal Transect - December 22, 2004

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	25	16.57	51.98	446.43	54.35	1.00	29.41	45.25
Ilex cassine	3	0.86	2.69	53.57	6.52	0.20	5.88	5.03
Magnolia virginica	3	1.20	3.76	53.57	6.52	0.20	5.88	5.39
Nyssa sylvatica	2	0.56	1.76	35.71	4.35	0.20	5.88	4.00
Persea palustris	7	1.59	4.98	125.00	15.22	0.80	23.53	14.58
Pinus elliottii	2	2.35	7.38	35.71	4.35	0.40	11.76	7.83
Pinus taeda	1	0.51	1.61	17.86	2.17	0.20	5.88	3.22
Quercus laurifolia	1	6.11	19.17	17.86	2.17	0.20	5.88	9.07
Taxodium distichum	2	2.13	6.67	35.71	4.35	0.20	5.88	5.63
Total	46	31.87	100.00	821.43	100.00	3.40	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	59	2.84	49.86	1053.57	55.66	0.80	25.00	43.51
Ilex cassine	8	0.68	12.01	142.86	7.55	0.20	6.25	8.60
Ilex sp.	1	0.04	0.72	17.86	0.94	0.20	6.25	2.64
Magnolia virginica	1	0.14	2.42	17.86	0.94	0.20	6.25	3.20
Myrica cerifera	2	0.06	1.03	35.71	1.89	0.40	12.50	5.14
Persea palustris	30	1.55	27.32	535.71	28.30	1.00	31.25	28.96
Pinus elliottii	2	0.15	2.64	35.71	1.89	0.20	6.25	3.59
Taxodium distichum	3	0.23	4.01	53.57	2.83	0.20	6.25	4.36
Total	106	5.69	100.00	1892.86	100.00	3.20	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-34
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - March 3, 2004

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum							12	1.71	66.67
Cladium jamaicense	1							0.14	5.56
Osmunda cinnamomea							2	0.29	11.11
Saururus cernuus	1							0.14	5.56
Woodwardia virginica	1				1			0.29	11.11
Total	3	0	0	0	1	0	14	2.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum							4	0.57	33.33
Carex sp.	1							0.14	8.33
Saururus cernuus	1	5						0.86	50.00
Toxicodendron radicans							1	0.14	8.33
Total	2	5	0	0	0	0	5	1.71	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum				3	8			1.57	61.11
Dulichium arundinaceum				2				0.29	11.11
Saururus cernuus				3				0.43	16.67
Woodwardia aereolata			1					0.14	5.56
Woodwardia virginica							1	0.14	5.56
Total	0	0	1	8	8	0	1	2.57	100.00

Osmunda cinnamomea

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum				1.0	2.7		5.3	1.29	57.45
Carex sp.	0.3							0.05	2.13
Cladium jamaicense	0.3							0.05	2.13
Dulichium arundinaceum				0.7				0.10	4.26
Osmunda cinnamomea							0.7	0.10	4.26
Saururus cernuus	0.7	1.7		1.0				0.48	21.28
Toxicodendron radicans							0.3	0.05	2.13
Woodwardia aereolata			0.3					0.05	2.13
Woodwardia virginica	0.3						0.3	0.10	4.26
Total	1	2	0	3	3	0	6	2.24	100.00

Table D-35
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - January 5, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					3		0	0.43	42.86
Lyonia lucida						1		0.14	14.29
Mosses				1				0.14	14.29
Nyssa sylvatica							1	0.14	14.29
Saururus cernuus				1				0.14	14.29
Total	0	0	0	2	3	1	1	1.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					0		2	0.29	3.77
Cyperus sp.	1							0.14	1.89
Lyonia lucida						1		0.14	1.89
Mosses	2			1		40	2	6.43	84.91
Saururus cernuus	1	2						0.43	5.66
Woodwardia virginica				1				0.14	1.89
Total	4	2	0	2	0	41	4	7.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					0		1	0.14	14.29
Lyonia lucida		1					1	0.29	28.57
Mosses				1				0.14	14.29
Osmunda cinnamomea							1	0.14	14.29
Saururus cernuus	1							0.14	14.29
Woodwardia virginica	1							0.14	14.29
Total	2	1	0	1	0	0	3	1.00	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					1.0		1.0	0.29	8.96
Cyperus sp.	0.3							0.05	1.49
Lyonia lucida		0.3				0.7	0.3	0.19	5.97
Mosses	0.7			1.0		13.3	0.7	2.24	70.15
Nyssa sylvatica							0.3	0.05	1.49
Osmunda cinnamomea							0.3	0.05	1.49
Saururus cernuus	0.7	0.7		0.3				0.24	7.46
Woodwardia virginica	0.3			0.3				0.10	2.99
Total	2	1	0	2	1	14	3	3.19	100.00

Table D-36
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - March 2, 2004

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.96					0.96	0.48	49.38	0.20	20.00	34.69
Toxicodendron radicans	FAC	0.04					0.04	0.02	2.07	0.20	20.00	11.03
Vitis rotundifolia	FAC	0.36		0.33			0.69	0.35	35.64	0.40	40.00	37.82
Woodwardia aereolata	OBL	0.25					0.25	0.13	12.91	0.20	20.00	16.46
Total		1.61	0.00	0.33	0.00	0.00	1.94	0.97	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	1.17	0.58		0.94		2.69	1.35	99.26	0.60	75.00	87.13
Toxicodendron radicans	FAC	0.02					0.02	0.01	0.74	0.20	25.00	12.87
Total		1.19	0.58	0.00	0.94	0.00	2.71	1.36	100.00	0.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL			0.21			0.21	0.11	15.33	0.20	16.67	16.00
Toxicodendron radicans	FAC	0.02		0.07			0.09	0.05	6.57	0.40	33.33	19.95
Vitis rotundifolia	FAC	0.57	0.44				1.01	0.51	73.72	0.40	33.33	53.53
Woodwardia aereolata	OBL	0.06					0.06	0.03	4.38	0.20	16.67	10.52
Total		0.65	0.44	0.28	0.00	0.00	1.37	0.69	100.00	1.20	100.00	100.00

Table D-37
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - January 5, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.04		0.17			0.21	0.11	45.65	0.40	40.00	42.83
Toxicodendron radicans	FAC	0.03		0.06			0.09	0.05	19.57	0.40	40.00	29.78
Vitis rotundifolia	FAC	0.16					0.16	0.08	34.78	0.20	20.00	27.39
Total		0.23	0.00	0.23	0.00	0.00	0.46	0.23	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	7.70	1.10			2.70	11.50	5.75	72.78	0.60	75.00	73.89
Vitis rotundifolia	FAC	4.30					4.30	2.15	27.22	0.20	25.00	26.11
Total		12.00	1.10	0.00	0.00	2.70	15.80	7.90	100.00	0.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.05					0.05	0.03	5.62	0.20	14.29	9.95
Toxicodendron radicans	FAC				0.30	0.20	0.50	0.25	56.18	0.40	28.57	42.38
Vitis rotundifolia	FAC	0.12	0.01			0.13	0.26	0.13	29.21	0.60	42.86	36.04
Woodwardia aereolata	OBL	0.08					0.08	0.04	8.99	0.20	14.29	11.64
Total		0.25	0.01	0.00	0.30	0.33	0.89	0.44	100.00	1.40	100.00	100.00

Table D-38

Summary of Shrubs on one 200-meter Line Intercept Transect for Hammock Field - January 6, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	0.16					0.16	0.08	0.25	0.20	7.14	3.70
Ilex cassine		1.50				1.50	0.75	2.39	0.20	7.14	4.76
Lyonia lucida	4.00	13.35	6.05	1.10		24.50	12.25	38.98	0.80	28.57	33.78
Myrica cerifera	2.05		0.37			2.42	1.21	3.85	0.40	14.29	9.07
Persea palustris	2.00			6.40	23.45	31.85	15.93	50.68	0.60	21.43	36.05
Sabal palmetto	0.20					0.20	0.10	0.32	0.20	7.14	3.73
Vaccinium elliottii	1.57		0.65			2.22	1.11	3.53	0.40	14.29	8.91
Total	9.98	14.85	7.07	7.50	23.45	62.85	31.43	100.00	2.80	100.00	100.00

Table D-39
Summary of Canopy and Subcanopy Tree Importance Values for Hammock Field Transect - January 6, 2005

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	3	0.91	2.48	75.00	8.82	0.20	6.25	5.85
Liquidambar styraciflua	2	2.30	6.24	50.00	5.88	0.40	12.50	8.21
Magnolia virginica	8	9.60	26.03	200.00	23.53	0.60	18.75	22.77
Nyssa sylvatica	8	12.41	33.64	200.00	23.53	0.60	18.75	25.31
Persea palustris	7	3.62	9.82	175.00	20.59	0.60	18.75	16.39
Pinus elliottii	1	2.97	8.06	25.00	2.94	0.20	6.25	5.75
Quercus laurifolia	2	0.79	2.15	50.00	5.88	0.20	6.25	4.76
Quercus nigra	1	0.24	0.64	25.00	2.94	0.20	6.25	3.28
Taxodium distichum	2	4.04	10.95	50.00	5.88	0.20	6.25	7.69
Total	34	36.88	100.00	850.00	100.00	3.20	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	2	0.20	9.87	50.00	7.69	0.20	10.00	9.19
Magnolia virginica	10	0.86	42.21	2500.00	38.46	0.80	40.00	40.22
Myrica cerifera	1	0.05	2.31	25.00	3.85	0.20	10.00	5.38
Persea palustris	11	0.86	42.24	275.00	42.31	0.60	30.00	38.18
Taxodium distichum	2	0.07	3.37	50.00	7.69	0.20	10.00	7.02
Total	26	2.05	100.00	650.00	100.00	2.00	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-40
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - March 4, 2004

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum		2						0.29	3.33
Carex sp.		1						0.14	1.67
Itea virginica	1	1						0.29	3.33
Lyonia lucida	25	3		1	4			4.71	55.00
Moss						1	6	1.00	11.67
Persea palustris			1		2			0.43	5.00
Smilax sp.				1				0.14	1.67
Toxicodendron radicans					1			0.14	1.67
Unknown seedling - Gordonia?						1	1	0.29	3.33
Vitis rotundifolia				2	1			0.43	5.00
Woodwardia areolata	1							0.14	1.67
Woodwardia virginica		1	3					0.57	6.67
Total	27	8	4	4	8	2	7	8.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum seedling					1			0.14	1.10
Blechnum serrulatum	4			19	1			3.43	26.37
Carex sp.		1						0.14	1.10
Lyonia lucida	10	2		7			4	3.29	25.27
Moss		6			12	2	5	3.57	27.47
Osmunda cinnamomea			3					0.43	3.30
Panicum ensifolium		2						0.29	2.20
Persea palustris	1		2					0.43	3.30
Pinus sp. seedling		1						0.14	1.10
Unknown seedling - Gordonia?		1						0.14	1.10
Vitis rotundifolia					1	2		0.43	3.30
Woodwardia areolata	1			2				0.43	3.30
Woodwardia virginica						1		0.14	1.10
Total	16	13	5	28	15	5	9	13.00	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			2	5			6	1.86	22.03
Godonia lasianthus		3				2		0.71	8.47
Lyonia lucida	5		6	4				2.14	25.42
Moss		2	12		1	2		2.43	28.81
Panicum ensifolium		1						0.14	1.69
Saururus cernuus							3	0.43	5.08
Smilax laurifolia	1							0.14	1.69
Vitis rotundifolia				1				0.14	1.69
Woodwardia virginica		1		1	1			0.43	5.08
Total	6	7	20	11	2	4	9	8.43	100.00

Table D-40
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - March 4, 2004

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum seedling					0.3			0.05	0.51
Blechnum serrulatum		0.7	0.7	8.0	0.3			1.38	14.80
Carex sp.		0.7						0.10	1.02
Gordonia lasianthus		1.0				0.7		0.24	2.55
Itea virginica	0.3	0.3						0.10	1.02
Lyonia lucida	13.3	1.7	2.0	4.0	1.3		1.3	3.38	36.22
Moss		2.7	4.0		4.3	1.7	3.7	2.33	25.00
Osmunda cinnamomea			1.0					0.14	1.53
Panicum ensifolium		1.0						0.14	1.53
Persea palustris	0.3		1.0		0.7			0.29	3.06
Pinus sp. seedling		0.3						0.05	0.51
Saururus cernuus							1.0	0.14	1.53
Smilax laurifolia	0.3							0.05	0.51
Smilax sp.				0.3				0.05	0.51
Toxicodendron radicans					0.3			0.05	0.51
Unknown seedling - Gordonia?		0.3				0.3	0.3	0.14	1.53
Vitis rotundifolia				1.0	0.7	0.7		0.33	3.57
Woodwardia areolata	0.7			0.7				0.19	2.00
Woodwardia virginica		0.7	1.0	0.3	0.3	0.3		0.38	4.08
Total	15.00	9.33	9.67	14.33	8.33	3.67	6.33	9.52	100.00

Table D-41
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - January 5, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus		1					1	0.29	22.22
Lyonia lucida	1	1			1			0.43	33.33
Mosses							1	0.14	11.11
Toxicodendron radicans					1			0.14	11.11
Vitis rotundifolia				1		1		0.29	22.22
Total	1	2	0	1	2	1	2	1.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum	4			4	1			1.29	24.32
Gordonia lasianthus		1	1			1	1	0.57	10.81
Lyonia lucida	1	2		1				0.57	10.81
Mosses		4			7		5	2.29	43.24
Vitis rotundifolia	2				1	1		0.57	10.81
Total	7	7	1	5	9	2	6	5.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			7	2			1	1.43	37.04
Gordonia lasianthus		1						0.14	3.70
Lyonia lucida	1		1	1				0.43	11.11
Mosses		1	7					1.14	29.63
Pinus elliottii		1						0.14	3.70
Vitis rotundifolia			1	1		1		0.43	11.11
Woodwardia virginica			1					0.14	3.70
Total	1	3	17	4	0	1	1	3.86	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum	1.3		2.3	2.0	0.3			0.86	25.00
Gordonia lasianthus		1.0	0.3			0.3	0.7	0.33	9.72
Lyonia lucida	1.0	1.0	0.3	0.7	0.3			0.48	13.89
Mosses		1.7	2.3		2.3		2.0	1.19	34.72
Pinus elliottii		0.3						0.05	1.39
Toxicodendron radicans					0.3			0.05	1.39
Vitis rotundifolia	0.7		0.3	0.7	0.3	1.0		0.43	12.50
Woodwardia virginica			0.3					0.05	1.39
Total	3.00	4.00	6.00	3.33	3.67	1.33	2.67	3.43	100.00

Table D-42
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - March 2, 2004

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					5.22	5.22	2.66	19.59	0.25	11.11	15.35
Toxicodendron radicans	FAC	0.44	10.15	0.16			10.75	5.48	40.35	0.75	33.33	36.84
Vitis rotundifolia	FAC	0.56		0.72		0.98	2.26	1.15	8.48	0.75	33.33	20.91
Woodwardia areolata	OBL	6.87	1.54				8.41	4.29	31.57	0.50	22.22	26.90
Total		7.87	11.69	0.88		6.20	26.64	13.59	100.00	2.25	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.14		0.10			0.24	0.12	2.73	0.50	22.22	12.47
Vitis rotundifolia	FAC	0.03	0.02	0.31		0.61	0.97	0.49	11.02	1.00	44.44	27.73
Woodwardia areolata	OBL	6.33	0.89	0.37			7.59	3.87	86.25	0.75	33.33	59.79
Total		6.50	0.91	0.78		0.61	8.80	4.49	100.00	2.25	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					5.91	5.91	3.02	26.85	0.25	11.11	18.98
Toxicodendron radicans	FAC	0.15		0.07			0.22	0.11	1.00	0.50	22.22	11.61
Vitis rotundifolia	FAC	0.16	6.12	0.79			7.07	3.61	32.12	0.75	33.33	32.73
Woodwardia areolata	OBL	7.55	0.73	0.53			8.81	4.49	40.03	0.75	33.33	36.68
Total		7.86	6.85	1.39		5.91	22.01	11.23	100.00	2.25	100.00	100.00

Table D-43
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - January 5, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Toxicodendron radicans	FAC			1.60			1.60	0.82	21.62	0.25	20.00	20.81
Vitis rotundifolia	FAC	2.20	1.80	1.30			5.30	2.70	71.62	0.75	60.00	65.81
Woodwardia areolata	OBL	0.50					0.50	0.26	6.76	0.25	20.00	13.38
Total		2.70	1.80	2.90		0.00	7.40	3.78	100.00	1.25	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Vitis rotundifolia	FAC	3.70	4.50	7.50			15.70	8.01	100.00	0.75	100.00	100.00
Total		3.70	4.50	7.50		0.00	15.70	8.01	100.00	0.75	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Saururus cernuus	OBL					0.45	0.45	0.23	12.13	0.25	14.29	13.21
Toxicodendron radicans	FAC	0.10		0.10			0.20	0.10	5.39	0.50	28.57	16.98
Vitis rotundifolia	FAC	1.15	1.10	0.67			2.92	1.49	78.71	0.75	42.86	60.78
Woodwardia areolata	OBL	0.14					0.14	0.07	3.77	0.25	14.29	9.03
Total		1.39	1.10	0.77		0.45	3.71	1.89	100.00	1.75	100.00	100.00

Table D-44
Summary of Shrubs on one 196-meter Line Intercept Transect for Lower Bennett Swamp - January 5, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	1.00	1.64				2.64	1.35	6.05	0.50	13.33	9.69
Itea virginica	1.65					1.65	0.84	3.78	0.25	6.67	5.23
Lyonia lucida	15.82	1.88	9.51			27.21	13.88	62.39	0.75	20.00	41.20
Myrica cerifera	0.60		0.65			1.25	0.64	2.87	0.50	13.33	8.10
Persea palustris	0.87	0.87	0.45		5.37	7.56	3.86	17.34	1.00	26.67	22.00
Sabal palmetto	0.98	0.92				1.90	0.97	4.36	0.50	13.33	8.85
Vaccinium elliottii	1.40					1.40	0.71	3.21	0.25	6.67	4.94
Total	22.32	5.31	10.61		5.37	43.61	22.25	100.00	3.75	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-45

Summary of Canopy and Subcanopy Tree Importance Values for Lower Bennett Swamp Transect - December 22, 2004

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	15	24.85	52.55	407.61	46.88	1.00	30.77	43.40
Nyssa sylvatica	2	2.20	4.65	54.35	6.25	0.25	7.69	6.20
Persea palustris	3	3.56	7.52	81.52	9.38	0.75	23.08	13.32
Pinus elliottii	1	0.71	1.49	27.17	3.13	0.25	7.69	4.10
Taxodium distichum	11	15.98	33.79	298.91	34.38	1.00	30.77	32.98
Total	32	47.29	100.00	869.57	100.00	3.25	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	25	2.31	79.11	679.35	83.33	1.00	50.00	70.81
Ilex cassine	3	0.35	12.10	81.52	10.00	0.50	25.00	15.70
Myrica cerifera	1	0.12	4.00	27.17	3.33	0.25	12.50	6.61
Nyssa sylvatica	1	0.14	4.79	27.17	3.33	0.25	12.50	6.87
Total	30	2.92	100.00	815.22	100.00	2.00	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (4)

Operational Year 2 - Detailed Vegetation Data

Table D-46
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - March 24, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lachnanthes caroliniana							1	0.14	7.69
Lyonia lucida				1				0.14	7.69
Moss				1				0.14	7.69
Nyssa sylvatica var. biflora							1	0.14	7.69
Persea palustris			3					0.43	23.08
Toxicodendron radicans				1				0.14	7.69
Vitis rotundifolia		1	1					0.29	15.38
Woodwardia virginica					2		1	0.43	23.08
Total	0	1	4	3	2	0	3	1.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus					1			0.14	9.09
Lyonia lucida		3	1					0.57	36.36
Moss					2			0.29	18.18
Vitis rotundifolia		1	1	1				0.43	27.27
Woodwardia virginica				1				0.14	9.09
Total	0	4	2	2	3	0	0	1.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Gordonia lasianthus						1		0.14	4.35
Lyonia lucida		2	2	1	1	1		1.00	30.43
Moss			1	2		3		0.86	26.09
Vitis rotundifolia	2		1					0.43	13.04
Woodwardia virginica	1	1	1		3			0.86	26.09
Total	3	3	5	3	4	5	0	3.29	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lachnanthes caroliniana							0.33	0.05	2.13
Gordonia lasianthus					0.33	0.33		0.10	4.26
Lyonia lucida		1.67	1.00	0.67	0.33	0.33		0.57	25.53
Moss			0.33	1.00	0.67	1.00		0.43	19.15
Nyssa sylvatica var. biflora							0.33	0.05	2.13
Persea palustris			1.00					0.14	6.38
Toxicodendron radicans				0.33				0.05	2.13
Vitis rotundifolia	0.67	0.67	1.00	0.33				0.38	17.02
Woodwardia virginica	0.33	0.33	0.33	0.33	1.67		0.33	0.48	21.28
Total	1.00	2.67	3.67	2.67	3.00	1.67	1.00	2.24	100.00

Table D-47
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - September 13, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lyonia lucida		1	1	1				0.43	37.50
Persea palustris		1	2					0.43	37.50
Vitis rotundifolia			1		1			0.29	25.00
Total	0	2	4	1	1	0	0	1.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lyonia lucida		1	1					0.29	33.33
moss		1	1					0.29	33.33
Panicum hemitomon	1							0.14	16.67
Vitis rotundifolia		1						0.14	16.67
Total	1	3	2	0	0	0	0	0.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lachnanthes caroliniana	1							0.14	6.25
Lyonia lucida		1	3	2				0.86	37.50
moss			2	3				0.71	31.25
Panicum hemitomon	1							0.14	6.25
Woodwardia virginica	1		2					0.43	18.75
Total	3	1	7	5	0	0	0	2.29	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Lachnanthes caroliniana	0.33							0.05	3.33
Lyonia lucida		1.00	1.67	1.00				0.52	36.67
moss		0.33	1.00	1.00				0.33	23.33
Panicum hemitomon	0.67							0.10	6.67
Persea palustris		0.33	0.67					0.14	10.00
Vitis rotundifolia		0.33	0.33		0.33			0.14	10.00
Woodwardia virginica	0.33		0.67					0.14	10.00
Total	1.33	2.00	4.33	2.00	0.33	0.00	0.00	1.43	100.00

Table D-48
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal- March 24, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Lachnanthes caroliniana	FAC					0.08	0.08	0.06	1.31	0.20	14.29	7.80
Toxicodendron radicans	FAC	0.09		0.01			0.10	0.07	1.64	0.40	28.57	15.11
Vitis rotundifolia	FAC	1.45	3.09		0.20	1.17	5.91	4.22	97.04	0.80	57.14	77.09
Total		1.54	3.09	0.01	0.20	1.25	6.09	4.35	100.00	1.40	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Vitis rotundifolia	FAC	2.57	0.90	0.05			3.52	2.51	100.00	0.60	100.00	100.00
Total		2.57	0.90	0.05	0.00	0.00	3.52	2.51	100.00	0.60	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.71	0.20	0.10			1.01	0.72	19.27	0.60	60.00	39.64
Vitis rotundifolia	FAC	1.94	2.29				4.23	3.02	80.73	0.40	40.00	60.36
Total		2.65	2.49	0.10	0.00	0.00	5.24	3.74	100.00	1.00	100.00	100.00

Table D-49
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - September 13, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC	0.45					0.45	0.32	52.33	0.20	14.29	33.31
Panicum hemitomon	OBL	0.20					0.20	0.14	23.26	0.40	28.57	25.91
Vitis rotundifolia	FAC		0.21				0.21	0.15	24.42	0.80	57.14	40.78
Total		0.65	0.21	0.00	0.00	0.00	0.86	0.61	100.00	1.40	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Panicum hemitomon	OBL	0.37					0.37	0.26	14.34	0.20	33.33	23.84
Vitis rotundifolia	FAC	1.92	0.29				2.21	1.58	85.66	0.40	66.67	76.16
Total		2.29	0.29	0.00	0.00	0.00	2.58	1.84	100.00	0.60	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC	0.12					0.12	0.09	20.69	0.20	33.33	27.01
Panicum hemitomon	OBL	0.37					0.37	0.26	63.79	0.20	33.33	48.56
Vitis rotundifolia	FAC	0.09					0.09	0.06	15.52	0.20	33.33	24.43
Total		0.58	0.00	0.00	0.00	0.00	0.58	0.41	100.00	0.60	100.00	100.00

Table D-50
Summary of Shrubs on one 140-m Line Intercept Transect for Thayer Canal - September 13, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	1.70	4.00	1.90	0.40		8.00	5.71	11.11	0.80	22.22	16.67
Itea virginica			0.80	3.00	3.00	6.80	4.86	9.44	0.60	16.67	13.06
Lyonia lucida	10.00	4.00	6.60	15.00	12.00	47.60	34.00	66.11	1.00	27.78	46.94
Myrica cerifera	4.30					4.30	3.07	5.97	0.20	5.56	5.76
Persea palustris	3.20	0.40	1.00			4.60	3.29	6.39	0.60	16.67	11.53
Vaccinium elliottii	0.30		0.40			0.70	0.50	0.97	0.40	11.11	6.04
Total	19.50	8.40	10.70	18.40	15.00	72.00	51.43	100.00	3.60	100.00	100.00

Table D-51
Summary of Canopy and Subcanopy Tree Importance Values for Thayer Canal Transect - September 13, 2005

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	27	17.65	52.66	482.14	56.25	1.00	29.41	46.11
Ilex cassine	3	0.92	2.75	53.57	6.25	0.20	5.88	4.96
Magnolia virginica	3	1.29	3.84	53.57	6.25	0.20	5.88	5.32
Nyssa sylvatica	2	0.56	1.67	35.71	4.17	0.20	5.88	3.90
Persea palustris	7	1.59	4.75	125.00	14.58	0.80	23.53	14.29
Pinus elliottii	2	2.45	7.30	35.71	4.17	0.40	11.76	7.74
Pinus taeda	1	0.60	1.78	17.86	2.08	0.20	5.88	3.25
Quercus laurifolia	1	6.15	18.34	17.86	2.08	0.20	5.88	8.77
Taxodium distichum	2	2.32	6.92	35.71	4.17	0.20	5.88	5.66
Total	48	33.52	100.00	857.14	100.00	3.40	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	57	2.87	49.58	1017.86	56.44	0.80	26.67	44.23
Ilex cassine	8	0.74	12.73	142.86	7.92	0.20	6.67	9.10
Ilex sp.	1	0.04	0.76	17.86	0.99	0.20	6.67	2.81
Magnolia virginica	1	0.14	2.42	17.86	0.99	0.20	6.67	3.36
Myrica cerifera	2	0.05	0.90	35.71	1.98	0.40	13.33	5.41
Persea palustris	27	1.48	25.62	482.14	26.73	0.80	26.67	26.34
Pinus elliottii	2	0.16	2.73	35.71	1.98	0.20	6.67	3.79
Taxodium distichum	3	0.30	5.25	53.57	2.97	0.20	6.67	4.96
Total	101	5.79	100.00	1803.57	100.00	3.00	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-52
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - March 23, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Carex sp.	1							0.14	8.33
Moss						1	2	0.43	25.00
Nyssa sylvatica var. biflora			1	1	1			0.43	25.00
Saururus cernuus	1							0.14	8.33
Vitis rotundifolia				1		2		0.43	25.00
Woodwardia virginica	1							0.14	8.33
Total	3	0	1	2	1	3	2	1.71	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Blechnum serrulatum							3	0.43	4.48
Dulichium arundinaceum				1	1			0.29	2.99
Lyonia lucida						2	1	0.43	4.48
Moss						30	5	5.00	52.24
Nyssa sylvatica var. biflora			1	1	1		1	0.57	5.97
Saururus cernuus	1	8						1.29	13.43
Toxicodendron radicans						1		0.14	1.49
Vitis rotundifolia						2		0.29	2.99
Woodwardia virginica	1			1		5	1	1.14	11.94
Total	2	8	1	3	2	40	11	9.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Blechnum serrulatum			8	6	13		2	4.14	29.29
Dulichium arundinaceum				1				0.14	1.01
Gordonia lasianthus	1							0.14	1.01
Itea virginica	2			1	1			0.57	4.04
Lyonia lucida	4		4	5	1	3		2.43	17.17
Magnolia virginiana		1						0.14	1.01
Moss		1	20					3.00	21.21
Nyssa sylvatica var. biflora			1	1			1	0.43	3.03
Panicum ensifolium	1							0.14	1.01
Persea palustris	1							0.14	1.01
Pinus elliottii		1						0.14	1.01
Saururus cernuus		4		2				0.86	6.06
Smilax sp.		1						0.14	1.01
Vitis rotundifolia		1	1	1				0.43	3.03
Woodwardia virginica	1			5		3		1.29	9.09
Total	10	9	34	22	15	6	3	14.14	100.00

Table D-52
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - March 23, 2005

1-METER SQUARE PLOTS - COMBINED W,C, & E FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			2.67	2.00	4.33		1.67	1.52	17.98
Carex sp.	0.33							0.05	0.56
Dulichium arundinaceum				0.67	0.33			0.14	1.69
Gordonia lasianthus	0.33							0.05	0.56
Itea virginica	0.67			0.33	0.33			0.19	2.25
Lyonia lucida	1.33		1.33	1.67	0.33	1.67	0.33	0.95	11.24
Magnolia virginiana		0.33						0.05	0.56
Moss		0.33	6.67			10.33	2.33	2.81	33.15
Nyssa sylvatica var. biflora			1.00	1.00	0.67		0.67	0.48	5.62
Panicum ensifolium	0.33							0.05	0.56
Persea palustris	0.33							0.05	0.56
Pinus elliottii		0.33						0.05	0.56
Saururus cernuus	0.67	4.00		0.67				0.76	8.99
Smilax sp.		0.33						0.05	0.56
Toxicodendron radicans						0.33		0.05	0.56
Vitis rotundifolia		0.33	0.33	0.67		1.33		0.38	4.49
Woodwardia virginica	1.00			2.00		2.67	0.33	0.86	10.11
Total	4.00	5.67	12.00	7.00	6.00	13.67	5.00	8.48	100.00

Table D-53
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - September 13, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum							4	0.57	40.00
Lachnanthes caroliniana	1							0.14	10.00
Lyonia lucida							1	0.14	10.00
mosses							2	0.29	20.00
Panicum hemotomon	1							0.14	10.00
Saururus cernuus	1							0.14	10.00
Woodwardia virginica	2							0.29	20.00
Total	3	0	0	0	0	0	7	1.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum							4	0.57	6.15
Ilex cassine		1						0.14	1.54
Lyonia lucida						1		0.14	1.54
moss						50	2	7.43	80.00
Panicum hemotomon	1							0.14	1.54
Saururus cernuus	1	3						0.57	6.15
Unknown sedge	1							0.14	1.54
Woodwardia virginica	1							0.14	1.54
Total	4	4	0	0	0	51	6	9.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					5			0.71	41.67
Lyonia lucida						2		0.29	16.67
moss						1		0.14	8.33
Persea palustris	1							0.14	8.33
Saururus cernuus				1				0.14	8.33
Woodwardia virginica	2							0.29	16.67
Total	3	0	0	1	5	3	0	1.71	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Blechnum serrulatum					1.67		2.67	0.62	14.61
Ilex cassine		0.33						0.05	1.12
Lachnanthes caroliniana	0.33							0.05	1.12
Lyonia lucida						1.00	0.33	0.19	4.49
moss						17.00	1.33	2.62	61.80
Panicum hemotomon	0.67							0.10	2.25
Persea palustris	0.33							0.05	1.12
Saururus cernuus	0.67	1.00		0.33				0.29	6.74
Unknown sedge	0.33							0.05	1.12
Woodwardia virginica	1.67							0.24	5.62
Total	4.00	1.33	0.00	0.33	1.67	18.00	4.33	4.24	100.00

Table D-54
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - March 23, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.79					0.79	0.40	50.32	0.20	20.00	35.16
Toxicodendron radicans	FAC					0.03	0.03	0.02	1.91	0.20	20.00	10.96
Vitis rotundifolia	FAC	0.71			0.03	0.01	0.75	0.38	47.77	0.60	60.00	53.89
Total		1.50	0.00	0.00	0.03	0.04	1.57	0.79	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL				0.10		0.10	0.05	7.25	0.20	16.67	11.96
Toxicodendron radicans	FAC			0.46	0.23	0.10	0.79	0.40	57.25	0.60	50.00	53.62
Vitis rotundifolia	FAC		0.36			0.13	0.49	0.25	35.51	0.40	33.33	34.42
Total		0.00	0.36	0.46	0.33	0.23	1.38	0.69	100.00	1.20	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	1.17					1.17	0.59	24.43	0.20	14.29	19.36
Woodwardia areolata	OBL	0.13					0.13	0.07	2.71	0.20	14.29	8.50
Toxicodendron radicans	FAC		0.53		0.48	0.43	1.44	0.72	30.06	0.60	42.86	36.46
Vitis rotundifolia	FAC	1.99		0.06			2.05	1.03	42.80	0.40	28.57	35.68
Total		3.29	0.53	0.06	0.48	0.43	4.79	2.40	100.00	1.40	100.00	100.00

Table D-55
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - September 13, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.79					0.79	0.40	50.32	0.20	20.00	35.16
Toxicodendron radicans	FAC					0.03	0.03	0.02	1.91	0.20	20.00	10.96
Vitis rotundifolia	FAC	0.71			0.03	0.01	0.75	0.38	47.77	0.60	60.00	53.89
Total		1.50	0.00	0.00	0.03	0.04	1.57	0.79	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	1.69					1.69	0.85	76.13	0.20	25.00	50.56
Vitis rotundifolia	FAC	0.04	0.35				0.39	0.20	17.57	0.40	50.00	33.78
Woodwardia areolata	OBL	0.14					0.14	0.07	6.31	0.20	25.00	15.65
Total		1.87	0.35	0.00	0.00	0.00	2.22	1.11	100.00	0.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	2.75					2.75	1.38	55.00	0.20	50.00	52.50
Vitis rotundifolia	FAC	2.25					2.25	1.13	45.00	0.20	50.00	47.50
Total		5.00	0.00	0.00	0.00	0.00	5.00	2.50	100.00	0.40	100.00	100.00

Table D-56
Summary of Shrubs on one 200-meter Line Intercept Transect for Hammock Field - September 13, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Itea virginica				1.00		1.00	0.50	0.96	0.20	7.69	4.33
Lyonia lucida	6.80	22.25	16.50	28.00	16.00	89.55	44.78	86.27	1.00	38.46	62.37
Magnolia virginica				1.00		1.00	0.50	0.96	0.20	7.69	4.33
Myrica cerifera	3.45			2.50		5.95	2.98	5.73	0.40	15.38	10.56
Persea palustris	0.40			2.50		2.90	1.45	2.79	0.40	15.38	9.09
Vaccinium elliottii	3.00		0.40			3.40	1.70	3.28	0.40	15.38	9.33
Total	13.65	22.25	16.90	35.00	16.00	103.80	51.90	100.00	2.60	100.00	100.00

Table D-57

Summary of Canopy and Subcanopy Tree Importance Values for Hammock Field Transect - September 13, 2005

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	3	0.96	2.44	75.00	9.38	0.20	6.25	6.02
Liquidambar styraciflua	2	2.56	6.54	50.00	6.25	0.40	12.50	8.43
Magnolia virginica	8	9.93	25.32	200.00	25.00	0.60	18.75	23.02
Nyssa sylvatica	8	14.34	36.58	200.00	25.00	0.60	18.75	26.78
Persea palustris	5	3.00	7.64	125.00	15.93	0.60	18.75	14.01
Pinus elliottii	1	3.11	7.93	25.00	3.13	0.20	6.25	5.77
Quercus laurifolia	2	0.88	2.25	50.00	6.25	0.20	6.25	4.92
Quercus nigra	1	0.27	0.69	25.00	3.13	0.20	6.25	3.35
Taxodium distichum	2	4.16	10.61	50.00	6.25	0.20	6.25	7.70
Total	32	39.22	100.00	800.00	100.00	3.20	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	2	0.22	9.83	50.00	7.14	0.20	8.33	8.44
Magnolia virginica	10	0.92	41.89	250.00	35.71	0.80	33.33	36.98
Myrica cerifera	1	0.05	2.41	25.00	3.57	0.20	8.33	4.77
Persea palustris	13	0.93	42.38	325.00	46.43	1.00	41.67	43.49
Taxodium distichum	2	0.08	3.48	50.00	7.14	0.20	8.33	6.32
	28	2.20	100.00	700.00	100.00	2.40	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-58
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - March 22, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum		1						0.14	3.85
Gordonia lasianthus	1	1	1					0.43	11.54
Itea virginica	1							0.14	3.85
Lyonia lucida	4	1			2			1.00	26.92
Moss	1						2	0.43	11.54
Pinus elliottii		1						0.14	3.85
Toxicodendron radicans		1			1			0.29	7.69
Vitis rotundifolia				1				0.14	3.85
Woodwardia virginica		4	3					1.00	26.92
Total	7	9	4	1	3	0	2	3.71	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum seedling					1			0.14	2.44
Blechnum serrulatum	4			4				1.14	19.51
Gordonia lasianthus		1	1		1			0.43	7.32
Lyonia lucida	1	2		1				0.57	9.76
Moss		6	1		12		5	3.43	58.54
Panicum ensifolium		1						0.14	2.44
Phlebodium aureum					1			0.14	2.44
Vitis rotundifolia				1	1		4	0.86	14.63
Woodwardia virginica				2				0.29	4.88
Total	5	10	2	8	16	0	9	5.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			8	6				2.00	22.58
Gordonia lasianthus	1							0.14	1.61
Itea virginica	2							0.29	3.23
Lyonia lucida	4		4	5				1.86	20.97
Moss			20					2.86	32.26
Panicum ensifolium								0.00	0.00
Pinus elliottii		1						0.14	1.61
Smilax laurifolia		1						0.14	1.61
Vitis rotundifolia			1	1				0.29	3.23
Woodwardia virginica				5			3	1.14	12.90
Total	7	2	33	17	0	0	3	8.86	100.00

Table D-58
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - March 22, 2005

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum seedling					0.33			0.05	0.72
Blechnum serrulatum	1.33	0.33	2.67	3.33				1.10	16.67
Gordonia lasianthus	0.67	0.67	0.67		0.33			0.33	5.07
Itea virginica	1.00							0.14	2.17
Lyonia lucida	3.00	1.00	1.33	2.00	0.67			1.14	17.39
Moss	0.33	2.00	7.00		4.00		2.33	2.24	34.06
Panicum ensifolium		0.33						0.05	0.72
Phlebodium aureum					0.33			0.05	0.72
Pinus elliottii		0.67						0.10	1.45
Smilax laurifolia		0.33						0.05	0.72
Toxicodendron radicans		0.33			0.33			0.10	1.45
Vitis rotundifolia			0.33	1.00	0.33		1.33	0.43	6.52
Woodwardia virginica		1.33	1.00	2.33	0.00		1.00	0.81	12.32
Total	6.33	7.00	13.00	8.67	6.33	0.00	4.67	6.57	100.00

Table D-59
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - September 12, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum		3						0.43	15.00
Itea virginica	1							0.14	5.00
Lachnanthes caroliniana		1						0.14	5.00
Lyonia lucida	1	1			2			0.57	20.00
moss	1							0.14	5.00
Toxicodendron radicans					2			0.29	10.00
Vitis rotundifolia						2		0.29	10.00
Woodwardia virginica		3	3					0.86	30.00
Total	3	8	3	0	4	2	0	2.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum				6	1			1.00	10.77
Blechnum serrulatum	4							0.57	6.15
Gordonia lasianthus		1						0.14	1.54
Lyonia lucida	2	1		2			2	1.00	10.77
moss		8			15		10	4.71	50.77
Panicum hemotomon		1						0.14	1.54
Phlebodium aureum					1			0.14	1.54
Woodwardia virginica		4		4		3		1.57	16.92
Total	6	15	0	12	17	3	12	9.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			6	6			2	2.00	31.11
Gordonia lasianthus	1							0.14	2.22
Lyonia lucida	2		2	1				0.71	11.11
moss		3	8					1.57	24.44
Vitis rotundifolia				1				0.14	2.22
Woodwardia virginica		1	4	5		3		1.86	28.89
Total	3	4	20	13	0	3	2	6.43	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum				2.00	0.33			0.33	5.38
Blechnum serrulatum	1.33	1.00	2.00	2.00			0.67	1.00	16.15
Gordonia lasianthus	0.33	0.33						0.10	1.54
Itea virginica	0.33							0.05	0.77
Lachnanthes caroliniana		0.33						0.05	0.77
Lyonia lucida	1.67	0.67	0.67	1.00	0.67		0.67	0.76	12.31
moss	0.33	3.67	2.67		5.00		3.33	2.14	34.62
Panicum hemotomon		0.33						0.05	0.77
Phlebodium aureum					0.33			0.05	0.77
Toxicodendron radicans					0.67			0.10	1.54
Vitis rotundifolia				0.33		0.67		0.14	2.31
Woodwardia virginica		2.67	2.33	3.00		2.00		1.43	23.08
Total	4.00	9.00	7.67	8.33	7.00	2.67	4.67	6.19	100.00

Table D-60
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - March 23, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					1.26	1.26	0.64	11.61	0.25	12.50	12.06
Toxicodendron radicans	FAC	0.07		0.51			0.58	0.30	5.35	0.50	25.00	15.17
Vitis rotundifolia	FAC	0.14		5.45		2.89	8.48	4.33	78.16	0.75	37.50	57.83
Woodwardia areolata	OBL	0.11		0.42			0.53	0.27	4.88	0.50	25.00	14.94
Total		0.32	0.00	6.38		4.15	10.85	5.54	100.00	2.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Vitis rotundifolia	FAC		0.25	1.20		3.84	5.29	2.70	100.00	0.75	100.00	100.00
Total		0.00	0.25	1.20		3.84	5.29	2.70	100.00	0.75	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.18	0.18	0.41			0.77	0.39	6.15	0.75	37.50	21.82
Vitis rotundifolia	FAC	0.56	0.76	3.25		6.43	11.00	5.61	87.79	1.00	50.00	68.89
Woodwardia areolata	OBL	0.76					0.76	0.39	6.07	0.25	12.50	9.28
Total		1.50	0.94	3.66		6.43	12.53	6.39	100.00	2.00	100.00	100.00

Table D-61
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - September 13, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.08					0.08	0.04	0.29	0.25	20.00	10.14
Vitis rotundifolia	FAC	0.55		7.11		20.02	27.68	14.12	99.35	0.75	60.00	79.68
Woodwardia areolata	OBL	0.10					0.10	0.05	0.36	0.25	20.00	10.18
Total		0.73	0.00	7.11		20.02	27.86	14.21	100.00	1.25	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	4.30	0.13	0.23			4.66	2.38	34.80	0.75	37.50	36.15
Vitis rotundifolia	FAC	0.28	4.49	1.55		2.23	8.55	4.36	63.85	1.00	50.00	56.93
Woodwardia areolata	OBL			0.18			0.18	0.09	1.34	0.25	12.50	6.92
Total		4.58	4.62	1.96		2.23	13.39	6.83	100.00	2.00	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Vitis rotundifolia	FAC	6.98	0.50	0.91		0.66	9.05	4.62	93.78	1.00	80.00	86.89
Woodwardia areolata	OBL	0.60					0.60	0.31	6.22	0.25	20.00	13.11
Total		7.58	0.50	0.91		0.66	9.65	4.92	100.00	1.25	100.00	100.00

Table D-62
Summary of Shrubs on one 196-meter Line Intercept Transect for Lower Bennett Swamp - September 12, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	3.70	6.80	5.31		30.00	45.81	23.37	37.85	1.00	25.00	31.43
Lyonia lucida	27.99	1.27	14.30		13.80	57.36	29.27	47.40	1.00	25.00	36.20
Myrica cerifera	1.50					1.50	0.77	1.24	0.25	6.25	3.74
Persea palustris	7.32				4.60	11.92	6.08	9.85	0.50	12.50	11.17
Sabal palmetto		0.60	1.40			2.00	1.02	1.65	0.75	18.75	10.20
Vaccinium elliottii	1.03				1.40	2.43	1.24	2.01	0.50	12.50	7.25
Total	41.54	8.67	21.01		49.80	121.02	61.74	100.00	4.00	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-63
Summary of Canopy and Subcanopy Tree Importance Values for Lower Bennett Swamp Transect - September 12, 2005

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	13	23.34	50.79	353.26	44.83	1.00	33.33	42.98
Nyssa sylvatica	2	2.34	5.08	54.35	6.90	0.25	8.33	6.77
Persea palustris	2	3.19	6.95	54.35	6.90	0.50	16.67	10.17
Pinus elliottii	1	0.79	1.71	27.17	3.45	0.25	8.33	4.50
Taxodium distichum	11	16.30	35.48	298.91	37.93	1.00	33.33	35.58
Total	29	45.96	100.00	788.04	100.00	3.00	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	25	2.33	81.56	679.35	86.21	1.00	57.14	71.68
Ilex cassine	3	0.37	12.92	81.52	10.34	0.50	28.57	19.46
Nyssa sylvatica	1	0.16	5.52	27.17	3.45	0.25	14.29	8.87
Total	29	2.86	100.00	788.04	100.00	1.75	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (4)

Operational Year 3 - Detailed Vegetation Data

Table D-64
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - March 29, 2006

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1							0.14	4.00
Gordonia lasianthus				1		1		0.29	8.00
Lyonia lucida		1	2	1	1			0.71	20.00
moss			2	3				0.71	20.00
Panicum hemotomon	1							0.14	4.00
Persea palustris							1	0.14	4.00
Pluchea sp. (rosea)						1		0.14	4.00
Rhynchospora sp.							1	0.14	4.00
Similax laurifolia						1		0.14	4.00
Woodwardia virginica	2		2		2		1	1.00	28.00
Total	4	1	6	5	3	3	3	3.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1					2		0.43	13.64
Andropogon virginicus							1	0.14	4.55
Dulichium arundinaceum							2	0.29	9.09
Fern							1	0.14	4.55
Juncus repens						1		0.14	4.55
Ludwigia alata							1	0.14	4.55
Ludwigia sp.						1		0.14	4.55
Lyonia lucida		2						0.29	9.09
Myrica cerifera	1							0.14	4.55
Panicum hemotomon	1							0.14	4.55
Persea palustris					1			0.14	4.55
Pluchea sp. (rosea)						1		0.14	4.55
Quercus laurifolia		1						0.14	4.55
Rhynchospora sp.							1	0.14	4.55
Toxicodendron radicans								0.00	0.00
Vitis rotundifolia		1						0.14	4.55
Woodwardia virginica				2				0.29	9.09
Total	3	4	0	2	1	5	7	3.14	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Eupatorium capillifolium							12	1.71	30.77
Lachnanthes caroliniana						11	2	1.86	33.33
Ludwigia alata							1	0.14	2.56
Panicum ensifolium						1	3	0.57	10.26
Panicum hemotomon							1	0.14	2.56
Rhynchospora sp.							1	0.14	2.56
Vitis rotundifolia			3					0.43	7.69
Woodwardia virginica					3			0.43	7.69
Xyris sp.							1	0.14	2.56
Total	0	0	3	0	3	12	21	5.57	100.00

Table D-64
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - March 29, 2006

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	0.67					0.67		0.19	4.65
Andropogon virginicus							0.33	0.05	1.16
Dulichium arundinaceum							0.67	0.10	2.33
Eupatorium capillifolium							4.00	0.57	13.95
Fern							0.33	0.05	1.16
Gordonia lasianthus				0.33		0.33		0.10	2.33
Juncus repens						0.33		0.05	1.16
Lachnanthes caroliniana						3.67	0.67	0.62	15.12
Ludwigia alata							0.67	0.10	2.33
Ludwigia sp.						0.33		0.05	1.16
Lyonia lucida		1.00	0.67	0.33	0.33			0.33	8.14
moss			0.67	1.00				0.24	5.81
Myrica cerifera	0.33							0.05	1.16
Panicum ensifolium						0.33	1.00	0.19	4.65
Panicum hemotomon	0.67						0.33	0.14	3.49
Persea palustris					0.33		0.33	0.10	2.33
Pluchea sp. (rosea)						0.67		0.10	2.33
Quercus laurifolia		0.33						0.05	1.16
Rhynchospora sp.							1.00	0.14	3.49
Similax laurifolia						0.33		0.05	1.16
Vitis rotundifolia		0.33	1.00					0.19	4.65
Woodwardia virginica	0.67		0.67	0.67	1.67		0.33	0.57	13.95
Xyris sp.							0.67	0.10	2.33
Total	2.33	1.67	3.00	2.33	2.33	6.67	10.33	4.10	100.00

Table D-65
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - September 26, 2006

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1							0.14	4.00
Gordonia lasianthus				1		1		0.29	8.00
Lyonia lucida		1	2	1	1			0.71	20.00
moss			2	3				0.71	20.00
Panicum hemotomon	1							0.14	4.00
Persea palustris							1	0.14	4.00
Pluchea sp. (rosea)						1		0.14	4.00
Rhynchospora sp.							1	0.14	4.00
Similax laurifolia						1		0.14	4.00
Woodwardia virginica	2		2		2		1	1.00	28.00
Xyris sp.								0.00	0.00
Total	4	1	6	5	3	3	3	3.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1					2		0.43	13.64
Andropogon virginicus							1	0.14	4.55
Dulichium sp.							2	0.29	9.09
Fern							1	0.14	4.55
Juncus repens						1		0.14	4.55
Ludwigia alata							1	0.14	4.55
Ludwigia sp.						1		0.14	4.55
Lyonia lucida		2						0.29	9.09
Myrica cerifera	1							0.14	4.55
Panicum hemotomon	1							0.14	4.55
Persea palustris					1			0.14	4.55
Pluchea sp. (rosea)						1		0.14	4.55
Quercus laurifolia		1						0.14	4.55
Rhynchospora sp.							1	0.14	4.55
Vitis rotundifolia		1						0.14	4.55
Woodwardia virginica				2				0.29	9.09
Xyris sp.							1	0.14	4.55
Total	3	4	0	2	1	5	7	3.14	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Eupatorium capillifolium							12	1.71	30.77
Lachnanthes caroliniana						11	2	1.86	33.33
Ludwigia alata							1	0.14	2.56
Panicum ensifolium						1	3	0.57	10.26
Panicum hemotomon							1	0.14	2.56
Rhynchospora sp.							1	0.14	2.56
Vitis rotundifolia			3					0.43	7.69
Woodwardia virginica					3			0.43	7.69
Xyris sp.							1	0.14	2.56

Table D-65
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - September 26, 2006

Total	0	0	3	0	3	12	21	5.57	100.00

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	0.67					0.67		0.19	4.65
Andropogon virginicus							0.33	0.05	1.16
Dulichium sp.							0.67	0.10	2.33
Eupatorium capillifolium							4.00	0.57	13.95
Fern							0.33	0.05	1.16
Gordonia lasianthus				0.33		0.33		0.10	2.33
Juncus repens						0.33		0.05	1.16
Lachnanthes caroliniana						3.67	0.67	0.62	15.12
Ludwigia alata							0.67	0.10	2.33
Ludwigia sp.						0.33		0.05	1.16
Lyonia lucida		1.00	0.67	0.33	0.33			0.33	8.14
moss			0.67	1.00				0.24	5.81
Myrica cerifera	0.33							0.05	1.16
Panicum ensifolium						0.33	1.00	0.19	4.65
Panicum hemotomon	0.67						0.33	0.14	3.49
Persea palustris					0.33		0.33	0.10	2.33
Pluchea sp. (rosea)						0.67		0.10	2.33
Quercus laurifolia		0.33						0.05	1.16
Rhynchospora sp.							1.00	0.14	3.49
Similax laurifolia						0.33		0.05	1.16
Vitis rotundifolia		0.33	1.00					0.19	4.65
Woodwardia virginica	0.67		0.67	0.67	1.67		0.33	0.57	13.95
Xyris sp.							0.67	0.10	2.33
Total	2.33	1.67	3.00	2.33	2.33	6.67	10.33	4.10	100.00

Table D-66
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - March 29, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Toxicodendron radicans	FAC	0.28					0.28	0.20	21.54	0.20	25.00	23.27
Vitis rotundifolia	FAC	0.21	0.63	0.18			1.02	0.73	78.46	0.60	75.00	76.73
Total		0.49	0.63	0.18	0.00	0.00	1.30	0.93	100.00	0.80	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Panicum hemitomon	OBL	0.20					0.20	0.14	2.70	0.20	25.00	13.85
Lachnanthes caroliniana	FAC		6.10				6.10	4.36	82.43	0.20	25.00	53.72
Vitis rotundifolia	FAC	0.80	0.30				1.10	0.79	14.86	0.40	50.00	32.43
Total		0.80	6.40	0.00	0.00	0.00	7.20	5.29	100.00	0.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Toxicodendron radicans	FAC		0.23				0.23	0.16	22.33	0.20	33.33	27.83
Vitis rotundifolia	FAC	0.19	0.61				0.80	0.57	77.67	0.40	66.67	72.17
Total		0.19	0.84	0.00	0.00	0.00	1.03	0.74	100.00	0.60	100.00	100.00

Table D-67
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - September 26, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC			3.05	6.38	7.54	16.97	12.12	85.02	0.60	27.27	56.15
Ludwigia alata	OBL					1.12	1.12	0.80	5.61	0.20	9.09	7.35
Panicum hemitomon	OBL						0.00	0.00	0.00	0.00	0.00	0.00
Toxicodendron radicans	FAC	0.24		0.05		0.03	0.32	0.23	1.60	0.60	27.27	14.44
Vitis rotundifolia	FAC	0.05	0.89	0.48			1.42	1.01	7.11	0.60	27.27	17.19
Xyris sp.	OBL					0.13	0.13	0.09	0.65	0.20	9.09	4.87
Total		0.29	0.89	3.58	6.38	8.82	19.96	14.26	100.00	2.20	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC		0.56	0.05	2.87	1.07	4.55	3.25	27.91	0.80	28.57	28.24
Ludwigia alata	OBL			0.05	0.08	8.84	8.97	6.41	55.03	0.60	21.43	38.23
Panicum hemitomon	OBL	0.79					0.79	0.56	4.85	0.20	7.14	5.99
Toxicodendron radicans	FAC	0.13					0.13	0.09	0.80	0.20	7.14	3.97
Vitis rotundifolia	FAC	0.08		0.09			0.17	0.12	1.04	0.40	14.29	7.66
Xyris sp.	OBL			0.15	0.17	1.37	1.69	1.21	10.37	0.60	21.43	15.90
Total		1.00	0.56	0.34	3.12	11.28	16.30	11.64	100.00	2.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC				2.44	0.35	2.79	1.99	66.75	0.40	22.22	44.48
Ludwigia alata	OBL					0.17	0.17	0.12	4.07	0.20	11.11	7.59
Panicum hemitomon	OBL	0.21					0.21	0.15	5.02	0.20	11.11	8.07
Toxicodendron radicans	FAC	0.18	0.16				0.34	0.24	8.13	0.40	22.22	15.18
Vitis rotundifolia	FAC	0.17	0.04				0.21	0.15	5.02	0.40	22.22	13.62
Xyris sp.	FAC					0.46	0.46	0.33	11.00	0.20	11.11	11.06
Total		0.56	0.20	0.00	2.44	0.98	4.18	2.99	100.00	1.80	100.00	100.00

Table D-68
Summary of Shrubs on one 140-m Line Intercept Transect for Thayer Canal - September 26, 2006

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus		2.55	3.10			5.65	4.04	13.58	0.40	13.33	13.45
Itea virginica					0.66	0.66	0.47	1.59	0.20	6.67	4.13
Lyonia lucida	7.18	4.03	0.91	8.92	8.72	29.76	21.26	71.50	1.00	33.33	52.42
Magnolia virginica				0.51		0.51	0.36	1.23	0.20	6.67	3.95
Myrica cerifera	1.24					1.24	0.89	2.98	0.20	6.67	4.82
Persea palustris	1.70	0.18	0.76	0.86	0.30	3.80	2.71	9.13	1.00	33.33	21.23
Total	10.12	6.76	4.77	10.29	9.68	41.62	29.73	100.00	3.00	100.00	100.00

Table D-69
Summary of Canopy and Subcanopy Tree Importance Values for Thayer Canal Transect - September 26, 2006

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	26	17.74	51.71	464.29	54.17	1.00	27.78	44.55
Ilex cassine	3	0.96	2.79	53.57	6.25	0.20	5.56	4.86
Magnolia virginica	4	1.47	4.29	71.43	8.33	0.40	11.11	7.91
Nyssa sylvatica	2	0.62	1.82	35.71	4.17	0.20	5.56	3.85
Persea palustris	7	1.58	4.61	125.00	14.58	0.80	22.22	13.80
Pinus elliottii	2	2.50	7.28	35.71	4.17	0.40	11.11	7.52
Pinus taeda	1	0.68	1.98	17.86	2.08	0.20	5.56	3.21
Quercus laurifolia	1	6.54	19.07	17.86	2.08	0.20	5.56	8.90
Taxodium distichum	2	2.22	6.47	35.71	4.17	0.20	5.56	5.40
Total	48	34.31	100.00	857.14	100.00	3.60	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	53	2.61	49.13	946.43	57.61	0.80	28.57	45.10
Ilex cassine	9	0.81	15.19	160.71	9.78	0.40	14.29	13.09
Magnolia virginica	2	0.21	3.86	35.71	2.17	0.40	14.29	6.77
Myrica cerifera	2	0.08	1.44	35.71	2.17	0.20	7.14	3.59
Persea palustris	23	1.30	24.45	410.71	25.00	0.80	28.57	26.01
Taxodium distichum	3	0.32	5.93	53.57	3.26	0.20	7.14	5.45
Total	92	5.32	100.00	1642.86	100.00	2.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-70
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - March 29, 2006

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum	1	1						0.29	5.13
Blechnum serrulatum							10	1.43	25.64
Lachnanthes caroliniana	1							0.14	2.56
Osmunda cinnamomea							5	0.71	12.82
Panicum ensifolium	1							0.14	2.56
Saururus cernuus	1							0.14	2.56
Smilax sp		2		1				0.43	7.69
Utricularia sp						15		2.14	38.46
Woodwardia virginica	1							0.14	2.56
Total	5	3	0	1	0	15	15	5.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		1						0.14	1.39
Blechnum serrulatum							20	2.86	27.78
Dulichium sp				3				0.43	4.17
moss						30		4.29	41.67
Saururus cernuus		10						1.43	13.89
Toxicodendron radicans						1		0.14	1.39
Woodwardia virginica	5						2	1.00	9.72
Total	5	11	0	3	0	31	22	10.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		2						0.29	6.06
Blechnum serrulatum					15			2.14	45.45
Lyonia lucida					1	2		0.43	9.09
moss							1	0.14	3.03
Nyssa biflora				1				0.14	3.03
Panicum hemotomon	1							0.14	3.03
Persea palustris	1							0.14	3.03
Saururus cernuus				3				0.43	9.09
Utricularia sp			5					0.71	15.15
Woodwardia virginica	1							0.14	3.03
Total	3	2	5	4	16	2	1	4.71	100.00

Table D-70
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - March 29, 2006

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum	0.33	1.33						0.24	3.38
Blechnum serrulatum					5.00		10.00	2.14	30.41
Dulichium sp				1.00				0.14	2.03
Lachnanthes caroliniana	0.33							0.05	0.68
Lyonia lucida					0.33	0.67		0.14	2.03
moss						10.00	0.33	1.48	20.95
Nyssa biflora			1.67					0.24	3.38
Osmunda cinnamomea							1.67	0.24	3.38
Panicum ensifolium	0.33							0.05	0.68
Panicum hemotomon	0.33							0.05	0.68
Persea palustris	0.33							0.05	0.68
Saururus cernuus	0.33	3.33		1.00				0.67	9.46
Smilax sp		0.67		0.33				0.14	2.03
Toxicodendron radicans						0.33		0.05	0.68
Utricularia sp			1.67			5.00		0.95	13.51
Woodwardia virginica	2.33						0.67	0.43	6.08
Total	3.67	5.33	1.67	1.33	5.00	5.33	12.33	7.05	100.00

Table D-71
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - September 26, 2006

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Carex sp.			1					0.14	16.67
Lachnanthes caroliniana	1							0.14	16.67
Panicum ensifolium	1							0.14	16.67
Panicum hemotomon	1							0.14	16.67
Woodwardia virginica	1	1						0.29	33.33
Total	4	1	1	0	0	0	0	0.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		1						0.14	1.28
Blechnum serrulatum							5	0.71	6.41
Cana flaccida					1			0.14	1.28
Cephalanthus occidentalis					1			0.14	1.28
Dulichium arundinaceum				1				0.14	1.28
Hedyotis uniflora					1			0.14	1.28
Liquidambar styraciflua		1						0.14	1.28
Lyonia lucida						2		0.29	2.56
moss	2					50	4	8.00	71.79
Myrica cerifera	1							0.14	1.28
Panicum ensifolium	1							0.14	1.28
Persea palustris	1							0.14	1.28
Pluchea sp.					1			0.14	1.28
Quercus laurifolia		1						0.14	1.28
Rhynchospora sp.			1		1			0.29	2.56
Saururus cernuus		2						0.29	2.56
Total	5	5	1	1	5	52	9	11.14	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		1						0.14	2.33
Blechnum serrulatum					20			2.86	46.51
Dulichium arundinaceum				1				0.14	2.33
Gordonia lasianthus				1				0.14	2.33
Lyonia lucida					1	2		0.43	6.98
moss	1	1			3	3	1	1.29	20.93
Panicum sp.	1							0.14	2.33
Persea palustris	1							0.14	2.33
Saururus cernuus				3				0.43	6.98
Toxicodendron radicans				1				0.14	2.33
Woodwardia virginica	2							0.29	4.65
Total	5	2	0	6	24	5	1	6.14	100.00

Table D-71
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - September 26, 2006

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		0.67						0.10	1.57
Blechnum serrulatum					6.67		1.67	1.19	19.69
Cana flaccida					0.33			0.05	0.79
Carex sp.			0.33					0.05	0.79
Cephalanthus occidentalis					0.33			0.05	0.79
Dulichium arundinaceum				0.67				0.10	1.57
Gordonia lasianthus				0.33				0.05	0.79
Hedyotis uniflora					0.33			0.05	0.79
Lachnanthes caroliniana	0.33							0.05	0.79
Liquidambar styraciflua		0.33						0.05	0.79
Lyonia lucida					0.33	1.33		0.24	3.94
moss	1.00	0.33			1.00	17.67	1.67	3.10	51.18
Myrica cerifera	0.33							0.05	0.79
Panicum ensifolium	0.67							0.10	1.57
Panicum hemotomon	0.33							0.05	0.79
Panicum sp.	0.33							0.05	0.79
Persea palustris	0.67							0.10	1.57
Pluchea sp.					0.33			0.05	0.79
Quercus laurifolia		0.33						0.05	0.79
Rhynchospora sp.			0.33		0.33			0.10	1.57
Saururus cernuus		0.67		1.00				0.24	3.94
Toxicodendron radicans				0.33				0.05	0.79
Woodwardia virginica	1.00	0.33						0.19	3.15
Total	4.67	2.67	0.67	2.33	9.67	19.00	3.33	6.05	100.00

Table D-72

Summary of Herbaceous Groundcover Belt Transects for Hammock Field - March 29, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	1.01					1.01	0.51	83.47	0.20	50.00	66.74
Vitis rotundifolia	FAC					0.20	0.20	0.10	16.53	0.20	50.00	33.26
Total		1.01	0.00	0.00	0.00	0.20	1.21	0.61	100.00	0.40	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	2.20	2.00		0.60		4.80	2.40	66.85	0.60	33.33	50.09
Toxicodendron radicans	FAC		1.00	0.30		0.46	1.76	0.88	24.51	0.60	33.33	28.92
Vitis rotundifolia	FAC	0.32	0.20				0.52	0.26	7.24	0.40	22.22	14.73
Woodwardia areolata	OBL	0.10					0.10	0.05	1.39	0.20	11.11	6.25
Total		0.42	1.20	0.30	0.00	0.46	2.38	3.59	100.00	1.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	0.08		0.29		1.05	1.42	0.71	55.25	0.60	33.33	44.29
Toxicodendron radicans	FAC	0.17	0.03		0.18	0.60	0.98	0.49	38.13	0.80	44.44	41.29
Vitis rotundifolia	FAC	0.09	0.08				0.17	0.09	6.61	0.40	22.22	14.42
Total		0.34	0.11	0.29	0.18	1.65	2.57	1.29	100.00	1.80	100.00	100.00

Table D-73
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - September 26, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC			0.05	0.18	0.22	0.45	0.23	31.69	0.60	60.00	45.85
Vitis rotundifolia	FAC	0.36				0.61	0.97	0.49	68.31	0.40	40.00	54.15
Total		0.36	0.00	0.05	0.18	0.83	1.42	0.71	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL		0.23		1.37		1.60	0.80	33.13	0.40	16.67	24.90
Toxicodendron radicans	FAC	0.05	1.04	0.30		0.24	1.63	0.82	33.75	0.80	33.33	33.54
Vitis rotundifolia	FAC	0.10	0.15	0.10	0.86	0.27	1.48	0.74	30.64	1.00	41.67	36.15
Woodwardia areolata	OBL	0.12					0.12	0.06	2.48	0.20	8.33	5.41
Total		0.27	1.19	0.40	0.86	0.51	3.23	2.42	100.00	2.40	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL			0.31		0.48	0.79	0.40	24.69	0.40	22.22	23.45
Toxicodendron radicans	FAC		0.10	0.09	1.19	0.25	1.63	0.82	50.94	0.80	44.44	47.69
Vitis rotundifolia	FAC	0.38	0.37				0.75	0.38	23.44	0.40	22.22	22.83
Woodwardia areolata	OBL	0.03					0.03	0.02	0.94	0.20	11.11	6.02
Total		0.41	0.47	0.40	1.19	0.73	3.20	1.60	100.00	1.80	100.00	100.00

Table D-74
Summary of Shrubs on one 200-meter Line Intercept Transect for Hammock Field - September 26, 2006

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Lyonia lucida	4.95	8.53	12.73	20.83	19.72	66.76	33.38	72.99	1.00	27.78	50.39
Magnolia virginica		0.79	1.19	1.93		3.91	1.96	4.28	0.60	16.67	10.47
Myrica cerifera	0.46			1.14		1.60	0.80	1.75	0.40	11.11	6.43
Persea palustris	4.34			0.97		5.31	2.66	5.81	0.40	11.11	8.46
Sabal palmetto	0.23					0.23	0.12	0.25	0.20	5.56	2.90
Serenoa repens	0.46					0.46	0.23	0.50	0.20	5.56	3.03
Vaccinium elliottii	3.66		2.44	6.10	0.99	13.19	6.60	14.42	0.80	22.22	18.32
Total	14.10	9.32	16.36	30.97	20.71	91.46	45.73	100.00	3.60	100.00	100.00

Table D-75

Summary of Canopy and Subcanopy Tree Importance Values for Hammock Field Transect - September 25, 2006

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	3	0.99	2.57	75.00	9.38	0.20	5.88	5.94
Liquidambar styraciflua	2	2.58	6.70	50.00	6.25	0.40	11.76	8.24
Magnolia virginica	7	9.94	25.74	175.00	21.88	0.60	17.65	21.76
Nyssa sylvatica	8	13.47	34.91	200.00	25.00	0.60	17.65	25.82
Persea palustris	6	3.07	7.95	150.00	18.75	0.80	23.53	16.74
Pinus elliottii	1	3.02	7.82	25.00	3.13	0.20	5.88	5.61
Quercus laurifolia	2	0.92	2.38	50.00	6.25	0.20	5.88	4.84
Quercus nigra	1	0.29	0.74	25.00	3.13	0.20	5.88	3.25
Taxodium distichum	2	4.32	11.20	50.00	6.25	0.20	5.88	7.78
Total	32	38.60	100.00	800.00	100.00	3.40	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	2	0.22	11.10	50.00	7.69	0.20	9.09	9.29
Magnolia virginica	10	0.94	46.91	250.00	38.46	0.80	36.36	40.58
Myrica cerifera	1	0.05	2.65	25.00	3.85	0.20	9.09	5.20
Persea palustris	11	0.70	34.74	275.00	42.31	0.80	36.36	37.80
Taxodium distichum	2	0.09	4.60	50.00	7.69	0.20	9.09	7.13
	26	2.00	100.00	650.00	100.00	2.20	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-76
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - March 16, 2006

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum						1	2	0.43	10.00
Blechnum serrulatum		4						0.57	13.33
Gordonia lasianthus		1						0.14	3.33
Lyonia lucida	1	1			1			0.43	10.00
moss	1						6	1.00	23.33
Serenoa repens	1							0.14	3.33
Similax laurifolia	1							0.14	3.33
Toxicodendron radicans					2			0.29	6.67
Vitis rotundifolia						2		0.29	6.67
Toxicodendron radicans		3	3					0.86	20.00
Total	4	9	3	0	3	3	8	4.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum			1			1	1	0.43	4.92
Blechnum serrulatum	4			6				1.43	16.39
Gordonia lasianthus		1	1	1			1	0.57	6.56
Lyonia lucida	3	1		1			1	0.86	9.84
moss		6	1		15	2	5	4.14	47.54
Panicum sp		2						0.29	3.28
Phlebodium aureum					1			0.14	1.64
Pinus elliottii		1						0.14	1.64
Vitis rotundifolia					2			0.29	3.28
Woodwardia virginica				2		1		0.43	4.92
Total	7	11	3	10	18	4	8	8.71	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum						1	1	0.29	3.92
Blechnum serrulatum			6	12				2.57	35.29
Gordonia lasianthus		1			1			0.29	3.92
Lyonia lucida	1		2	2				0.71	9.80
moss			10				1	1.57	21.57
Similax laurifolia	1	1	1					0.43	5.88
Vitis rotundifolia			1	1				0.29	3.92
Woodwardia virginica		1	1	2	1	3		1.14	15.69
Total	2	3	21	17	2	4	2	7.29	100.00

Table D-76
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - March 16, 2006

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum			0.33			1.00	1.33	0.38	6.40
Blechnum serrulatum	1.33	1.33	2.00	6.00				1.52	25.60
Gordonia lasianthus		1.00	0.33	0.33	0.33		0.33	0.33	5.60
Lyonia lucida	1.67	0.67	0.67	1.00	0.33		0.33	0.67	11.20
moss	0.33	2.00	3.67				4.00	1.43	24.00
Panicum sp		0.67						0.10	1.60
Phlebodium aureum					0.33			0.05	0.80
Pinus elliottii		0.33						0.05	0.80
Serenoa repens	0.33							0.05	0.80
Similax laurifolia	0.67	0.33	0.33					0.19	3.20
Toxicodendron radicans					0.67			0.10	1.60
Vitis rotundifolia			0.33	0.33	0.67	0.67		0.29	4.80
Woodwardia virginica		1.33	1.33	1.33	0.33	1.33		0.81	13.60
Total	4.33	7.67	9.00	9.00	2.67	3.00	6.00	5.95	100.00

Table D-77
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - September 25, 2006

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus							1	0.14	1.61
Acer rubrum							1	0.14	1.61
Blechnum serrulatum		21						3.00	33.87
Eupatorium capillifolium							1	0.14	1.61
Gordonia lasianthus							1	0.14	1.61
moss							4	0.57	6.45
Toxicodendron radicans				1	2			0.43	4.84
Vitis rotundifolia						7		1.00	11.29
Woodwardia virginica		18	5					3.29	37.10
Total	0	39	5	1	2	7	8	8.86	100.00

Toxicodendron radicans

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum							1	0.14	1.33
Blechnum serrulatum	6			22	6			4.86	45.33
Lyonia lucida							1	0.14	1.33
moss						2	6	1.14	10.67
Panicum ensifolium		2			2			0.57	5.33
Phlebodium aureum					1			0.14	1.33
Rhynchospora sp.						1		0.14	1.33
Vitis rotundifolia							1	0.14	1.33
Woodwardia virginica		5		10		9		3.43	32.00
Total	6	7	0	32	9	12	9	10.71	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum						1	1	0.29	3.03
Blechnum serrulatum			4	5			5	2.00	21.21
Gordonia lasianthus	1	1						0.29	3.03
Lyonia lucida	2		2	1				0.71	7.58
moss		4	12					2.29	24.24
Persea palustris			1					0.14	1.52
Pinus elliottii		1						0.14	1.52
Similax laurifolia		1						0.14	1.52
Vitis rotundifolia			1	1		1		0.43	4.55
Woodwardia virginica		2	2	4	2	11		3.00	31.82
Total	3	9	22	11	2	13	6	9.43	100.00

Table D-77
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - September 25, 2006

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus							0.33	0.05	0.49
Acer rubrum						0.33	1.00	0.19	1.97
Blechnum serrulatum	2.00	7.00	1.33	9.00	2.00		1.67	3.29	33.99
Eupatorium capillifolium							0.33	0.05	0.49
Gordonia lasianthus	0.33	0.33					0.33	0.14	1.48
Lyonia lucida	0.67		0.67	0.33			0.33	0.29	2.96
moss		1.33	4.00			0.67	3.33	1.33	13.79
Panicum ensifolium		0.67			0.67			0.19	1.97
Persea palustris			0.33					0.05	0.49
Phlebodium aureum					0.33			0.05	0.49
Pinus elliottii		0.33						0.05	0.49
Rhynchospora sp.						0.33		0.05	0.49
Similax laurifolia		0.33						0.05	0.49
Toxicodendron radicans				0.33	0.67			0.14	1.48
Vitis rotundifolia			0.33	0.33		2.67	0.33	0.52	5.42
Woodwardia virginica		8.33	2.33	4.67	0.67	6.67		3.24	33.50
Total	3.00	18.33	9.00	14.67	4.33	10.67	7.67	9.67	100.00

Table D-78
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - March 16, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.55	0.29				0.84	0.43	19.91	0.50	25.00	22.45
Vitis rotundifolia	FAC	1.25	0.95	0.33		0.48	3.01	1.54	71.33	1.00	50.00	60.66
Woodwardia areolata	OBL	0.13	0.24				0.37	0.19	8.77	0.50	25.00	16.88
Total		1.93	1.48	0.33		0.48	4.22	2.15	100.00	2.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.78		0.60			1.38	0.70	23.71	0.50	28.57	26.14
Vitis rotundifolia	FAC	0.62	0.95	0.60			2.17	1.11	37.29	0.75	42.86	40.07
Woodwardia areolata	OBL	2.07	0.20				2.27	1.16	39.00	0.50	28.57	33.79
Total		3.47	1.15	1.20		0.00	5.82	2.97	100.00	1.75	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					0.40	0.40	0.20	7.41	0.25	14.29	10.85
Toxicodendron radicans	FAC	0.30					0.30	0.15	5.56	0.25	14.29	9.92
Vitis rotundifolia	FAC	0.70	1.40	2.10		0.30	4.50	2.30	83.33	1.00	57.14	70.24
Woodwardia areolata	FAC	0.20					0.20	0.10	3.70	0.25	14.29	8.99
Total		1.20	1.40	2.10		0.70	5.40	2.76	100.00	1.75	100.00	100.00

Table D-79
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - September 25, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.14	0.43	1.60			2.17	1.11	36.29	0.75	42.86	39.57
Vitis rotundifolia	FAC	1.02	0.22	2.39		0.18	3.81	1.94	63.71	1.00	57.14	60.43
Total		1.16	0.65	3.99		0.18	5.98	3.05	100.00	1.75	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Vitis rotundifolia	FAC	0.94	0.25				1.19	0.61	62.63	0.50	66.67	64.65
Woodwardia areolata	OBL	0.71					0.71	0.36	37.37	0.25	33.33	35.35
Total		1.65	0.25	0.00		0.00	1.90	0.97	100.00	0.75	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	0.15				0.04	0.19	0.10	1.80	0.50	33.33	17.56
Vitis rotundifolia	FAC	3.82	1.59	2.90		2.08	10.39	5.30	98.20	1.00	66.67	82.44
Total		3.97	1.59	2.90		2.12	10.58	5.40	100.00	1.50	100.00	100.00

Table D-80

Summary of Shrubs on one 196-meter Line Intercept Transect for Lower Bennett Swamp - September 25, 2006

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	6.02	5.11	3.07		0.66	14.86	7.58	31.02	1.00	40.00	35.51
Itea virginica	0.51					0.51	0.26	1.06	0.25	10.00	5.53
Lyonia lucida	24.56	1.02	13.59		3.35	42.52	21.69	88.75	1.00	40.00	64.37
Myrica cerifera			0.28			0.28	0.14	0.58	0.25	10.00	5.29
Persea palustris	1.14	0.46	1.35			2.95	1.51	6.16	0.75	30.00	18.08
Sabal palmetto		1.09				1.09	0.56	2.28	0.25	10.00	6.14
Vaccinium elliottii	1.07					1.07	0.55	2.23	0.25	10.00	6.12
Total	26.77	2.57	15.22		3.35	47.91	24.44	100.00	2.50	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-81
Summary of Canopy and Subcanopy Tree Importance Values for Lower Bennett Swamp Transect - September 25, 2006

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	11	19.59	45.58	298.91	39.29	1.00	30.77	38.55
Nyssa sylvatica	3	2.63	6.11	81.52	10.71	0.50	15.38	10.74
Persea palustris	2	3.17	7.38	54.35	7.14	0.50	15.38	9.97
Pinus elliottii	1	0.85	1.97	27.17	3.57	0.25	7.69	4.41
Taxodium distichum	11	16.75	38.96	298.91	39.29	1.00	30.77	36.34
Total	28	42.99	100.00	760.87	100.00	3.25	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	24	2.45	90.56	652.17	92.31	1.00	66.67	79.49
Ilex cassine	1	0.08	3.04	27.17	3.85	0.25	16.67	10.26
Nyssa sylvatica	1	0.17	6.40	27.17	3.85	0.25	16.67	10.26
Total	26	2.70	100.00	706.52	100.00	1.50	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (4)

Operational Year 4 - Detailed Vegetation Data

Table D-82
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect- April 4, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Dichanthelium sp.						2	1	0.43	7.32
Eupatorium capillifolium							11	1.57	26.83
Gordonia lasianthus						1	1	0.29	4.88
Lachnanthes caroliniana						1	1	0.29	4.88
Ludwigia alata						1		0.14	2.44
Lygodium japonica						1	2	0.43	7.32
Lyonia lucida		2	3	1	1			1.00	17.07
Moss				3				0.43	7.32
Persea palustris		3	2					0.71	12.20
Pluchea rosea							1	0.14	2.44
Vitis rotundifolia			3					0.43	7.32
Total	0	5	8	4	1	6	17	5.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus							10	1.43	17.24
Dichanthelium sp.						2		0.29	3.45
Dulichium arundinaceum							15	2.14	25.86
Itea virginica							1	0.14	1.72
Ludwigia alata						2		0.29	3.45
Lygodium japonica							18	2.57	31.03
Myrica cerifera	1							0.14	1.72
Panicum hemitomon	1							0.14	1.72
Persea palustris					1			0.14	1.72
Pluchea rosea						2		0.29	3.45
Rhynchospora sp.						1		0.14	1.72
Toxicodendron radicans		1						0.14	1.72
Vitis rotundifolia			1					0.14	1.72
Woodwardia virginica				1			1	0.29	3.45
Total	2	1	1	1	1	7	45	8.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1							0.14	4.17
Gordonia lasianthus				1		1		0.29	8.33
Lyonia lucida		1	1	1		1		0.57	16.67
moss			3	4		1		1.14	33.33
Persea palustris							1	0.14	4.17
Woodwardia virginica	2		4				2	1.14	33.33
Total	3	1	8	6	0	3	3	3.43	100.00

Table D-82
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect- April 4, 2007

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	0.33							0.05	0.81
Andropogon virginicus							3.33	0.48	8.13
Dichanthelium sp.						1.33	0.33	0.24	4.07
Dulichium arundinaceum							5.00	0.71	12.20
Eupatorium capillifolium							3.67	0.52	8.94
Gordonia lasianthus				0.33		0.67	0.33	0.19	3.25
Itea virginica							0.33	0.05	0.81
Lachnanthes caroliniana						0.33	0.33	0.10	1.63
Ludwigia alata						1.00		0.14	2.44
Lygodium japonica						0.33	6.67	1.00	17.07
Lyonia lucida		1.00	1.33	0.67	0.33	0.33		0.52	8.94
Moss			1.00	2.33		0.33		0.52	8.94
Myrica cerifera	0.33							0.05	0.81
Panicum hemitomon	0.33							0.05	0.81
Persea palustris		1.00	0.67		0.33		0.33	0.33	5.69
Pluchea rosea						0.67	0.33	0.14	2.44
Rhynchospora sp.						0.33		0.05	0.80
Toxicodendron radicans		0.33						0.05	0.81
Vitis rotundifolia			1.33					0.19	3.25
Woodwardia virginica	0.67		1.33	0.33			1.00	0.48	8.13
Total	1.67	2.33	5.67	3.67	0.67	5.33	21.67	5.86	100.00

Table D-83
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - September 13, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum	1							0.14	3.03
Andropogon virginicus							1	0.14	3.03
Eupatorium capillifolium							1	0.14	3.03
Gordonia lasianthus						1		0.14	3.03
Lachnanthes caroliniana						1		0.14	3.03
Ludwigia sp.						1		0.14	3.03
Lygodium japonica						2	7	1.29	27.27
Lyonia lucida		1	1	1				0.43	9.09
Moss				2				0.29	6.06
Panicum ensifolium						2	1	0.43	9.09
Panicum gymnocarpum							1	0.14	3.03
Persea palustris		1	2					0.43	9.09
Vitis rotundifolia			2					0.29	6.06
Woodwardia virginica					3		1	0.57	12.12
Total	1	2	5	3	3	7	12	4.71	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum	1							0.14	1.06
Andropogon virginicus						4	2	0.86	6.38
Blechnum serrulatum							1	0.14	1.06
Ludwigia alata						1		0.14	1.06
Lygodium japonica							70	10.00	74.47
Lyonia lucida		1	1					0.29	2.13
Myrica cerifera	1							0.14	1.06
Panicum (Dichanthelium)						1		0.14	1.06
Panicum hemitomon	1							0.14	1.06
Persea palustris			1				1	0.29	2.13
Pluchea odorata						1		0.14	1.06
Quercus laurifolia		1						0.14	1.06
Rhynchospora microcephala						1	1	0.29	2.13
Rubus argutus							1	0.14	1.06
Vitis rotundifolia		1						0.14	1.06
Woodwardia virginica				1			1	0.29	2.13
Total	3	3	2	1	0	8	77	13.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum		1						0.14	4.76
Gordonia lasianthus						1	1	0.29	9.52
Lyonia lucida		2	2	1		1		0.86	28.57
Magnolia virginiana							1	0.14	4.76
moss			1					0.14	4.76
Persea palustris							1	0.14	4.76
Rhynchospora sp.							1	0.14	4.76
Woodwardia virginica	2		2		2		2	1.14	38.10
Total	2	3	5	1	2	2	6	3.00	100.00

Table D-83
Summary of Herbaceous 1-Meter Squares for Thayer Canal Transect - September 13, 2007

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	0.67	0.33						0.14	1.96
Andropogon virginicus		0.33	1.00	0.33	0.67	1.33	1.00	0.67	9.15
Blechnum serrulatum							0.33	0.05	0.65
Eupatorium capillifolium							0.33	0.05	0.65
Gordonia lasianthus						0.67		0.10	1.31
Lachnanthes caroliniana						0.33		0.05	0.65
Ludwigia sp.						0.67		0.10	1.31
Lygodium japonica						0.67	25.67	3.76	51.64
Lyonia lucida		1.33	1.33	0.67		0.33		0.52	7.19
Magnolia virginiana							0.33	0.05	0.65
moss			0.33	0.67				0.14	1.96
Myrica cerifera	0.33							0.05	0.65
Panicum (Dichanthelium)						0.33		0.05	0.65
Panicum ensifolium						0.67	0.33	0.14	1.96
Panicum gymnocarpum							0.33	0.05	0.65
Panicum hemitomon	0.33							0.05	0.65
Persea palustris		0.33	1.00				0.67	0.29	3.92
Pluchea odorata						0.33		0.05	0.65
Quercus laurifolia		0.33						0.05	0.65
Rhynchospora microcephala						0.33	0.33	0.10	1.31
Rhynchospora sp.							0.33	0.05	0.65
Rubus argutus							0.33	0.05	0.65
Vitis rotundifolia		0.33	0.67					0.14	1.96
Woodwardia virginica	0.67		0.67		1.67		1.33	0.62	8.50
Total	2.00	3.00	5.00	1.67	2.33	5.67	31.33	7.28	100.00

Table D-84
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - April 4, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC					0.31	0.31	0.22	18.02	0.20	20.00	19.01
Toxicodendron radicans	FAC	0.11					0.11	0.08	6.40	0.20	20.00	13.20
Vitis rotundifolia	FAC	0.27	0.52	0.51			1.30	0.93	75.58	0.60	60.00	67.79
Total		0.38	0.52	0.51	0.00	0.31	1.72	1.23	100.00	1.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC				0.52		0.52	0.37	15.62	0.20	11.11	13.36
Ludwigia alata	OBL				0.33	0.1	0.43	0.31	12.91	0.40	22.22	17.57
Panicum hemitomon	OBL	0.51					0.51	0.36	15.32	0.20	11.11	13.21
Toxicodendron radicans	FAC	0.1					0.10	0.07	3.00	0.20	11.11	7.06
Vitis rotundifolia	FAC	1.27	0.06				1.33	0.95	39.94	0.40	22.22	31.08
Xyris sp.	OBL				0.42	0.02	0.44	0.31	13.21	0.40	22.22	17.72
Total		1.88	0.06	0.00	1.27	0.12	3.33	2.38	100.00	1.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Panicum hemitomon	OBL	0.13					0.13	0.09	2.38	0.20	12.50	7.44
Toxicodendron radicans	FAC		0.17				0.17	0.12	3.11	0.20	12.50	7.81
Vitis rotundifolia	FAC	1.92		0.43		0.23	2.58	1.84	47.25	0.60	37.50	42.38
Xyris sp.	OBL					0.11	0.11	1.84	47.25	0.60	37.50	42.38
Total		2.05	0.17	0.43	0.00	0.34	2.99	3.90	100.00	1.60	100.00	100.00

Table D-85
Summary of Herbaceous Groundcover Belt Transects for Thayer Canal - September 13, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC				1.80	0.27	2.07	1.48	36.00	0.20	1.82	18.91
Panicum hemitomon	OBL	1.86					1.86	1.33	32.35	1.20	10.91	21.63
Toxicodendron radicans	FAC		0.13				0.13	0.09	2.26	2.20	20.00	11.13
Vitis rotundifolia	FAC		0.04				0.04	0.03	0.70	3.20	29.09	14.89
Xyris sp.	OBL					1.65	1.65	1.18	28.70	4.20	38.18	33.44
Total		1.86	0.17	0.00	1.80	1.92	5.75	4.11	100.00	11.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC		0.12		0.09		0.21	0.15	3.00	0.40	16.67	9.83
Ludwigia alata	OBL					0.39	0.39	0.28	5.56	0.20	8.33	6.95
Panicum hemitomon	OBL	1.25					1.25	0.89	17.83	0.20	8.33	13.08
Toxicodendron radicans	FAC	0.10				0.01	0.11	0.08	1.57	0.40	16.67	9.12
Vitis rotundifolia	FAC	2.15	0.57		0.25	0.01	2.98	2.13	42.51	0.80	33.33	37.92
Xyris sp.	OBL				0.28	1.79	2.07	1.48	29.53	0.40	16.67	23.10
Total		3.50	0.69	0.00	0.62	2.20	7.01	5.01	100.00	2.40	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC				0.75	4.96	5.71	4.08	48.47	0.40	18.18	33.33
Toxicodendron radicans	FAC	0.05		0.07	0.27	0.15	0.54	0.39	4.58	0.80	36.36	20.47
Vitis rotundifolia	FAC	1.75	2.37	0.61	0.55	0.25	5.53	3.95	46.94	1.00	45.45	46.20
Total		1.80	2.37	0.68	1.57	5.36	11.78	8.41	100.00	2.20	100.00	100.00

Table D-86
Summary of Shrubs on one 140-m Line Intercept Transect for Thayer Canal - September 13, 2007

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	1.55	1.65	0.53	0.21		3.94	2.81	9.08	0.80	26.67	17.87
Lyonia lucida	7.25	4.64	1.20	11.85	10.47	35.41	25.29	81.57	1.00	33.33	57.45
Magnolia virginiana				0.47		0.47	0.34	1.08	0.20	6.67	3.87
Myrica cerifera	1.60					1.60	1.14	3.69	0.20	6.67	5.18
Persea palustris	0.68	0.45	0.11			1.24	0.89	2.86	0.60	20.00	11.43
Sabal palmetto	0.75					0.75	0.54	1.73	0.20	6.67	4.20
Total	11.83	6.74	1.84	12.53	10.47	43.41	31.01	100.00	3.00	100.00	100.00

Table D-87
Summary of Canopy and Subcanopy Tree Importance Values for Thayer Canal Transect - September 13, 2007

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	26	17.58	51.35	464.29	56.52	1.00	29.41	45.76
Ilex cassine	3	0.94	2.75	53.57	6.52	0.20	5.88	5.05
Magnolia virginica	4	1.43	4.18	71.43	8.70	0.40	11.76	8.21
Nyssa sylvatica	2	0.63	1.84	35.71	4.35	0.20	5.88	4.02
Persea palustris	5	1.33	3.88	89.29	10.87	0.60	17.65	10.80
Pinus elliottii	2	2.55	7.44	35.71	4.35	0.40	11.76	7.85
Pinus taeda	1	0.74	2.15	17.86	2.17	0.20	5.88	3.40
Quercus laurifolia	1	6.87	20.07	17.86	2.17	0.20	5.88	9.37
Taxodium distichum	2	2.17	6.34	35.71	4.35	0.20	5.88	5.52
Total	46	34.24	100.00	821.43	100.00	3.40	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	50	2.70	51.51	892.86	61.73	0.80	28.57	47.27
Ilex cassine	9	0.85	16.13	160.71	11.11	0.40	14.29	13.84
Magnolia virginica	2	0.22	4.23	35.71	2.47	0.40	14.29	7.00
Myrica cerifera	2	0.08	1.54	35.71	2.47	0.20	7.14	3.72
Persea palustris	15	1.04	19.90	267.86	18.52	0.80	28.57	22.33
Taxodium distichum	3	0.35	6.68	53.57	3.70	0.20	7.14	5.84
Total	81	5.25	100.00	1446.43	100.00	2.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-88
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - April 4, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum	1							0.14	5.26
Blechnum serrulatum							2	0.29	10.53
Gordonia lasianthus				1		1		0.29	10.53
Liquidambar styraciflua		1						0.14	5.26
Lyonia lucida		1						0.14	5.26
Moss							4	0.57	21.05
Nyssa biflora			1		1			0.29	10.53
Osmunda cinnamomea							1	0.14	5.26
Panicum hemitomon	1							0.14	5.26
Rhynchospora sp.			1					0.14	5.26
Smilax laurifolia						1		0.14	5.26
Toxicodendron radicans			1					0.14	5.26
Woodwardia virginica		1						0.14	5.26
Total	2	3	3	1	1	2	7	2.71	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum	1	1						0.29	5.00
Axonopus sp.				1				0.14	2.50
Blechnum serrulatum							8	1.14	20.00
Cephalanthus occidentalis					1			0.14	2.50
Dulichium arundinaceum				1				0.14	2.50
Moss						20		2.86	50.00
Rhynchospora sp.					1			0.14	2.50
Saururus cernuus		1						0.14	2.50
Toxicodendron radicans						1		0.14	2.50
Viola sp.		1						0.14	2.50
Vitis rotundifolia						1		0.14	2.50
Woodwardia virginica	1			1				0.29	5.00
Total	2	3	0	3	2	22	8	5.71	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum	1	1						0.29	0.05
Blechnum serrulatum				1	16	1		2.57	0.45
Dulichium arundinaceum				1				0.14	0.03
Gordonia lasianthus				1				0.14	0.03
Lyonia lucida					2	1		0.43	0.08
Moss					5			0.71	0.13
Nyssa biflora		1		1				0.29	0.05
Persea palustris	1							0.14	0.03
Saururus cernuus				3				0.43	0.08
Smilax laurifolia				1				0.14	0.03
Toxicodendron radicans				1				0.14	0.03
Woodwardia virginica	2							0.29	0.05
Total	4	2	0	9	23	2	0	5.71	100.00

Table D-88
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - April 4, 2007

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum	1.00	0.67						0.24	5.15
Axonopus sp.				0.33				0.05	1.03
Blechnum serrulatum				0.33	5.33	0.33	3.33	1.33	28.87
Cephalanthus occidentalis					0.33			0.05	1.03
Dulichium arundinaceum				0.67				0.10	2.06
Gordonia lasianthus				0.67		0.33		0.14	3.09
Liquidambar styraciflua		0.33						0.05	1.03
Lyonia lucida		0.33			0.67	0.33		0.19	4.12
Moss					1.67	6.67	1.33	1.38	29.90
Nyssa biflora		0.33	0.33	0.33	0.33			0.19	4.12
Osmunda cinnamomea							0.33	0.05	1.03
Panicum hemitomon	0.33							0.05	1.03
Rhynchospora sp.			0.33		0.33			0.10	2.06
Saururus cernuus		0.33		1.00				0.19	4.12
Smilax laurifolia				0.33		0.33		0.10	2.06
Toxicodendron radicans			0.33	0.33		0.33		0.14	3.09
Viola sp.		0.33						0.05	1.03
Vitis rotundifolia						0.33		0.05	1.03
Woodwardia virginica	1.00	0.33						0.19	4.12
Total	2.33	2.67	1.00	4.00	8.67	8.67	5.00	4.62	100.00

Table D-89
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - September 14, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum					2		2	0.57	66.67
Ilex cassine						1		0.14	16.67
Lachnanthes caroliniana	1		1					0.29	33.33
Lyonia lucida	1						1	0.29	33.33
Nyssa biflora					1			0.14	16.67
Panicum ensifolium	1							0.14	16.67
Panicum hemitomon	1							0.14	16.67
Rhynchospora inundata			1					0.14	16.67
Toxicodendron radicans	1							0.14	16.67
Woodwardia virginica	2	1						0.43	50.00
Total	7	1	2	0	3	1	3	0.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus				1				0.14	1.41
Blechnum serrulatum							4	0.57	5.63
Cephalanthus occidentalis					1			0.14	1.41
Dulichium arundinaceum				1				0.14	1.41
Liquidambar styraciflua		1						0.14	1.41
Magnolia virginiana		1						0.14	1.41
Moss						50		7.14	70.42
Persea palustris	1							0.14	1.41
Pluchea sp.					1			0.14	1.41
Rhynchospora inundata			1		1			0.29	2.82
Saururus cernuus		2						0.29	2.82
Vitis rotundifolia						1		0.14	1.41
Woodwardia virginica	2				1		1	0.57	5.63
Xyris					1			0.14	1.41
Total	3	4	1	2	5	51	5	10.14	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		1						0.14	0.08
Andropogon virginicus	1							0.14	0.08
Blechnum serrulatum				2				0.29	0.15
Gordonia lasianthus				1				0.14	0.08
Lyonia lucida					1	1		0.29	0.15
Persea palustris	1				1		1	0.43	0.23
Saururus cernuus				1				0.14	0.08
Toxicodendron radicans				1				0.14	0.08
Woodwardia virginica	1							0.14	0.08
Total	3	1	0	5	2	1	1	1.86	100.00

Table D-89
Summary of Herbaceous 1-Meter Squares for Hammock Field Transect - September 14, 2007

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		0.33						0.05	0.99
Andropogon virginicus	0.33			0.33				0.10	1.98
Blechnum serrulatum					0.67		2.00	0.38	7.92
Cephalanthus occidentalis					1.00			0.14	2.97
Dulichium arundinaceum				0.33				0.05	0.99
Gordonia lasianthus				0.33				0.05	0.99
Ilex cassine						0.33		0.05	0.99
Lachnanthes caroliniana	0.33		0.33					0.10	1.98
Liquidambar styraciflua		0.33						0.05	0.99
Lyonia lucida	0.33				0.33	0.33	0.33	0.19	3.96
Magnolia virginiana		0.33						0.05	0.99
Moss						16.67		2.38	49.50
Nyssa biflora					0.33			0.05	0.99
Panicum ensifolium	0.33							0.05	0.99
Panicum hemitomon	0.33							0.05	0.99
Persea palustris	0.67				0.33		0.33	0.19	3.96
Pluchea sp.					0.33			0.05	0.99
Rhynchospora inundata			0.67		0.33			0.14	2.97
Saururus cernuus		0.67		0.33				0.14	2.97
Toxicodendron radicans	0.33			0.33				0.10	1.98
Vitis rotundifolia						0.33		0.05	0.99
Woodwardia virginica	1.67	0.33			0.33		0.33	0.38	7.92
Xyris					0.33			0.05	0.99
Total	4.33	2.00	1.00	1.67	4.00	17.67	3.00	4.81	100.00

Table D-90
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - April 4, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	1.01					1.01	0.51	83.47	0.20	50.00	66.74
Vitis rotundifolia	FAC					0.20	0.20	0.10	16.53	0.20	50.00	33.26
Total		1.01	0.00	0.00	0.00	0.20	1.21	0.61	100.00	0.40	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	2.20	2.00		0.60		4.80	2.40	66.85	0.60	33.33	50.09
Toxicodendron radicans	FAC		1.00	0.30		0.46	1.76	0.88	24.51	0.60	33.33	28.92
Vitis rotundifolia	FAC	0.32	0.20				0.52	0.26	7.24	0.40	22.22	14.73
Woodwardia areolata	OBL	0.10					0.10	0.05	1.39	0.20	11.11	6.25
Total		0.42	1.20	0.30	0.00	0.46	2.38	3.59	100.00	1.80	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	0.08		0.29		1.05	1.42	0.71	55.25	0.60	33.33	44.29
Toxicodendron radicans	FAC	0.17	0.03		0.18	0.60	0.98	0.49	38.13	0.80	44.44	41.29
Vitis rotundifolia	FAC	0.09	0.08				0.17	0.09	6.61	0.40	22.22	14.42
Total		0.34	0.11	0.29	0.18	1.65	2.57	1.29	100.00	1.80	100.00	100.00

Table D-91
Summary of Herbaceous Groundcover Belt Transects for Hammock Field - September 14, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.03	0.1		0.25		0.38	0.19	3.55	0.60	25.00	14.27
Toxicodendron radicans	FAC		1.40	0.01	1.05	3.10	5.56	2.78	51.91	0.80	33.33	42.62
Vitis rotundifolia	FAC	3.55	0.12		0.60	0.20	4.47	2.24	41.74	0.80	33.33	37.54
Woodwardia areolata	OBL	0.30					0.30	0.15	2.80	0.20	8.33	5.57
Total		3.88	1.62	0.01	1.90	3.30	10.71	5.36	100.00	2.40	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.57			0.28		0.85	0.43	23.94	0.40	25.00	24.47
Toxicodendron radicans	FAC		2.05	0.06	0.06	0.27	2.44	1.22	68.73	0.80	50.00	59.37
Vitis rotundifolia	FAC			0.08	0.18		0.26	0.13	7.32	0.40	25.00	16.16
Total		0.57	2.05	0.14	0.52	0.27	3.55	1.78	100.00	1.60	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL			0.19			0.19	0.10	8.09	0.20	20.00	14.04
Toxicodendron radicans	FAC	0.05	0.08	0.18			0.31	0.16	13.19	0.60	60.00	36.60
Vitis rotundifolia	FAC	1.85					1.85	0.93	78.72	0.20	20.00	49.36
Total		1.90	0.08	0.37	0.00	0.00	2.35	1.18	100.00	1.00	100.00	100.00

Table D-92
Summary of Shrubs on one 200-meter Line Intercept Transect for Hammock Field - September 14, 2007

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Lyonia lucida	7.70	15.75	10.20	16.20	11.00	60.85	30.43	77.47	1.00	41.67	59.57
Myrica cerifera	0.80			1.60		2.40	1.20	3.06	0.40	16.67	9.86
Persea palustris	5.30			1.40		6.70	3.35	8.53	0.40	16.67	12.60
Vaccinium corymbosum	5.00			3.25	0.35	8.60	4.30	10.95	0.60	25.00	17.97
Total	18.80	15.75	10.20	22.45	11.35	78.55	39.28	100.00	2.40	100.00	100.00

Table D-93
Summary of Canopy and Subcanopy Tree Importance Values for Hammock Field Transect - September 14, 2007

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	3	0.98	0.67	75.00	9.68	0.20	5.88	5.41
Liquidambar styraciflua	2	111.89	75.59	50.00	6.45	0.40	11.76	31.27
Magnolia virginica	6	9.72	6.57	150.00	19.35	0.60	17.65	14.52
Nyssa sylvatica	8	13.33	9.01	200.00	25.81	0.60	17.65	17.49
Persea palustris	6	3.22	2.17	150.00	19.35	0.80	23.53	15.02
Pinus elliottii	1	3.02	2.04	25.00	3.23	0.20	5.88	3.72
Quercus laurifolia	2	0.96	0.65	50.00	6.45	0.20	5.88	4.33
Quercus nigra	1	0.34	0.23	25.00	3.23	0.20	5.88	3.11
Taxodium distichum	2	4.56	3.08	50.00	6.45	0.20	5.88	5.14
Total	31	148.03	100.00	775.00	100.00	3.40	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Ilex cassine	2	0.22	13.02	50.00	9.52	0.20	9.09	10.54
Magnolia virginica	9	0.90	53.67	225.00	42.86	0.80	36.36	44.30
Myrica cerifera	1	0.05	3.16	25.00	4.76	0.20	9.09	5.67
Persea palustris	7	0.42	24.68	175.00	33.33	0.80	36.36	31.46
Taxodium distichum	2	0.09	5.48	50.00	9.52	0.20	9.09	8.03
	21	1.68	100.00	525.00	100.00	2.20	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Table D-94
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - April 4, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum							2	0.29	2.78
Andropogon virginicus							1	0.14	1.39
Blechnum serrulatum		18						2.57	25.00
Eupatorium capillifolium							3	0.43	4.17
Gordonia lasianthus							1	0.14	1.39
Lyonia lucida	1	1			2			0.57	5.56
moss		2						0.29	2.78
Toxicodendron radicans				4				0.57	5.56
Vitis rotundifolia				13		12		3.57	34.72
Woodwardia virginica		8	4					1.71	16.67
Total	1	29	4	17	2	12	7	10.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum							1	0.14	1.14
Blechnum serrulatum	4			25	5			4.86	38.64
moss		3					10	1.86	14.77
Panicum ensifolium		1						0.14	1.14
Phlebodium aureum					2			0.29	2.27
Pinus elliottii		1						0.14	1.14
Vitis rotundifolia					3	1		0.57	4.55
Woodwardia virginica		2		9		21		4.57	36.36
Total	4	7	0	34	10	22	11	12.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum						1	1	0.29	3.28
Blechnum serrulatum			4	9			10	3.29	37.70
Gordonia lasianthus		1						0.14	1.64
Itea virginica	1							0.14	1.64
Lyonia lucida	1		1	1			1	0.57	6.56
Smilax laurifolia		1						0.14	1.64
Vitis rotundifolia						1		0.14	1.64
Woodwardia virginica		2	5	4	7	10		4.00	45.90
Total	2	4	10	14	7	12	12	8.71	100.00

Table D-94
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - April 4, 2007

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum						0.33	1.33	0.24	2.50
Andropogon virginicus							0.33	0.05	0.50
Blechnum serrulatum	1.33	6.00	1.33	11.33			3.33	3.33	35.00
Eupatorium capillifolium							1.00	0.14	1.50
Gordonia lasianthus		0.33					0.33	0.10	1.00
Itea virginica	0.33							0.05	0.50
Lyonia lucida	0.67	0.33	0.33	0.33		0.67	0.33	0.38	4.00
moss		1.67					3.33	0.71	7.50
Panicum ensifolium		0.33						0.05	0.50
Phlebodium aureum					0.67			0.10	1.00
Pinus elliottii		0.33						0.05	0.50
Smilax laurifolia		0.33						0.05	0.50
Toxicodendron radicans				1.33				0.19	2.00
Vitis rotundifolia						4.67		0.67	7.00
Woodwardia virginica		4.00	3.00	4.33	2.33	10.33		3.43	36.00
Total	2.33	9.33	1.67	13.00	0.67	5.67	10.00	9.52	100.00

Table D-95
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - September 14, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum							1	0.14	2.78
Andropogon virginicus							1	0.14	2.78
Blechnum serrulatum		7						1.00	19.44
Eupatorium capillifolium							1	0.14	2.78
Gordonia lasianthus							1	0.14	2.78
Itea virginica	1							0.14	2.78
Lyonia lucida	2	1			3		1	1.00	19.44
moss					2		3	0.71	13.89
Toxicodendron radicans					1		1	0.29	5.56
Vitis rotundifolia		1		1		3		0.71	13.89
Woodwardia virginica		3	2					0.71	13.89
Total	3	12	2	1	6	3	9	5.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum	3			10	3			2.29	29.63
Lyonia lucida	1			1				0.29	3.70
moss			1		10	3	1	2.14	27.78
Panicum ensifolium		2						0.29	3.70
Phlebodium aureum					2			0.29	3.70
Polypodium polypodioides					1			0.14	1.85
Vitis rotundifolia					2			0.29	3.70
Woodwardia virginica		3		5		6		2.00	25.93
Total	4	5	1	16	18	9	1	7.71	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			8	65			35	15.43	63.91
Panicum ensifolium	1	21						3.14	13.02
Vitis rotundifolia			2	1	4			1.00	4.14
Woodwardia virginica		2	4	6	20			4.57	18.93
Total	2	25	17	76	29	6	42	24.14	100.00

Table D-95
Summary of Herbaceous 1-Meter Squares for Lower Bennett Swamp Transect - September 14, 2007

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum							0.33	0.05	0.39
Andropogon virginicus							0.33	0.05	0.39
Blechnum serrulatum	1.00	2.33	2.67	25.00	1.00		11.67	6.24	50.58
Eupatorium capillifolium							0.33	0.05	0.39
Gordonia lasianthus							0.33	0.05	0.39
Itea virginica	0.33							0.05	0.39
Lyonia lucida	1.00	0.33		0.33	1.00		0.33	0.43	3.47
moss			0.33		4.00	1.00	1.33	0.95	7.72
Panicum ensifolium	0.33	7.67						1.14	9.27
Phlebodium aureum					0.67			0.10	0.77
Polypodium polypodioides					0.33			0.05	0.39
Toxicodendron radicans					0.33		0.33	0.10	0.77
Vitis rotundifolia		0.33	0.67	0.67	2.00	1.00		0.67	5.41
Woodwardia virginica		2.67	2.00	3.67	6.67	2.00		2.43	19.69
Total	2.67	13.33	5.67	29.67	16.00	4.00	15.00	12.33	100.00

Table D-96
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp- April 4, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					0.14	0.14	0.07	0.60	0.25	12.50	6.55
Toxicodendron radicans	FAC	1.36	0.27	3.69			5.32	2.77	22.71	0.75	37.50	30.10
Vitis rotundifolia	FAC	1.43	0.48	4.97		11.09	17.97	9.36	76.70	1.00	50.00	63.35
Total		2.79	0.75	8.66		11.23	23.43	12.20	100.00	2.00	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Toxicodendron radicans	FAC	0.57	0.88			0.14	1.59	0.83	23.28	0.75	38.46	30.87
Vitis rotundifolia	FAC	0.06	1.22	0.67		2.29	4.24	2.21	62.08	1.00	51.28	56.68
Woodwardia areolata	OBL	1.00					1.00	0.52	14.64	0.20	10.26	12.45
Total		1.63	2.10	0.67		2.43	6.83	3.56	100.00	1.95	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Saururus cernuus	OBL					1.93	1.93	1.01	33.57	0.25	17.24	25.40
Toxicodendron radicans	FAC			0.14			0.14	0.07	2.43	0.20	13.79	8.11
Vitis rotundifolia	FAC	0.22	0.33	0.21		2.92	3.68	1.92	64.00	1.00	68.97	66.48
Total		0.22	0.33	0.35		4.85	5.75	2.99	100.00	1.45	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-97
Summary of Herbaceous Groundcover Belt Transects for Lower Bennett Swamp - September 14, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					0.17	0.17	0.09	1.38	0.25	11.11	6.24
Toxicodendron radicans	FAC	0.14		0.70		0.09	0.93	0.48	7.53	0.75	33.33	20.43
Vitis rotundifolia	FAC	1.16	1.61	2.02		6.35	11.14	5.80	90.20	1.00	44.44	67.32
Woodwardia areolata	OBL					0.11	0.11	0.06	0.89	0.25	11.11	6.00
Total		1.30	1.61	2.72		6.72	12.35	6.43	100.00	2.25	100.00	100.00

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Toxicodendron radicans	FAC	1.25		1.80		1.11	4.16	2.17	34.72	0.75	42.86	38.79
Vitis rotundifolia	FAC	1.64	0.30	2.09		3.79	7.82	4.07	65.28	1.00	57.14	61.21
Total		2.89	0.30	3.89		4.90	11.98	6.24	100.00	1.75	100.00	100.00

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL					0.35	0.35	0.18	2.17	0.25	11.11	6.64
Toxicodendron radicans	FAC	0.65		1.35		0.25	2.25	1.17	13.98	0.75	33.33	23.65
Vitis rotundifolia	FAC	0.41	0.85	10.38		1.81	13.45	7.01	83.54	1.00	44.44	63.99
Woodwardia areolata	OBL					0.05	0.05	0.03	0.31	0.25	11.11	5.71
Total		1.06	0.85	11.73		2.46	16.10	8.39	100.00	2.25	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-98

Summary of Shrubs on one 196-meter Line Intercept Transect for Lower Bennett Swamp - September 14, 2007

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Total Linear Distance (m)	Cover		Frequency		Importance Value
							Percent	Relative	Absolute	Relative	
Gordonia lasianthus	1.15	4.55	17.51		3.89	27.10	14.11	41.77	0.80	28.57	35.17
Ilex cassine					1.40	1.40	0.73	2.16	0.20	7.14	4.65
Lyonia lucida	29.25	0.60	14.25		5.90	50.00	26.04	77.07	0.80	28.57	52.82
Myrica cerifera	0.50					0.50	0.26	0.77	0.20	7.14	3.96
Persea palustris	3.95	1.55	4.00		1.10	10.60	5.52	16.34	0.80	28.57	22.45
Pinus sp.	0.11					0.11	0.06	0.17	0.20	7.14	3.66
Sabal palmetto	1.80	0.60				2.40	1.25	3.70	0.40	14.29	8.99
Smilax sp.	1.20				0.07	1.27	0.66	1.96	0.40	14.29	8.12
Total	36.81	2.75	18.25		7.07	64.88	33.79	100.00	2.80	100.00	100.00

Data not used. Plots severely damaged by storms.

Table D-99
Summary of Canopy and Subcanopy Tree Importance Values for Lower Bennett Swamp Transect - September 14, 2007

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	12	19.62	48.89	326.09	44.44	1.00	36.36	43.23
Nyssa sylvatica	2	2.34	5.84	54.35	7.41	0.25	9.09	7.45
Persea palustris	1	0.53	1.33	27.17	3.70	0.25	9.09	4.71
Pinus elliottii	1	0.87	2.17	27.17	3.70	0.25	9.09	4.99
Taxodium distichum	11	16.77	41.78	298.91	40.74	1.00	36.36	39.63
Total	27	40.14	100.00	733.70	100.00	2.75	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	17	1.68	85.89	461.96	89.47	0.75	60.00	78.45
Ilex cassine	1	0.09	4.47	27.17	5.26	0.25	20.00	9.91
Nyssa sylvatica	1	0.19	9.64	27.17	5.26	0.25	20.00	11.64
Total	19	1.96	100.00	516.30	100.00	1.25	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (4)

Operational Year 5 - Detailed Vegetation Data

Table D-100
Summary Of Herbaceous 1-Meter Squares from Thayer Canal - March 10, 2008

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Eupatorium capillifolium							4	0.57	9.52
Gordonia lasianthus						1	1	0.29	4.76
Grass sp.							2	0.29	4.76
Lygodium japonicum						2	15	2.43	40.48
Lyonia lucida		1	1	1				0.43	7.14
moss				3	1	1		0.71	11.90
Panicum ensifolium						2		0.29	4.76
Persea palustris		1	1					0.29	4.76
Toxicodendron radicans							1	0.14	2.38
Triadenum virginicum							2	0.29	4.76
Vitis rotundifolia			2					0.29	4.76
Total	0	2	4	4	1	6	25	6.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Gordonia lasianthus		1	1	1		1	1	0.71	20.00
Lyonia lucida		1	1	1		1		0.57	16.00
Moss				2		7		1.29	36.00
Persea palustris	1				1	1		0.43	12.00
Pinus elliottii								0.00	0.00
Toxicodendron radicans					1			0.14	4.00
Woodwardia virginica			1		2			0.43	12.00
Total	1	2	3	4	4	10	1	3.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Andropgon virginicus						15		2.14	13.16
Eupatorium capillifolium						1		0.14	0.88
Lygodium japonicum							90	12.86	78.95
Panicum hemitomon	2							0.29	1.75
Pluchea rosea						1		0.14	0.88
Rubus sp.							1	0.14	0.88
Toxicodendron radicans		1						0.14	0.88
Vitis rotundifolia		3						0.43	2.63
Total	2	4	0	0	0	17	91	16.29	100.00

Table D-100
Summary Of Herbaceous 1-Meter Squares from Thayer Canal - March 10, 2008

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropgon virginicus						5.00		0.71	8.29
Eupatorium capillifolium						0.33	1.33	0.24	2.76
Gordonia lasianthus		0.33	0.33	0.33		0.67	0.67	0.33	3.87
Grass sp.							0.67	0.10	1.10
Lygodium japonicum						0.67	35.00	5.10	59.12
Lyonia lucida		0.67	0.67	0.67		0.33		0.33	3.87
Moss				1.67	0.33	2.67		0.67	7.73
Panicum ensifolium						0.67		0.10	1.10
Panicum hemitomon	0.67							0.10	1.10
Persea palustris	0.33	0.33	0.33		0.33	0.33		0.24	2.76
Pluchea rosea						0.33		0.05	0.55
Rubus sp.							0.33	0.05	0.55
Toxicodendron radicans		0.33			0.33		0.33	0.14	1.66
Triadenum virginicum							0.67	0.10	1.10
Vitis rotundifolia		1.00	0.67					0.24	2.76
Woodwardia virginica			0.33		0.67			0.14	1.66
Total	1.00	2.67	2.33	2.67	1.67	5.67	37.67	8.62	100.00

Table D-101
Summary of Herbaceous Ground Cover Belt Transects for Thayer Canal Transect, Bennett Swamp - March 10th, 2008.

		Mean Linear Distance (meters)					Total	Mean		Mean		
		Belt Transect Zone					Mean	Percent Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Absolute	Relative	Absolute	Relative	Value
Lachnanthes caroliniana	FAC	0.22				0.01	0.22	0.16	11.41	0.13	8.70	10.05
Ludwigia alata	OBL				0.04		0.04	0.03	2.04	0.07	4.35	3.20
Panicum hemitomon	OBL				0.03	0.06	0.10	0.07	4.94	0.13	8.70	6.82
Toxicodendron radicans	FAC	0.08	0.03	0.03	0.01	0.10	0.24	0.17	12.44	0.53	34.78	23.61
Vitis rotundifolia	FAC	0.42	0.78		0.03	0.01	1.24	0.89	63.37	0.53	34.78	49.08
Xyris sp.	OBL					0.11	0.11	0.08	5.79	0.13	8.70	7.24
Total		0.71	0.81	0.03	0.11	0.29	1.96	1.40	100.00	1.53	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		0.50	0.81	0.03	0.08	0.11	1.52	1.22	87.22	1.20	78.26	82.74
OBL		0.22	0.00	0.00	0.03	0.18	0.43	0.18	12.78	0.33	21.74	17.26
Total		0.71	0.81	0.03	0.11	0.29	1.96	1.40	100.00	1.53	100.00	100.00

Table D-102
Summary Of Herbaceous 1-Meter Squares from Hammock Field - March 11, 2008

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		1						0.14	3.45
Blechnum serrulatum					14	1		2.14	51.72
Gordonia lasianthus				1			1	0.29	6.90
Liquidambar styraciflua	1							0.14	3.45
Lyonia lucida					1	1		0.29	6.90
Persea palustris	1	1	1		1		1	0.71	17.24
Saururus cernuus				1				0.14	3.45
Toxicodendron radicans				1		1		0.29	6.90
Total	2	2	1	3	16	3	2	4.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum		1						0.14	3.57
Blechnum serrulatum							15	2.14	53.57
Erechities heirarciifolius			1					0.14	3.57
Gordonia lasianthus				1				0.14	3.57
Panicum ensifolium	1							0.14	3.57
Persea palustris							1	0.14	3.57
Rhynchospora sp.			1					0.14	3.57
Saururus cernuus		5						0.71	17.86
Vitis rotundifolia						1		0.14	3.57
Woodwardia virginica				1				0.14	3.57
Total	1	6	2	2	0	1	16	4.00	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum					3		1	0.57	18.18
Erechities heirarciifolius						1		0.14	4.55
Gordonia lasianthus			1	1		2		0.57	18.18
Liquidambar styraciflua	1	1			1			0.43	13.64
Lyonia lucida		2					1	0.43	13.64
Magnolia virginiana						1		0.14	4.55
moss			1				1	0.29	9.09
Persea palustris			1					0.14	4.55
Rhynchospora sp.			1					0.14	4.55
Saururus cernuus	1							0.14	4.55
Toxicodendron radicans			1					0.14	4.55
Total	2	3	5	1	4	4	3	3.14	100.00

Table D-102
Summary Of Herbaceous 1-Meter Squares from Hammock Field - March 11, 2008

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Acer rubrum		0.67						0.10	2.53
Blechnum serrulatum					5.67	0.33	5.33	1.62	43.04
Erechities heirarciifolius			0.33			0.33		0.10	2.53
Gordonia lasianthus			0.33	1.00		0.67	0.33	0.33	8.86
Liquidambar styraciflua	0.67	0.33			0.33			0.19	5.06
Lyonia lucida		0.67			0.33	0.33	0.33	0.24	6.33
Magnolia virginiana						0.33		0.05	1.27
moss			0.33				0.33	0.10	2.53
Panicum ensifolium	0.33							0.05	1.27
Persea palustris	0.33	0.33	0.67		0.33		0.67	0.33	8.86
Rhynchospora sp.			0.67					0.10	2.53
Saururus cernuus	0.33	1.67		0.33				0.33	8.86
Toxicodendron radicans			0.33	0.33		0.33		0.14	3.80
Vitis rotundifolia						0.33		0.05	1.27
Woodwardia virginica				0.33				0.05	1.27
Total	1.67	3.67	2.67	2.00	6.67	2.67	7.00	3.76	100.00

Table D-103
Summary of Herbaceous Ground Cover Belt Transects for Hammock FieldTransect, Bennett Swamp - March 11th, 2008.

		Mean Linear Distance (meters)					**Total**	**Mean**		**Mean**		
		Belt Transect Zone					**Mean**	**Percent Cover**		**Frequency**		**Importance**
Species	Indicator	**A**	**B**	**C**	**D**	**E**	**Distance**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Value**
Saururus cernuus	OBL	0.52	0.07	0.06	0.77	0.28	1.70	0.85	34.76	0.53	26.67	30.71
Toxicodendron radicans	FAC	0.00	0.68	0.21	0.48	0.48	1.85	0.93	37.76	0.80	40.00	38.88
Vitis rotundifolia	FAC	0.50	0.10	0.01	0.58	0.06	1.25	0.62	25.44	0.60	30.00	27.72
Woodwardia areolata	OBL	0.10	0.00	0.00	0.00	0.00	0.10	0.05	2.04	0.07	3.33	2.69
Total		1.12	0.85	0.28	1.83	0.82	4.90	2.45	100.00	2.00	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		0.50	0.79	0.22	1.06	0.53	3.10	1.55	63.20	1.40	70.00	66.60
OBL		0.62	0.07	0.06	0.77	0.28	1.80	0.90	36.80	0.60	30.00	33.40
Total		1.12	0.85	0.28	1.83	0.82	4.90	2.45	100.00	2.00	100.00	100.00

Table D-104
Summary Of Herbaceous 1-Meter Squares from Lower Bennett Swamp - March 12, 2008

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum							1	0.14	2.78
Blechnum serrulatum		5					1	0.86	16.67
Itea virginica	1	1						0.29	5.56
Lyonia lucida	1	1					1	0.43	8.33
moss					1			0.14	2.78
Persea palustris					1			0.14	2.78
Toxicodendron radicans					2		1	0.43	8.33
Vitis rotundifolia				3		8		1.57	30.56
Woodwardia virginica		3	3			2		1.14	22.22
Total	2	10	3	3	4	10	4	5.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum				1				0.14	2.94
Blechnum serrulatum				21				3.00	61.76
Gordonia lasianthus	1						1	0.29	5.88
Lyonia lucida	1			1			1	0.43	8.82
Vitis rotundifolia						3	3	0.86	17.65
Woodwardia virginica				1				0.14	2.94
Total	2	0	0	24	0	3	5	4.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Blechnum serrulatum			6	12			25	6.14	63.70
Gordonia lasianthus		1						0.17	1.73
Lyonia lucida	1		1	1				0.50	5.19
Moss			6			1		1.17	12.10
Persea palustris			1					0.17	1.73
Toxicodendron radicans				1				0.17	1.73
Woodwardia virginica		1		3	1	3		1.33	13.83
Total	1	2	14	17	1	4	25	9.64	100.00

Table D-104
Summary Of Herbaceous 1-Meter Squares from Lower Bennett Swamp - March 12, 2008

1-METER SQUARE PLOTS - COMBINED N,C, & S FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Acer rubrum				0.33			0.33	0.10	1.49
Blechnum serrulatum		1.67	2.00	11.00			8.67	3.33	52.24
Gordonia lasianthus	0.33	0.33					0.33	0.14	2.24
Itea virginica	0.33	0.33						0.10	1.49
Lyonia lucida	1.00	0.33	0.33	0.67			0.67	0.43	6.72
moss			2.00		0.33	0.33		0.38	5.97
Persea palustris			0.33		0.33			0.10	1.49
Toxicodendron radicans				0.33	0.67		0.33	0.19	2.99
Vitis rotundifolia				1.00		3.67	1.00	0.81	12.69
Woodwardia virginica		1.33	1.00	1.33	0.33	1.67		0.81	12.69
Total	1.67	2.67	4.67	13.33	1.33	5.67	11.33	6.38	100.00

Table D-105
Summary of Herbaceous Ground Cover Belt Transects for Lower Bennett Swamp Transect, Bennett Swamp - March 12th, 2008

		Mean Linear Distance (meters)					Total	Mean		Mean		
		Belt Transect Zone					Mean	Percent Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance	Absolute	Relative	Absolute	Relative	Value
Saururus cernuus	OBL	0.00	0.00	0.00		0.65	0.65	0.35	6.25	0.17	8.33	7.29
Toxicodendron radicans	FAC	0.65	0.15	0.52		0.30	1.62	0.88	15.55	0.75	37.50	26.52
Vitis rotundifolia	FAC	1.32	2.40	2.98		1.00	7.70	4.19	74.09	0.83	41.67	57.88
Woodwardia areolata	OBL	0.37	0.00	0.00		0.06	0.43	0.23	4.10	0.25	12.50	8.30
Total		2.34	2.55	3.50		2.01	10.40	5.65	100.00	2.00	100.00	100.00
UPL		0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		1.97	2.55	3.50		1.30	9.32	5.07	89.64	1.58	79.17	84.41
OBL		0.37	0.00	0.00		0.71	1.08	0.59	10.36	0.42	20.83	15.59
Total		2.34	2.55	3.50		2.01	10.40	5.65	100.00	2.00	100.00	100.00

Data not used. Plots severely damaged by storms.

Appendix E
Benthic Data

Benthic Macroinvertebrates Collected at the Thayer Canal Transect, Bennett Swamp on March 14, 2000

Phylum Class Order Family *Genus species*	Thayer Canal
ANNELIDA	
Oligochaeta	
Haplotaxida	
Naididae	8
Dero sp.	15
Tubificidae w.o.h.c.	1
ARTHROPODA	
Crustacea	
Ostracoda	1
Amphipoda	
Crangonyctidae	
Crangonyx sp.	8
Isopoda	
Asellidae	
Caecidotea sp.	123
Decapoda	
Cambaridae	
Procambarus sp.	8
Insecta	
Heteroptera	
Nepidae	
Ranatra sp.	1
Trichoptera	
Polycentropodidae	
Cyrnellus fraternus	3
Coleoptera	
Dytiscidae	
Coptotomus sp.	3
Laccodytes sp.	128
Elmidae	
Optioservus sp.	3
Haliplidae	
Peltodytes sp.	3
Diptera	
Chironomidae	3
Chironomus sp.	164
Polypedilum illinoense	67
Procladius bellus	113
Tanytarsus sp.	23
Thienemannimyia gp.	7
TOTAL NO. OF ORGANISMS	682
TOTAL NO. OF SPECIES	19
CHORDATA	
Osteichthyes	
Poeciliidae	
Gambusia sp.	10

Identification and Analysis done by Pennington & Associates, Inc.

Benthic Macroinvertebrates Collected at Bennett Swamp on October 11, 2001

SPECIES	**Tolerance Values	***Functional Feeding Group	Hammock	Lower BS	Thayer Canal
NEMATODA	**6.02**		20		
ANNELIDA					
Oligochaeta	***10**	Collector/Gatherer			
Haplotaxida					
Enchytraidae	**9.84**	Collector/Gatherer		4	
Naididae	***8**	Collector/Gatherer	160	13	18
Lumbriculida					
Lumbriculidae	**7.03**	Collector/Gatherer		14	
ARTHROPODA					
Crustacea					
Ostracoda				1	
Cladocera					
Daphnidae					
Ceriodaphnia sp.			70	1	1
Isopoda					
Asellidae	***8**	Shredder			
Caecidotea sp.	**9.11**	Collector/Gatherer	30	2	
Decapoda					
Cambaridae					5
Insecta					
Odonata					
Libellulidae	***9**	Predator		2	
Pachydiplax sp.	***8**	Predator			1
Heteroptera					
Belostomatidae					
Belostoma sp.	**9.8**	Predator			1
Lethocerus sp.					1
Coleoptera					
Dytiscidae	***5**	Predator	10		
Hydroporus sp.	***5**	Piercer		2	
Hydrophilidae		Predator		2	
Dineutus sp.	**5.54**	Predator		1	
Scirtidae	***7**	Scraper		1	
Diptera					
Chaoboridae					
Chaoborus sp.	**8.5**	Predator			1
Chironomidae			20	4	14
Chironomus sp.	**9.63**	Collector/Gatherer	1467	74	193
Polypedilum illinoense	**9**	Shredder	523	288	95
Tanytarsus sp.	**6.76**	Filtering Collector	20		
Thienemanniella xena	**5.86**	Collector/Gatherer		7	
TOTAL NO. OF ORGANISMS			**2320**	**416**	**330**
TOTAL NO. OF TAXA			**9**	**15**	**10**
BIOTIC INDEX			**9.28**	**8.94**	**9.33**
RATIO OF SHREDDER TO TOTAL			**0.00**	**0.00**	**0.00**
EPT/CHIRONOMIDAE			**0**	**0**	**0**
% CONTRIBUTION DOMINANT TAXA			**63.23%**	**69.23%**	**58.48%**
SHANNON DIVERSITY			**1.613**	**1.591**	**1.610**

* Hilsenhoff Tolerance Values used when North Carolina Tolerance Values not available.

** North Carolina Tolerance Values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes.

*** Functional Feeding Group: Shredder, Collector/Gatherer, Filtering Collector, Scraper, Predator and Piercer

Identification and Analysis done by Pennington & Associates, Inc.

Benthic Macroinvertebrates Collected at Bennett Swamp on April 17, 2002

SPECIES	**Tolerance Values	Functional Feeding Group	Lower BS	Hammock	Thayer Canal
NEMATODA	**6.02**				
ANNELIDA					
Oligochaeta [C] Aquatic Worm	***10**	Collector/Gatherer			
Haplotaxida					
Enchytraidae	**9.84**	Collector/Gatherer			
Naididae	***8**	Collector/Gatherer			40
Dero sp.	**9**	Collector/Gatherer	270	1800	95
Nais behningi	**8.89**	Collector/Gatherer	10		
Pristina sp.	**9.56**	Collector/Gatherer			70
Lumbriculida					
Lumbriculidae	**7.03**	Collector/Gatherer	20		
ARTHROPODA					
Crustacea					
Ostracoda					
Cladocera					
Daphnidae					
Ceriodaphnia sp.					
Isopoda					
Asellidae	***8**	Shredder			
Caecidotea sp.	**9.11**	Collector/Gatherer	498	160	
Decapoda					
Cambaridae [B] Crayfish					
Procambarus sp.	**9.49**	Shredder	1		7
Insecta					
Odonata					
Libellulidae	***9**	Predator			
Libellula sp.	**9.64**	Predator			1
Pachydiplax longipennis	***8**	Predator		2	1
Hemiptera					
Belostomatidae					
Belostoma sp.	**9.8**	Predator		30	
Lethocerus sp.					
Coleoptera					
Dytiscidae [B] Whirligig Beetle La	***5**	Predator			3
Coptotomus sp.	**9.26**	Predator			18
Desmopachnia sp.		Predator	20		
Hydaticus sp.		Predator		2	
Hydroporus sp.	***5**	Piercer			
Thermonectus sp.		Predator		8	7
Gyrinidae [B] Predaceous Diving Beetle Larva		Predator			
Dineutus sp.	**5.54**	Predator		2	
Scirtidae	***7**	Scraper			
Cyphron sp.		Scraper		20	
Diptera					
Ceratopogonidae	***5**	Predator			
Bezzia/Palpomyia gp.	**6.86**	Predator	10		10
Chaoboridae					
Chaoborus punctipennis	**8.5**	Predator			5
Chironomidae [C] Midge Larva					10
Chironomus sp.	**9.63**	Collector/Gatherer	545	3030	490
Cricotopus sp.	***7**	Collector/Gatherer			5
Glyptotendipes sp.	**9.47**	Filtering Collector		130	
Polypedilum illinoense	**9**	Shredder	534		60
Procladius sp.	**9.1**	Predator	12		295
Psectrocladius sp.	**3.59**	Shredder			5
Stenochironomus sp.	**6.45**	Shredder	70		
Tanytarsus sp.	**6.76**	Filtering Collector			
Thienemanniella xena	**5.86**	Collector/Gatherer			
TOTAL NO. OF ORGANISMS			**1990**	**5184**	**1122**
TOTAL NO. OF TAXA			**11**	**10**	**17**
BIOTIC INDEX			**9.08**	**9.39**	**9.25**
RATIO OF SHREDDER TO TOTAL			**0.30**	**0.00**	**0.06**
EPT/CHIRONOMIDAE			**0**	**0**	**0**
% CONTRIBUTION DOMINANT TAXA			**27.39%**	**58.45%**	**43.67%**
SHANNON DIVERSITY			**2.34**	**1.37**	**2.43**

* Hilsenhoff Tolerance Values used when North Carolina Tolerance Values not available.
** N. Carolina Tolerance Values range from 0 to 10 for organisms very intolerant to very tolerant of organic wastes.
Indicator of Water Quality as per Northern Virginia Soil and Water Conservation District (NVSWCD).

[A] GOOD
[B] MODERATE
[C] POOR

Identification and Analysis done by Pennington & Associates, Inc.

Benthic Macroinvertebrates Collected at Bennett Swamp on April 6, 2004

SPECIES	T.V.	F.F.G.	PA27663 Thayer Canal Sweep	PA27664 Hammock Field Sweep
MOLLUSCA				
Gastropoda				
Basommatophora				
Ancylidae				
Ferrissia rivularis	***6**	**SC**	80	
ANNELIDA				
Oligochaeta	***10**	**CG**		
Tubificida				
Naididae	***8**	**CG**		
Dero sp.	**10**	**CG**	131	105
Lumbriculida				
Lumbriculidae	**7**	**CG**		5
ARTHROPODA				
Crustacea				
Cladocera				
Daphnidae				
Ceriodaphnia sp.			200	
Copepoda			80	
Isopoda				
Asellidae		**SH**		
Caecidotea sp.	**9.1**	**CG**	223	276
Amphipoda			10	
Decapoda				
Cambaridae	**7.5**			
Procambarus sp.	**7**	**SH**		1
Insecta				
Collembola				20
Odonata				
Coenagrionidae		**P**	10	
Ischnura sp.	**9.5**		10	
Libellulidae		**P**		5
Pachydiplax sp.		**P**		1
Megaloptera				
Corydalidae		**P**		
Chauliodes pectinicornis	**9.6**		30	
Trichoptera				
Hydropsychidae		**FC**		
Cheumatopsyche sp.	**6.2**	**FC**		5
Coleoptera				
Dytiscidae		**P**	51	6
Hydroporus sp.	**8.6**	**PI**	323	5
Haliplidae				
Peltodytes sp.	**8.7**	**SH**		5
Hydrophilidae		**P**		
Hydrobius sp.		**P**	30	20
Hydrochus sp.	**6.6**	**SH**	10	
Diptera				
Chironomidae			130	
Ablabesmyia mallochi	**7.2**	**P**	30	
Chironomus sp.	**9.6**	**CG**	150	632
Dicrotendipes neomodestus	**8.1**	**CG**	132	20
Labrundinia sp.	**5.9**	**P**		20
Nilotanypus sp.	**3.9**	**P**	10	
Polypedilum illinoense	**9**	**SH**	100	20
Procladius sp.	**9.1**	**P**	60	5
Psectrocladius (Monopsectroclaidus) sp.	**3.6**	**SH**	211	
Stenochironomus sp.	**6.5**	**SH**	30	
Tanytarsus sp.	**6.8**	**FC**	31	
Culicidae		**FC**	20	
Anopheles sp.	**8.6**	**FC**	40	
CHORDATA****				
Osteichthyes			40	
TOTAL NO. OF ORGANISMS			**2132**	**1151**
TOTAL NO. OF TAXA			**25**	**17**
FLORIDA INDEX			**4**	**3**
BIOTIC INDEX			**7.75**	**8.46**
MARGALEF			**2.17**	**1.573**
MENHINICK			**0.541**	**0.501**
SIMPSON			**0.924**	**0.632**
SHANNON			**4.038**	**2.054**
HILL (N1)			**16.432**	**4.152**
HILL (N2)			**13.112**	**2.714**
PIELOU			**0.87**	**0.502**
SHELDON			**0.657**	**0.244**
HEIP			**0.643**	**0.197**
HILL			**0.798**	**0.654**
HILL MOD.			**0.785**	**0.544**

Benthic Macroinvertebrates Collected at Bennett Swamp on January 4, 2005

SPECIES	T.V.	F.F.G	Hammock Field	Thayer Canal
ANNELIDA				
Oligochaeta	***10**	**CG**		
Tubificida				
Naididae	***8**	**CG**		
Dero sp.	**10**	**CG**	189	32
Insecta				
Odonata				
Coenagrionidae		**P**		
Ischnura sp.	**9.5**		1	3
Libellulidae	**9**	**P**		
Pachydiplax longipennis	**9.9**			2
Hemiptera				
Naucoridae	**-**	**-**		
Pelocoris sp.	**7.01**	**-**		2
Coleoptera				
Dytiscidae		**P**		
Hydroporus sp.	**8.6**	**PI**		6
Hydrophilidae		**P**		
Derallus sp.				1
Tropisternus sp.	**9.68**	**P**		1
Noteridae				
Hydrocanthus sp.	**7.14**		1	2
Diptera				
Ceratopogonidae	**5**	**P**		
Bezzia/Palpomyia gp.	**6.9**	**P**		225
Chironomidae				1
Chironomus sp.	**9.6**	**CG**	191	278
Polypedilum illinoense	**9**	**SH**		25
Procladius sp.	**9.1**	**P**		18
Tanypus sp.	**9.2**	**P**		10
Thienemannimyia gp.	**8.42**	**P**		5
Tipulidae	**3**	**SH**		
Prionocera sp.				2
CHORDATA****				
Osteichthyes				1
TOTAL NO. OF ORGANISMS			**382**	**613**
TOTAL NO. OF TAXA			**4**	**16**
BIOTIC INDEX			**9.79**	**8.51**
FLORIDA INDEX			**0**	**2**
MARGALEF			**0.35**	**1.63**
MENHINICK			**0.205**	**0.646**
SIMPSON			**0.507**	**0.655**
SHANNON			**1.047**	**2.018**
HILL (N1)			**2.067**	**4.049**
HILL (N2)			**2.026**	**2.898**
PIELOU			**0.524**	**0.504**
SHELDON			**0.517**	**0.253**
HEIP			**0.356**	**0.203**
HILL			**0.981**	**0.716**
HILL MOD.			**0.962**	**0.622**

Benthic Macroinvertebrates Collected at Bennett Swamp on March 22, 2005

SPECIES	T.V.	F.F.G.	Hammock Field	Thayer Canal
MOLLUSCA				
Gastropoda				
Basommatophora				
Ancylidae		**SC**		
Ferrissia rivularis	***6**	**SC**		9
ANNELIDA				
Oligochaeta	***10**	**CG**		
Tubificida				
Naididae	***8**	**CG**	23	
Dero sp.	**10**	**CG**	55	56
ARTHROPODA				
Crustacea				
Cladocera				
Chydoridae				7
Isopoda				
Caecidotea sp.	**9.1**	**CG**	22	19
Amphipoda				
Crangonyctidae				
Crangonyx sp.	**7.9**	**CG**	2	
Insecta				
Odonata				
Coenagrionidae		**P**		
Ischnura sp.	**9.5**			3
Libellulidae		**P**		
Pachydiplax longipennis	**9.9**		3	5
Hemiptera				2
Naucoridae		**-**		
Pelocoris sp.	**7**	**-**		1
Megaloptera				
Corydalidae		**P**		
Chauliodes rastricornis	**8.4**	**P**		1
Trichoptera				
Hydroptilidae		**PI**		
Oxyethira sp.	**2.2**	**PI**		9
Coleoptera				
Dytiscidae		**P**	1	8
Hydroporus sp.	**8.6**	**PI**	1	4
Laccophilus sp.	**10**	**P**		1
Thermonectus sp.		**P**		3
Gyrinidae		**P**		
Dineutus sp.	**5.5**	**P**	1	
Gyrinus sp.	**6.2**	**P**		1
Haliplidae				
Peltodytes sp.	**8.7**	**SH**		4
Hydrophilidae		**P**		
Hydrobius sp.		**P**		1
Noteridae				
Hydrocanthus sp.	**7.1**			5
Diptera				
Ceratopogonidae		**P**		6
Bezzia/Palpomyia gp.	**6.9**	**P**		8
Chironomidae				
Ablabesmyia mallochi	**7.2**	**P**		5
Chironomus sp.	**9.6**	**CG**	124	227
Conchapelopia sp.	**8.4**	**P**		1
Labrundinia sp.	**5.9**	**P**		1
Polypedilum illinoense	**9**	**SH**	3	13
Procladius sp.	**9.1**	**P**	2	3
Psectrocladius sp.	**3.6**	**SH**		2
Rheotanytarsus sp.	**5.9**	**FC**		1
TOTAL NO. OF ORGANISMS			**237**	**406**
TOTAL NO. OF TAXA			**11**	**28**
FLORIDA INDEX			**2**	**10**
BIOTIC INDEX			**8.63**	**8.41**
MARGALEF			**1.268**	**3.116**
MENHINICK			**0.715**	**1.39**
SIMPSON			**0.657**	**0.664**
SHANNON			**1.999**	**2.656**
HILL (N1)			**3.996**	**6.301**
HILL (N2)			**2.912**	**2.973**
PIELOU			**0.578**	**0.552**
SHELDON			**0.363**	**0.225**
HEIP			**0.3**	**0.196**
HILL			**0.729**	**0.472**
HILL MOD.			**0.638**	**0.372**

Benthic Macroinvertebrates Collected at Bennett Swamp on October 25th, 2005

SPECIES	T.V.	F.F.G.	Hammock	Thayer Chanel	L. Bennett Swamp
ANNELIDA					
Oligochaeta					
Tubificida					
Naididae					
Dero sp.	**10**	**CG**	785	223	90
ARTHROPODA					
Crustacea					
Isopoda					
Asellidae					
Caecidotea sp.	**9.5**	**P**	35	7	100
Amphipoda					
Crangonyctidae					
Crangonyx sp.	**7.9**	**CG**			10
Decapoda					
Cambaridae					
Procambarus sp.	**7**	**SH**			23
Insecta					
Odonata					
Coenagrionidae					
Ischnura sp.	**9.5**	**P**			20
Libellulidae					10
Pachydiplax longipennis	**9.9**		10	3	
Hemiptera					
Belostomatidae					10
Coleoptera					
Dytiscidae				10	
Hydrophilidae			5		
Hydrochus sp.	**6.6**	**SH**		3	
Diptera					
Ceratopogonidae					
Bezzia/Palpomyia gp.	**6.9**	**P**		3	
Chironomidae					
Chironomus sp.	**9.6**	**CG**	499	675	1140
Labrundinia sp.	**5.9**	**P**			10
Polypedilum illinoense	**9**	**SH**		10	14
Procladius sp.	**9.1**	**P**	5		110
Stenochironomus sp.	**6.5**	**SH**			10
Tipulidae					
Megistocera longipennis			5		
TOTAL NO. OF ORGANISMS			**1344**	**934**	**1547**
TOTAL NO. OF TAXA			**7**	**8**	**12**
BIOTIC INDEX			**9.83**	**9.67**	**9.48**
FLORIDA INDEX			**1**	**1**	**3**
MARGALEF			**0.577**	**0.709**	**1.038**
MENHINICK			**0.191**	**0.262**	**0.305**
SIMPSON			**0.521**	**0.421**	**0.444**
SHANNON			**1.264**	**1.105**	**1.558**
HILL (N1)			**2.401**	**2.151**	**2.944**
HILL (N2)			**2.086**	**1.727**	**1.789**
PIELOU			**0.45**	**0.368**	**0.435**
SHELDON			**0.343**	**0.269**	**0.245**
HEIP			**0.233**	**0.164**	**0.177**
HILL			**0.869**	**0.803**	**0.611**
HILL MOD.			**0.775**	**0.631**	**0.411**

Benthic Macroinvertebrates Collected at Bennett Swamp on March 27th, 2006

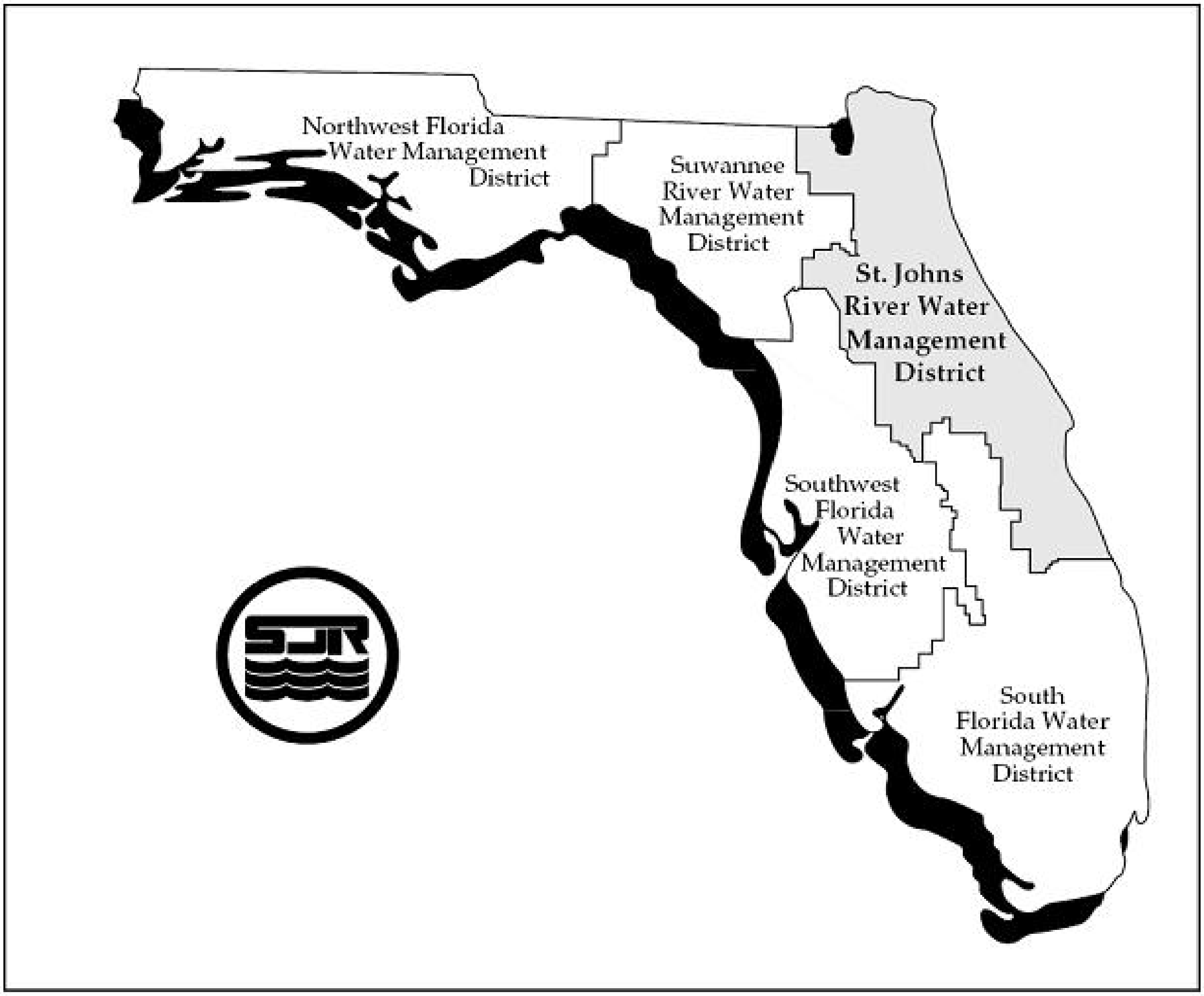
SPECIES	T.V.	F.F.G.	Hammock	Thayer	Titusville
MOLLUSCA					
Gastropoda					
Basommatophora					
Ancylidae		SC	531		
ANNELIDA					
Oligochaeta					
Tubificida					
Naididae	*8	CG	30	70	10
Dero sp.	10	CG	40		80
Pristina leidyi	9.6	CG			80
ARTHROPODA					
Crustacea					
Cladocera					
Chydoridae			10		
Daphnidae					
Ceriodaphnia sp.				40	
Copepoda				20	20
Isopoda					
Asellidae					
Caecidotea sp.	9.1	CG	511		
Amphipoda					
Crangonyctidae					
Crangonyx sp.	7.9	CG	1		
Gammaridae					
Gammarus sp.	9.1	SH		10	
Hyalellidae					
Hyalella azteca	7.8	CG			23
Decapoda					
Cambaridae					
Procambarus sp.	7	SH	10		
Insecta					
Collembola				2	
Odonata					
Coenagrionidae			11		11
Ischnura sp.	9.5		1		
Libellulidae					
Pachydiplax longipennis	9.9		13		
Hemiptera					
Belostomatidae					
Belostoma sp.	9.8	P			10
Corixidae	9	PI	11		
Naucoridae					
Pelocoris sp.	7		1		
Veliidae					
Microvelia sp.		P		10	
Trichoptera					
Hydroptilidae					
Oxyethira sp.	2.2	PI	10	20	
Coleoptera					
Dytiscidae			12		
Hydroporus sp.	8.6	PI	20	105	
Thermonectus sp.		P	1	10	
Haliplidae					
Peltodytes sp.	8.7	SH	92	153	
Hydrophilidae					
Tropisternus sp.	9.7	P	1	20	
Noteridae					
Hydrocanthus sp.	7.1				10
Scirtidae		SC			1
Diptera					
Ceratopogonidae		P	10		11
Bezzia/Palpomyia gp.	6.9	P		20	
Chironomidae					
Ablabesmyia mallochi	7.2	P		50	
Ablabesmyia rhamphe gp.	7.2	P			100
Chironomus sp.	9.6	CG	2900	670	20
Corynoneura sp.	6	CG			10
Dicrotendipes sp.	8.1	CG	130	510	
Guttipelopia guttipennis			360	150	110
Kiefferulus sp.	8		130	30	
Labrundinia sp.	5.9	P		20	
Parakiefferiella sp.	5.4	CG		20	
Polypedilum halterale gp.	7.3	SH			10
Polypedilum illinoense	9	SH	30	70	580
Procladius sp.	9.1	P		70	
Psectrocladius (Monopsectrocladius) sp.	3.6	SH		260	
Tanypus sp.	9.2	P		20	
Tanytarsus sp.	6.8	FC			580
TOTAL NO. OF ORGANISMS			**4866**	**2350**	**1666**
TOTAL NO. OF TAXA			**24**	**23**	**17**
FLORIDA INDEX			**3**	**6**	**5**
BIOTIC INDEX			**9.37**	**8.04**	**8.07**
MARGALEF			**1.878**	**1.965**	**1.495**
MENHINICK			**0.344**	**0.474**	**0.416**
SIMPSON			**0.615**	**0.845**	**0.745**
SHANNON			**2.151**	**3.327**	**2.545**
HILL (N1)			**4.44**	**10.033**	**5.836**
HILL (N2)			**2.594**	**6.464**	**3.917**
PIELOU			**0.469**	**0.735**	**0.623**
SHELDON			**0.185**	**0.436**	**0.343**
HEIP			**0.15**	**0.411**	**0.302**
HILL			**0.584**	**0.644**	**0.671**
HILL MOD.			**0.463**	**0.605**	**0.603**

Appendix D - City of Port Orange Wellfield: Fifth Annual Hydration Report

DEMONSTRATION PROJECT NO. 3, VOLUSIA COUNTY
CITY OF PORT ORANGE WELLFIELD
FIFTH ANNUAL HYDRATION REPORT

St. Johns River Water Management District
Palatka, Florida

August 2009
(Originally prepared December 2007)



The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 18 counties in northeast Florida. The mission of SJRWMD is to ensure the sustainable use and protection of water resources for the benefit of the people of the District and the state of Florida. SJRWMD accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

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EXECUTIVE SUMMARY

This report summarizes the activities of the Demonstration Pilot Project No. 3 – Direct Discharge of Raw Groundwater to Wetlands at the City of Port Orange Wellfield, Volusia County, Florida, from its inception in February 2000 through April 2007. The purpose of the demonstration project is to evaluate the potential to avoid ecological impacts from wellfield drawdown by increasing the duration and depth of water storage by augmenting the surficial aquifer within the wetland. The 27-month baseline period (February 2000 through April 2002) provided background information on the wetland hydrology and biological community. The 60-month hydration period began in May 2002 after completion of the water delivery system. Construction of the water delivery system (pump system, delivery pipe, and diffuser) had been delayed for several months due to unseasonably heavy rainfall. Thus, the “hydration year” is from May through April, across calendar years. However, this start time coincided with the initial hydration goal, namely to begin each of the five hydration years prior to the start of the normal rainy season.

The demonstration wetland is a 6.5-acre second-growth cypress wetland within the City of Port Orange Wellfield. It is one of many wetland systems that are intermixed among planted pine and natural uplands west of Tomoka Farms Road and south of Interstate 4.

This City of Port Orange wetland was selected for the District’s demonstration program titled *Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District* because it corresponds to the program’s objectives to study the effects of changes in local hydrology on a wetland. The study wetland on the wellfield is a shallow system that quickly reflects changes in water-table elevations.

The demonstration wetland project is designed for direct hydration with groundwater from a nearby well (Well 19). In May 2002, a groundwater delivery pipe and diffuser pipe were installed to bring raw groundwater to the wetland edge. The objective of the Port Orange hydration project is to increase the storage depth and duration during the natural rainy season without interrupting the natural dry season. The intent is to maintain wetland functions and characteristics that are sometimes adversely affected in areas of high groundwater withdrawal.

BASELINE PERIOD

Activities during the baseline period from February 2000 through April 2002 included design, installation, and monitoring. Two shallow water-level recorders were installed at upland and wetland ends of a vegetation transect 108 meters long. The scope of work called for a one-time baseline sampling event of the vegetation communities, benthic macroinvertebrates, fish, and water quality. During the first two ecological monitoring events (March and September 2000), no surface water was present in the wetland, and consequently, sampling was not feasible for all parameters. Subsequent sampling and characterization of baseline conditions were conducted in August and October 2001. The wetland's water levels were monitored continuously throughout the baseline period, except when equipment malfunctioned. Construction of the water delivery pipe was delayed in 2001 due to high water levels. Ecological monitoring resumed in 2002 after the water delivery pipe was installed and operational.

An analysis of the baseline period showed that water levels in the demonstration wetland were above the ground surface (38.2 feet North American Vertical Datum 1988, NAVD88) 42% of the time. Average mean water-level elevation was 36.69 feet NAVD88 during the 27-month period, with a median water-level elevation of 36.84 feet NAVD88.

Trees, shrubs, and emergent vegetation coverage were dominated by obligate wetland species. Groundcover was dense due to a relatively open canopy and shallow surface water. The site was characterized as a cypress head dominated by pond cypress (*Taxodium ascendens*) and black gum (*Nyssa sylvatica*) with an understory of wetland grasses and sedges.

Benthic macroinvertebrates and fish communities exhibited low densities and were dominated by species characteristic of lentic water bodies with low dissolved oxygen. Fish were rare to absent in the Port Orange wetland and were collected only in October 2001. Fish species were the common wetland species mosquito fish (*Gambusia affinis*) and pygmy killifish (*Leptolucania ommata*). Overall water quality in the baseline period (based on one sample event) was typical of northeast Florida still-water cypress swamps set amid managed pinelands. These generally have tannic-colored water with low conductivity, nutrients, metals, and total dissolved solids.

Amphibian populations were surveyed by University of Florida biologists L. Richard Franz, Ryan C. Means, and Steve A. Johnson. Frog species observed in the Port Orange wetland during the baseline period were typical of shallow Florida wetlands in pine flatwoods, with a species richness (number of species) of 10 and individual captures totaling 213 for the entire baseline period.

HYDRATION PERIOD

Hydration during the 60 months of operation provided an average of 37% of the long-term average annual rainfall, and was applied to the wetland as follows:

– First hydration year (Year 1) - 8.5 inches (1.5 million gallons [MG])
– Second hydration year (Year 2) - 24.4 inches (4.3 MG)
– Third hydration year (Year 3) - 14.0 inches (2.5 MG)
– Fourth hydration year (Year 4) - 25.0 inches (4.4 MG)
– Fifth hydration year (Year 5) - 21.7 inches (3.8 MG)

The average water-level elevations in the wetland increased approximately 0.80 foot during the 60 months of hydration. Water levels exceeded the wetland ground surface 62% of the time during the hydration period. The mean water-level elevation was 37.48 feet NAVD88 during the 60-month period. Water levels in the wetland rose to their maximum recorded value (41.26 feet National Geodetic Vertical Datum [NGVD]) on September 6, 2004, a level that was 0.58 foot above the previous maximum record.

The water level fell below the surface of the wetland less often in the hydration period than it did in the baseline period. Water was below the surface of the wetland during the entire fifth year of hydration monitoring (May 2006 through April 2007). During the previous 4 years of hydration, dry periods in the wetland occurred during late winter through spring to early summer, which is typical for central Florida wetlands. Based on hydrologic indicators measured in the field, the median stage value of the hydration period exceedence curve was 38.4 feet NAVD88, or 1.0 foot below normal pool, which is within the expected range of the median stage value for non-impacted wetlands (SWFWMD 1999).

Rainfall has been variable compared with the long-term annual average (between 48 and 50 inches) for the region during the 60 months of the hydration period. Rainfall was significantly above average in hydration Years 1, 3, and 4, near average in the Year 2, and below average in Year 5.

The 2004 hurricane season produced five named storms that hit Florida: Tropical Storm Bonnie and Hurricane Charley in August and Hurricanes Frances, Ivan, and Jeanne in September. The storms occurred during hydration Year 3, and cumulatively these storms produced significant rainfall in the Port Orange Wetland watershed. The greatest monthly rainfall total (19.5 inches) since the beginning of the project in February 2000 occurred in September 2004, as recorded by the City of Port Orange's water treatment plant. The rainfall total in hydration Year 3 was 69 inches. During hydration Year 4, with another active tropical storm season, rainfall totaled 59.6 inches.

Rainfall was lowest during hydration Year 5, at 41.5 inches. Rainfall across Florida in 2006 was the third lowest in 112 years (Tampa *Tribune* 2007). Drought conditions began in late March 2006 and progressed across the state. By November 2006, half of the state was experiencing moderate drought (NDMC 2007), and by May 2007, the end of Year 5, half the state was undergoing severe drought and most of the other half was in moderate drought.

Ecological monitoring was conducted three times a year during the 5-year hydration period. Differences in herbaceous vegetation between the baseline and hydration period were observed, primarily near the upland end of the monitoring transects. Obligate wetland species continued to dominate the vegetation coverage of tree, shrub, and emergent strata, and groundcover remained dense. Differences and trends in vegetation monitoring data will be presented in the Final Report

Benthic macroinvertebrate community densities varied depending on the season. During the first 4 years of hydration monitoring, they were dominated by species characteristic of lentic water bodies with low dissolved oxygen. No benthic macroinvertebrate samples were collected during hydration Year 5 monitoring, as water levels were below the wetland ground surface.

Fish were rare to absent in the Port Orange wetland and were collected only once during the hydration period, in October 2003. The fish observed were the common wetland species mosquito fish and killifish (*Heterandria formosa*).

In general, surface water quality sampled during the baseline and hydration periods was similar; however, some differences were apparent in a few water quality parameters. A more in-depth assessment of these anomalies will be made for the Final Report in 2008, which will include a discussion of event-driven effects or factors that could influence water quality and whether any can be attributed to ground water hydration or to changes in the amphibian data. Some factors of potential influence could include particulate matter, shallow water, deep water, rainfall, phytoplankton blooms, and submerged aquatics. No surface water samples were collected during hydration Year 5.

Amphibian surveys were conducted by Coastal Plains Institute (CPI) from January through September each year. A full presentation of these survey results is submitted by CPI directly to the District in a separate report. Summarized results from CPI's 2007 survey year are provided within this (CH2M HILL) final annual report. Amphibian species richness and abundance declined due to persistent dry conditions throughout the year (Means and Meegan 2007). Total captures (3) were the lowest of all previous monitoring years of this study, including the baseline years. All conclusions are preliminary, and the final assessment will be available at the end of the pilot demonstration project in 2008.

CONTENTS

APPENDIXES

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
CompQAP	Comprehensive Quality Assurance Plan
CPI	Coastal Plains Institute
CPVC	chlorinated polyvinyl chloride
dbh	diameter at breast height
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
FDEP	Florida Department of Environmental Protection
ft	foot/feet
gpm	gallons per minute
in	inch(es)
m	meter(s)
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
µg/L	micrograms per liter
µmhos/cm	microhmos per centimeter
NAVD88	North American Vertical Datum 1988
NGVD	National Geodetic Vertical Datum
NRCS	Natural Resource Conservation Service
OBL	obligate wetland
PVC	polyvinyl chloride
SJRWMD	St. Johns River Water Management District
SWFWMD	Southwest Florida Water Management District
UF	University of Florida
UP	upland
USDA	U.S. Department of Agriculture
WTP	water treatment plant

INTRODUCTION

PROJECT BACKGROUND AND RATIONALE

This pilot project is part of Phase 2 of Task E of *the Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District* (SJRWMD). The recommended duration of this demonstration project is a 5-year operational period. The study provides an assessment of the feasibility of avoiding projected impacts to native vegetation and wildlife resulting from the projected increases in groundwater withdrawals. The project is a partnership between SJRWMD and the City of Port Orange Utilities. The Wetland Hydration Demonstration Project is one of four projects being conducted by the SJRWMD to test impact avoidance strategies in various ways.

Avoiding impacts to wetlands is an approach to balancing impact and resource development. One impact-avoidance strategy is to compensate for altered hydrology due to water-table decline by directly augmenting water levels in the affected wetlands. This project, for example, was designed to increase the duration of inundation / saturation of the wetland by augmenting the surface water with groundwater pumped from a nearby well. Likewise, the augmentation of water levels can be used as a means to avoid impacts to wetlands for which there is concern regarding future impacts from groundwater withdrawal. In other cases, water-level augmentation may be used to mitigate impacts as an interim strategy while alternative sources are developed.

Projecting the water-table impacts of aquifer withdrawals on a regional scale can be difficult and is associated with a high degree of uncertainty. However, developing water supplies without regard for impacts to wetland and aquatic systems, and then mitigating later, is likely to be a very costly alternative. Compared to the pump-and-mitigate strategy, impact-avoidance strategies are likely to be more cost-effective.

At the completion of the 5-year study, conclusions about this type of augmentation will be drawn from the data analysis in terms of water quantity, efficiency, ecological responses, cost-benefit, and operation and maintenance. Subsequently, better decision making can be achieved by extrapolating these conclusions to other wetlands systems being assessed for augmentation.

PORT ORANGE WETLAND

The Port Orange study wetland is located in the Port Orange Wellfield in Volusia County, Florida. The wetland is located approximately 2,000 feet southeast of Interstate 4 and about 5 miles west of Tomoka Farms Road (Figures 1 and 2). The adjacent land uses are primarily managed pinelands, consisting of both natural pine flatwoods and areas of planted pine. Surface outflow from the wetland discharges to the north into a ditch along Puddle Lane (a paved pump house road) and through a culvert to a larger wetland.

Encompassing approximately 6.5 acres, the wetland's canopy is dominated by an open stand of pond cypress (*Taxodium ascendens*) and black gum (*Nyssa sylvatica*), with a dense groundcover of grasses and sedges. The canopy cypress trees appear to be evenly aged. The wildfires of 1998 may have contributed to this condition by killing some of the smaller, younger cypress. As mapped by the U.S. Department of Agriculture Soil Conservation Service and the University of Florida Institute for Food and Agricultural Sciences (USDA / UF 1980), the wetland is underlain with hydric soil Myakka-St. Johns Complex (map unit 34). Myakka-St. Johns Complex is described by the NRCS as nearly level, poorly drained soil interspersed in the landscape and within depressions in the flatwoods. It is well suited for cypress, gum, pine, bays, and wetland grasses.

The Port Orange wetland was selected to be part of the demonstration program for the following reasons:

- The City of Port Orange Utilities Department was a willing participant in the impact avoidance strategy study.
- Several of the wetlands on the wellfield are shallow systems, which quickly reflect changes in water-table elevations.
- Land ownership was not an issue.
- Water could be piped to the wetland from a nearby production well.

PURPOSE

This Fifth Annual Report summarizes the results of the 27-month baseline period (February 2000 through April 2002) and the 60 months of hydration (May 2002 through April 2007). The report presents the ongoing evaluation of the effects of hydration on water elevations and any changes in flora or fauna. These data are used annually to evaluate the hydrologic and ecological responses of the wetland during the hydration period.

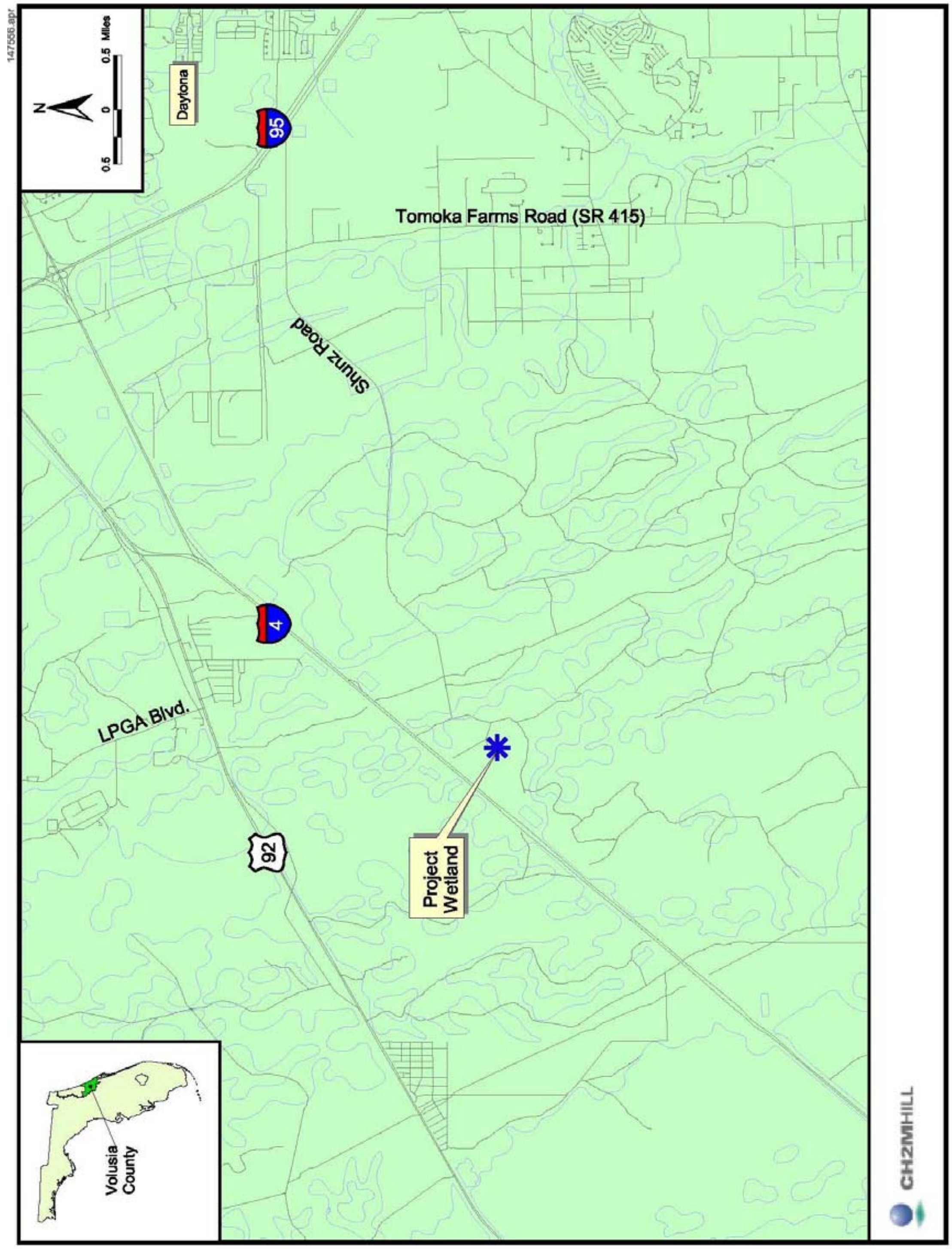

Figure 1. Port Orange Wetland project location

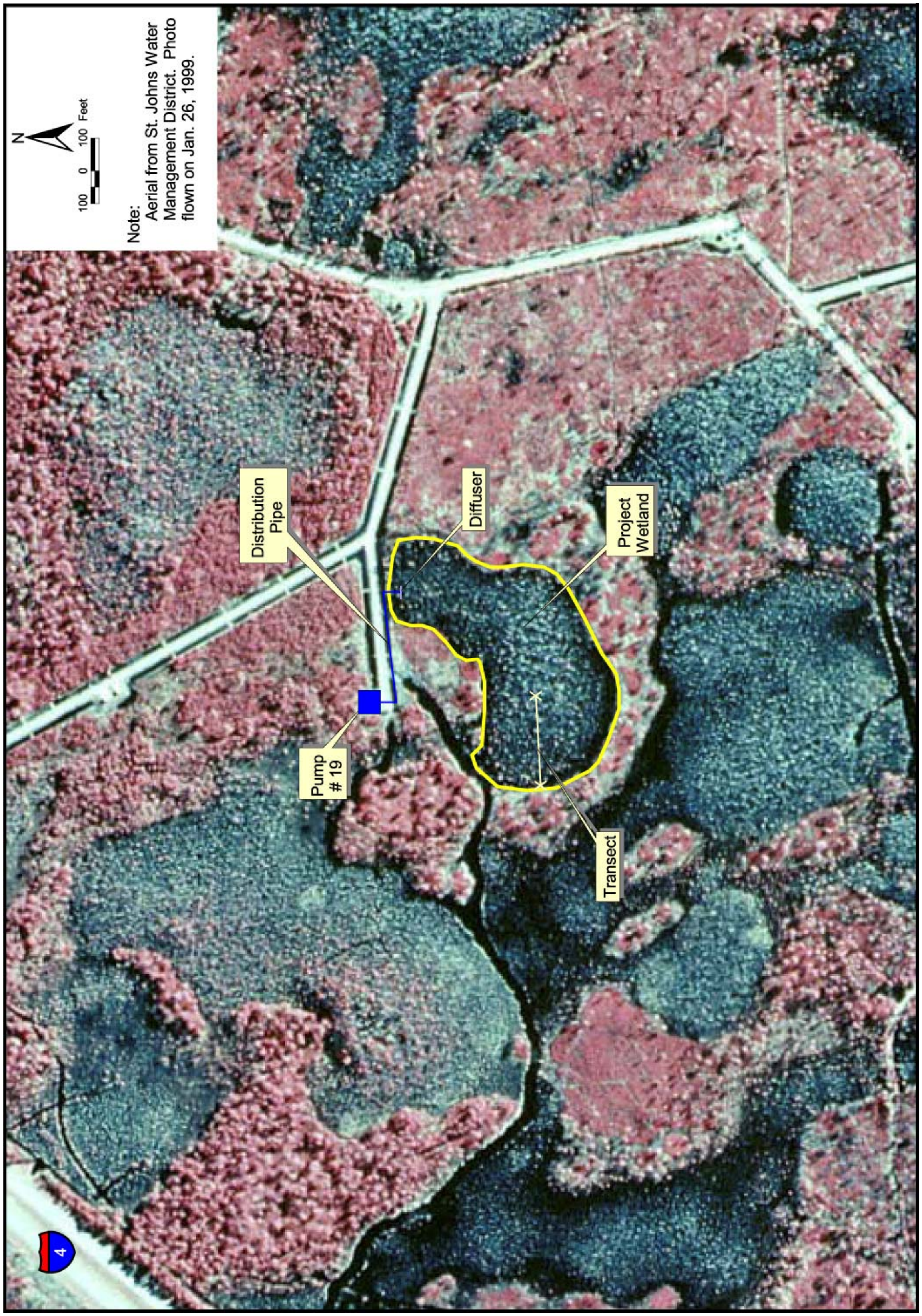

Figure 2. Port Orange Wellfield location

METHODS

WATER SUPPLY SYSTEM

The Port Orange hydration demonstration project is designed to use direct discharge of raw groundwater. The objective is to increase the depth and length of time of inundation / saturation of surface water within the wetland during the normal wet season, without increasing flooding during major storm events. Hydrologic evaluations and water delivery system design were performed by CH2M HILL hydrologist Ron Wycoff and engineer Mandy Parks. The delivery system was designed to bring water to the edge of the wetland, thus avoiding the need for wetland resource permitting. A schematic of the water delivery design is shown in Figure 3.

Water Source and Pump

Well 19 is the nearest production well to the wetland. The route from the pump house to the wetland followed the existing pipeline and required less extensive clearing and grubbing.

The existing Peabody vertical turbine pump in Pump House 19, operating at an application rate of 250 gallons per minute (gpm), supplies 0.35 million gallons per day (mgd). A control valve is used to modulate the flow to 250 gpm.

Piping

The existing 6-inch ductile-iron water treatment plant (WTP) supply line is tapped below grade, and a gate valve isolates the wetland augmentation line from the WTP supply line.

A 2-foot by 4-foot pre-cast vault contains a check valve to prevent backflow, a flow meter, and a control valve. A distance of at least 40 inches remains between the flow meter and any upstream valves.

All water augmentation piping is polyvinyl chloride (PVC) or chlorinated PVC (CPVC) except for the initial pipeline connection and ditch crossing, which is composed of ductile iron. All of the bends are appropriately restrained (recommended series 1600 Megalug Restraint). The CPVC pipeline placed above the ground is supported at distances exceeding 10 feet. Exposed pipe is not protected against freezing temperatures with insulation or heat tracing. The unpainted ductile iron is not protected against corrosion.
A photograph of the delivery pipe is presented in Figure 4.

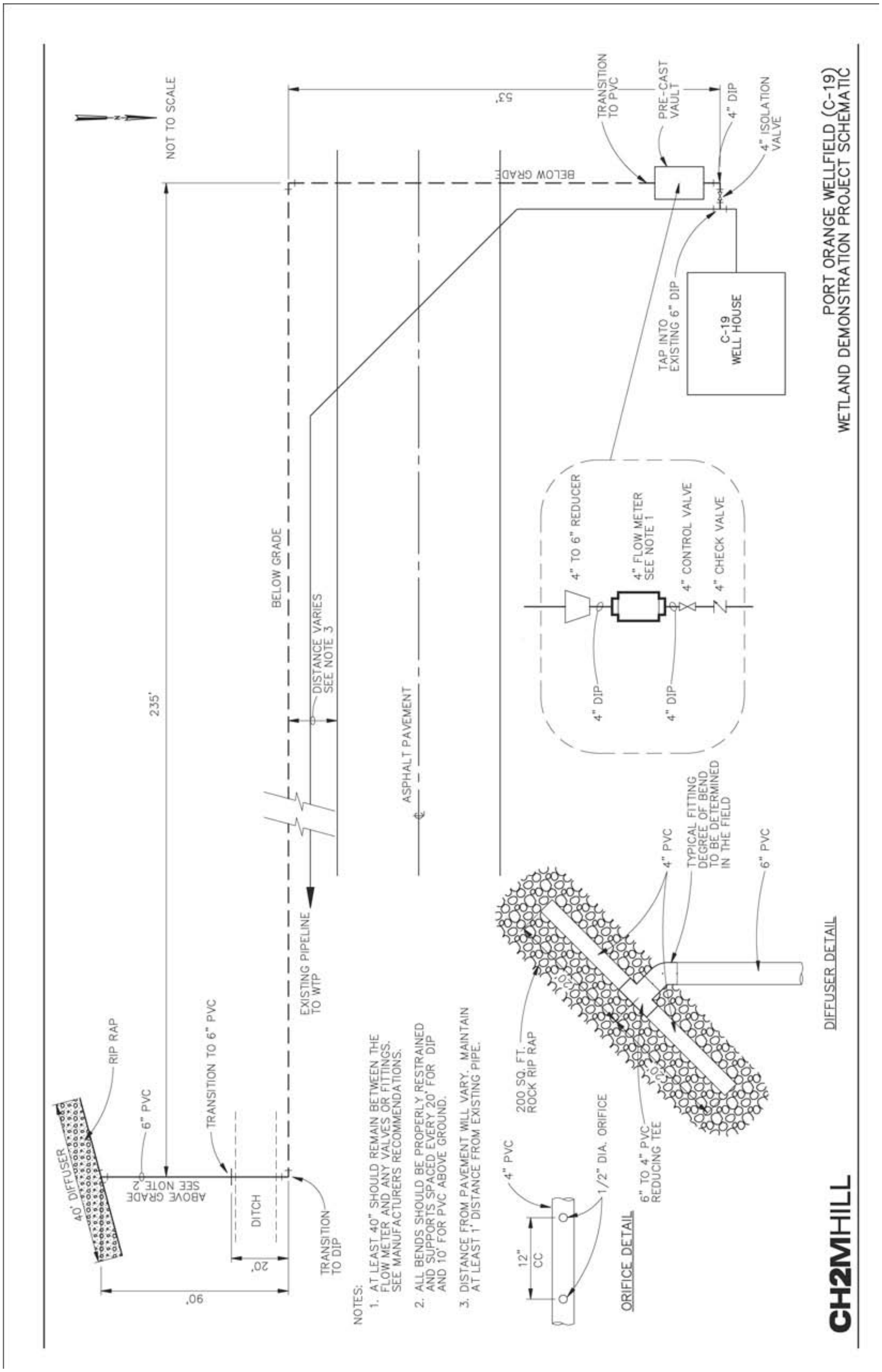

Figure 3. Design drawing of water delivery system to Port Orange Wetland

Figure 4. Construction of groundwater delivery pipe to Port Orange Wetland

Top photo: PVC pipe being buried; pump house is shown in the background. **Bottom photo**: Ductile iron pipe being placed across roadside ditch adjacent to study wetland. These photographs were taken in March 2002.

Diffuser Pipe

Prior to the wetland boundary, the 6-inch pipeline tapers to a 4-inch diffuser pipe (Figure 5). The 40-foot diffuser sets on a layer of sand bags to dissipate energy. One-half-inch-diameter orifices (not seen in photo) are located every 12 inches along the centerline of the diffuser pipe. During the construction, no alterations were made within the wetland boundary.

Figure 5. Diffuser pipe (left foreground) and "T" from delivery pipe (right-center)

Managed Hydration Amount

The initial hydration schedule called for water to be applied over the first 12-month period in specific months to mimic the dry / wet seasons. The amount of water scheduled to be delivered was 24 inches, which is approximately half of the annual rainfall (48 to 50 inches). The full planned hydration amount was not delivered by the Utility operators during the first operational year because of heavy rainfall. The shallow system responded quickly to above normal rainfall, which filled the wetland to its maximum control point above which surface water begins to flow into an adjacent ditch. During this first year, a method for skipping a scheduled hydration event when the wetland was at maximum water level was proposed and agreed to by the Utility operators; however, it was inconsistently followed by the Utility operators in subsequent years. The hydration schedule was modified after the fourth operational year to deliver water across more months to lengthen the wetland's hydroperiod.

For ease of operation, hydration occurs in 24-hour increments each month. The number of irrigation periods per month is scheduled to be between zero and two, depending on the season. At a rate of 250 gpm, the 6.5-acre wetland receives an application depth of 2 inches of groundwater per 24-hour irrigation period.

An unusually heavy rainfall in June 2002 (during hydration Year 1) caused the City of Port Orange Wellfield Manager to question the effectiveness of hydration during periods of heavy rainfall, due to the shallow topography of the wetland. CH2M HILL agreed to forego hydration whenever the surface water in the adjacent ditch was at or above the elevation at which water in the wetland “pops off” into the ditch. Subsequently, CH2M HILL determined that the maximum surface water elevation in the wetland is controlled by a connection to a roadway ditch near its northern boundary. Surface water in the wetland begins to spill into the ditch above an elevation of 38.40 feet North American Vertical Datum 1988 (NAVD88), only 0.20 foot above the ground surface at the wetland water-level recorder. It was agreed with the wellfield technicians that any scheduled hydration event would be skipped when the surface water in the wetland was above the pop-off elevation.

Data Collection

Data collection for the Port Orange hydration demonstration project includes hydrologic, water quality, floral, and faunal sampling. CH2M HILL is responsible for all sampling except that of the amphibian community, which is being performed independently by Coastal Plains Institute (CPI).

CH2M HILL biologists Steve Eakin and Anthony Davanzo were the primary field investigators during this period of the project for all parameters except amphibians. CPI biologists Ryan Means and Rebecca Meegan monitored amphibians.

Sampling Transect Design

The monitoring transect location was selected after a site visit in January 2000. The wetland was selected based on its proximity to a well, ease of access, and habitat representative of regional wetlands. The transect was set up on January 25, 2000. The setup included installation of PVC markers, two recording groundwater monitoring wells, and two staff gauges. Figure 6 presents a sketch of the monitoring transect setup.

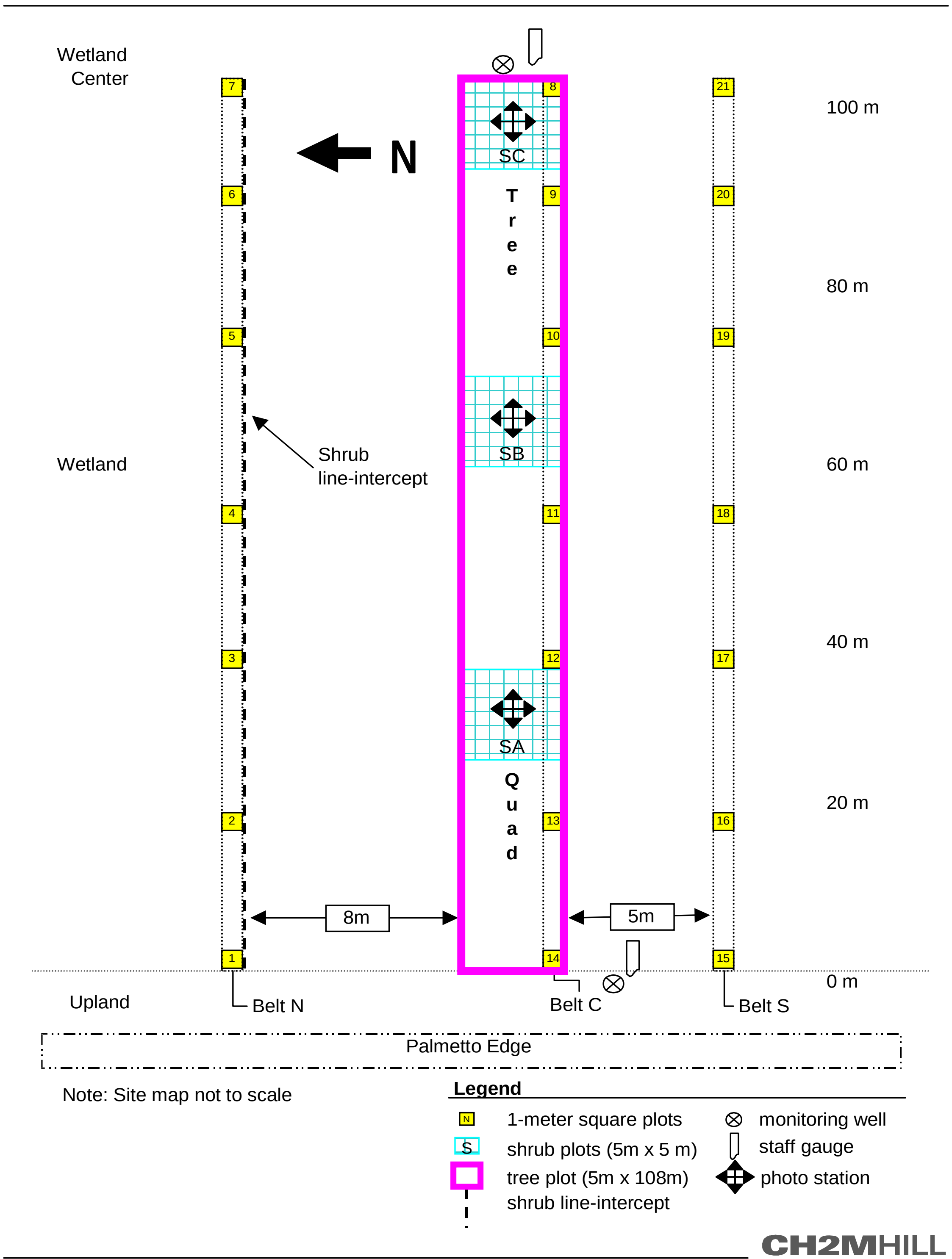

Figure 6. Port Orange Wetland transect site map

One main monitoring transect with two adjacent parallel groundcover transects were set up in an area that provides an adequate range of water depths and representative vegetative communities. The transects are 108 meters long, running from the upland edge to an interior deep zone. PVC markers, placed over rebar, were used to mark the end points and intermediate points on the transects and corners of each sampling plot (tree, shrub, groundcover).

Ground surface elevations were surveyed at 3-meters intervals along the length of the main transect. Elevations also were surveyed of staff gauges and at the tops of casings and the ground surface at each piezometer.

Photo Stations

Three photo stations were established along the main transect in the center of each shrub plot. The photographs cover four quadrants (north, south, east, and west) surrounding the station.

Sampling Schedule

The scope of work required a one-time baseline sampling event of the vegetation communities, benthic macroinvertebrates, fish, and water quality. However, at the time of the first two ecological monitoring events (March and September 2000), no surface water was present in the wetland; therefore, sampling could not be conducted for aquatic data. Subsequent sampling and characterization of baseline conditions were conducted in August and October 2001. The water levels were monitored continuously throughout the baseline period, except when equipment malfunctioned. Construction of the water delivery pipe was delayed in 2001 due to high water levels. Ecological monitoring resumed in 2002 after the water delivery pipe was operational. The sampling schedule and parameter list for the project are presented in Table 1.

Stage and Rainfall

Two recording piezometers and staff gauges were installed along the main monitoring transect. One set was installed near the upland boundary and the second in the wetland interior. The piezometers were set approximately 6 to 8 feet into the ground. Each piezometer contains a datalogger that is programmed to collect and record water levels at a minimum of 6-hour intervals.

Table 1. Port Orange sampling plan

	Baseline Period				Hydration Period														
	2000		2001		2002	2003			2004			2005			2006			2007	
Parameter	Mar	Sep	Aug	Oct	Dec	Mar	Jun	Oct	Mar	Jun	Oct	Apr	Jul	Oct	Mar	Jul	Oct	Mar	Jul
Biota																			
Benthic Invertebrates			X			X		X					X	X					
Trees		X		X	X			X			X			X			X		
Herbs	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Shrubs		X		X	X			X			X			X			X		
Fish				X	X			X			X								
T & E Plant And Animal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Water Samples																			
Alkalinity			X			X		X	X		X		X	X					
Ammonia			X			X		X	X		X		X	X					
Cadmium			X			X		X	X		X		X	X					
Calcium			X			X		X	X		X		X	X					
Chloride			X			X		X	X		X		X	X					
Color			X			X		X	X		X		X	X					
Conductivity			X			X		X	X		X		X	X					
Copper			X			X		X	X		X		X	X					
Iron			X			X		X	X		X		X	X					
Lead			X			X		X	X		X		X	X					
Magnesium			X			X		X	X		X		X	X					
Nickel			X			X		X	X		X		X	X					
No2+No3			X			X		X	X		X		X	X					
Orthophosphate, low			X			X		X	X		X		X	X					

Table 1 — *Continued*

	Baseline Period				Hydration Period														
	2000		2001		2002	2003			2004			2005			2006		2007		
Parameter	**Mar**	**Sep**	**Aug**	**Oct**	**Dec**	**Mar**	**Jun**	**Oct**	**Mar**	**Jun**	**Oct**	**Apr**	**Jul**	**Oct**	**Mar**	**Jul**	**Oct**	**Mar**	**Jul**
Potassium			X			X		X	X		X		X	X					
Sodium			X			X		X	X		X		X	X					
Sulfate			X			X		X	X		X		X	X					
Total dissolved solids			X			X		X	X		X		X	X					
Total Kjeldahl nitrogen			X			X		X	X		X		X	X					
Total organic carbon			X			X		X	X		X		X	X					
Total phosphorus, low			X			X		X	X		X		X	X					
Total suspended solids			X			X		X	X		X		X	X					
Turbidity			X			X		X	X		X		X	X					
Zinc			X			X		X	X		X		X	X					
Field Parameters																			
Dissolved oxygen			X			X		X	X		X		X	X					
Temperature			X			X		X	X		X		X	X					
pH			X			X		X	X		X		X	X					
Conductivity			X			X		X	X		X		X	X					
Stage (continuous)	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Photographs		X				X	X	X	X	X	X	X	X	X	X	X	X	X	
Sediment Samples																			
Soil description	X																		

The original dataloggers installed were Remote Data Systems' model WL40 and had a scrolling memory for 500 readings. These units were replaced, due to malfunction, with Infinities USA Dataloggers, which have a scrolling memory for 3,900 readings. The dataloggers were downloaded every 4 to 8 weeks and staff gauged the recorded measurements to verify that the dataloggers were functioning properly.

The rainfall monitoring gauge is located at the Garnsey WTP in Port Orange. Plant staff recorded the daily rainfall and provided the data to CH2M HILL.

Water Quality Sampling

Surface Water Quality Sampling. Samples for surface water quality were collected once during the baseline period (in August 2001) and six times during the 60-month hydration period (in March 2003, October 2003, March 2004, October 2004, July 2005, and October 2005). Surface water was not present during the other hydration-period monitoring events.

A grab sample was collected from the surface water for analysis for the range of water-quality parameters listed in Table 1. Temperature, dissolved oxygen, pH, total depth, and conductivity were measured and recorded during field sampling. Dissolved oxygen and temperature were measured at depths 5 to 8 centimeters below the water surface and within 8 to 10 centimeters of the ground surface, when water depths allowed.

All of the samples were kept on ice below 4 degrees Celsius (°C) until arrival at the analytical laboratory. A field blank composed of analyte-free water also was collected and analyzed for all parameters. Specific sample containers, holding times, and preservation techniques are based on the approved quality assurance plan, as described in the next subsection.

Quality Assurance and Quality Control. The quality assurance and quality control techniques used in monitoring at the Port Orange Wetland have been approved by the Quality Assurance Section of the Florida Department of Environmental Protection (FDEP). The techniques used are accepted protocol for each type of sampling procedure. CH2M HILL field personnel followed procedures outlined in CH2M HILL's Comprehensive Quality Assurance Plan (CompQAP) No. 910036G (updated October 19, 1999) for the execution of field activities, proper completion of chain-of-custody forms, sample preservation requirements, proper handling of samples, and certified laboratory analytical services. Strict adherence of holding times for all parameters was observed.

The laboratory analytical work for samples collected during the baseline period was conducted by Columbia Environmental Laboratories Inc. according to its CompQAP No. 930298G (dated May 20, 1998). Beginning in March 2003, the water quality samples were sent to Advanced Environmental Laboratories Inc. in Jacksonville, Florida. Laboratory personnel followed the procedures outlined in the laboratory's CompQAP for sample kit preparation, tracking and analysis of samples, and data validation.

Approved instrument maintenance and calibration procedures were followed by the field team in accordance with the manufacturer's recommendations and were consistent with standard procedures outlined in CH2M HILL's CompQAP. Calibration results were recorded on the field data sheets. During each sampling event, one field blank was collected.

Soils

Two soil profile pits were excavated in March 2000 along the main monitoring transect. Soils were excavated by digging a small pit to a depth below the water table of 90 centimeters. The soil horizons and their major subdivisions were identified, and a thickness measurement was taken for each horizon or subdivision. These surficial sediments comprise the principal zone of biological activity, where the hydration efforts are likely to have measurable ecological effects.

Vegetation Sampling

Sampling was conducted along the transects running from the upland edge to the interior of the wetland. Vegetative community sampling included three main strata:

- Herbaceous groundcover
- Shrubs and saplings
- Canopy/subcanopy

Herbaceous Groundcover. The herbaceous groundcover community included all annual plants, soft-stemmed perennials, and woody seedlings less than 0.3 meter in height. Two sampling methods were used to characterize the herbaceous plant stratum: 21 plots (1 meter by 1 meter) and three belt-intercept transects (1 meter by 108 meter).

For the seven 1-square-meter plots, groundcover data were recorded along the main transect and along the two additional transects, each with seven plots (1 meter by 1 meter). Within each plot, species composition and percent cover of herbaceous species and woody seedlings (less than 0.3 meter tall) were determined.

For the three belt-intercept transects, a modified line-intercept technique was used to evaluate herbaceous plant occurrences along the three 1-meter by 108-meter transects. The line-intercept technique was used to monitor changes in aerial cover and zonation of target indicator species along an upland-to-wetland gradient.

The occurrence of selected target species along the belt transect was recorded as the linear distance covered by a species within six intervals along the belt. For each target species, the belt-intercept linear distance of cover was used to generate estimates of percent cover and frequency (number of 18-meter intervals in which the species occurred), which are converted to relative vegetative cover, relative frequency, and importance value as shown in Table 2.

Table 2. Plant cover and frequency statistics for herbaceous plant measurements

Statistic		Formula
Linear cover distance for Species A	=	Sum of all belt-intercept distances for Species A
Percent cover	=	(Linear distance of Species A **/** total transect distance) x 100
Relative percent cover	=	(Linear distance of Species A / total linear distance of all species) x 100
Frequency	=	Number of intervals in which Species A occurred **/** total number of intervals
Relative frequency	=	(Frequency of Species A **/** sum of frequencies of all species) x 100
Importance value	=	(Relative percent cover + relative frequency) / 2

Shrubs/Saplings. The shrub / sapling stratum is defined as all woody vascular plant species as well as sapling trees and sucker shoots that are less than 1 meter in height and less than 2.5 centimeters diameter at breast height (dbh). Two sampling methods were used to characterize the shrub / sapling stratum: three plots (5 meters by 5 meters) and one line-intercept transect (108 meters).

The three 25-square-meter plots were regularly spaced along the centerline of the main transect. All woody plants within the size class and rooted in or overhanging the plot were identified and recorded. For shrub and sapling species, the percent cover was determined. For sapling species, the stem density was determined.

The line-intercept transect was established along the northern belt transect to monitor the occurrence and percent cover of shrub / sapling strata. A tape measure was placed along the length of the transect, and the linear intercept distance of each species lying vertically over, under, or touching the tape was recorded. The 108-meter transect was subdivided into 18-meter intervals for measuring frequency.

For the shrub stratum, the line-intercept linear distance data were used to generate estimates of percent cover and relative vegetative cover. Relative percent cover and relative frequency are averaged to yield an importance value as for each species (Table 2).

Canopy/Subcanopy. One 5-meter by 108-meter plot was used to characterize the canopy/subcanopy stratum. All trees rooted within the tree plot were identified by species and measured for dbh. Trees less than 2.5 centimeters dbh were not tagged. The canopy/subcanopy stratum was defined as woody specimens greater than 1 meter in height and of at least 2.5 centimeters dbh. This stratum included dominant and subdominant hardwood and softwood trees. Canopy trees included those greater than or equal to 10.2 centimeters dbh. Subcanopy trees were those between 2.5 and 10.2 centimeters dbh. All trees were identified to species and measured for dbh at approximately 1.4 meters above the ground surface within each 18 meters interval along the 108 meters transect. All trees greater than or equal to 2.5 centimeters dbh were marked with a permanent numbered aluminum tag. Subsequent measurements were made at the bottom edge of the hanging tag to maintain consistency between annual measurements. The canopy/subcanopy data were collected annually.

Importance values for the canopy / subcanopy species were calculated from dominance, density, and frequency data as shown in Table 3.

Species composition, density and dominance (basal area), importance value, and stand size structure can be assessed from the data collected. Long-term monitoring allows for an assessment of the annual growth, recruitment, mortality, and observable changes in health or character of the canopy over a specific period.

Table 3. Dominance, density, and frequency statistics for canopy/subcanopy species measurements

Statistic		Formula
Dominance	=	Total basal area of Species A
Relative dominance	=	(Total basal area of Species A / total basal area of all species) x 100
Density	=	Number of individuals of Species A
Relative density	=	(Density of Species A / total density of all species) x 100
Frequency	=	Number of intervals in which Species A occurred / total number of intervals
Relative frequency	=	(Frequency of Species A / sum of the frequencies of all species) x 100
Importance value	=	(Relative dominance + relative density + relative frequency) / 3

Animals

Benthic Macroinvertebrates. Sampling was conducted within the various habitats found along the monitoring transect. Benthic macroinvertebrate populations were monitored in accordance with the FDEP Standard Operating Procedure BA-7 (7/11/96), which is based on the U.S. Environmental Protection Agency (EPA) rapid bioassessment protocols. The method includes sweep net sampling of all micro-habitats within the sampling area by two field personnel. Sampling is limited to a fixed number of sweeps at each site. All individual organisms that are collected are sorted and identified by a subconsultant to species or the nearest practical taxonomic unit.

Fish. Fish populations were sampled in the fall event near the transect using a 0.94-square-meter Wegner Ring. Sampling is limited by the presence of standing water. If standing surface water is present, the number of tosses will vary depending on fish densities.

Amphibians. During the baseline period, amphibian populations were surveyed by University of Florida biologists L. Richard Franz, Ryan C. Means, and Steve A. Johnson. Ryan Means later joined CPI and, with Rebecca P. Meegan of CPI, conducted the amphibian surveys monthly from January through September.

Monitoring stations were established around the periphery of the wetland. Each station included a Y-shaped drift fence array with screen funnel traps, cover boards, and PVC pipes to sample the amphibians in the area. Dip-netting and frog call surveys also were used to detect the presence of amphibian species.

RESULTS

TOPOGRAPHIC SURVEY

A survey of the Port Orange topographic relief along the main transect was performed by Blount Sikes and Associates Inc. surveyors in September 2000 using NAVD88 datum. The average elevation (38.0 feet) of the wetland along the monitoring transect (Figure 7) was estimated by averaging all the measurement points shown in the figure, excluding the upland edge. The beginning of the monitoring transect began at the upland edge of the wetland (elevation 38.6 feet) and concluded in the interior of the wetland (elevation 37.5 feet). The wetland monitoring well was sited approximately 5 feet from the end of the transect at a ground elevation of 38.2 feet NAVD88.

RAINFALL

The total measured volume of water entering the Port Orange Wetland included rainfall and hydration volumes (Table 4 and Figure 8). During the baseline period, rainfall averaged 48 inches annually, which was consistent with the annual average rainfall for the area of 48 to 50 inches. Rainfall during hydration Year 1 (a 12-month period) totaled 68 inches and exceeded typical annual rainfall for the area. During hydration Year 2, rainfall totaled 51 inches. The greatest annual inputs from rainfall were recorded in Year 3 and totaled 69 inches, with the highest total monthly amount, 19.5 inches, recorded in September 2004. This amount was mainly from Hurricane Frances, which dropped 11 inches on September 5, as recorded at the Port Orange Wellfield. In the hydration Year 4, rainfall totaled 60 inches. Annual rainfall in hydration Year 5 totaled 42 inches, the lowest recorded during the entire study period. Drought conditions began in late March 2006 and progressed across the state. By November 2006, half of the state was experiencing moderate drought (National Drought Mitigation Center 2007), and by the May 2007 (the end of hydration Year 5), half the state was in severe drought and most of the rest was in moderate drought.

Average annual rainfall during the 5-year hydration period was 58 inches, slightly greater than the long-term annual average rainfall for the area. Average annual rainfall during the hydration period was also approximately 10 inches greater than the average annual (48 inches) rainfall during the baseline period.

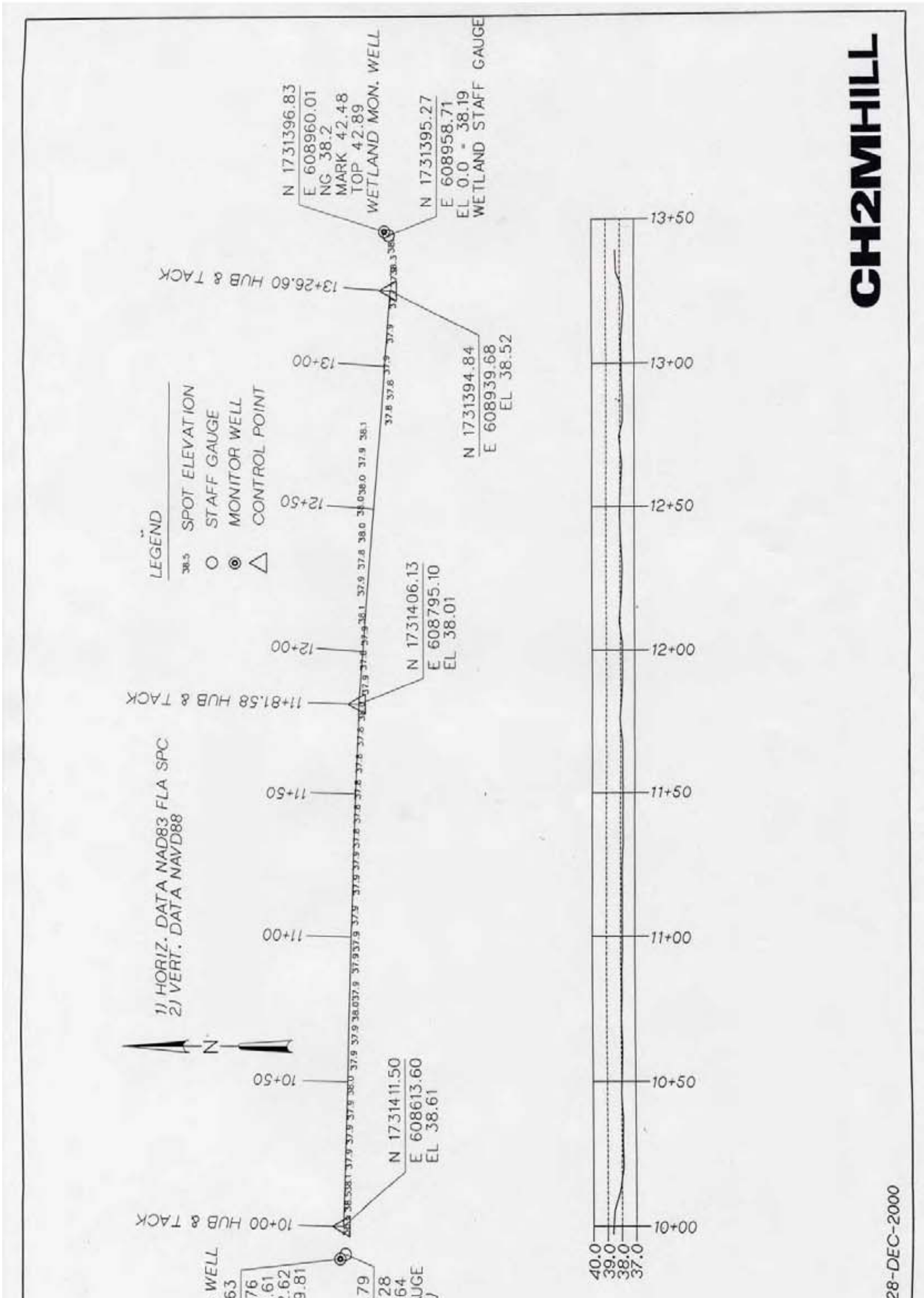

Figure 7. Transect profile at Port Orange Wetland

Table 4. Monthly rainfall totals at Port Orange Wetland, May 2000 to April 2007

	Baseline Period		Hydration Period				
	Year 1	Year 2	Year 1	Year 2	Year 3	Year 4	Year 5
Month	**2000-2001**	**2001-2002**	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**
May	0.20	1.49	0.69	1.30	0.90	8.60	0.10
Jun	5.25	6.25	12.88	7.25	9.65	12.45	7.50
Jul	5.51	8.89	7.29	7.95	6.80	3.90	4.60
Aug	2.97	5.08	9.41	5.60	13.10	3.70	8.95
Sep	11.42	18.06	6.21	5.80	19.50	8.20	4.50
Oct	1.59	1.95	2.13	10.00	1.30	12.85	1.95
Nov	1.23	7.68	2.20	2.50	1.20	2.00	1.37
Dec	0.50	0.42	9.13	1.10	2.90	1.60	5.14
Jan	0.63	2.25	1.64	1.00	3.10	0.30	1.45
Feb	0.41	2.72	5.95	6.80	1.40	5.00	4.05
Mar	8.41	1.82	9.60	0.70	5.70	0.00	0.60
Apr	0.41	1.38	0.60	1.05	3.65	1.00	1.32
Total per year	38.50	57.97	67.70	51.05	69.20	59.60	41.53
Monthly average per year	3.21	4.83	5.64	4.25	5.77	4.97	3.46
Annual average for the period	48.23		57.82				

HYDRATION

For ease of operation, hydration occurs in 24-hour increments each month. The number of irrigation periods per month is scheduled to be between zero and two, depending on the season. At a rate of 250 gpm, the 6.5-acre wetland receives an application depth of 2 inches of groundwater per 24-hour irrigation period.

The initial hydration schedule called for water to be applied over the first 12-month period in specific months to mimic the dry / wet seasons. The amount of water scheduled to be delivered was 24 inches, which is approximately half of the annual rainfall (48 to 50 inches). The full planned hydration amount was not delivered by the Utility operators during hydration Year 1 because of heavy rainfall. The shallow system responded quickly to above normal rainfall, which filled the wetland to its maximum control point above which surface water begins to flow into an adjacent ditch. During Year 1, a method for skipping a scheduled hydration event when the wetland was at maximum water level was proposed and agreed to by the Utility operators; however, it was inconsistently followed by the Utility operators in subsequent years.

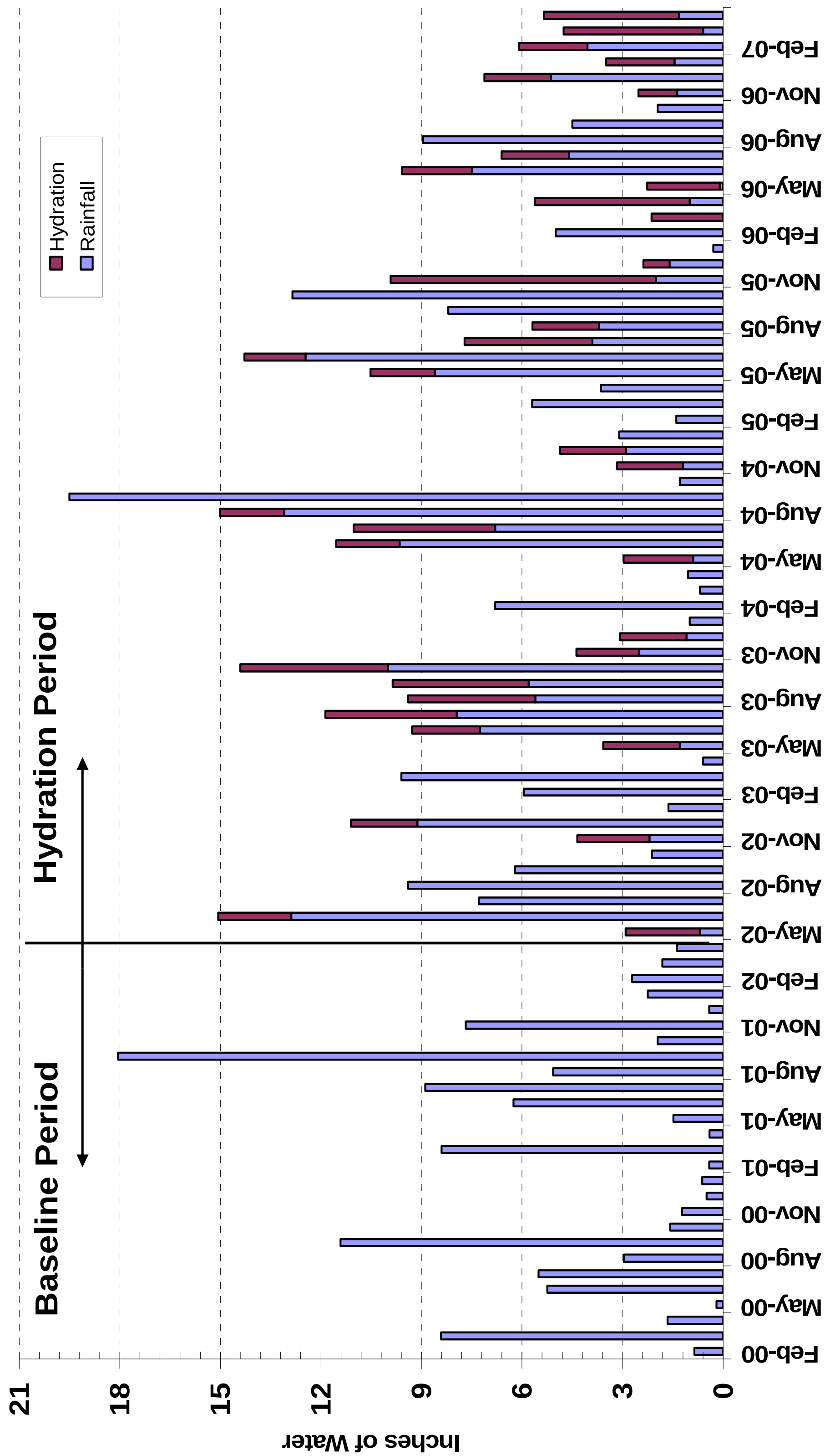

Figure 8. Rainfall and hydration water input to 6.5-acre test site, February 2000 to April 2007

Surface water in the wetland begins to spill into the ditch above an elevation of 38.40 feet NAVD88, only 0.20 foot above the ground surface at the wetland water-level recorder. Surface water in the wetland and ditch exceeded 38.40 feet NAVD88 during 22 of 60 months. Surface water in the wetland and ditch exceeded the pop-off elevation from July to October 2002 (Year 1), March 2003 (Year 1), August to November 2003 (Year 2), August 2004 to January 2005 (Year 3), June to December 2005 (Year 4), and February 2006 (Year 4). The hydration schedule was modified after the fourth operational year to deliver water across more months to lengthen the wetland's hydroperiod.

The June and July high-water episode in Year 4 continued through August to November 2005. This was not caused by excessive rainfall but by contractors working on the wellfield expansion and rehabilitation project. Contractors used Well 19 to blow off excess pressure from the water lines and discharged the water through the delivery pipe that serves the study wetland. The blow-down discharge occurred without the knowledge of the City of Port Orange Utilities wellfield operator. During these months, water was discharged directly to the study wetland at unspecified times and at estimated volumes. The City of Port Orange Utilities staff was not informed of the contractor's unauthorized use of the study wetland delivery pipe until construction activities stopped in November 2005, at which time the City informed CH2M HILL.

Estimates of water discharged to the study wetland were based on flow meter readings associated with the pump valve. While the volume of water discharged during construction activities could reasonably be quantified, the timing of the discharge was unknown. Wellfield technicians and CH2M HILL scientists noted high surface water elevations throughout this period, and piezometer readings during these months confirm elevated water levels.

In January 2006, CH2M HILL supplied the City with a revised hydration schedule that would mostly affect the upcoming Year 5 hydration schedule. In this revised schedule, the same amount of water as previously scheduled would be applied, but it would be applied earlier in the spring and later in the fall, lengthening the hydroperiod. The intent of this change was to have a better comparison to the control wetlands used in the amphibian study and clearer assessment of the effects of hydration on this parameter.

Eleven irrigation periods were applied at specified times during hydration Year 5. The actual amount of water applied at each hydration event conducted at the Port Orange Wetland from May 2006 to April 2007 is presented in Table 5. The drought was unanticipated and masked the effect of the attempt to lengthen the hydroperiod.

Table 5. Hydration of Port Orange Wetland, May 2006 to April 2007

Month	Date ON	Date OFF	24-Hour Periods	Hydration Volume (MG)
May 2006	05/16/2006	05/17/2006	1	0.382
June	06/27/2006	06/28/2006	1	0.367
July	07/10/2006	07/11/2006	1	0.356
August	No hydration scheduled			
September				
October				
November	11/07/2006	11/08/2006	1	0.205
December	Estimated	Estimated	1	0.350 estimated
January 2007	01/30/2007	01/31/2007	1	0.360
February	02/19/2007	02/20/2007	1	0.360
March	03/07/2007	03/08/2007	1	0.358
March	03/19/2007	03/20/2007	1	0.378
April	04/18/2007	04/19/2007	1	0.357
April	04/24/2007	04/25/2007	1	0.355
	TOTAL		**11 periods**	**3.83 (21.68 inches)**

The pumps are turned on and off at 8 A.M. of the day noted on the schedule. All pumping periods are therefore 24 hours. The volume of water is recorded by a flow meter and read by Port Orange Public Utilities Department staff.

During each known irrigation period, pumps were run for 24 hours beginning and ending at 8 A.M. Hydration application ranged from 1.16 to 4.37 inches per month. The total volume of water discharged to the study wetland (known and estimated) during hydration Year 5 totaled 21.68 inches, or 3.83 million gallons (MG). During December 2006, the flow meter associated with Well 19 failed and was replaced during January 2007. The volume of water pumped from the well during December 2006 was estimated.

The total volume of water added to the wetland during hydration Year 5 was similar to the volume added in hydration Years 2 and 4 and greater than in Years 1 and 3. Hydration during the 60 months of operation provided an average of 37% of the long-term average annual rainfall and applied as follows:

– Year 1 - 8.5 inches (1.5 MG)
– Year 2 - 24.4 inches (4.3 MG)
– Year 3 - 14.0 inches (2.5 MG)
– Year 4 - 25.0 inches (4.4 MG)
– Year 5 - 21.7 inches (3.8 MG)

SURFACE-WATER ELEVATION ANALYSIS

Daily Water-Level Elevation

Figure 9 depicts water levels as recorded by upland and wetland dataloggers associated with piezometers for the baseline and hydration periods. Erroneous data from the wetland recorder was produced when the water level fell below the bottom of the piezometer (35.18 feet). Water levels fell below the bottom of the piezometers once in the baseline period (May 14, 2000 through March 19, 2001), once at the start of the hydration period (May 1, 2002 through June 13, 2002), and during most hydration Year 5 (May 22, 2006 through June 12, 2006, and June 24, 2006 through April 30, 2007. Since the project initiation, both water-level dataloggers have been replaced. Each malfunction resulted in some loss of data; however, while one datalogger was down, the other continued to log the groundwater level. At another time, in December 2002, the calculator also malfunctioned and data were lost.

When possible, the erroneous data were replaced with estimated data calculated as the upland recorder elevation for each erroneous data point minus the average difference between the upland and wetland recorder. The difference was calculated only at times when water levels at both the upland and wetland recorders were below the ground surface. Data were not estimated during periods when water was above ground surface at one datalogger and below ground surface at the other because the relationship between the two piezometers under those conditions was not well correlated. Data was estimated for the wetland piezometers when water fell below the wetland piezometers at the dates mentioned above.

Daily upland and wetland water elevations showed similar trends over the reporting period. All further references to water elevation in this report refer to wetland water elevation.

Daily hydration period mean water elevation exceeded baseline mean by 0.8 foot and median water elevation by 1.5 feet (Figure 9). Maximum daily value during hydration (41.26 feet) occurred on September 7, 2004, and was 0.58 foot greater than maximum baseline value (40.68 feet). The new maximum water-level record was due to the cumulative effects of Hurricane Charley and especially Hurricane Frances, which produced a major rainfall event (11 inches on September 5) in the Port Orange Wetland watershed.

Water-level data from both the wetland and upland piezometers indicate an apparent flow gradient from the wetland outward, indicating that under some conditions the wetland is discharging to the surficial aquifer system in the adjacent uplands. During periods when water was above the ground surface at both the piezometers, the recorded water elevations were similar (Figure 9). When water was below the surface at the upland piezometers, the data recorded from the piezometers differed. Data from the wetland piezometers were greater than those recorded at the upland piezometer, except for occasional peaks in the upland data. These peaks likely occurred because of the difference in the type of recorders at the two piezometer locations. The seasonal gradient of outward flow from the wetland has been documented for cypress dome wetlands in a pine flatwoods landscape at another demonstration site (Tillman Ridge, St. John's County, Florida), which included installation of perimeter piezometers.

During the baseline period (27 months), water levels were above the wetland surface 42% of the time. During the hydration period (60 months), water levels were above the wetland surface 63% of the time.

Survey of Hydrologic Indicators

Field measurements of vegetative indicators of hydrology were collected by CH2M HILL biologists in October 2005 to estimate the historic seasonal high water level or "normal pool" at the Port Orange Wetland. Nine types of indictors were used, and multiple samples were collected for a total of 96 measurements.

Hydrologic indicators were surveyed while standing surface water was present at the Port Orange Wetland. Elevations of the selected indicators were measured relative to the elevation of the surface water as measured by the upland and wetland piezometers and converted to NAVD88 based on the topographic survey by Blount Sikes and Associates Inc. in September 2000.

The elevations of the vegetative indicators of hydrology were compared to a list of hydrologic indictors used by the St. Johns River and Southwest Florida Water Management Districts to set minimum water levels needed to maintain the ecological function in palustrine cypress wetlands in central Florida (Carr and Rochow 2004, Hall 2002).

Indicators surveyed by CH2M HILL biologists in October 2005 at the Port Orange Wetland include:

1. The lower limit of epiphytic moss collars on tree trunks
2. Elevations of the upper and lower cypress buttress inflections

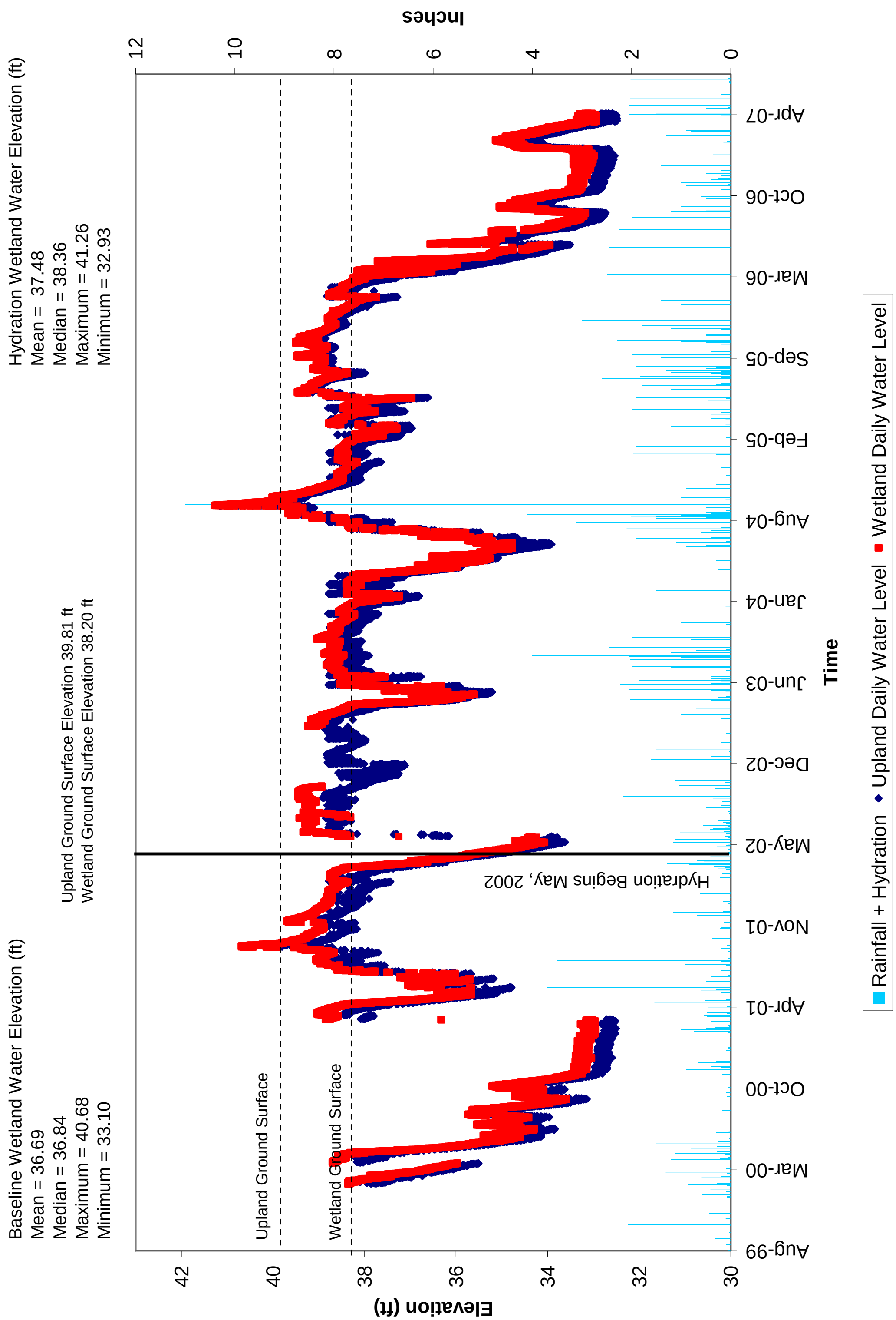

Figure 9. Daily water elevations and rainfall, Port Orange Wetland, February 2000 to April 2007

3. Ground elevation at the base of the saw palmetto edge near the upland border of the wetland
4. Ground elevation of mature cypress growing at the outside edge of the wetland
5. Upper elevation o cypress flutes
6. Ground elevation of mature pines growing in the interior of the wetland

These indicators were selected because they are present at the Port Orange Wetland, are persistent, and can be used consistently in cypress swamps as vertical indicators of inundation (Hull et al. 1989, SWFWMD 1999). Two other indicators were used by Carr and Rochow (2004) but not by CH2M HILL at the Port Orange Wetland; these are the upper adventitious rooting on St. John's-wort (*Hypericum fasciculatum*) and the root crown base of fetterbush (*Lyonia lucida*). Fetterbush was not present in sufficient abundance to be used as a reliable indicator, and the St. John's-wort had been so severely damaged by wildfire before the project started that no adventitious roots were evident.

In further researching available technical studies on biological indicators of seasonal water levels, CH2M HILL reviewed the SWFWMD Technical Memorandum *Use of Biologic Indicators for the Establishment of Historic Normal Pool* (Schultz et al. 2004). This technical memorandum presents the results of a District reevaluation of methodologies used to determine normal pool. The SWFWMD team of scientists concluded that cypress buttress, fetterbush base, and in some situations moss collars are significantly consistent indictors of historic normal pool. Conversely, they concluded that ground elevation of the outermost cypress and saw palmetto, if used, would need an adjustment factor of +0.55 and +0.25 feet, respectively, to approximate the historic normal pool (Schultz et al. 2004).

CH2M HILL data compared well for most of the indicators measured versus data presented in Carr and Rochow 2004 and Schultz et al. 2004 (Table 6). One indicator measured by CH2M HILL at the Port Orange Wetland, ground surface of the palmetto edge, appears to be as reliable an indicator as buttress swelling and moss collar for this particular wetland.

Percentile ranks were used to identify the distribution of each indicator's median elevation. These median elevations were compared to the pre- and post-hydration exceedence curves developed for the Port Orange Wetland. On average, the water level in the wetland exceeds the elevation of the saw palmetto edge 5% of the time. Similarly, the inundation frequency of the median elevation is 5% at the lower inflection point of the cypress trunks and 3% of the bottom of the moss collars (Table 6).

Table 6. Comparison of hydrologic indicators found at Port Orange Wetland in 2005 to established indicators presented in Carr and Rochow 2004 and Schultz et al. 2004

Hydrologic Indicator*		Number of Samples	Water-Level Percentile (%)		
			CH2M HILL 2005	Carr and Rochow 2004	Schultz et al. 2004
1	Moss collar lower limit	10	3	3	2.2
2	Cypress buttress swelling – lower inflection point	28	5	2	2.4
3	Saw palmetto edge	14	5	14	12.6
4	Outermost cypress	11	26	29	29.9

*Indicators not used by Carr and Rochow 2004 or Schultz et al. 2004 included ground elevation of mature pines and upper elevation of cypress flutes.

The normal pool at the Port Orange Wetland was estimated to occur at 39.4 feet NAVD88 based on median elevation of the lower cypress buttress point (39.35 feet NAVD88) and of the ground surface of the palmetto edge (39.55 feet NAVD88). This elevation would be the expected seasonal high-water elevation reached in the wetland under typical, non-impacted conditions.

Results in *Establishment of Minimum Levels in Palustrine Cypress Wetlands* (SWFWMD 1999) state that unacceptable harm had been found to occur in wetlands if the median (P50) stage value was more than 1.9 feet below the normal pool value. The document states that the frequency range of the departure of the median stage value (P50) from the normal pool (NP-P50) value for non-impacted wetlands was within 1.0 foot of the normal pool. Therefore, a reasonable target elevation for restoration of water levels at the Port Orange Wetland would be between 38.4 and 39.4 feet NAVD88. The median stage value for the pre-hydration exceedence curve at the Port Orange wetland was 36.8 feet NAVD88, or 2.6 feet below the normal pool. The median stage value of the post-hydration exceedence curve was 38.4 feet NAVD88 or 1.0 foot below normal pool. Pre- and post-hydration stage exceedence curves reflect the differences in water-level elevations (Figure 10). Increased inputs from rainfall and hydration have moved the median stage value at the Port Orange Wetland to within the target range during the hydration period.

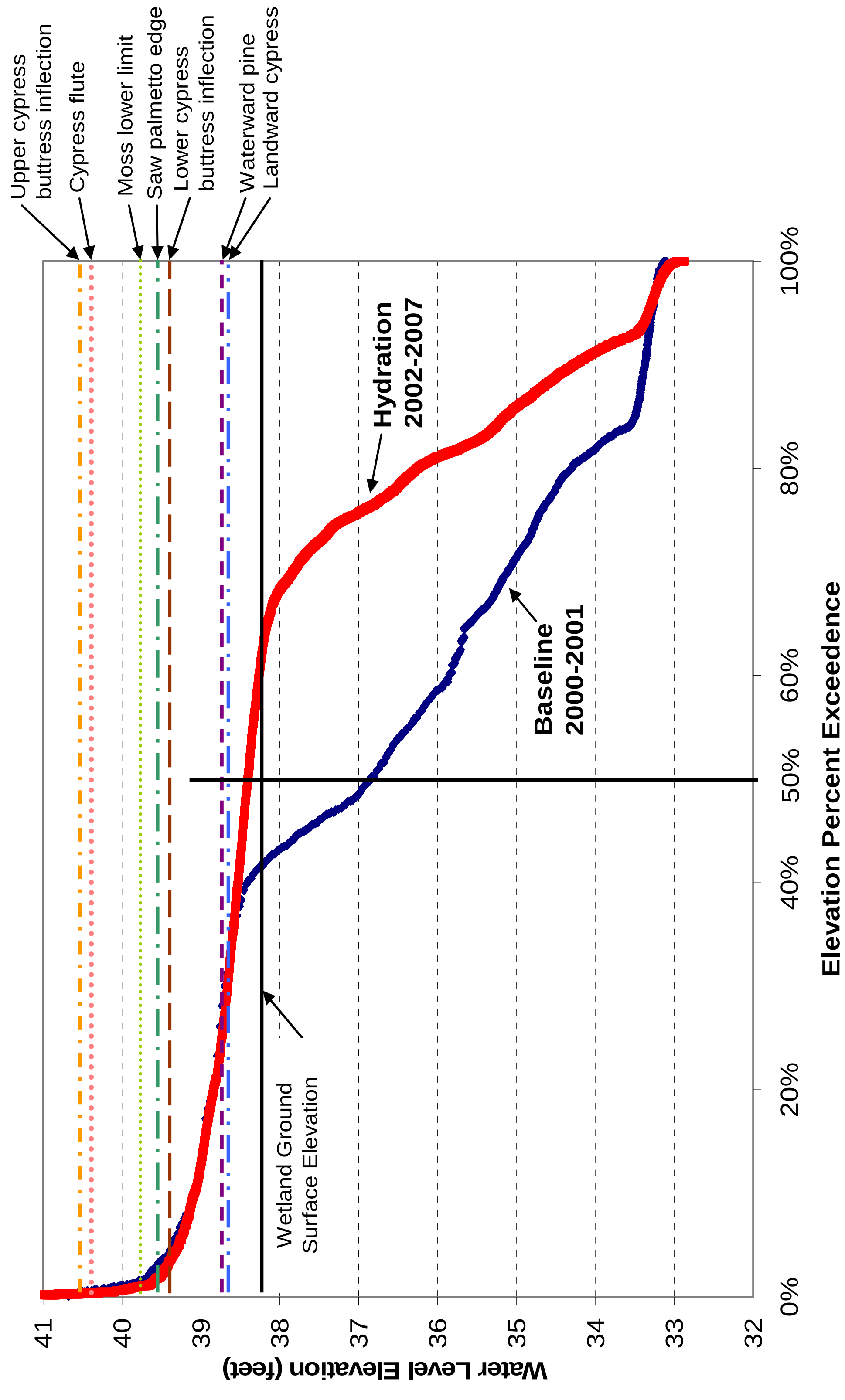

Figure 10. Pre-hydration and post-hydration stage exceedence curves and hydrologic indicator stage elevation percentile rank for Port Orange Wetland

Monthly Water-Level Elevations

Differences in mean monthly water-level elevations during the hydration period were greater than during the baseline period in every month except April (Table 7). Water-level elevations during the hydration year were more typical of a natural hydroperiod for this type of shallow cypress wetland. Water-level elevations were lowest in May and greatest in September. Mean monthly water-level elevations were lower in hydration Year 5 than in the four previous hydration years.

Table 7. Monthly water-level elevations for baseline and hydration periods, February 2000 to April 2007

	Water-level Elevation (feet NAVD88)											
	Baseline				Hydration							Mean Difference
Month	2000	2001	2002	Mean	2002	2003	2004	2005	2006	2007	Mean	
Jan		33.35*	38.77	**36.15**		#	37.92	38.48	38.27	33.2	**36.97**	0.82
Feb	37.99	33.24*	38.60	**36.50**		#	38.29	38.18	38.51	34.5	**37.39**	0.89
Mar	36.74	35.65*	38.59	**37.09**		39.00	37.91	37.93	38.16	34.3	**37.46**	0.37
Apr	38.39	38.66	36.67	**37.86**		36.67	36.11	38.33	36.99	33.2	**36.27**	-1.59
May	35.85*	36.34	†	**36.12**	34.98*	36.90	35.58	38.11	35.61	‡	**36.24**	0.12
Jun	34.90*	36.24		**35.69**	37.03*	37.40	35.76	39.04	35.07		**36.86**	1.17
Jul	35.22*	37.68		**36.45**	39.13	38.37	37.79	38.82	34.61		**37.74**	1.29
Aug	34.88*	38.90		**36.90**	39.04	38.65	39.22	38.92	33.47		**37.86**	0.96
Sep	34.41*	39.65		**37.03**	39.26	38.67	40.12	39.07	34.57		**38.34**	1.31
Oct	34.58*	39.17		**36.88**	39.30	38.74	39.11	39.20	33.81		**38.03**	1.15
Nov	33.46*	39.25		**36.41**	#	38.56	38.54	38.86	33.33		**37.32**	0.91
Dec	33.37*	39.00		**36.28**	#	38.39	38.37	38.69	33.22		**37.17**	0.89
Mean		**36.69**			**37.48**							**0.79**
Median		**36.84**			**38.36**							**1.52**

Note:
= data unavailable due to equipment malfunction
* Numbers shown are estimates based on the relationship between the upland and wetland recorder when water levels were below the wetland surface.
† Data continue next month as beginning of hydration period.
‡ End of 5-year study.

Water levels were above the surface at the wetland piezometer for 10 months during the 27-month baseline period. During the hydration period, groundwater elevations were above the wetland surface for 28 months during the 48-month period including 4 months when data were only available from the upland recorder. During that period when the wetland datalogger was inoperable, groundwater elevations at the wetland piezometer were estimated to be at or just below the wetland surface.

Precipitation and Water-Level Elevations

Before the effect of hydration on groundwater elevations could be assessed, the effect of rainfall on water-level elevations had to be evaluated. Figure 11 shows the relationship between the cumulative monthly water levels relative to ground surface and the cumulative monthly total water inputs from rainfall. Water elevations show positive relative increases with increased rainfall in both the baseline period and hydration period. Linear regressions were performed on both data sets. The slopes of the baseline period and hydration period curves were similar (8.79 and 10.44, respectively). The difference between the slopes indicates a trend that water levels had a greater increase relative to rainfall inputs in the hydration period. However, the hydration period currently includes data for times when hydration water was added to the wetland, but would have flowed out. Under this condition the volume of water would have no effect on stage in the wetland, thus would contribute to an under estimate of the true hydration effect. In the Final Report (September 2008) the data for the hydration amounts that were applied after the wetland reached its maximum elevation will be removed. This will likely show a steeper slope for the hydration period; thus the effects of hydration will be more apparent.

Figure 9 and Table 7 show increases in average daily and monthly water elevations of 0.79 feet during the hydration period compared to the baseline period. Rainfall however, has been the dominant input at the Port Orange Wetland since the onset of hydration. The total augmentation volume over the 60-month hydration period accounted for 33% of the total rainfall volume that entered the wetland. Water levels were lower during hydration Year 5 than the previous year, while hydration inputs were similar. Rainfall during hydration Year 5 was 8.5 inches below the regional long-term annual average.

The effects of rainfall on water levels may be compounded by the connection of the study wetland to other surface water bodies at times of high surface water. Surface-water levels equaled or exceeded the pop-off level in the adjacent ditch (38.4 feet) 50% of the time during the 60-month hydration period. The connection between the wetland and the ditch may serve to reduce the effects of hydration by increasing total wetted area and evaporation when elevations exceed the pop-off point. The connection also may serve to hydrate the wetland during rainfall events when runoff water from surrounding uplands spills from the ditch into the wetland.

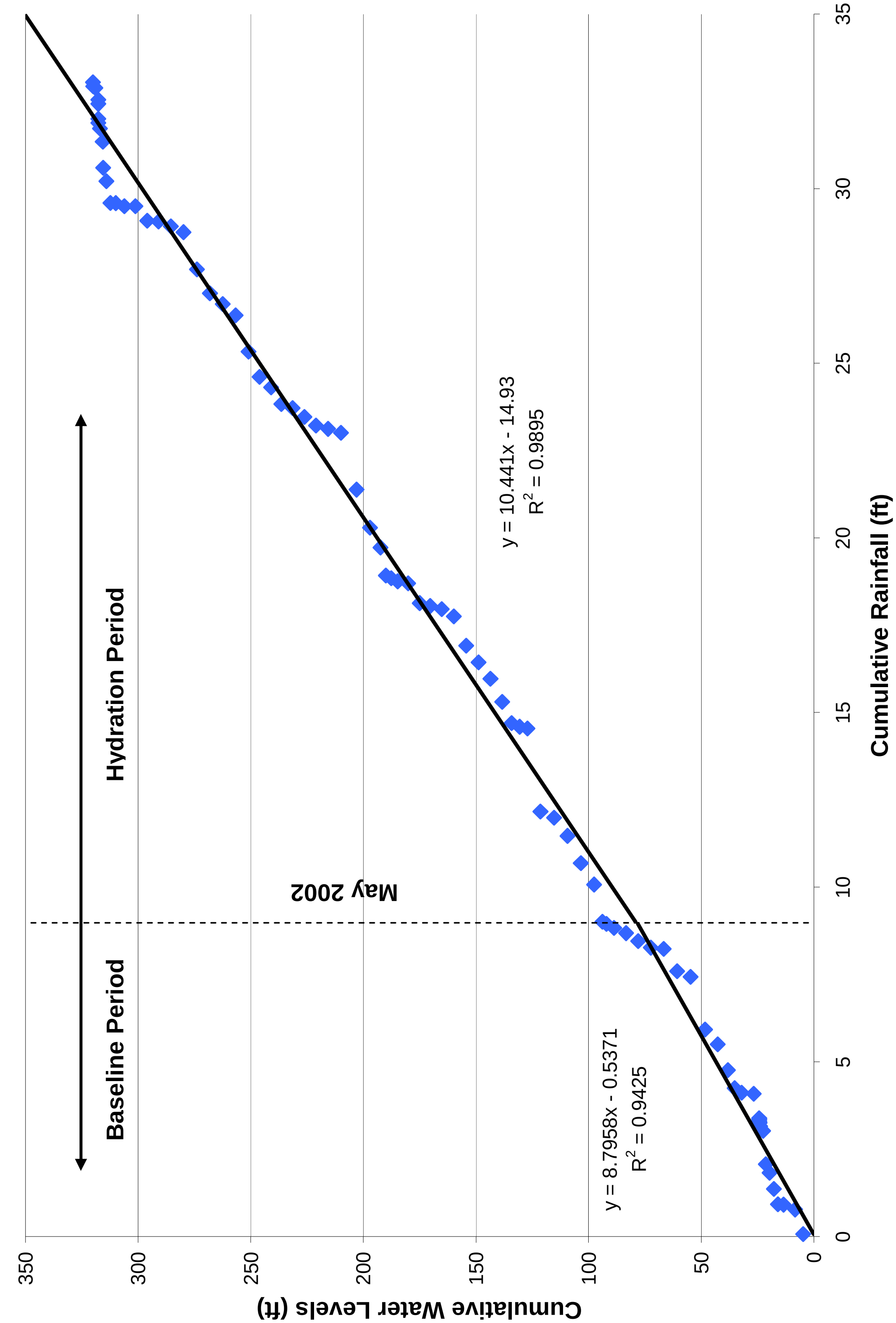

Figure 11. Cumulative water level versus cumulative rainfall, February 2000 through April 2007

Water Input-Output Evaluation

One way to consider the effects of the hydration is to compare the water estimated to be entering and leaving the wetland during the baseline and hydration periods (Table 8). Although this is only a coarse analysis, it provides some insight into the relationship between hydration amounts and changes in water-level elevation. This input-output analysis is based on the following assumptions:

1. Annual average evapotranspiration (ET) is about 4 inches less than the long-term average rainfall for the area (Mitsch and Gosselink 1983), or about 46 of 50 inches per year. In Table 8, total estimated ET is adjusted for the length of time in the baseline and hydration periods.

2. Lateral and vertical seepage rates are variable throughout the season. These variables are dependent on such factors as wellfield pumping and the differences between water levels in the wetland and the surrounding uplands. Measuring these variables is beyond the scope of work for the current project.

3. Median water-level values are influenced by the frequency of data collected by the dataloggers. Changes in frequency result in median values being skewed toward the more frequent observations. Since the frequency of the dataloggers has changed several times over the project period, the mean values for baseline and hydration water levels were used for this analysis.

There was a net input of water during both the baseline and hydration periods. The mean water-level elevation rose by an amount less than the net input difference (hydration year input minus baseline input) during each of the five hydration years.

Table 8. Water input-output analysis for baseline and hydration periods by year

Hydrologic Variables						Groundwater	
Period	**Rainfall (in)**	**Hydration (in)**	**ET (in)**	**Net input (in)**	**Input Difference (Baseline vs. Hydration)**	**Mean GW (ft)* Datum NAVD88**	**Difference (ft)* (Baseline vs. Hydration)**
Baseline Year 1 (365 d)	38.5	0	-46.0	-7.5		34.69	
Baseline Year 2 (365 d)	58.0	0	-46.0	12.0		38.24	

Table 8 — *Continued*

Hydrologic Variables						Groundwater	
Period	**Rainfall (in)**	**Hydration (in)**	**ET (in)**	**Net input (in)**	**Input Difference (Baseline vs. Hydration)**	**Mean GW (ft)* Datum NAVD88**	**Difference (ft)* (Baseline vs. Hydration)**
Hydration Year 1 (365 d)	67.7	8.5	-46.0	30.2	**28.2 inches (2.3 ft)**	38.51	**1.82**
Hydration Year 2 (365 d)	51.1	24.4	-46.0	29.5	**27.5 inches (2.3 ft.)**	38.06	**1.37**
Hydration Year 3 (365 d)	69.2	14.0	-46.0	37.2	**35.2 inches (2.9 ft)**	38.12	**1.43**
Hydration Year 4 (365 d)	59.6	25.0	-46.0	38.6	**36.6 inches (3.1 ft)**	38.55	**1.86**
Hydration Year 5 (365 d)	41.5	23.9	-46.0	19.4	**17.4 inches (1.5 ft)**	37.48	**0.79**

Note:
Evapotranspiration is assumed to be 46 inches per 365 days and is adjusted to the length of days in each period.
Rainfall long-term annual average is between 48 and 50 inches.
*These data are in feet, while all other data are in inches.

avg = average
d = days
ET = evapotranspiration
ft = foot/feet
GW = groundwater
in = inch(es)

Net inputs from rainfall and hydration were highest (38.6 inches) during hydration Year 4 and lowest (19.4 inches) during hydration Year 5. Net input differences did not consistently relate to differences between mean groundwater levels over the 60-month study period. The lateral and vertical seepage factor could be responsible for some of the difference in observed water levels relative to total inputs and expected increases. The first year of the baseline period recorded below average rainfall input, while the second year had above average rainfall. Whereas, four of five hydration years recorded above-normal rainfall, making conclusions concerning changes in water elevations difficult. Additional years of data may provide greater understanding of the hydration effects aside from the effects of rainfall.

Summary of Hydration Observations

Observations of changes in water-level elevations and associated water inputs between February 2000 and April 2007 include the following:

1. Mean groundwater elevation increased 0.8 feet from the baseline period to the hydration period (2002 to 2007) (Figure 9).

2. Water elevations exceeded the surface of the wetland 63% of the time during the hydration period, compared to 42% of the time during the baseline period (Figure 10).

3. Based on hydrologic indicators measured in the field, the median stage value of the hydration period exceedence curve was 38.4 feet NAVD88, or 1.0 foot below normal pool, which is within the expected range of the median stage value for non-impacted wetlands (SWFWMD 1999) (Figure 10).

4. The double mass comparison of cumulative changes in water levels to cumulative rainfall totals showed a moderate difference in the trend of the relationship between the baseline and hydration periods (Figure 11). The slope of the regression for the hydration period data showed a slight increase to that of the baseline period.

5. The ratio between the net water input and mean stage differences represents the amount of water required to raise the mean water-level elevation by 1 foot over baseline. Approximately 1.3, 1.7, 2.0, 1.7, and 1.9 feet of water were needed to raise the mean water-level elevation by 1 foot during each of the five hydration years, respectively.

ET is considered the primary source of water loss in still-water cypress swamps and is greater than both lateral and vertical seepage unless anthropogenic forces affect water levels (Ewel and Smith 1992). Therefore, quantification of actual ET rates in the wetland is necessary to separate ET effects from water-table drawdowns in the wellfield, which is beyond the limits of this project scope. ET rates vary seasonally, and values were estimated from available studies on North Florida still-water cypress swamps for this 2007 Annual Report.

WATER QUALITY

Samples for surface water quality were collected when surface water was present during the scheduled monitoring events. Water-quality samples were collected once during the baseline period (August 2001), once during the first 12 months of the hydration period (March 2003), twice during hydration Year 2 (October 2003 and March 2004), twice during hydration Year 3 (October 2004 and July 2005), and once during hydration Year 4 (October 2005). No surface water quality samples were collected during hydration Year 5. Copies of the laboratory reports from the baseline and hydration periods are included in Appendix A.

The measured water-quality parameter values were similar during the baseline and hydration periods (Table 9). A few parameters showed differences that could be described as spikes in value, such as pH 8.23 in March 2004, compared to previous and subsequent sampling events, which had a median value of 5.87, and alkalinity values in October 2003 (80 milligrams per liter [mg/L]) and in October 2004 (78 mg/L), which were an order of magnitude greater than the median (6.0 mg/L) of the other five sampling events. The wide range in values of some of these parameters may indicate a chemical signature dominated by surface water, groundwater, or an intermediate condition.

Discussion of the data in the final report will include event-driven effects or factors to assess the snapshot water-quality views that have apparent spikes or dips in any one parameter and whether those can be attributed to groundwater hydration. Many factors can influence water-quality parameters, including particulate matter, shallow water, deep water, rainfall, phytoplankton blooms, and submerged aquatics. In the final report, CH2M HILL will analyze ionic differences between samples, relative differences, and possible association of water-quality value spikes to changes in the amphibian data.

The Port Orange Wetland generally exhibits water quality typical of northeastern Florida still-water cypress swamps set amid managed pinelands, with water that has low conductivity, nutrients, metals, and total dissolved solids. The short residence time of the wetland probably contributes to the low to moderate color of the water by reducing the contact time with organic acids resulting from the breakdown of plant detritus within the watershed (Kadlec and Knight 1996). These water-quality values also are typical of water associated with groundwater from the surficial aquifer.

Table 9. Water-quality parameters at Port Orange Wetland

Parameter	Unit	Baseline	Hydration					
		Aug 2001	Mar 2003	Oct 2003	Mar 2004	Oct 2004	Jul 2005	Oct 2005
Dissolved oxygen*	mg/L	4.29	7.08	1.29	3.85	1.01	0.98	1.12
Temperature*	°C	29.9	28.5	22.7	17.8	21.0	31.3	22.3
pH*	units	5.48	5.26	5.83	8.23	6.14	5.91	5.91
Conductivity	µmhos/cm	46.3	36	140	59	210	24	24
Alkalinity	mg/L as $C0_3$	6	5.0	80	10	78	6.0	8.0
Ammonia - N	mg/L	<0.1	<0.050	<0.019	<0.026	0.040	<0.026	<0.026

Table 9 — *Continued*

Parameter	Unit	Baseline	Hydration					
		Aug 2001	Mar 2003	Oct 2003	Mar 2004	Oct 2004	Jul 2005	Oct 2005
Cadmium	µg/L	<0.001	<0.00036	0.00065	<0.00021	<0.00021	0.000054	0.000062
Calcium	µg/L	3.9	2.5	26	4.6	34	2.7	4.3
Chloride	µg/L	5.6	7.0	13	15	19	5.3	5.8
Color	Color units	500	250	150	300	150	230	150
Copper	µg/L	<0.002	<0.0011	<0.0011	0.0011	<0.0071	<0.00096	0.0026
Iron	µg/L	1.5	0.54	0.39	<0.41	2.4	0.59	0.65
Lead	µg/L	<0.002	0.0032	<0.00091	0.0017	0.0025	<0.0019	<0.0019
Magnesium	µg/L	1.4	0.76	2.5	1.2	1.7	0.66	0.85
Nickel	µg/L	<0.002	<0.00085	<0.00085	<0.0026	<0.0026	<0.0016	<0.0016
Nitrate + nitrite - N	mg/L	<0.2	<0.050	<0.027	0.027	0.90	<0.027	<0.027
Ortho-phosphate-P	mg/L	0.012	<0.090	<0.013	<0.013	0.12	<0.013	0.035
Potassium	µg/L	<2.0	0.56	0.93	0.96	2.6	0.26	0.38
Sodium	µg/L	3.1	4.0	8.1	8.0	9.6	3.3	5.1
Sulfate	mg/L	<1	<2.5	5.7	6.9	<5.0	<5.0	<5.0
Total dissolved solids	mg/L	94	90	170	100	170	32	22
Total Kjeldahl - N	mg/L	1.6	1.5	0.66	1.6	1.2	0.64	0.61
Total organic carbon	mg/L	25	26	<0.50	29	30	23	18
Total phosphorus, low	mg/L	0.058	<0.050	<0.037	0.16	0.39	<0.043	<0.043
Total suspended solids	mg/L	10	31	<2.0	31	44	5.0	6.5
Turbidity	mg/L	5.3	4.0	<1.0	6.4	4.1	<1.0	<1.0
Zinc	µg/L	<0.01	0.0066	0.0055	0.0072	0.010	0.0079	0.0095

Note:
mg/L = milligrams per liter
µg/L = micrograms per liter
µmhos/cm = microhmos per centimeter

* Measurement taken in field.

SOILS

Soil profiles were characterized once during the baseline period (March 2000) from two locations along the main transect. The first location was approximately 18 meters from the start of the monitoring transect in the upland transitional zone. The second was approximately 5 meters from the transect end near the wetland center. All strata or horizons within this surficial zone were characterized. These surficial sediments comprise the principal zone of biological activity, where the hydration efforts are likely to have measurable ecological effects. Soil layers were excavated by digging a small pit to a depth of 90 centimeters or below the water table. The soil horizons and their major subdivisions were identified, and a thickness measurement was taken for each horizon or subdivision.

Soil identified at the Port Orange Wetland is mapped as *Myakka-St. Johns Complex* (map unit 34) and described in the *Soil Survey of Volusia County* (USDA / UF 1980) as a hydric, nearly level, poorly drained soil interspersed in the landscape and within depressions in the flatwoods. It is well suited for cypress, gum, pine, and bay trees and wetland grasses. Surface soil horizons were found to be lighter in hue than those described for the Myakka-St. Johns Complex. The lighter hue was likely due to the loss of organic matter that burned away during a fire in the wellfield in 1998. The soil horizons showed characteristics of both the Myakka and St. Johns series that make up the complex. In this complex, approximately 50% of the component soil is typically Myakka series and 35% St. Johns series. Inclusions to this soil complex are non-hydric. Table 10 presents brief descriptions of study area upland and wetland soils at horizons from 0 to 23 inches.

Table 10. Soil characteristics at Port Orange Wetland

Sample Location	Horizon (depth)	Description
Upland	A1 (0-6 inches)	Very dark gray (10YR3/1) sand with 40 to 50% organic matter-coated sand grains; loose
	A2 (6-23 inches)	Black (10YR2/1) mucky sand with 100% organic matter-coated sand grains; slightly sticky
Wetland	A1 (0-4 inches)	Very dark gray (5YR3/1) with pale brown (10YR6/3) zones; mucky sand with 80% organic matter (40% in zones); very friable
	A2 (4-13 inches)	Black (10YR2/1) mucky sand; slightly sticky
	C (13-23 inches)	Very dark grayish-brown (10YR3/2) sand with slightly mucky texture; slightly sticky

Source:: USDA/UF 1980

VEGETATION

The herbaceous ground-cover stratum was evaluated twice during the baseline and 15 times during the 60-month hydration period. Field evaluations included monitoring of the 21 plots 1 square meter each and the three linear-belt transects for species diversity and percent cover. The greatest total number of species (36) was recorded during the March 2000 baseline sampling event. The fewest number of species (20) was observed during the March 2003 and October 2005 hydration sampling events. Eighty species have been identified in the Port Orange Wetland during the entire monitoring period (Table 11). Differences in herbaceous vegetation between the baseline and hydration period were observed, primarily near the upland end of the monitoring transects.

Herbaceous Groundcover

Meter-Square Plots. Percent cover and species composition during hydration Year 5 were less than those observed during baseline monitoring. Overall, the herbaceous stratum was dominated by wetland grass maidencane (*Panicum hemitomon*). Table 12 presents a summary of the dominant herbaceous groundcover species having a relative cover greater than 9% during the baseline and hydration Year 5.

The relative percent cover over all the plots was dominated by maidencane (25%) in March 2000 and by wooly maidencane (*Panicum scabriusculum*) (55%) in October 2001 of the baseline period. Other species that showed relatively high percent cover during the baseline period included blue maidencane (*Amphicarpum muhlengergianum*) and wiregrass (*Aristida stricta*).

The relative percent cover in October 2006 was dominated by maidencane (45%) and beakrush (*Rhynchospora* sp.) (16%). In April 2007, relative percent cover was dominated by maidencane (21%), wrinkled-jointtailgrass (*Coelorachis rugosa)* (15%), and blue maidencane (12%). In July 2007, relative percent cover was dominated by maidencane (41%) and wrinkled-jointtailgrass (12%). Maidencane was most often observed toward the wetland end of the monitoring transect, and blue maidencane was most often observed toward the upland end.

Results of the herbaceous groundcover observation within the 21 plots of 1 square meter are presented in Appendix B. During hydration Year 5, the diversity within the herbaceous groundcover plots varied between 2 and 12 species. Species diversity and percent cover during Year 5 was similar to those in the first 4 years of hydration. During the baseline period, the diversity within the herbaceous groundcover plots varied between 3 and 17 species.

Table 11. Herbaceous species observed in Port Orange Wetland

Common Name	Scientific Name	Stratum	Wetland Indicator	Baseline		Hydration Period														
						Year 1			Year 2			Year 3			Year 4			Year 5		
				Mar '00	Oct '01	Dec '02	Mar '03	Jun '03	Dec '03	Apr '04	Jun '04	Oct '04	Apr '05	Jul '05	Oct '05	Mar '06	Jul '06	Oct '06	Mar '07	Jul '07
Blue maidencane	*Amphicarpum muhlenbergianum*	Herb	FACW	X	X	X		X	X		X		X	X	X	X	X	X	X	X
Broomsedge	*Andropogon virginicus*	Herb	FAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wiregrass	*Aristida stricta*	Herb	FAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern false-willow	*Baccharis halimifolia*	Shrub	FAC		X	X														
Swamp fern	*Blechnum serrulatum*	Herb	FACW													X				
American bluehearts	*Buchnera americana*	Herb	FAC														X			
Dense-tuft hairsedge	*Bulbostylis capillaries*	Herb	FAC*			X														
Sedges	*Carex sp.*	Herb	FACW			X														
Nuttall's thistle	*Cirsium nuttallii*	Herb	FAC	X																
Coinwort	*Centella asiatica*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X						
Water-hemlock	*Cicuta mexicana*	Herb	OBL		X															
Wrinkled jointtailgrass	*Coelorachis rugosa*	Herb	FACW															X	X	X
Variable witchgrass	*Dichanthelium commutatum*	Herb	FAC	X																
White-top sedge	*Dichromena colorata*	Herb	FACW		X	X					X									
Buttonweed	*Diodea virginiana*	Herb	FACW	X																
Dwarf sundew	*Drosera brevifolia*	Herb	FACW	X		X		X	X	X			X	X		X				
Smooth elephants foot	*Elephantopus nudata*	Herb	FAC*			X													X	
Coastal spikerush	*Eleocharis cellulosa*	Herb	OBL	X																

Table 11 — *Continued*

Common Name	Scientific Name	Stratum	Wetland Indicator	Hydration Period																
				Baseline		Year 1			Year 2			Year 3			Year 4			Year 5		
				Mar '00	Oct '01	Dec '02	Mar '03	Jun '03	Dec '03	Apr '04	Jun '04	Oct '04	Apr '05	Jul '05	Oct '05	Mar '06	Jul '06	Oct '06	Mar '07	Jul '07
Fireweed	*Erechtites hieraciifolius*	Herb	FAC																X	X
Sugarcane plumegrass	*Erianthus giganteus*	Herb	OBL									X	X	X	X	X	X	X	X	X
Flattened pipewort	*Eriocaulon compressum*	Herb	OBL	X		X		X	X	X	X	X	X	X		X				
Pipewort	*Eriocaulon decangulare*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dogfennel	*Eupatorium capillifolium*	Herb	FAC							X									X	
Umbrellagrass	*Fuirena scirpoidea*	Herb	OBL											X		X	X			
Hedgehyssop	*Gratiola sp.*	Herb	FACW							X						X				
Roundpod St. John's-wort	*Hypericum cistifolium*		FACW																X	
Marsh St. John's-wort	*Hypericum fasciculatum*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
St. Andrew's cross	*Hypericum hypericoides*	Herb	FAC	X	X			X						X						
Myrtle leaf St. John's-wort	*Hypericum mrytifolium*	Herb	FACW			X			X											
Four petal St. John's-wort	*Hypericum tetrapetalum*	Herb	FAC			X			X		X									
Musky mint	*Hyptis alata*	Herb	OBL														X			
Dahoon holly	*Ilex cassine*	Shrub	OBL	X	X															
Gallberry	*Ilex glabra*	Shrub	FACW*			X	X		X											
Lesser creeping rush	*Juncus repens*	Herb	OBL							X	X		X	X		X	X	X		X
Red-root	*Lachnanthes caroliniana*	Herb	FAC		X	X					X	X	X	X			X	X		X
Southern bogbutton	*Lachnocaulon beyrichianum*	Herb	FACW				X	X			X									

Table 11 — *Continued*

Common Name	Scientific Name	Stratum	Wetland Indicator	Hydration Period																
				Baseline		Year 1			Year 2			Year 3			Year 4			Year 5		
				Mar '00	Oct '01	Dec '02	Mar '03	Jun '03	Dec '03	Apr '04	Jun '04	Oct '04	Apr '05	Jul '05	Oct '05	Mar '06	Jul '06	Oct '06	Mar '07	Jul '07
Southern cut grass	*Leersia hexandra*	Herb	OBL	X										X	X		X	X		X
Fetterbush	*Lyonia lucida*	Shrub	FACW	X																
Water hoarhound	*Lycopus rubellus*	Herb	OBL			X		X		X	X							X		X
Loosestrife	*Lythrum sp.*	Herb	OBL								X									
Sweetbay	*Magnolia virginica*	Tree	FAC*				X													
Bunch flower lily	*Melanthium virginicum*	Herb	OBL	X																
Black gum	*Nyssa sylvatica*	Tree	FAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Royal fern	*Osmunda regalis*	Herb	OBL						X											
Cinnamon fern	*Osmunda cinnamomea*	Herb	FACW												X					
Panicum	*Panicum commutatum*	Herb	FAC			X														
Erect-leaf witch grass	*Panicum erectifolium*	Herb	OBL	X				X	X	X					X		X	X	X	X
Shinning panic grass	*Panicum dichotomnum*	Herb	FACW	X																
Maidencane	*Panicum hemitomon*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red-top Panicum	*Panicum ridigulum*	Herb	FACW	X									X					X	X	X
Wooly Panicum	*Panicum scabriusculum*	Herb	OBL	X	X		X			X										
Switchgrass	*Panicum virgatum*	Herb	FACW	X			X											X		X
Panicum	*Panicum sp.*	Herb	FAC-OBL														X			
Swamp bay	*Persea palustris*	Herb	OBL							X	X	X	X	X	X	X	X	X		X
Blueflower butterwort	*Pinguicula caerulea*	Herb	OBL															X		X
Slash pine	*Pinus elliottii*	Tree	FACW*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 11 — *Continued*

Common Name	Scientific Name	Stratum	Wetland Indicator	Hydration Period: Baseline Mar '00	Baseline Oct '01	Year 1 Dec '02	Year 1 Mar '03	Year 1 Jun '03	Year 2 Dec '03	Year 2 Apr '04	Year 2 Jun '04	Year 3 Oct '04	Year 3 Apr '05	Year 3 Jul '05	Year 4 Oct '05	Year 4 Mar '06	Year 4 Jul '06	Year 5 Oct '06	Year 5 Mar '07	Year 5 Jul '07
Loblolly pine	*Pinus taeda*	Tree	FAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marsh fleabane	*Pluchea rosea*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Drumheads	*Polygala cruciata*	Herb	FACW										X							
Low pinebarren milkwort	*Polygala ramosa*	Herb	FACW					X			X									
Drumheads	*Polygala sp.*	Herb	FACW														X			
Mermaid-weed	*Proserpinaca pectinata*	Herb	OBL	X		X														
Oak seedling	*Quercus sp.*	Tree	FACW		X															
Meadow beauty	*Rhexia sp.*	Herb	FACW							X	X									
Softbristle horned beaksedge	*Rhynchospora corniculata*	Herb	OBL													X		X	X	X
Narrowfruit horned beaksedge	*Rhynchospora inundata*	Herb	OBL														X			
Beakrush	*Rhynchospora sp.*	Herb	UP-OBL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bartram's rosegentian	*Sabatia bartramii*	Herb	OBL								X	X								
Carolina willow	*Salix caroliniana*	Shrub	OBL			X			X			X								
Hooded pitcher plant	*Sarracenia minor*	Herb	FACW	X	X	X	X	X	X	X	X	X	X							
Bulrush	*Scirpus sp.*	Herb	OBL	X																
Little bluestem	*Schizachyrium scoparium*	Herb	FAC			X				X	X	X			X					
Nutrush	*Scleria baldwinii*	Herb	FACW	X	X	X		X			X						X	X		X
Sweetbroom	*Scoparia dulcis*	Herb	FAC															X		X
Bantam-buttons	*Syngonanthus flavidulus*	Herb	FACW							X	X					X	X	X	X	X

Table 11 — *Continued*

Common Name	Scientific Name	Stratum	Wetland Indicator	Baseline		Hydration Period														
						Year 1			Year 2			Year 3			Year 4			Year 5		
				Mar '00	Oct '01	Dec '02	Mar '03	Jun '03	Dec '03	Apr '04	Jun '04	Oct '04	Apr '05	Jul '05	Oct '05	Mar '06	Jul '06	Oct '06	Mar '07	Jul '07
Pond cypress	*Taxodium ascendens*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marsh St. John's-wort	*Triadenum walterii*	Herb	OBL	X																
Virginia chain fern	*Woodwardia virginica*	Herb	FACW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-eyed grass	*Xyris difformis*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Total Number of Species				36	25	33	20	24	24	27	31	22	24	24	20	24	28	29	23	30

Note:
Event dates: Baseline 3/15/00 and 10/8/01.
Hydration: Year 1 – 12/9/02, 3/13/03, 6/11/03. Year 2 – 12/3/03, 4/6/04, 6/10/04. Year 3 – 10/20/04, 4/27/05, 7/12/05. Year 4 – 10/25/05, 3/15/06, 7/15/06. Year 5 – 10/24/06, 4/5/07, 7/5/07
*National Wetlands Inventory Indicator Status and/or State of Florida Indicator Status by FDEP.
FAC = facultative
FACU = facultative upland
FACW = facultative wetland
OBL = obligate wetland
UP = upland

Table 12. Dominant species (greater than 9% relative cover) in herbaceous groundcover square-meter sampling plots at Port Orange Wetland

Species	Cover Plot No.							Cover	
	1	2	3	4	5	6	7	Percent	Relative
March 2000 Baseline									
Aristida stricta		3.33	11.00	3.33		1.67	0.33	2.81	9.82
Panicum hemitomon		0.33	17.33	1.33	4.00	11.67	15.00	7.10	24.79
October 2001 Baseline									
Amphicarpum muhlenbergianum	1.67		16.67	6.67	0.67			3.67	9.63
Carex sp.		5.00		13.33	1.00	18.67	26.67	9.24	24.25
Panicum hemitomon			51.67	1.67	3.33	11.00	33.33	14.43	37.88
October 2006 Hydration									
Panicum hemitomon			4.00	0.67	2.33	30.00	46.67	11.95	45.39
Rhynchospora corniculata				27.67	0.67	0.67	1.00	4.29	16.27
April 2007 Hydration									
Amphicarpum muhlenbergianum	2.33	2.33		0.67	2.33			1.10	11.92
Coelorachis rugosa		2.00	0.67	3.33	3.67			1.38	15.03
Panicum erectifolium	1.00	2.67		2.67				0.90	9.84
Panicum hemitomon			1.33	0.33	1.33	3.67	7.00	1.95	21.24
July 2007 Hydration									
Coelorachis rugosa		2.33	0.67	3.00	2.00	0.33		1.19	11.74
Panicum erectifolium	0.67	2.67		1.67	1.67			0.95	9.39
Panicum hemitomon			2.00	0.67	1.00	8.33	17.00	4.14	40.85

Belt Intercept (1-meter wide) Target Species. The target species composition along the three 1-meter-wide belt transects during the period covered in this report provided three obligate species (maidencane, pipewort, and St. John's-wort) and two facultative species (broomsedge and wiregrass).

All target species were observed during the 2 baseline events and the 15 hydration monitoring events.

Total and relative linear distance and frequency were calculated to produce an importance value for each of the target species and its indicator status along the three belt transects. The importance values for the baseline and hydration Year 5 are presented in Table 13. Importance value results for all years are presented in Appendix B.

Highest importance values during the baseline period varied between obligate and facultative species. During the March 2000 baseline event, combined obligate species recorded the highest importance value (71.73). These species were maidencane (36.17), followed by pipewort (22.83), and St. John's-wort (12.74). These same species reached a combined importance value of 44.82 in October 2001 of the baseline period, with pipewort at 22.28, maidencane at 17.97, and St. John's-wort at 4.57.

Facultative species wiregrass and broomsedge, combined, reached importance values of 28.27 in March 2000 and 55.18 in October 2001 of the baseline period.

Obligate species, combined, consistently had the highest importance values during hydration Year 5, with a peak of 63.03 in October 2006. Maidencane was the dominate species during each monitoring event in Year 5, with important values ranging from 53 to 55 (Table 13).

The two facultative species, broomsedge and wiregrass, reached a combined importance value of 36.94 in October 2006, of 37.19 in March 2007, and of 40.51 in July 2007 (Table 13).

Shrub/Sapling Community

For the purpose of data analysis and discussion, the canopy species were subdivided into three size classes:

- Shrub / sapling -- less than 2.5 centimeters dbh and more than 0.3 meter tall
- Subcanopy -- greater than or equal to 2.5 centimeters to less than 10.0 centimeters dbh
- Canopy -- greater than or equal to 10.0 centimeters dbh

Shrub / sapling sampling is conducted annually in conjunction with canopy / subcanopy sampling. Shrub / sapling data (Table 14) were collected twice during the baseline (September 2000 and October 2001) and five times during hydration (December 2002, December 2003, October 2004, October 2005, and October 2006). The shrub stratum in the Port Orange Wetland was very sparse during the study period.

Table 13. Herbaceous groundcover belt transects for target species at Port Orange Wetland

Species	Indicator	Percent Cover (%) Belt Transect Zone A	B	C	D	E	F	Total Mean Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
March 2000 (Baseline – 3/15/00)													
Andropogon virginicus	FAC	0.50	0.97	0.20	0.37	0.11		2.14	1.98	3.20	0.83	19.23	11.21
Aristida stricta	FAC	1.90	3.87	3.17	1.03	0.01		9.97	9.23	14.87	0.83	19.23	17.05
Eriocaulon decangulare	OBL	3.44	2.27	4.04	4.77	3.21		17.72	16.41	26.43	0.83	19.23	22.83
Hypericum fasciculatum	OBL	3.62	0.33	0.04	0.11	0.09		4.19	3.88	6.25	0.83	19.23	12.74
Panicum hemitomon	OBL	0.27	1.40	7.34	7.31	5.71	11.11	33.03	30.58	49.25	1.00	23.08	36.17
Total		9.73	8.83	14.78	13.59	9.12	11.00	67.05	62.09	100.00	4.33	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		2.40	4.83	3.37	1.40	0.11	0.00	12.12	11.22	18.07	1.67	38.46	28.27
OBL		7.33	4.00	11.42	12.19	9.00	11.00	54.94	50.87	81.93	2.67	61.54	71.73
Total		9.73	8.83	14.78	13.59	9.12	11.00	67.05	62.09	100.00	4.33	100.00	100.00
October 2001 (Baseline – 10/8/01)													
Andropogon virginicus	FAC	2.37	1.40	0.53	0.36	2.33	1.13	8.12	7.52	13.85	1.00	27.27	20.56
Aristida stricta	FAC	7.22	7.80	6.84	4.90	0.52		27.28	25.26	46.52	0.83	22.73	34.62
Eriocaulon decangulare	OBL	4.49	1.24	1.82	3.11	2.14		12.81	11.86	21.84	0.83	22.73	22.28
Hypericum fasciculatum	OBL	2.69						2.69	2.49	4.59	1.17	4.55	4.57
Panicum hemitomon	OBL	0.82	3.15	2.22	1.17	0.39		7.74	7.17	13.20	0.83	22.73	17.97
Total		17.60	13.59	11.40	9.54	5.38	1.13	58.65	54.30	100.00	3.67	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		9.59	9.20	7.37	5.26	2.85	1.13	35.40	32.78	60.37	0.83	50.00	55.18
OBL		8.01	4.39	4.03	4.28	2.53	0.00	23.24	21.52	39.63	1.83	50.00	44.82
Total		17.60	13.59	11.40	9.54	5.38	1.13	58.65	54.30	100.00	3.67	100.00	100.00

Table 13 — *Continued*

Species	Indicator	Percent Cover (%) Belt Transect Zone A	B	C	D	E	F	Total Mean Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
October 2006 (Year 5 – 10/5/06)													
Andropogon virginicus	FAC	1.92	1.20	1.04	1.21	1.27		6.63	6.14	10.14	0.83	29.41	19.78
Aristida stricta	FAC	0.64	2.63	2.08	1.70			7.05	6.53	10.79	0.67	23.53	17.16
Eriocaulon decangulare	OBL	0.94						0.94	0.87	1.44	0.17	5.88	3.66
Hypericum fasciculatum	OBL	1.55						1.55	1.43	2.37	0.17	5.88	4.12
Panicum hemitomon	OBL	2.96	6.48	1.97	11.73	8.03	18.00	49.18	45.53	75.26	1.00	35.29	55.28
Total		8.00	10.31	5.09	14.64	9.30	18.00	65.34	60.50	100.00	2.83	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		2.55	3.83	3.12	2.91	1.27	0.00	13.68	12.67	20.94	1.50	52.94	36.94
OBL		5.44	6.48	1.97	11.73	8.03	18.00	51.66	47.84	79.06	1.33	47.06	63.03
Total		8.00	10.31	5.09	14.64	9.30	18.03	65.34	60.50	100.00	2.83	100.00	100.00
March 2007 (Year 5 – 3/31/07)													
Andropogon virginicus	FAC	2.90	0.76	1.70	0.70	0.08		6.14	5.69	11.47	0.83	29.41	20.44
Aristida stricta	FAC	1.00	3.04	0.90	.40			5.34	4.94	9.97	0.67	23.53	16.75
Eriocaulon decangulare	OBL	1.18						1.18	1.09	2.20	0.17	5.88	4.04
Hypericum fasciculatum	OBL	.80						0.80	0.74	1.49	0.17	5.88	3.69
Panicum hemitomon	OBL	.97	1.61	2.35	6.64	12.54	16.00	40.11	37.14	74.87	1.0	35.29	55.08
Total		6.85	5.41	4.95	7.75	12.62	16.00	53.58	49.61	100.00	2.83	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		3.90	3.80	2.59	1.11	0.08	0.00	11.48	10.63	21.43	1.50	52.94	37.19
OBL		2.95	1.61	2.35	6.64	12.54	16.00	42.09	38.98	78.57	1.33	47.06	62.81
Total		6.85	5.41	4.95	7.75	12.62	16.00	53.58	49.61	100.00	2.83	100.00	100.00
July 2007 (Year 5 – 7/5/07)													
Andropogon virginicus	FAC	1.53	1.30	0.89	2.03	1.73		7.48	6.93	12.41	0.83	27.78	20.09
Aristida stricta	FAC	2.54	2.09	1.22	0.58	1.45		7.88	7.29	13.06	0.83	27.78	20.42

Table 13 — *Continued*

Species	Indicator	Percent Cover (%) Belt Transect Zone A	B	C	D	E	F	Total Mean Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Eriocaulon decangulare	OBL	0.93						0.93	0.86	1.54	0.17	5.56	3.55
Hypericum fasciculatum	OBL	0.52						0.52	0.48	0.86	0.17	5.56	3.21
Panicum hemitomon	OBL	0.30	0.92	3.17	7.67	13.45	18.00	43.51	40.28	72.13	1.0	33.33	52.73
Total		5.82	4.30	5.27	10.28	16.63	18.00	60.31	55.85	100.00	3.00	100.00	100.00
UPL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FAC		4.08	3.39	2.11	2.61	3.18	0.00	15.36	14.22	25.47	1.67	55.56	40.51
OBL		1.75	0.92	3.17	7.67	13.45	18.00	44.95	41.62	74.53	1.33	44.44	59.49
Total		5.82	4.30	5.27	10.28	16.63	18.00	60.31	55.85	100.00	3.00	100.00	100.00

Note:

m = meter

Table 14. Percent cover in shrub/sapling plots

Shrub Plot*	Scientific Name	Percent Cover						
		Baseline Period		Hydration Period				
		Sep 27, 2000	Oct 8, 2001	Dec 9, 2002	Dec 3, 2003	Oct 21, 2004	Oct 27, 2005	Oct 24, 2006
SA	*Taxodium ascendens*	10	15	10	7	6	7	12
SB	*Taxodium ascendens*	1	7	5	3	2	3	3
	Baccharis halimifolia		1	2				
SC	*Taxodium ascendens*		1	2	2	1	3	4
	Salix caroliniana				1	1		4

*Plot size = 5 meter x 5 meter

Percent cover of pond cypress dominated all plots during all sampling events and was greatest near the upland edge (plot SA, Table 14). During the December 2002 event, pond cypress and eastern false-willow were identified within the plots. In December 2003, eastern false-willow was absent from the plots, and 1% Carolina willow (*Salix caroliniana*) was observed in plot C. In October 2004, diversity and percent cover were similar to those in the previous 2 years but with slightly reduced values. In October 2005, only pond cypress was present in the shrub/sapling plots. A year later, in October 2006, percent cover of pond cypress was highest in plot A and Carolina willow was again observed in plot C.

Line Intercept. Results from the line intercept observations in the baseline and hydration periods varied (Table 15). Low density and infrequent occurrence of shrub/sapling species in the wetland over the study period resulted in marked changes in species importance value.

Pond cypress was the dominant shrub/sapling species identified along the 108-meter transect during the baseline period and hydration Year 5. Pond cypress total linear distance and frequency were highest near the middle of the transect. Two other shrub/sapling species were identified, eastern false-willow in October 2001 and Carolina willow in October 2006.

Table 15. Shrub/sapling line-intercept transect at Port Orange Wetland

Species	Linear Distance (m)						Total Linear Distance (m)	Cover		Frequency		Importance Value
18 m Interval*	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
September 2000												
Taxodium ascendens	0.30	0.31	1.50	0.40			2.51	2.32	100.00	0.67	100.00	100.00
Total	0.30	0.31	1.50	0.40			2.51	2.32	100.00	0.67	100.00	100.00

Table 15 — *Continued*

Species	Linear Distance (m)						Total Linear Distance (m)	Cover		Frequency		Importance Value
18 m Interval*	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
October 2001												
Baccharis halimifolia			0.62				0.62	0.57	35.63	0.17	33.33	34.48
Taxodium ascendens			0.73	0.39			1.12	1.04	64.37	0.33	66.67	65.52
Total			1.35	0.39			1.74	1.61	100.00	0.50	100.00	100.00
October 2006												
Taxodium ascendens			1.90	0.30		0.20	2.40	2.22	92.31	0.50	74.63	83.47
Salix caroliniana						0.20	0.20	0.19	7.69	0.17	25.37	16.53
Total			1.90	0.30		0.40	2.60	2.41	100.00	0.67	100.00	100.00

*Each Interval is approximately 18 meters. “A” is at the upland end, and “F” is at the deep end of the transect.

Canopy/Subcanopy

Encompassing approximately 6.5 acres, the wetland’s canopy is dominated by an open stand of pond cypress (*Taxodium ascendens*) and black gum (*Nyssa sylvatica*), with a dense groundcover of grasses and sedges. The canopy cypress trees appear to be evenly aged. The wildfires of 1998 may have contributed to this condition by killing some of the smaller, younger cypress.

The canopy/subcanopy stratum was sampled twice during the baseline period (September 2000 and October 2001) and five times during hydration (December 2002, December 2003, October 2004, October 2005, and October 2006). During the initial plot setup in September 2000 (Appendix B), 98 trees were tagged. No changes in dominance, density, or frequency were observed in the canopy/subcanopy stratum between 2001 and 2006. Growth and recruitment to this layer were relatively slow compared to herbaceous and shrub/sapling communities.

Changes in importance value between the hydration period and the baseline were most noticeable in species with very low numbers of individuals. As the relative frequency of a given species was averaged with the relative density to calculate the importance value, species with low numbers of individuals showed large changes in relative frequency based on the presence or absence of only a few individuals.

Care must be taken when using importance values to evaluate changes in low-density species. Species such as pond cypress, which dominate the Port Orange Wetland canopy/subcanopy stratum, showed less of a change in importance value between the October 2001 (baseline) and October 2006 (hydration Year 5) monitoring events. Pond cypress showed a small increase in importance value in the subcanopy and a small decrease in the canopy. Individual tree dbh information and basal area calculations are provided in Appendix B.

During the October 2006 event, 98 trees from four species were identified within the tree plot, four fewer than in the previous event, in October 2005 (Table 16). Of these, 33 were canopy-sized (at least 10 centimeters dbh). The most common canopy species was pond cypress with an importance value of 72.08, a slight decrease from the 2001 baseline event (78.32). Other species recorded included loblolly pine (Pinus taeda), black gum (Nyssa sylvatica), and slash pine (Pinus elliottii), with importance values of 12.07, 10.19, and 5.66, respectively. The October 2006 canopy density was 247.41 trees per acre. The basal area of the trees (or dominance) was 65.24 square feet per acre.

Table 16. Importance values for canopy and subcanopy at Port Orange Wetland

Species	Sep 27, 2000 Baseline		Oct 8, 2001 Baseline		Oct 24, 2006 Hydration Year 5		% Change Oct 06-Oct 01
	Count	Importance Value	Count	Importance Value	Count	Importance Value	
Canopy							
Nyssa sylvatica	1	7.45	1	6.70	3	10.19	52.09
Pinus elliottii			1	5.75	1	5.66	-1.57
Pinus taeda	2	8.47	3	9.24	5	12.07	30.63
Taxodium ascendens	23	84.09	24	78.32	24	72.08	-7.97
Total	**26**	**100.00**	**29**	**100.00**	**33**	**100.00**	
Subcanopy							
Nyssa sylvatica	3	14.07	3	15.54	1	6.41	-58.75
Pinus elliottii	1	4.85					
Pinus taeda	4	8.40	3	7.92	1	6.59	-16.79
Taxodium ascendens	64	72.68	63	76.54	63	87.00	13.37
Total	**72**	**100.00**	**69**	**100.00**	**65**	**100.00**	

Note:
Values for relative density and relative frequency used to calculate importance values are presented in Appendix B.

The canopy continues to recruit trees at a slow pace from the subcanopy. Sixty-five trees from three species were identified as subcanopy-sized trees (less than 10 centimeters dbh) (Table 16). The most common subcanopy species was pond cypress, with an importance value of 87.00, an increase from the 2001 baseline event (76.54). The October 2006 subcanopy density was 487.33 trees per acre. The basal area of the trees (or dominance) was 16.08 square feet per acre.

ANIMALS

Benthic Macroinvertebrates

Samples were collected once during the baseline period (August 2001) and four times during the hydration period (March 2003, October 2003, July 2005, and October 2005). No benthic samples were collected during hydration Year 5. When water levels are low, surface water collects in pools and becomes isolated. Benthic macroinvertebrates are not sampled under these conditions due to the absence of some micro-habitats making the samples unrepresentative. Benthic samples were analyzed to nearest taxa possible (usually genus) by Pennington and Associates Inc. Benthic macroinvertebrate laboratory results and information on the taxa collected are presented in Appendix C. Most of the taxa from the four collections are those that are tolerant of drought conditions (small with short lifespans) and are considered typical of poor or moderate habitat quality.

Fish

The fish community was sampled once along the main transect during the baseline period (October 2001) and four times during the hydration period (December 2002, October 2003, October 2004, and October 2005). During the baseline event, five fish were collected with five tosses of the Wegener Ring; they were four specimens of mosquito fish (*Gambusia affinis*) and one pygmy killifish (*Leptolucania ommata*) (Table 17).

The wetland was sampled for fish, but none were collected, during the hydration period in December 2002, October 2004, and October 2005. Fish were sampled for and collected in October 2003; the two species collected were mosquito fish and killifish (*Heterandria formosa*). Fish were also observed at the Port Orange Wetland during the March 2003 event but according to the sampling schedule were not collected.

Table 17. Fish sampling data from Port Orange Wetland

Toss	Depth		Fish*				Dissolved Oxygen (mg/L)		Temperature (°C)	
	Meters	Feet	Common Name	Species name	Count	Density (#/m^2)	Surface	Bottom	Surface	Bottom
October 8, 2001										
1	0.24	0.80	Mosquito fish	*Gambusia affinis*	2	3.19	3.75	3.9	23.9	23.8
			Pigmy killifish	*Leptolucania ommata*	1	1.06				
2	0.24	0.80			0	0.00	3.9	3.22	23.8	23.8
3	0.27	0.90	Mosquito fish	*Gambusia affinis*	2	2.13	3.65	3.50	23.8	23.8
4	0.24	0.80			0	0.00	2.79	2.65	23.7	23.7
5	0.22	0.73			0	0.00	3.21	3.22	23.7	23.7
Average	0.25	0.81			1.0	1.06	3.46	3.30	23.8	23.8
December 9, 2002 *Fish sampled but none collected										
October 21, 2003										
1	0.24	0.80	Killifish	*Heterandria formosa*	1	1.06	2.09	2.00	22.7	22.5
2	0.21	0.69			0	0.00	1.89	2.10	22.1	22.3
3	0.23	0.76			0	0.00	2.73	2.11	22.6	22.5
4	0.20	0.66			0	0.00	3.01	2.62	22.7	22.7
5	0.17	0.55	Mosquito fish	*Gambusia affinis*	1	1.06	1.75	1.83	22.2	22.4
Average	0.21	0.69			0.4	0.42	2.29	2.13	22.5	22.5
October 21, 2004 * Fish sampled but none collected										
October 25, 2005 * Fish sampled but none collected										
October 24, 2006 * No surface water present										

*Fish sampling conducted with five 0.94-m^2 Wegener Ring tosses along center transect.

Amphibians

A full presentation of the 2007 amphibian survey results, *Assessment of Amphibian Response to Wetlands Augmentation Fifth Annual Report*, will be submitted by CPI directly to the District. A brief summary of the CPI survey results from 2007, specifically the drift-fence array new captures, is included in this CH2M HILL annual report. The presence of additional amphibian species has been detected through other sampling techniques used by CPI during its live capture-release study. These include a pitfall trap, ground PVC pipes (for treefrog capture), cover boards, incidental collecting, dip-netting, and aural (auditory) surveys (Means and Meegan 2007). The same sampling methods have been employed during all of the survey periods.

Baseline Period. University of Florida biologists Franz, Means, and Johnson surveyed amphibian populations monthly during the baseline period, from January through September 1999 and January through September 2000.

Frog species observed in the Port Orange Wetland were common to northeast Florida wetlands amid pine flatwoods. Study results, in number and species composition, were typical of the drought conditions found throughout the region. Ten amphibians were identified (by drift-fence array capture) during the 2-year baseline period (Franz and Means 2001).

Hydration Period (2007). Amphibian populations at the Port Orange Wetland were surveyed monthly from January through September 2007 by CPI biologists Means and Meegan. The wetland and the control wetlands were dry throughout 2007, which was the second consecutive year of drought in Florida. Because of the dry conditions, no breeding took place (Means and Meegan 2007). Water levels in the wetland were below ground surface throughout the year, similar to 2006 conditions. Table 18 presents a list of the amphibian species observed at or near the Port Orange Wetland using the drift-fence array capture method.

Table 18. Herpetological species captured in drift-fence arrays at Port Orange Wetland through September 2007

Common Name	Scientific Name	Baseline Period 1999–2000	Hydration Period				
			2003	2004	2005	2006	2007
Amphibians							
Florida cricket frog	*Acris gryllus*	22	24	34	47	8	
Oak toad	*Bufo quercicus*	52	11	7	4	3	
Southern toad	*Bufo terrestris*	5	1				
Greenhouse frog*	*Eleutherodactlyus planirostris**			3	2	1	
Eastern narrow-mouthed toad	*Gastrophryne carolinensis*	39	15	30	28	15	
Green treefrog	*Hyla cinerea*	1		1	3		
Pine woods treefrog	*Hyla femoralis*	53	20	16	20	7	2
Squirrel treefrog	*Hyla squirella*	22	5	15	25	5	1
Florida chorus frog	*Pseudacris nigrita*	1		3	3		
Little grass frog	*Pseudacris ocularis*	7	7	6	12	4	
Southern leopard frog	*Rana sphenocephala*	11	153	25	55	8	
Dwarf siren	*Pseudobranchus axanthus*		1				
Number of individuals (abundance)		213	237	140	199	51	3
Number of species (richness)		10	9	10	10	8	2

Source, baseline: Franz. and Means 2001.
Source, hydration years: Means and Meegan 2003, 2004, 2005, 2006.
* Exotic species

General Wildlife Observed

Wildlife within the wetland and adjacent upland areas was recorded as observed during each sampling event. Wildlife observed included little grass frog (*Pseudacris ocularis*), oak toads (*Bufo quercicus*), five-lined skink (*Eumeces fasciatus*), eastern diamondback rattlesnake (*Crotalus adamanteus*), water moccasin (*Agkistrodon piscivorus*), green anoles (*Anolis carolinensis*), zebra longwing (*Heliconius charitonius*) and zebra swallowtail (*Eurytides Marcellus*) butterflies, red-shouldered hawk (*Buteo lineatus*), black vulture (*Coragyps atratus*) and turkey vulture (*Cathartes aura*), wild turkeys (*Meleagris gallopavo*), downy woodpecker (*Picoides pubescens*), red-bellied woodpecker (*Melanerpes carolinus*), brown-headed nuthatch (*Sitta pusilla*), belted kingfisher (*Ceryle alcyon*), gray catbird (*Dumetella carolinensis*), northern cardinal (*Cardinalis cardinalis*), tufted titmouse (*Baeolophus bicolor*), northern bobwhite (*Colinus virginianus*), sandhill cranes (*Grus canadensis*), bald eagle (*Haliaeetus leucocephalus*), and white-tailed deer (*Odocoileus virginianus*).

PHOTO STATIONS

Photos of the Port Orange Wetland were taken once during the baseline period and 14 times during the hydration period. Photos were taken from the center of the 5-meter by 5-meter shrub plots are included in this final report.

SUMMARY

This fifth annual report provides a comparison of the results from the baseline period with the 60-month hydration period. The baseline investigation provided background information on the wetland hydrology and biological community. The hydration period began in May 2002 with the completion of the water delivery system constructed by Port Orange Utilities from Well 19 to the wetland edge.

The objective of the Port Orange water delivery system is to increase the depth and length of time of inundation/saturation of surface water within the wetland during the normal wet season without increasing flooding during major storm events. With the onset of hydration, water levels and the duration of inundation in the wetland have increased relative to the baseline period. Mean water level was approximately 0.80 foot higher during the hydration period than in the baseline period. Water levels exceeded wetland ground surface (elevation 38.2 feet NAVD88) 62% of the time during the hydration period, compared to 42% during the baseline period.

A comparison of field-measured elevations of the vegetative hydrologic indictors to those used by the St. Johns River and Southwest Florida Water Management Districts (Carr and Rochow 2004) showed that the Port Orange field data compared relatively well for most of the indicators measured (Table 6). The normal pool at the Port Orange Wetland was estimated to occur at the same elevation as the lower cypress buttress point and the ground surface of the palmetto edge.

Data presented by SWFWMD (1999) indicate that the median stage value for normal pool for non-impacted wetlands ranged within 1.0 foot of the normal pool. Therefore, a reasonable target elevation for restoration of water levels at the Port Orange Wetland would be between 38.4 and 39.4 feet NAVD88. The median stage value of the hydration period exceedence curve was 38.4 feet NAVD88, or 1.0 foot below normal pool.

Rainfall totaled 107 inches during the 27-month baseline period and averaged 48 inches annually, which was consistent with the annual average rainfall for the area (48 to 50 inches). Rainfall averaged 58 inches per year during the hydration period, above the normal average. During hydration Year 3, rainfall totaled 69 inches because of hurricanes in 2004. On September 6, 2004, water levels in the wetland rose to their maximum recorded value (41.26 feet NGVD), 0.58 feet above the previous maximum record for this study. At 41.5 inches, rainfall was lowest during hydration Year 5.

During hydration Year 1, application resulted in a total supply of 8.5 inches (1.5 MG) applied over four months in 2002. Year 2's application resulted in a total supply of 24.4 inches (4.3 MG) applied over 8 months in 2003. Year 3's application resulted in a total supply of 14.0 inches (2.5 MG) applied over 6 months in 2004. Year 4's application resulted in a total supply of 25.0 inches (4.4 MG) applied over 8 months in 2005. Finally, Year 5's application resulted in a total supply of 23.9 inches (3.8 MG) applied over 9 months in 2006 and 2007. The data suggest that increased inputs from rainfall combined with applied groundwater during the hydration period had a moderate effect on the average groundwater elevation.

In general, surface-water quality sampled during the baseline period was similar to that of the hydration period and comparable to that of cypress wetlands surrounded by natural and managed pine community uplands. However, some differences are apparent in a few water quality parameters. A more in-depth assessment of these anomalies will be made for the final report in 2008.

The wetland vegetation, both woody and herbaceous, is dominated by obligate wetland species. No obvious changes or trends were observed in the plant community's structure (canopy, subcanopy, shrub, and groundcover) or species composition between the baseline period and the hydration period to date. A more in-depth assessment of these data will be made for the final report in 2008.

The results of benthic macroinvertebrate and fish community sampling showed densities and species richness that varied between seasonal sampling events. These species were dominated by taxa tolerant to wetland physical and chemical characteristics. No data were collected for these communities during hydration Year 5 because water levels were below the wetland surface for the entire year.

Amphibian surveys were conducted by CPI from January through September each year. A full presentation of these survey results is presented by CPI to the District. Amphibian species richness and abundance in 2007 were reduced compared to observations from previous monitoring years at the Port Orange Wetland. No breeding occurred during this second consecutive year of drought (Means and Meegan 2007).

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Appendix A
Water Quality Laboratory Data

Columbia Analytical Services INC.
An Employee-Owned Company

September 21, 2001

Service Request No. J2102715

Bill Dunn
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Project No.: 147556.IA.PO
Project Name: Port Orange

Dear Bill Dunn:

Enclosed are the results of the samples(s) submitted to our laboratory on August 30, 2001. For your reference, these analyses have been assigned our service request number: J2102715.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in the entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Paul Gunsaulies

Paul Gunsaulies
Project Manager

CAS Jacksonville is NELAC-accredited by the State of Florida (E82502). Other state accreditations include: LA, AI 30759; MA, M-FL937; NH, 2942; NC, 527; SC, 96021; WA, C278.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2102715
Project:	Port Orange / 147556.IA.PO	**Date Collected:**	8/28/01
Sample Matrix:	Water	**Date Received:**	8/30/01
		Date Extracted:	9/6/01

Total Metals
Units: mg/L(ppm)

		Sample Name:	**PO-BL**	**PO-FB**	**Method Blank**
		Lab Code:	J2102715-001	J2102715-002	J210906-MB
		Date Analyzed:	9/10-11/01	9/10-11/01	9/10-11/01
Analyte	**EPA Method**	**MRL**			
Cadmium	200.8	0.001	U	U	U
Calcium	200.7	0.5	3.9	U	U
Copper	200.8	0.002	U	U	U
Iron	200.7	0.1	1.5	U	U
Lead	200.8	0.002	U	U	U
Magnesium	200.7	0.1	1.4	U	U
Nickel	200.8	0.002	U	U	U
Potassium	200.7	2.0	U	U	U
Sodium	200.7	0.2	3.1	U	U
Zinc	200.8	0.01	U	U	U

U Not detected at or above the MRL.

Approved By: Paul [signature] Date: 9/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2102715
Project:	Port Orange/147556.IA.PO	**Date Collected:**	8/28/01
Sample Matrix:	Water	**Date Received:**	8/30/01
		Date Extracted:	NA

Inorganic Parameters

				Sample Name:	**PO-BL**	**PO-FB**	**Method Blank**
				Lab Code:	J2102715-001	J2102715-002	J210830-MB
Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**			
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	9/10/01 1000	6	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	9/20/01 1015	U	U	U
Chloride	mg/L (ppm)	300.0	0.4	8/30/01 1516	5.6	0.48	U
Color	Color Units	110.2	5	8/30/01 2105	500	U	U
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	8/30/01 1516	U	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	8/30/01 1726	0.012	U	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	9/6/01 0710	0.058	U	U
Solids, Total Dissolved	mg/L (ppm)	160.1	10	9/4/01 1400	94	U	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	8/31/01 1030	10	U	U
Sulfate	mg/L (ppm)	300.0	1	8/30/01 1516	U	U	U
TKN	mg/L (ppm)	351.4	0.5	9/18/01300	1.6	U	U
TOC	mg/L (ppm)	415.1	1.0	9/20/01	25	U	U
Turbidity	NTU	180.1	0.1	8/30/01 2040	5.3	U	U

U Not detected at or above the MRL.

Approved By: Paul [signature] Date: 9/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2102715
Project:	Port Orange / 147556.IA.PO	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Extracted:	9/6/01
		Date Analyzed:	9/10-11/01

Duplicate Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Note
Cadmium	200.8	0.001	0.0205	0.0179	0.0192	14	
Calcium	200.7	0.5	33.5	33.7	33.6	1	
Copper	200.8	0.005	0.0432	0.0371	0.0402	15	
Iron	200.7	0.1	29.0	29.0	29.0	<1	
Lead	200.8	0.002	0.0600	0.0515	0.0558	15	
Magnesium	200.7	0.1	22.0	21.7	21.8	1	
Nickel	200.8	0.005	0.0490	0.0429	0.0460	13	
Potassium	200.7	2.0	52.9	52.0	52.4	2	
Sodium	200.7	0.2	42.3	42.4	42.4	<1	
Zinc	200.8	0.02	0.0520	0.0446	0.0483	15	

Approved By: [signature] Date: 9/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill		**Service Request:**	J2102715
Project:	Port Orange / 147556.IA.PO		**Date Collected:**	NA
Sample Matrix:	Water		**Date Received:**	NA
			Date Extracted:	9/6/01
			Date Analyzed:	9/10-11/01

Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptanc Limits**	**Result Note**
Cadmium	200.8	0.001	0.0200	U	0.0205	103	75-125	
Calcium	200.7	0.5	20.0	12.7	33.5	104	75-125	
Copper	200.8	0.005	0.0500	U	0.0432	86	75-125	
Iron	200.7	0.1	2.00	26.3	NA	NC	75-125	a
Lead	200.8	0.002	0.0500	0.00575	0.0600	109	75-125	
Magnesium	200.7	0.1	10.0	11.8	22.0	102	75-125	
Nickel	200.8	0.005	0.0500	U	0.0490	98	75-125	
Potassium	200.7	2.0	50.0	3.10	52.9	100	75-125	
Sodium	200.7	0.2	10.0	32.2	42.3	101	75-125	
Zinc	200.8	0.02	0.0500	U	0.0520	104	75-125	

U Not detected at or above the MRL.

a Not Applicable because of the sample matrix. Accuracy of spike recovery value is reduced since the sample concentration is greater than four times the amount spiked.

Approved By: Paul [signature] Date: 7/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2102715
Project:	Port Orange / 147556.IA.PO	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	9/10-11/01

Laboratory Control Sample Summary
Total Metals
Units: mg/L(ppm)

Analyte	**EPA Method**	**TRUE VALUE**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Cadmium	200.8	0.0200	0.0202	101	80-120
Calcium	200.7	20.0	20.7	104	80-120
Copper	200.8	0.0500	0.0469	94	80-120
Iron	200.7	2.00	2.07	104	80-120
Lead	200.8	0.0500	0.0498	100	80-120
Magnesium	200.7	10.0	10.2	102	80-120
Nickel	200.8	0.0500	0.0488	98	80-120
Potassium	200.7	50.0	50.6	101	80-120
Sodium	200.7	10.0	10.3	103	80-120
Zinc	200.8	0.0500	0.0524	105	80-120

Approved By: [signature] Date: 9/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Port Orange/147556.IA.PO
Sample Matrix: Water

Service Request: J2102715
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 8/30-9/20/01

Duplicate Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**Units**	**EPA Method**	**MRL**	**Sample Result**	**Duplicate Sample Result**	**Average**	**Relative Percent Difference**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	146	146	146	<1
Ammonia as N	mg/L (ppm)	350.3	0.1	0.113	0.103	0.108	9.26
Chloride	mg/L (ppm)	300.0	0.2	0.61	0.55	0.58	10.34
Color	Color Units	110.2	5	10	10	10	<1
Orthophosphate as P	mg/L (ppm)	365.3	0.01	1.03	1.01	1.02	1.96
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	U	U	U	<1
Solids, Total Dissolved	mg/L (ppm)	160.1	10	94	101	97.5	7.18
Solids, Total Suspended	mg/L (ppm)	160.2	5	U	U	U	<1
Sulfate	mg/L (ppm)	300.0	0.2	U	U	U	<1
TKN	mg/L (ppm)	351.4	0.5	1.69	1.51	1.6	11.25
TOC	mg/L (ppm)	415.1	1.0	20.9	21.2	21.05	1.43
Turbidity	NTU	180.1	0.1	1.2	1.19	1.195	0.84

U Not detected at or above the MRL.

Approved By: Paul Hanrahan Date: 1/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2102715
Project:	Port Orange/147556.IA.PO	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	8/30-9/20/01

Matrix Spike Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**Units**	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	52.3	146	200	103	NA
Ammonia as N	mg/L (ppm)	350.3	0.1	20	0.113	20.4	101	75-125
Chloride	mg/L (ppm)	300.0	0.2	5	0.61	4.92	86.2	85-115
Orthophosphate as P	mg/L (ppm)	365.3	0.01	2.5	1.03	3.35	92.8	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	1.0	U	0.894	89.4	75-125
Sulfate	mg/L (ppm)	300.0	0.2	10	U	10	100	85-115
TKN	mg/L (ppm)	351.4	0.5	10	1.69	11.1	94.1	75-125
TOC	mg/L (ppm)	415.1	1.0	20	2.1	20.9	94.0	75-125

U Not detected at or above the MRL.

Approved By: Paul [signature] Date: 9/24/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2102715
Project:	Port Orange/147556.IA.PO	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	8/30-9/20/01

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	**Units**	**EPA Method**	**TRUE Value**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	51	52	102	75-125
Ammonia as N	mg/L (ppm)	350.3	10	10.4	104	75-125
Chloride	mg/L (ppm)	300.0	10	9.73	97.3	90-110
Color	Color Units	110.2	25	25	100	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.500	100	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.5	0.466	93.2	75-125
Solids, Total Dissolved	mg/L (ppm)	160.1	300	312	104	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	76	95.0	75-125
Sulfate	mg/L (ppm)	300.0	10	10.1	101	90-110
TKN	mg/L (ppm)	351.4	10	7.54	75.4	75-125
TOC	mg/L (ppm)	415.1	141	131	92.9	75-125
Turbidity	NTU	180.1	20	20.2	101	75-125

Approved By: Paul [illegible] Date: 9/24/01

Cooler Receipt and Preservation Form

Project/Client: Port Orange/CH2M Hill **SR Number:** J2102715

Cooler received on 8/30/01 by: SS

Courier: CAS ☐ UPS ☐ FEDEX ☒
CLIENT ☐ CD&L ☐ OTHER ☐

	Yes	No	N/A
1. Were custody seals on the outside of the cooler?	☒	☐	☐
2. Were custody seals intact?	☒	☐	☐
3. Were custody papers properly filled out(ink, singed, ect.)?	☒	☐	☐
4. Did all bottles arrive in good condition(unbroken)?	☒	☐	☐
5. Did any VOA vials contain significant air bubbles?	☐	☒	☐
6. Were ice or ice packs present?	☒	☐	☐
7. Did all samples arrive within appropriate holding times?	☒	☐	☐

8. Where did the bottles originate? CAS/JAX ☒ CLIENT ☐

9. Temperature of cooler(s) upon receipt/within 0-6C?:

	Temp.	Yes	No	N/A		Temp.	Yes	No	N/A
Cooler 1:	2.1	☒	☐	☐	Cooler 3:		☐	☐	☐
Cooler 2:		☐	☐	☐	Cooler 4:		☐	☐	☐

Date/Time Temperature Taken: 8/30/01 10:40 **If No/NA, Explain**

Thermometer ID: 2618380101-0015 ☐ Temp Blank: ☐ Cooler Temp.: ☐
15-078-J-4 ☐ Sample Bottle: ☐ IR. Gun: ☒

If out of temperature, client approval to run samples

Cooler Breakdown: Date: 8/30/01 By: SS

	Yes	No	N/A
1. Were all the bottle labels complete(i.e. analysis, preservation, ect.)	☒	☐	☐
2. Did all bottle labels and tags agree with custody papers?	☒	☐	☐
3. Were correct containers used for the test indicated?	☐	☒	☐

4. Air samples: Cassettes/Tubes Intact: ☐ Tedlar Bags Inflated: ☐
Canisters Pressurized: ☐ NA: ☒

Explain any discrepancies TOC container not received. Unpreserved volume preserved with HCL.

		Yes	No	Sample ID	Reagent	Volume Added
pH	Reagent					
>12	NaOH					
>9	NaOH+ZnAc					
<2	HNO3	X				
<2	H2SO4	X				
<2	HCl					
5-9*	P/PCB (608 Only)					

* If pH adjustment is required, use NaOH/or H2SO4 PM OK to adjust pH________

YES= All samples OK NO=Samples were preserved at lab as listed

VOC Vial pH Verification(Tested after Analysis) Following Samples Exhibited pH >2				

Other Comments:

Columbia Analytical Services, Inc.
An Employee-Owned Company
www.caslab.com

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

8540 Baycenter Rd. • Jacksonville, FL 32256 • (904) 739-2277 • 800-695-7222 x06 • FAX (904) 739-2011

PAGE 1 OF 1

SR # 2715
CAS Contact

Project Name: Port Orange
Project Number: 147556.IA.PO
Project Manager: Bill Dunn
Report CC: Steve Eakin
Company/Address: CH2M HILL Inc.
3011 SW Williston Rd.
Gainesville, FL 32608
Phone # (352) 335-7991
FAX# (352) 335-2959
Sampler's Signature: [signature]
Sampler's Printed Name: Steve B. Eakin

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

CLIENT SAMPLE ID	LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NUMBER OF CONTAINERS	Alk, NH3, Ca, Cl	Color, NO3+NO2 as N	Ortho Phos, Potassium	Sodium, SO4	TDS, TKN, TOC	TP, TSS, Turb.	Metals (*)	REMARKS/ ALTERNATE DESCRIPTION
PO-BL		8/28/01	1915	WTR	4	X	X	X	X	X	X	X	
PO-FB		↓	1930	WTR	4	X	X	X	X	X	X	X	

PRESERVATIVE

Preservative Key
0. NONE
1. HCL
2. HNO_3
3. H_2SO_4
4. NaOH
5. Zn. Acetate
6. MeOH
7. $NaHSO_4$
8. Other ______

SPECIAL INSTRUCTIONS/COMMENTS
* Metals:
Cadmium, Copper, Iron, Lead, Magnesium, Nickel, Zinc

See QAPP ☐

TURNAROUND REQUIREMENTS
____ RUSH (SURCHARGES APPLY)
X STANDARD
REQUESTED FAX DATE ______
REQUESTED REPORT DATE ______

REPORT REQUIREMENTS
____ I. Results Only
X II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
____ III. Results + QC and Calibration Summaries
____ IV. Data Validation Report with Raw Data
____ V. Specialized Forms / Custom Report
Edata ____ Yes ____ No

INVOICE INFORMATION
PO#
BILL TO:

SAMPLE RECEIPT: CONDITION/COOLER TEMP: 2.1°C
CUSTODY SEALS: Y N

	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	[signature]	[signature]				
Printed Name	Steve B. Eakin	S. Bouch				
Firm	CH2M HILL	CAS				
Date/Time	08/29/01	8/30/01 1040				

Distribution: White .. um to Originator; Yellow - Lab Copy; Pink - Retained by Client

SCOC-1000-07

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J031407
Project Name:	Port Orange	**Date Sampled:**	3/13/2003
Project Number:	147556.03.PO	**Date Received:**	3/14/03 09:45
		Date Reported:	3/26/03

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Port Orange

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 3+2 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange
Report No.: J031407
Date/Time Received: 3/14/03 09:45

Lab Code: J031407-01
Client Sample ID: PO1
Site: Surface Water
Matrix: Water
Date/Time Sampled: 3/13/2003 12:00
Sampled By: Steve Eakin
Shipping Method: Fed Ex

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.050	0.050	**0.050**	mg/L	U	E350.1		*T*
* Color	1	5.0	5.0	**250**	Color Units		110.2		*J*
Conductivity	1	2.0	2.0	**36**	µmhos/cm		E120.1		*J*
Nitrate + Nitrite (as N)	1	0.050	0.050	**0.050**	mg/L	U	SM4500NO3-F		*T*
Ortho-phosphate (as P)	1	0.090	0.090	**0.090**	mg/L	, U	E365.2		*J*
Sulfate (as SO4)	1	2.5	2.5	**2.5**	mg/L	U	E375.4		*T*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*T*
Total Chlorides	1	2.5	2.5	**7.0**	mg/L	i	E325.3		*T*
Total Dissolved Solids	1	10	10	**90**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.050	0.050	**1.5**	mg/L		E351.2		*T*
Total Organic Carbon	1	1.0	1.0	**26**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.050	0.050	**0.050**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	4.0	4.0	**31**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**4.0**	NTU		E180.1		*J*

Total Metals

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00036	0.00036	**0.00036**	mg/L	U	E200.7		*J*
Calcium	1	0.018	0.018	**2.5**	mg/L		E200.7		*J*
Copper	1	0.0011	0.0011	**0.0011**	mg/L	U	E200.7		*J*
Iron	1	0.019	0.019	**0.54**	mg/L		E200.7		*J*
Lead	1	0.00091	0.00091	**0.0032**	mg/L	i	E200.7		*J*
Magnesium	1	0.016	0.016	**0.76**	mg/L		E200.7		*J*
Nickel	1	0.00085	0.00085	**0.00085**	mg/L	U	E200.7		*J*
Potassium	1	0.11	0.11	**0.56**	mg/L		E200.7		*J*
Sodium	1	0.049	0.049	**4.0**	mg/L		E200.7		*J*
Zinc	1	0.0025	0.0025	**0.0066**	mg/L	i	E200.7		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Color -- Analyte is applied for and approved by NELAC, awaiting certified analyte sheets.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J031407

Project Name: Port Orange **Date/Time Received:** 3/14/03 09:45

Sample Cross Reference Information

Lab Code: J031407-01 **Site: Surface Water**

Client Sample Number: PO1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT031803	3/18/2003 10:23	NBM		
Color	110.2	NONE	WCJ-031403-COLO	3/14/2003 13:50	AGF		
Conductivity	E120.1	NONE	WCJ-031403-COND	3/14/2003 11:45	AGF		
Nitrate + Nitrite (as N)	SM4500NO3-F	NONE	WCT031803NO3	3/18/2003 12:26	JH		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-031403-ORTH	3/14/2003 14:13	KDC		
Sulfate (as SO4)	E375.4	NONE	WCT031803SO4	3/18/2003 13:00	SB		
Total Alkalinity (as CaCO3)	E310.1	NONE	wct032003alk	3/20/2003 14:00	MC		
Total Chlorides	E325.3	NONE	WCT032103CL	3/21/2003 08:38	NBM		
Total Dissolved Solids	E160.1	NONE	WCJ-031703-TDS	3/17/2003 10:55	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	wct031903tkn	3/19/2003 16:37	SS		
Total Metals	E200.7	METHOD	M031703-3010 #1	3/17/2003 14:11	KC	M031703-3010 #1	3/17/2003 09:55:
Total Organic Carbon	E415.1	NONE	WCT31803TOC	3/18/2003 14:15	DLS		
Total Phosphorus (as P)	E365.4	NONE	wct032003tp	3/20/2003 16:02	SS		
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-031703-TSS	3/17/2003 15:00	KDC		
Turbidity	E180.1	NONE	WCJ-031403-TURB	3/14/2003	AGF		

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with an 'i' qualifier

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J031407
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J031407-01	PO1	Total Phosphorus (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03	1	250mL Poly (H2SO4)
J031407-01	PO1	TOC (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03	1	250mL Poly (H2SO4)
J031407-01	PO1	TKN (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03		250mL Poly (H2SO4)
J031407-01	PO1	Sulfate (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03		250mL Poly (unpres.)
J031407-01	PO1	Nitrate + Nitrite (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03		250mL Poly (H2SO4)
J031407-01	PO1	Chlorides (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03	1	250mL Poly (unpres.)
J031407-01	PO1	Ammonia (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03		250mL Poly (H2SO4)
J031407-01	PO1	Alkalinity (T)	Water	3/13/03	12:00	3/14/03 9:45	3/25/03		250mL Poly (unpres.)

Jacksonville Relinquisher: Macholz **Shipping Receiver:** Pony Express **Date/Time:** ~~[illegible] AM~~ 3/17/03 1600

Shipping Relinquisher: P.K **Tampa Receiver:** [signature] **Date/Time:** 3/18/03 945

80

Advanced Environmental Laboratories, Inc.

❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

J031407

1

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eaken

PROJECT NAME: Port Orange

P.O. NUMBER / PROJECT NUMBER: 147556.03.PO

PROJECT LOCATION: Volusia County, FL

SAMPLED BY: Steve Eaken

TURN AROUND TIME:
☑ STANDARD
❑ RUSH ________

REMARKS / SPECIAL INSTRUCTIONS:

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alkalinity, Ammonia, Cd, Ca, | Cl, Color, Cond., Cu, Fe, | Pb, Mg, Ni, NO2+NO3 | Ortho P, K, Na, SO4, | TDS, TKN, TOC, TP, | TSS, Turbidity, Zn

LAB NUMBER

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.
P01	Surface Water samples	Grab	3/13/03	1200	SW	5

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via:	RB	D/T
		AB	D/T
Ret: / /	Via:	Trip Bl.	

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	3/13/03	1200	[signature]	3/14/03	0945
2						
3						
4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J035993
Project Name:	Port Orange	**Date Sampled:**	10/21/2003
Project Number:	147556.03.PO	**Date Received:**	10/22/03 08:55
		Date Reported:	11/6/2003

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Port Orange

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 2 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange
Report No.: J035993
Date/Time Received: 10/22/03 08:55

Lab Code: J035993-01
Client Sample ID: PO-1
Site: Wetland Water Quality
Matrix: Water
Date/Time Sampled: 10/21/2003 11:00
Shipping Method: Client drop off
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.019	0.019	**0.019**	mg/L	U	E350.1		T
* Color	10	5.0	50	**150**	Color Units		E110.2		J
Conductivity	1	2.0	2.0	**140**	µmhos/cm		SW9050A		J
Ortho-phosphate (as P)	1	0.013	0.013	**0.013**	mg/L	U	E365.1		J
Sulfate (as SO4)	1	5.0	5.0	**5.7**	mg/L		E375.4		J
Total Alkalinity (as CaCO3)	1	5.0	5.0	**80**	mg/L		E310.1		J
Total Chlorides	1	0.50	0.50	**13**	mg/L		E325.2		J
Total Kjeldahl Nitrogen (as N)	1	0.034	0.034	**0.66**	mg/L		E351.2		T
Total Organic Carbon	1	0.50	0.50	**0.50**	mg/L	U	E415.1		T
Total Phosphorus (as P)	1	0.037	0.037	**0.037**	mg/L	U	E365.4		T
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		J
Turbidity	1	1.0	1.0	**1.0**	NTU	U	E180.1		J

Nitrate + Nitrite

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.027	**0.027**	mg/L	U	E353.2		J

TDS

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**170**	mg/L		E160.1		J

Total Metals

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
* Cadmium	1	0.00036	0.00036	**0.00065**	mg/L	i	SW6010B		J
Calcium	1	0.018	0.018	**26**	mg/L		SW6010B		J
* Copper	1	0.0011	0.0011	**0.0011**	mg/L	U	SW6010B		J
Iron	1	0.019	0.019	**0.39**	mg/L		SW6010B		J
Lead	1	0.00091	0.00091	**0.00091**	mg/L	U	SW6010B		J
Magnesium	1	0.016	0.016	**2.5**	mg/L		SW6010B		J
* Nickel	1	0.00085	0.00085	**0.00085**	mg/L	U	SW6010B		J
Potassium	1	0.11	0.11	**0.93**	mg/L		SW6010B		J
Sodium	1	0.049	0.049	**8.1**	mg/L		SW6010B		J
* Zinc	1	0.0025	0.0025	**0.0055**	mg/L	i	SW6010B		J

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Cadmium -- Analyzed 10-27-03 due to reanalysis.
* Comment for Color -- Color pH = 7.14
* Comment for Copper -- Analyzed 10-27-03 due to reanalysis.
* Comment for Nickel -- Analyzed 10-27-03 due to reanalysis.
* Comment for Zinc -- Analyzed 10-27-03 due to reanalysis.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J035993

Project Name: Port Orange **Date/Time Received:** 10/22/03 08:55

Sample Cross Reference Information

Lab Code: J035993-01 **Site: Wetland Water Quality**

Client Sample Number: PO-1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102303nh3-2	10/23/2003 11:30	SS		
Color	E110.2	NONE	WCJ-102203-COLO	10/22/2003 13:05	KDC		
Conductivity	SW9050A	NONE	WCJ-102203-COND	10/22/2003 11:30	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-102203-NITR	10/22/2003 11:23	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102203-ORTH	10/22/2003 09:07	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-110303-SO41	11/3/2003 11:35	AGF		
TDS	E160.1	NONE	WCJ-102403-TDS	10/24/2003 14:00	AGF		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-102403-ALK	10/24/2003 12:00	AA		
Total Chlorides	E325.2	NONE	WCJ-102403-CL	10/24/2003 09:30	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct110503tkn1	11/5/2003 10:41	CLB	PB110403TPTKN	11/4/2003 12:00:
Total Metals	SW6010B	METHOD	M102303-3010 #1	10/23/2003 19:13	KC	M102303-3010 #1	10/23/2003 08:11
Total Metals	SW6010B	SW3010A	M102303-3010 #1	10/23/2003 15:45	KC	M102303-3010 #1	10/23/2003 08:11
Total Metals	SW6010B	SW3010A	M102303-3010 #1	10/23/2003 19:13	KC	M102303-3010 #1	10/23/2003 08:11
Total Organic Carbon	E415.1	NONE	wct102803toc	10/28/2003 10:30	DLS		
Total Phosphorus (as P)	E365.4	METHOD	WCT110503TP1	11/5/2003 13:31	CLB	PB110403TPTKN	11/4/2003 12:00:
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102703-TSS2	10/27/2003 12:10	AGF		
Turbidity	E180.1	NONE	WCJ-102303-TUR	10/23/2003 09:35	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J035993

Project Name: Port Orange **Date/Time Received:** 10/22/03 08:55

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102303-3010 #1	Cadmium	Method Blank	SW6010B	0.00036	0.00036	mg/L	U
M102303-3010 #1	Calcium	Method Blank	SW6010B	0.018	0.029	mg/L	I
M102303-3010 #1	Copper	Method Blank	SW6010B	0.0011	0.0011	mg/L	U
M102303-3010 #1	Iron	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102303-3010 #1	Lead	Method Blank	SW6010B	0.00091	0.00091	mg/L	U
M102303-3010 #1	Magnesium	Method Blank	SW6010B	0.016	0.017	mg/L	I
M102303-3010 #1	Nickel	Method Blank	SW6010B	0.00085	0.00085	mg/L	U
M102303-3010 #1	Potassium	Method Blank	SW6010B	0.11	0.11	mg/L	U
M102303-3010 #1	Sodium	Method Blank	SW6010B	0.049	0.049	mg/L	U
M102303-3010 #1	Zinc	Method Blank	SW6010B	0.0025	0.0025	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102203-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102203-NIT	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102203-ORT	Ortho-phosphate (as P)	Method Blank	E365.1	0.10	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102303-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102403-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102403-CL	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102403-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102703-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110303-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102803toc	Total Organic Carbon	Method Blank	E415.1	0.50	0.50	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J035993

Project Name: Port Orange **Date/Time Received:** 10/22/03 08:55

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110503tkn1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.034	0.034	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT110503TP1	Total Phosphorus (as P)	Method Blank	E365.4	0.037	0.037	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J035993
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J035993-01	PO-1	Total Phosphorus (T)	Water	10/21/03	11:00	10/22/03 8:55	11/5/03		250mL Poly
J035993-01	PO-1	TKN (T)	Water	10/21/03	11:00	10/22/03 8:55	11/5/03		250mL Poly
J035993-01	PO-1	Ammonia (T)	Water	10/21/03	11:00	10/22/03 8:55	11/5/03		250mL Poly
J035993-01	PO-1	TOC (T)	Water	10/21/03	11:00	10/22/03 8:55	11/5/03		250mL Poly

Jacksonville Relinquisher: [signature] **Shipping Receiver:** PE **Date/Time:** 10/22/03 10:41:14 AM

Shipping Relinquisher: [signature] **Tampa Receiver:** [signature] **Date/Time:** 10/23/03 8:15

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-93
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-43
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-

CHAIN OF COUSTODY

J035993

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608

PHONE: (352) 335-7991 FAX: (352) 335-2819

CONTACT: S. Eakin

PROJECT NAME: Port Orange

P.O. NUMBER / PROJECT NUMBER: 147556.PO.03

PROJECT LOCATION: Port Orange, FL

SAMPLED BY: SBB. E

TURN AROUND TIME:
☑ STANDARD
❑ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:
*Metals: Cd, Ca, Cu, Fe, Pb, Mg, Ni, K, Na, Zn
1.4°

WW= waste water **SW**=surface water **GW**=ground water **DW**=drinking water **OIL** **A**=air **SO**=soil **SL**=sludge

ANALYSIS REQUIRED / SIZE & TYPE: TOC, Alk, NH_3, NO_2+NO_3 | Metals* | TKN, TP, TDS, TSS | Cl, SO_4, Color, Cond, | Turb., Ortho P

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	TOC, Alk, NH_3, NO_2+NO_3	Metals*	TKN, TP, TDS, TSS	Cl, SO_4, Color, Cond,	Turb., Ortho P			LAB NUMBER
Preserv							.							
PO-1	Wetland Water Quality	Grab	10/21/03	1100	SW	7	X	X	X	X	X			01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB ____ D/T ____	
Ret: / /	Via: ____	AB ____ D/T ____	
		Trip Bl. ❑ ❑	

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SBB. E	10/21/03				
2	Fedx	10-22-03	8:55	Chris Ferguson	10-22-03	8:55
3						
4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J041279
Project Name:	Port Orange	**Date Sampled:**	3/3/04
Project Number:	147556.03.PO	**Date Received:**	3/4/04 09:45
		Date Reported:	3/17/04

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Port Orange

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange
Report No.: J041279
Date/Time Received: 3/4/04 09:45

Lab Code: J041279-01
Client Sample ID: PO-1
Site: Port Orange Wetland Sample
Matrix: Water
Date/Time Sampled: 3/3/04 08:30
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.026	**0.026**	mg/L	U	E350.1		*T*
* Color	20	5.0	100	**300**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**59**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.013	**0.013**	mg/L	U	E365.1		*J*
Sulfate (as SO4)	1	5.0	5.0	**6.9**	mg/L		E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**10**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	0.50	**15**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.048	**1.6**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.73	0.73	**29**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.043	**0.16**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**31**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**6.4**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.027	**0.027**	mg/L	i	E353.2		*J*

TDS

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**100**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00021	0.00021	**0.00021**	mg/L	U	SW6010B		*J*
Calcium	1	0.014	0.014	**4.6**	mg/L		SW6010B		*J*
Copper	1	0.0071	0.0071	**0.0011**	mg/L		SW6010B		*J*
Iron	1	0.016	0.016	**0.41**	mg/L	U	SW6010B		*J*
Lead	1	0.00092	0.00092	**0.0017**	mg/L	i	SW6010B		*J*
Magnesium	1	0.0074	0.0074	**1.2**	mg/L		SW6010B		*J*
Nickel	1	0.0026	0.0026	**0.0026**	mg/L	U	SW6010B		*J*
Potassium	1	0.024	0.024	**0.96**	mg/L		SW6010B		*J*
Sodium	1	0.0084	0.0084	**8.0**	mg/L		SW6010B		*J*
Zinc	1	0.0072	0.0072	**0.0072**	mg/L	U	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Color -- Color pH = 5.59

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Port Orange

Report No.: J041279

Date/Time Received: 3/4/04 09:45

Sample Cross Reference Information

Lab Code: J041279-01 **Site: Port Orange Wetland Sam**

Client Sample Number: PO-1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct031204nh3-2	3/12/04	09:00	SS		
Color	E110.2	NONE	WCJ-030404-COL	3/4/04	18:00	AA		
Conductivity	SW9050A	NONE	WCJ-031004-COND	3/10/04	09:00	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-030504-N	3/5/04	10:56	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-030404-OP	3/4/04	14:31	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-031204-SO4	3/12/04	10:40	AA		
TDS	E160.1	NONE	WCJ-030904-TDS	3/9/04	13:10	AGF		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-030804-ALK	3/8/04	10:00	AA		
Total Chlorides	E325.2	NONE	WCJ-030804-CL	3/8/04	14:45	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT031504TKN3	3/15/04	11:12	CLB	PB030904TPTKN	3/9/04
Total Metals	SW6010B	SW3010A	M030504-3010-1	3/5/04	15:44	DS	M030504-3010-1	3/5/04 07:21:00
Total Metals	SW6010B	SW3010A	M031104-3010-1	3/12/04	00:41	KC	M031104-3010-1	3/11/04 07:30:00
Total Organic Carbon	E415.1	NONE	wct031004toc	3/10/04	10:00	DLS		
Total Phosphorus (as P)	E365.4	NONE	wct031504tp1	3/15/04	13:16	CLB	PB030904TPTKN	3/9/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-030904-TSS1	3/9/04	09:50	AGF		
Turbidity	E180.1	NONE	WCJ-030404-TUR	3/4/04	17:10	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J041279

Project Name: Port Orange **Date/Time Received:** 3/4/04 09:45

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M030504-3010-1	Cadmium	Method Blank	SW6010B	0.00021	0.00021	mg/L	U
M030504-3010-1	Calcium	Method Blank	SW6010B	0.014	0.031	mg/L	I
M030504-3010-1	Copper	Method Blank	SW6010B	0.0071	0.0071	mg/L	U
M030504-3010-1	Lead	Method Blank	SW6010B	0.00092	0.00092	mg/L	U
M030504-3010-1	Magnesium	Method Blank	SW6010B	0.0074	0.0074	mg/L	U
M030504-3010-1	Nickel	Method Blank	SW6010B	0.0026	0.0026	mg/L	U
M030504-3010-1	Potassium	Method Blank	SW6010B	0.024	0.031	mg/L	I
M030504-3010-1	Sodium	Method Blank	SW6010B	0.0084	0.015	mg/L	I

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M031104-3010-1	Iron	Method Blank	SW6010B	0.016	0.016	mg/L	U
M031104-3010-1	Zinc	Method Blank	SW6010B	0.0072	0.0072	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030404-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030404-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030404-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030504-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030804-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030804-CL	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030904-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-030904-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-031204-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill — **Report No.:** J041279

Project Name: Port Orange — **Date/Time Received:** 3/4/04 09:45

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct031004toc	Total Organic Carbon	Method Blank	E415.1	0.73	0.73	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct031204nh3-2	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT031504TKN3	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct031504tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill
Project name: Port Orange
Date/Time Rcvd: 3/4/04 0945
Log-In request number: J041279
Received by: SM
Completed by: SM

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ Other (describe): ______

Type: ☒ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	2.2				
Temp taken from	☐ Temp blank ☒ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*	✓		
15. Were the sample containers provided by AEL?	✓		
16. Were samples accepted into the laboratory?	✓		
17. Was it necessary to split samples into other bottles?		✓	

Comments:

C:\Documents and Settings\JOconnor\Desktop\Login Shortcuts\CUR form.doc (2/2/04)

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J041279

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J041279-01	PO-1	Total Phosphorus (T)	Water	3/4/04	8:30	3/4/04 9:45	**3/18/04**		250mL Poly
J041279-01	PO-1	TOC (T)	Water	3/4/04	8:30	3/4/04 9:45	**3/18/04**		250mL Poly
J041279-01	PO-1	TKN (T)	Water	3/4/04	8:30	3/4/04 9:45	**3/18/04**		250mL Poly
J041279-01	PO-1	Ammonia (T)	Water	3/4/04	8:30	3/4/04 9:45	**3/18/04**		250mL Poly

Jacksonville Relinquisher: [illegible] **Shipping Receiver:** PE **Date/Time:** 3/4/04 11:09:45 AM

Shipping Relinquisher: PE **Tampa Receiver:** [illegible] **Date/Time:** 3/5/04 800

Advanced Environmental Laboratories, Inc.
☒ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

J041279

1

CLIENT NAME: CH2M HILL

PROJECT NAME: Port Orange

ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608

P.O. NUMBER / PROJECT NUMBER: 147556.03.PO

PHONE: (352) 335-7991 FAX:

PROJECT LOCATION: Volusia County, FL

CONTACT: S. Eakin

SAMPLED BY: S. Eakin

TURN AROUND TIME: ☑ STANDARD ☐ RUSH ____

REMARKS / SPECIAL INSTRUCTIONS: Cd, Ca, Cl, Cu, Fe, Pb, Mg, Ni, K, Na, Zn
chloride
J.J

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alkalinity, Ammonia, Color | Cond, NO_2+NO_3, ortho P | Sulfate, TDS, TKN, TOC | TP, TSS, Turbidity | metals 3/4/04 am

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Preserv	Alkalinity, Ammonia, Color	Cond, NO_2+NO_3, ortho P	Sulfate, TDS, TKN, TOC	TP, TSS, Turbidity	metals			LAB NUMBER
PO-1	~~Port~~ Orange Wetland Sample	Grab	3/3/04	830	SW	7		X	X	X	X	X			1

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #		Relinquished by:	Date	Time	Received by:	Date	Time
Out: / /	Via: ____	RB ____	D/T ____	1	[signature]	3/3/04	1000	Fed Ex		
		AB ____	D/T ____	2	Fed Ex			[signature]	3/4/04	0945
Ret: / /	Via: ____	Trip Bl. ☐	☐	3						
				4						

Received on ice: ☒ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced
Environmental Laboratories, Inc.

6601 Southpoint Parkway

Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J046848
Project Name:	Titusville / Port Orange	**Date Sampled:**	10/20/04
Project Number:	147556.03.TV	**Date Received:**	10/21/04 10:25
		Date Reported:	10/29/04

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville / Port Orange

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 6 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville
Report No.: J046848
Date/Time Received: 10/21/04 10:25

Lab Code: J046848-01
Client Sample ID: Titusville
Site: Wetland Surface Water
Matrix: Water
Date/Time Sampled: 10/20/04 10:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.040**	mg/L	i	E350.1		*T*
* Color	5	25	25	**150**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**210**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.12**	mg/L		E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**78**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**19**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.2**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.73	2.9	**30**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.39**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**44**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**4.1**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.90**	mg/L		E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**170**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00021	0.00084	**0.00021**	mg/L	U	SW6010B		*J*
Calcium	1	0.014	0.056	**34**	mg/L		SW6010B		*J*
Copper	1	0.0071	0.028	**0.0071**	mg/L	U	SW6010B		*J*
Iron	1	0.016	0.064	**2.4**	mg/L		SW6010B		*J*
Lead	1	0.00092	0.0037	**0.0025**	mg/L	i , V	SW6010B		*J*
Magnesium	1	0.0074	0.030	**1.7**	mg/L		SW6010B		*J*
Nickel	1	0.0026	0.010	**0.0026**	mg/L	U	SW6010B		*J*
Potassium	1	0.024	0.096	**2.6**	mg/L		SW6010B		*J*
Sodium	1	0.0084	0.034	**9.6**	mg/L		SW6010B		*J*
Zinc	1	0.0072	0.029	**0.010**	mg/L	i	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 6.32

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville / Port Orange

Report No.: J046848
Date/Time Received: 10/21/04 10:25

Lab Code: J046848-02
Client Sample ID: Port Orange
Site: Wetland Surface Water
Matrix: Water

Date/Time Sampled: 10/20/04 13:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	10	50	50	**200**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**60**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Chlorides	1	0.50	2.0	**17**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.30**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.73	2.9	**24**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.054**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**6.0**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**1.0**	NTU	U	E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.030**	mg/L	i	E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**81**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00021	0.00084	**0.00021**	mg/L	U	SW6010B		*J*
Calcium	1	0.014	0.056	**2.7**	mg/L		SW6010B		*J*
Copper	1	0.0071	0.028	**0.0071**	mg/L	U	SW6010B		*J*
Iron	1	0.016	0.064	**0.55**	mg/L		SW6010B		*J*
Lead	1	0.00092	0.0037	**0.0012**	mg/L	i , V	SW6010B		*J*
Magnesium	1	0.0074	0.030	**1.0**	mg/L		SW6010B		*J*
Nickel	1	0.0026	0.010	**0.0026**	mg/L	U	SW6010B		*J*
Potassium	1	0.024	0.096	**1.0**	mg/L		SW6010B		*J*
Sodium	1	0.0084	0.034	**7.4**	mg/L		SW6010B		*J*
Zinc	1	0.0072	0.029	**0.0072**	mg/L	U	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 5.01

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville / Port Orange

Report No.: J046848

Date/Time Received: 10/21/04 10:25

Sample Cross Reference Information

Lab Code: J046848-01 **Site: Wetland Surface Water**

Client Sample Number: Titusville **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT102204NH3-2	10/22/04 16:30	SS		
Color	E110.2	NONE	WCJ-102204-COL	10/22/04 08:50	AA		
Conductivity	SW9050A	NONE	WCJ-102504-COND	10/25/04 13:25	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-102204-N	10/22/04 09:38	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102104-OP	10/21/04 09:31	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-102104-SO4b	10/21/04 16:40	AA		
TDS	E160.1	NONE	WCJ-102504-TDS	10/25/04 09:00	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-102204-ALK	10/22/04 10:30	AA		
Total Chlorides	E325.2	NONE	WCJ-102504-CL	10/25/04 13:13	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT102804TKN1	10/28/04 10:32	AJ	pb102404tptkn	10/24/04
Total Metals	SW6010B	SW3010A	M102104-3010-1	10/22/04 14:06	KC	M102104-3010-1	10/21/04 16:45:0
Total Organic Carbon	E415.1	NONE	WCT102604TOC	10/26/04 12:00	DLS		
Total Phosphorus (as P)	E365.4	NONE	WCT102704TP1	10/27/04 15:36	AJ	pb102404tptkn	10/24/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102504-TSS2	10/25/04 13:30	LM		
Turbidity	E180.1	NONE	WCJ-102204-TURB	10/22/04 08:50	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J046848-02 **Site: Wetland Surface Water**

Client Sample Number: Port Orange **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT102204NH3-2	10/22/04 16:30	SS		
Color	E110.2	NONE	WCJ-102204-COL	10/22/04 08:50	AA		
Conductivity	SW9050A	NONE	WCJ-102504-COND	10/25/04 13:25	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-102204-N	10/22/04 09:38	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102104-OP	10/21/04 09:31	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-102104-SO4b	10/21/04 16:40	AA		
TDS	E160.1	NONE	WCJ-102504-TDS	10/25/04 09:00	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-102204-ALK	10/22/04 10:30	AA		
Total Chlorides	E325.2	NONE	WCJ-102504-CL	10/25/04 13:13	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT102804TKN1	10/28/04 10:32	AJ	pb102404tptkn	10/24/04
Total Metals	SW6010B	SW3010A	M102104-3010-1	10/22/04 14:06	KC	M102104-3010-1	10/21/04 16:45:0
Total Organic Carbon	E415.1	NONE	WCT102604TOC	10/26/04 12:00	DLS		
Total Phosphorus (as P)	E365.4	NONE	WCT102704TP1	10/27/04 15:36	AJ	pb102404tptkn	10/24/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102504-TSS2	10/25/04 13:30	LM		
Turbidity	E180.1	NONE	WCJ-102204-TURB	10/22/04 08:50	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville / Port Orange

Report No.: J046848

Date/Time Received: 10/21/04 10:25

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102104-3010-1	Cadmium	Method Blank	SW6010B	0.00021	0.00021	mg/L	U
M102104-3010-1	Calcium	Method Blank	SW6010B	0.014	0.10	mg/L	
M102104-3010-1	Copper	Method Blank	SW6010B	0.0071	0.0071	mg/L	U
M102104-3010-1	Iron	Method Blank	SW6010B	0.016	0.016	mg/L	U
M102104-3010-1	Lead	Method Blank	SW6010B	0.00092	0.0011	mg/L	I
M102104-3010-1	Magnesium	Method Blank	SW6010B	0.0074	0.0098	mg/L	I
M102104-3010-1	Nickel	Method Blank	SW6010B	0.0026	0.0026	mg/L	U
M102104-3010-1	Potassium	Method Blank	SW6010B	0.024	0.024	mg/L	U
M102104-3010-1	Sodium	Method Blank	SW6010B	0.0084	0.026	mg/L	I
M102104-3010-1	Zinc	Method Blank	SW6010B	0.0072	0.0072	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-CL	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	µmhos/cm	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J046848

Project Name: Titusville / Port Orange **Date/Time Received:** 10/21/04 10:25

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102204NH3-	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102604TOC	Total Organic Carbon	Method Blank	E415.1	0.73	0.73	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102704TP1	Total Phosphorus (as P)	Method Blank	E365.4		0.043	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102804TKN1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2		0.048	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill **Project name:** Titusville

Date/Time Rcvd: 10/21/04 1025 **Log-In request number:** J0410848

Received by: als **Completed by:** als

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ Other (describe): ____

Type: ☒ Cooler ☐ Box ☐ Other (describe) ____

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	0.0°C				
Temp taken from	☐ Temp blank ☒ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?	✓		
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*	✓		
15. Were the sample containers provided by AEL?	✓		
16. Were samples accepted into the laboratory?	✓		
17. Was it necessary to split samples into other bottles?		✓	

Comments:

C:\Documents and Settings\Login_Jax\Desktop\Login Shortcuts\CUR form.doc (2/2/04)

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J046848
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J046848-01	Titusville	Total Phosphorus (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-01	Titusville	TOC (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-01	Titusville	TKN (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-01	Titusville	Ammonia (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-02	Port Orange	Total Phosphorus (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-02	Port Orange	TOC (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-02	Port Orange	TKN (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly	
J046848-02	Port Orange	Ammonia (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly	

Jacksonville Relinquisher: Amachols **Shipping Receiver:** Pony Express **Date/Time:** 10/21/2004 10:43:31 AM

Shipping Relinquisher: VR **Tampa Receiver:** VR **Date/Time:** 10-22-04 830

Advanced Environmental Laboratories, Inc.
☒ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

LAB NUMBER: J046848

104

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.TV

PROJECT LOCATION: Brevard County, FL

SAMPLED BY: SBB. EL

TURN AROUND TIME: ☑ STANDARD ☐ RUSH ____

REMARKS / SPECIAL INSTRUCTIONS: *Metals: Cd, Ca, Cl, Cu, Fe, Pb, Mg, Ni, K, Na, Zn
a Nutrients

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

ANALYSIS REQUIRED: Alkalinity, NH3, Color | Conductivity, NO2+NO3 | Ortho P, SO4, TDS | TKN, TOC, TP, TSS | Turbidity | Metals

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Alkalinity, NH_3, Color	Conductivity, NO_2+NO_3	Ortho P, SO_4, TDS	TKN, TOC, TP, TSS	Turbidity	Metals	LAB NUMBER
Preserv													
Titusville	Wetland Surface Water	Grab	10/20/04	1000	SW		X	X	X	X	X	X	
Port Orange	Wetland Surface Water	Grab	10/20/04	1300	SW		X	X	X	X	X	X	

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB____	D/T____
		AB____	D/T____
Ret: / /	Via: ____	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SBB EL	10/21/04	1200	[signature]	10/21/04	1025
2						
3						
4						

Received on ice ☒ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J054653
Project Name:	Port Orange	**Date Sampled:**	7/12/05
Project Number:	147556.03.PO	**Date Received:**	7/13/05 12:00
		Date Reported:	7/29/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Port Orange

Approved By: Paul Gunsaulies 2005.07.29 10:19:23 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange

Report No.: J054653
Date/Time Received: 7/13/05 12:00

Lab Code: J054653-01
Client Sample ID: 1
Site: PO-1
Matrix: Water

Date/Time Sampled: 7/12/05 12:00
Shipping Method: Client drop off
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	5	25	25	**230**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**24**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U , J4	E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**6.0**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**5.3**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**32**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.64**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**23**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**5.0**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**1.0**	NTU	U	E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000054**	mg/L	i	SW6010B		*J*
Calcium	1	0.019	0.076	**2.7**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.00096**	mg/L	U	SW6010B		*J*
Iron	1	0.011	0.044	**0.59**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**0.66**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**0.26**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**3.3**	mg/L		SW6010B		*J*
Zinc	1	0.0016	0.0064	**0.0079**	mg/L	, V	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
J4 The sample matrix interfered with the ability to make an accurate determination.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- The pH is 3.68.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Port Orange

Report No.: J054653

Date/Time Received: 7/13/05 12:00

Sample Cross Reference Information

Lab Code: J054653-01

Client Sample Number: 1

Site: PO-1

Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct071905nh3-1	7/19/05	13:57	AJK		
Color	E110.2	NONE	WCJ-071405-COL	7/14/05		MSA		
Conductivity	SW9050A	NONE	WCJ-072205-CON1	7/22/05	14:02	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-071405-N1	7/14/05	16:10	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-071405-O1	7/14/05	10:49	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-071805-SO4b	7/18/05	15:30	AA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-072005-ALK	7/20/05	11:15	AA		
Total Chlorides	E325.2	NONE	WCJ-071905-C1	7/19/05	14:28	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-071505-tds	7/15/05	15:10	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct072005tkn-2	7/20/05	12:12	AJK	pb071905tptkn	7/19/05
Total Metals	SW6010B	SW3010A	M071405-ICP-1	7/15/05	15:47	CDC	M071405-ICP-1	7/14/05 10:50:00
Total Organic Carbon	E415.1	NONE	WCT071705TOC	7/17/05	10:20	JH		
Total Phosphorus (as P)	E365.4	METHOD	wct072105tp-2	7/21/05	10:55	VI	pb071905tptkn	7/19/05
Total Suspended Solids (TSS)	E160.2	NONE	wcj-071805-tss1	7/18/05	15:40	LM		
Turbidity	E180.1	NONE	WCJ-071405-TURB	7/14/05	10:30	MSA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J054653

Project Name: Port Orange **Date/Time Received:** 7/13/05 12:00

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M071405-ICP-1	Cadmium	Method Blank	SW6010B	0.000051	0.000051	mg/L	U
M071405-ICP-1	Calcium	Method Blank	SW6010B	0.019	0.036	mg/L	I
M071405-ICP-1	Copper	Method Blank	SW6010B	0.00096	0.00096	mg/L	U
M071405-ICP-1	Iron	Method Blank	SW6010B	0.011	0.011	mg/L	U
M071405-ICP-1	Lead	Method Blank	SW6010B	0.0019	0.0019	mg/L	U
M071405-ICP-1	Magnesium	Method Blank	SW6010B	0.012	0.012	mg/L	U
M071405-ICP-1	Nickel	Method Blank	SW6010B	0.0016	0.0016	mg/L	U
M071405-ICP-1	Potassium	Method Blank	SW6010B	0.029	0.029	mg/L	U
M071405-ICP-1	Sodium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M071405-ICP-1	Zinc	Method Blank	SW6010B	0.0016	0.0096	mg/L	

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-071405-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-071405-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-071405-O1	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.036	mg/L	i

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-071405-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-071505-tds	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-071805-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-071805-tss1	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-071905-C1	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-072005-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange

Report No.: J054653
Date/Time Received: 7/13/05 12:00

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-072205-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	umhos/cm	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT071705TOC	Total Organic Carbon	Method Blank	E415.1	0.47	0.47	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct072005tkn-2	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct072105tp-2	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill

Project name: Port Orange

Date/Time Rcvd: 7/13/05 1200

Log-In request number: J0546633

Received by: LDS

Completed by: LDS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ AES ☐ ASAP ☐ Other (describe):

Type: ☒ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	5.0				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J054653

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J054653-01	1	Total Phosphorus (T)	Water	07/12/2005	12:00	7/13/05 12:00	**07/20/2005**		250mL Poly
J054653-01	1	TOC (T)	Water	07/12/2005	12:00	7/13/05 12:00	**07/20/2005**		250mL Poly
J054653-01	1	TKN (T)	Water	07/12/2005	12:00	7/13/05 12:00	**07/20/2005**		250mL Poly
J054653-01	1	Ammonia (T)	Water	07/12/2005	12:00	7/13/05 12:00	**07/20/2005**		250mL Poly

Jacksonville Relinquisher: W. Salter

Shipping Relinquisher:

Shipping Receiver: Blue Streak ~~Pony Express~~

Date/Time: 07/13/2005 16:59:58

Tampa Receiver: K. Mandelle

Date/Time: 7/14/05 8:30

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

NUMBER: J054653

112

CLIENT NAME: CHam HILL	PROJECT NAME: Port Orange
ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.PO
PHONE: (352) 335-7991 FAX:	PROJECT LOCATION: Volusia County, FL
CONTACT: Steve Eskin	SAMPLED BY: S. Eskin
TURN AROUND TIME: ☑ STANDARD ❑ RUSH ______	REMARKS / SPECIAL INSTRUCTIONS: * Cd, Ca, Cl, Cu, Fe, Pb, Mg, K, Na, Zn, Ni

BOTTL SIZE & TYPE — ANALYSIS REQUIRED — LAB NUMBER

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	BOTTL SIZE & TYPE	Alkalinity,	NH3, Color, Cond.	NO2+NO3	Ortho P, SO4,	TDS, TKN, TOC,	TP, TSS, Turb.	*	LAB NUMBER
PO-1	Surface Water Sampler	Grab	7/12/05	1200	SW			X	X	X	X	X	X	X	

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #		Relinquished by:	Date	Time	Received by:	Date	Time
Out: / /	Via: ____	RB____	D/T____	1	[signature]	7/12/05	1400	D. Salter	7/13/05	1200
		AB____	D/T____	2						
Ret: / /	Via: ____	Trip Bl.		3						
		❑	❑	4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J057201
Project Name:	Port Orange/Titusville	**Date Sampled:**	10/25/05
Project Number:	14755603PO	**Date Received:**	10/26/05 08:45
		Date Reported:	11/7/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Port Orange/Titusville

Approved By: Paul Gunsaulies 2005.11.07 14:59:10 -05'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 6 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange/Titusville
Report No.: J057201
Date/Time Received: 10/26/05 08:45

Lab Code: J057201-01
Client Sample ID: 1
Site: Port Orange Wetland Sample
Matrix: Water
Date/Time Sampled: 10/25/05 12:00
Shipping Method: Fed Ex
Sampled By: CLIENT
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	10	50	50	**150**	Color Units		E110.2		*J*
Conductivity	1	1.0	1.0	**24**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.035**	mg/L	i	E365.2		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**8.0**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**5.8**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**22**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.61**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**18**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**6.5**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**1.0**	NTU	U	E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000062**	mg/L	i , V	SW6010B		*J*
Calcium	1	0.019	0.076	**4.3**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.0026**	mg/L	i , V	SW6010B		*J*
Iron	1	0.011	0.044	**0.65**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**0.85**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**0.38**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**5.1**	mg/L		SW6010B		*J*
Zinc	1	0.0016	0.0064	**0.0095**	mg/L		SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 6.03.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange/Titusville
Report No.: J057201
Date/Time Received: 10/26/05 08:45

Lab Code: J057201-02
Client Sample ID: 2
Site: Titusville Wetland Surface Water
Matrix: Water
Date/Time Sampled: 10/25/05 09:00
Shipping Method: Fed Ex
Sampled By: CLIENT
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.034**	mg/L	i	E350.1		*T*
* **Color**	10	50	50	**100**	Color Units		E110.2		*J*
Conductivity	1	1.0	1.0	**100**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.054**	mg/L	i	E365.2		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**62**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**8.2**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**79**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.79**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**11**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.11**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**10**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**4.6**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000051**	mg/L	U	SW6010B		*J*
Calcium	1	0.019	0.076	**27**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.0022**	mg/L	i , V	SW6010B		*J*
Iron	1	0.011	0.044	**1.9**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**1.3**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**1.5**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**6.5**	mg/L		SW6010B		*J*
Zinc	1	0.0016	0.0064	**0.011**	mg/L		SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 6.39.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange/Titusville

Report No.: J057201
Date/Time Received: 10/26/05 08:45

Sample Cross Reference Information

Lab Code: J057201-01 **Site: Port Orange Wetland Sam**
Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102705nh3-2	10/27/05 14:21	AJ		
Color	E110.2	NONE	WCJ-102705-COL	10/27/05 08:50	MSA		
Conductivity	SW9050A	NONE	WCJ-102705-CON1	10/27/05 16:00	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-102805-N2	10/28/05 14:37	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-102605-O1	10/26/05 14:10	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-103105-SO4	10/31/05 10:00	AA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-110105-ALK	11/1/05 09:45	AA		
Total Chlorides	E325.2	NONE	WCJ-110105-C1	11/1/05 14:03	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-102705-tds	10/27/05 16:15	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct110305tkn-1	11/3/05 16:50	AJ	PB110205TPTKN	11/2/05
Total Metals	SW6010B	SW3010A	M102605-ICP-1	10/28/05 10:35	CDC	M102605-ICP-1	10/26/05 08:30:0
Total Organic Carbon	E415.1	NONE	wct102705toc	10/27/05 18:30	JH		
Total Phosphorus (as P)	E365.4	METHOD	wct110305tp-1	11/3/05 12:13	AJ	PB110205TPTKN	11/2/05
Total Suspended Solids (TSS)	E160.2	NONE	wcj-102805-tss3	10/28/05 14:56	AB		
Turbidity	E180.1	NONE	WCJ-102605-TURB	10/26/05 16:00	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J057201-02 **Site: Titusville Wetland Surface**
Client Sample Number: 2 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102705nh3-3	10/27/05 14:41	AJ		
Color	E110.2	NONE	WCJ-102705-COL	10/27/05 08:50	MSA		
Conductivity	SW9050A	NONE	WCJ-102705-CON1	10/27/05 16:00	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-102805-N2	10/28/05 14:37	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-102605-O1	10/26/05 14:10	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-103105-SO4	10/31/05 10:00	AA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-110105-ALK	11/1/05 09:45	AA		
Total Chlorides	E325.2	NONE	WCJ-110105-C1	11/1/05 14:03	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-102705-tds	10/27/05 16:15	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct110305tkn-1	11/3/05 16:50	AJ	PB110205TPTKN	11/2/05
Total Metals	SW6010B	SW3010A	M102605-ICP-1	10/28/05 10:35	CDC	M102605-ICP-1	10/26/05 08:30:0
Total Organic Carbon	E415.1	NONE	wct102705toc	10/27/05 18:30	JH		
Total Phosphorus (as P)	E365.4	METHOD	wct110305tp-1	11/3/05 12:13	AJ	PB110205TPTKN	11/2/05
Total Suspended Solids (TSS)	E160.2	NONE	wcj-102805-tss3	10/28/05 14:56	AB		
Turbidity	E180.1	NONE	WCJ-102605-TURB	10/26/05 16:00	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J057201

Project Name: Port Orange/Titusville **Date/Time Received:** 10/26/05 08:45

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102605-ICP-1	Cadmium	Method Blank	SW6010B	0.000051	0.000069	mg/L	I
M102605-ICP-1	Calcium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102605-ICP-1	Copper	Method Blank	SW6010B	0.00096	0.0024	mg/L	I
M102605-ICP-1	Iron	Method Blank	SW6010B	0.011	0.011	mg/L	U
M102605-ICP-1	Lead	Method Blank	SW6010B	0.0019	0.0019	mg/L	U
M102605-ICP-1	Magnesium	Method Blank	SW6010B	0.012	0.015	mg/L	I
M102605-ICP-1	Nickel	Method Blank	SW6010B	0.0016	0.0016	mg/L	U
M102605-ICP-1	Potassium	Method Blank	SW6010B	0.029	0.029	mg/L	U
M102605-ICP-1	Sodium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102605-ICP-1	Zinc	Method Blank	SW6010B	0.0016	0.0016	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102605-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102705-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102705-CO	Conductivity	Method Blank	SW9050A	2.0	1.0	umhos/cm	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-102705-tds	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102805-N2	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-102805-tss3	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-103105-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110105-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110105-C1	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Port Orange/Titusville

Report No.: J057201

Date/Time Received: 10/26/05 08:45

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705nh3-2	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705nh3-3	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705toc	Total Organic Carbon	Method Blank	E415.1	0.47	0.47	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110305tkn-1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110305tp-1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill/J'ville

Project name: Port Orange/Titusville

Date/Time Rcvd: 10/26/05 0845

Log-In request number: J057201

Received by: LDS

Completed by: LDS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ____

Type: ☒ Cooler ☐ Box ☐ Other (describe) ____

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	0				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J057201
CustomerName: CH2M Hill
Collector: CLIENT

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J057201-01	1	Total Phosphorus (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005			
J057201-01	1	TKN (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-01	1	Ammonia (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-01	1	TOC (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-02	2	Total Phosphorus (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005			
J057201-02	2	TKN (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-02	2	Ammonia (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-02	2	TOC (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005		250mL Poly	

B/5

Jacksonville Relinquisher: ________ **Shipping Receiver:** DHL ~~Pony Express~~ **Date/Time:** 10/26/2005 ~~10:46:24~~ 17:00

Shipping Relinquisher: ________ **Tampa Receiver:** K. Mandell **Date/Time:** 10-27-05 10:00

CHAIN OF CUSTODY RECORD

Advanced Environmental Laboratories, Inc.
☒ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

L

J057201

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd.
Gainesville FL 32605

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Port Orange / Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.PO

PROJECT LOCATION: Volusia / Brevard Counties Florida

SAMPLED BY: [signature]

TURN AROUND TIME:
☒ STANDARD
☐ RUSH ____________

REMARKS / SPECIAL INSTRUCTIONS:
* Ortho phosphate samples not filtered in field

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

BOTTLE SIZE & TYPE / ANALYSIS REQUIRED / Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Ortho P *	TOC	NO2+NO3	Metals	NH3/TKN/TP	Chl/SO4/Color/Cond	Turb/Alk	TDS/TSS	LAB NUMBER
Port Orange	Wetland Surface Water	Grab	10/25/05	12:00	SW	7	X	X	X	X	X	X	X	X	
Titusville	Wetland Surface Water	Grab	10/25/05	9:00	SW	7	X	X	X	X	X	X	X	X	

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB ____	D/T ____
		AB ____	D/T ____
Ret: / /	Via: ____	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	10/25/05	13:00	FE		
2	FE	10/26/05	0845	D. Salter	10/26/05	0845
3						
4						

Received on ice: ☒ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Appendix B
Detailed Vegetation Data

Baseline - Detailed Vegetation Data

TABLE B-1
Summary of Herbaceous Ground Cover Plots (1-Meter Squares) from the Port Orange Wetland - March 15, 2000.

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Amphicarpum muhlenbergianum	5	5		10	1		10	4.43	13.03
Andropogon virginicus	10	1						1.57	4.62
Aristida stricta			30	10				5.71	16.81
Centella asiatica	1							0.14	0.42
Cypress Butress					30			4.29	12.61
Drosera brevifolia	1		5					0.86	2.52
Eriocaulon compressum	5							0.71	2.10
Eriocaulon decangulare	10	5	2	2	3		5	3.86	11.34
Hypericum fasciculatum	10	1						1.57	4.62
Hypericum hypericoides	1	1						0.29	0.84
Lyonia lucida					1			0.14	0.42
Melanthium virginicum		2						0.29	0.84
Panicum dichanthelium		1	1	1				0.43	1.26
Panicum hemitomon			1	2	1	5	30	5.57	16.39
Pinus seedling					1			0.14	0.42
Rhynchospora sp.		10	1	10				3.00	8.82
Rhynchospora sp. (small)					1			0.14	0.42
Scirpus sp.	1							0.14	0.42
Triadenum walteri		1						0.14	0.42
Woodwardia virginica					1	2		0.43	1.26
Xyris difformis	1							0.14	0.42
Total	45	27	40	35	39	7	45	34.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Amphicarpum muhlenbergianum						1		0.14	0.85
Aristida stricta						5		0.71	4.24
Cirsium nuttallii	1							0.14	0.85
Diodia virginiana						1		0.14	0.85
Eriocaulon compressum		2	2	1			1	0.86	5.08
Hypericum fasciculatum							1	0.14	0.85
Leersia hexandra		1						0.14	0.85
Panicum dichanthelium		1						0.14	0.85
Panicum hemitomon		1	1	1	10			1.86	11.02
Panicum rigidulum	3	1		2			10	2.29	13.56
Panicum scabriusculum		1		1				0.29	1.69
Panicum sp.			2	20				3.14	18.64
Pinus (trunk)					20			2.86	16.95
Proserpinaca pectinata						1		0.14	0.85
Rhynchospora sp.		1	1			1		0.43	2.54
Sarracenia minor							1	0.14	0.85
Scleria baldwinii			10					1.43	8.47
Unknown grass					1	5		0.86	5.08
Unknown shrub							3	0.43	2.54
Xyris difformis				1		2	1	0.57	3.39
Total	4	8	16	26	31	16	17	16.86	100.00

TABLE B-1
Summary of Herbaceous Ground Cover Plots (1-Meter Squares) from the Port Orange Wetland - March 15, 2000.

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Amphicarpum muhlenbergianum	3							0.43	1.22
Andropogon virginicus					3			0.43	1.22
Aristida stricta		10	3				1	2.00	5.69
Cypress Butress						10	25	5.00	14.23
Drosera brevifolia	3							0.43	1.22
Eleocharis cellulosa				1				0.14	0.41
Eriocaulon compressum	2	5		10	1			2.57	7.32
Eriocaulon decangulare	15	10		2				3.86	10.98
Hypericum fasciculatum	10		1	1				1.71	4.88
Leersia hexandra							1	0.14	0.41
Melanthium virginicum					2			0.29	0.81
Mosses							1	0.14	0.41
Panicum hemitomon			50	1	1	30	15	13.86	39.43
Panicum rigidulum	3			1	1			0.71	2.03
Panicum scabriusculum							1	0.14	0.41
Panicum sp.		1		2	2			0.71	2.03
Panicum virgatum						2		0.29	0.81
Pinus seedling							1	0.14	0.41
Pluchea rosea				1				0.14	0.41
Proserpinaca pectinata	1					1	1	0.43	1.22
Rhynchospora sp.		1		5	3	1		1.43	4.07
Unknown grass			1					0.14	0.41
Total	37	27	55	24	13	44	46	35.14	100.00

TABLE B-2
Summary Of Herbaceous Ground Cover Plots (1-Meter Squares) from the Port Orange Wetland - October 10, 2001.

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Amphicarpum muhlenbergianum	3		50		1			7.71	18.31
Aristida stricta		1						0.14	0.34
Carex sp.		10		30		50	80	24.29	57.63
Centella asiatica	2							0.29	0.68
Dichromena colorata		1						0.14	0.34
Eriocaulon decangulare	8	3	6	1	8			3.71	8.81
Hypericum fasciculatum	25							3.57	8.47
Hypericum myrtifolium		1			1			0.29	0.68
Quercus sp.						1		0.14	0.34
Rhynchospora corniculata				10				1.43	3.39
Woodwardia virginica						3		0.43	1.02
Total	38	16	56	41	10	54	80	42.14	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Amphicarpum muhlenbergianum				20	1			3.00	10.40
Andropogon virginicus					2	10	25	5.29	18.32
Aristida stricta		1						0.14	0.50
Carex sp.		5		10	3	6		3.43	11.88
Eriocaulon decangulare	2	1						0.43	1.49
Hypericum fasciculatum	1							0.14	0.50
Hypericum myrtifolium							1	0.14	0.50
Ilex cassine	2							0.29	0.99
Lachnanthes caroliniana	1							0.14	0.50
Panicum hemitomon			80			3	10	13.29	46.04
Sarracenia minor	1							0.14	0.50
Unknown Grass		5		2				1.00	3.47
Xyris difformis							10	1.43	4.95
Total	7	12	80	32	6	19	46	28.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Amphicarpum muhlenbergianum	2							0.29	0.66
Andropogon virginicus		2			30			4.57	10.56
Aristida stricta				2				0.29	0.66
Cicuta mexicana	1							0.14	0.33
Eriocaulon decangulare	10	20						4.29	9.90
Hypericum fasciculatum	15							2.14	4.95
Ilex cassine	1							0.14	0.33
Panicum hemitomon			75	5	10	30	90	30.00	69.31
Rhynchospora corniculata				8				1.14	2.64
Scleria baldwinii		1						0.14	0.33
Woodwardia virginica						1		0.14	0.33
Total	29	23	75	15	40	31	90	43.29	100.00

TABLE B-3
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - March 15, 2000

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.30	0.60		0.30			2.20	2.04	3.53	0.50	13.64	8.58
Aristida stricta	0.80	2.50	3.40	1.20			7.90	7.31	12.68	0.67	18.18	15.43
Eriocaulon decangulare	2.40	2.80	2.00	5.40	5.20		17.80	16.48	28.57	0.83	22.73	25.65
Hypericum fasciculatum	2.56	0.23		0.32	0.04		3.15	2.92	5.06	0.67	18.18	11.62
Panicum hemitomon	0.81	1.50	1.90	4.83	7.52	14.70	31.26	28.94	50.17	1.00	27.27	38.72
Total	7.87	7.63	7.30	12.05	12.76	14.70	62.31	57.69	100.00	3.67	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.20	1.00	0.60	0.70			2.50	2.31	3.50	0.67	17.39	10.45
Aristida stricta	3.10	4.70	3.70	0.90	0.02		12.42	11.50	17.39	0.83	21.74	19.57
Eriocaulon decangulare	3.31	2.90	9.02	5.20	2.62		23.05	21.34	32.28	0.83	21.74	27.01
Hypericum fasciculatum	3.48	0.43	0.11		0.22		4.24	3.93	5.94	0.67	17.39	11.66
Panicum hemitomon		2.00	10.20	9.80	2.90	4.30	29.20	27.04	40.89	0.83	21.74	31.31
Total	10.09	11.03	23.63	16.60	5.76	4.30	71.41	66.12	100.00	3.83	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.01	1.30		0.10	0.32		1.73	1.60	2.57	0.67	18.18	10.37
Aristida stricta	1.80	4.40	2.40	1.00			9.60	8.89	14.23	0.67	18.18	16.21
Eriocaulon decangulare	4.60	1.11	1.10	3.70	1.80		12.31	11.40	18.25	0.83	22.73	20.49
Hypericum fasciculatum	4.83	0.33	0.01		0.01		5.18	4.80	7.68	0.67	18.18	12.93
Panicum hemitomon		0.70	9.91	7.31	6.70	14.00	38.62	35.76	57.27	0.83	22.73	40.00
Total	11.24	7.84	13.42	12.11	8.83	14.00	67.44	62.44	100.00	3.67	100.00	100.00

TABLE B-4
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - October 8, 2001

PORT ORANGE - NORTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	2.73	2.14	0.43		0.11		5.41	5.01	9.29	0.67	21.05	15.17
Aristida stricta	1.60	6.86	11.13	12.29			31.88	29.52	54.77	0.67	21.05	37.91
Eriocaulon decangulare	4.23	0.49	2.37	3.17	2.50		12.76	11.81	21.92	0.83	26.32	24.12
Hypericum fasciculatum	0.70						0.70	0.65	1.20	0.17	5.26	3.23
Panicum hemitomon	0.22	1.52	4.75	0.43	0.54		7.46	6.91	12.82	0.83	26.32	19.57
Total	9.48	11.01	18.68	15.89	3.15	0.00	58.21	53.90	100.00	3.17	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	2.80	1.39	0.95		0.98	1.74	7.86	7.28	14.68	0.83	25.00	19.84
Aristida stricta	6.97	9.07	5.65	2.40	1.55		25.64	23.74	47.90	0.83	25.00	36.45
Eriocaulon decangulare	3.88	1.91	1.16	1.74	1.44		10.13	9.38	18.92	0.83	25.00	21.96
Hypericum fasciculatum	1.92						1.92	1.78	3.59	0.17	5.00	4.29
Panicum hemitomon	1.53	5.17	1.18		0.10		7.98	7.39	14.91	0.67	20.00	17.45
Total	17.10	17.54	8.94	4.14	4.07	1.74	53.53	49.56	100.00	3.33	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.58	0.67	0.20	1.09	5.90	1.66	11.10	10.28	17.29	1.00	30.00	23.64
Aristida stricta	13.09	7.48	3.75				24.32	22.52	37.88	0.50	15.00	26.44
Eriocaulon decangulare	5.37	1.32	1.92	4.43	2.49		15.53	14.38	24.19	0.83	25.00	24.60
Hypericum fasciculatum	5.46						5.46	5.06	8.50	0.17	5.00	6.75
Panicum hemitomon	0.71	2.76	0.72	3.07	0.53		7.79	7.21	12.13	0.83	25.00	18.57
Total	26.21	12.23	6.59	8.59	8.92	1.66	64.20	59.44	100.00	3.33	100.00	100.00

TABLE B-5
Shrub Values for the Port Orange Wetland - September 27, 2000

	Linear Distance						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Taxodium ascendens	0.30	0.31	1.50	0.40			2.51	2.32	100.00	0.67	100.00	100.00
Total	0.30	0.31	1.50	0.40	0.00	0.00	2.51	2.32	100.00	0.67	100.00	100.00

TABLE B-6
Shrub Values for the Port Orange Wetland - October 8, 2001

Species	Linear Distance						Total Linear Distance (m)	Cover		Frequency		Importance Value
	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
Baccharis halimifolia			0.62				0.62	0.57	35.63	0.17	33.33	34.48
Taxodium ascendens			0.73	0.39			1.12	1.04	64.37	0.33	66.67	65.52
Total	0.00	0.00	1.35	0.39	0.00	0.00	1.74	1.61	100.00	0.50	100.00	100.00

TABLE B-7
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	Notes
1/1	401	Pinus taeda	13.9	15	Burned
1/1	402	Pinus taeda	7.35	8.5	
1/1	403	Pinus taeda	7.8	8.4	
1/1	404	Pinus taeda	9.05	10.5	
1/1	406	Taxodium ascendens	5.9	6	
1/1	407	Taxodium ascendens	7.7	7.9	
1/1	408	Taxodium ascendens	5.75	6	
1/1	409	Pinus taeda	10.5	11	
1/1	410	Taxodium ascendens	11.3	11.7	
1/1	411	Taxodium ascendens	12.4	12.6	
1/1	412	Pinus taeda	8.9	9.6	(still alive)
1/1	413	Pinus elliottii	9.5	11	Fallen
1/1	414	Taxodium ascendens	16.15	16.15	
1/1	415	Taxodium ascendens	7.5	7.5	
1/1	416	Taxodium ascendens	5.2	5.3	
1/2	417	Taxodium ascendens	5.5	5.7	
1/2	418	Taxodium ascendens	4.15	4.5	
1/2	419	Taxodium ascendens	3.7	4	
1/2	420	Taxodium ascendens	3.7	4	
1/2	421	Taxodium ascendens	8.7	0.9	
1/2	422	Taxodium ascendens	7.5	7.8	
1/2	423	Taxodium ascendens	16.55	16.6	
1/2	424	Taxodium ascendens	10.5	11	
1/2	425	Taxodium ascendens	5.65	6	
1/2	426	Taxodium ascendens	4.6	4.8	
1/2	427	Taxodium ascendens	6.35	6.8	
1/2	428	Taxodium ascendens	7.45	8	
1/2	429	Taxodium ascendens	5.55	6	
1/2	430	Taxodium ascendens	17.45	17.7	
1/2	431	Taxodium ascendens	6.15	6.3	
1/2	432	Taxodium ascendens	6.7	7.2	
1/2	433	Taxodium ascendens	16.77	16.6	
1/3	434	Taxodium ascendens	17.7	17.8	
1/3	435	Taxodium ascendens	18.98	19	
1/3	436	Taxodium ascendens	6.4	6.6	
1/3	437	Taxodium ascendens	7.75	8	
1/3	438	Taxodium ascendens	7.05	7.3	
1/3	439	Taxodium ascendens	5.85	6.2	
1/3	440	Taxodium ascendens	8.55	8.8	
1/3	441	Taxodium ascendens	4.65	4.8	
1/3	442	Taxodium ascendens	26	26.2	
1/3	443	Taxodium ascendens	4	4.1	
1/3	444	Taxodium ascendens	4.9	5	
1/3	445	Taxodium ascendens	4.5	4.8	
1/3	446	Taxodium ascendens	2.7	3.2	
1/3	447	Taxodium ascendens	6.53	7.4	
1/3	448	Taxodium ascendens	7.9	8.2	
1/3	449	Nyssa sylvatica	8	8.8	
1/3	450	Taxodium ascendens	6	6.3	
1/3	451	Taxodium ascendens	5.55	5.9	
1/3	452	Taxodium ascendens	6.4	6.8	
1/3	453	Taxodium ascendens	11.9	12.2	

TABLE B-7
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	Notes
1/3	454	Taxodium ascendens	27.1	27.3	
1/4	455	Taxodium ascendens	28.5	28.9	
1/4	456	Taxodium ascendens	27.5	27.5	
1/4	457	Nyssa sylvatica	19.3	19.7	
1/4	458	Nyssa sylvatica	9.5	10	
1/4	459	Taxodium ascendens	4.95	5.2	
1/4	460	Taxodium ascendens	4.05	4.8	
1/4	461	Taxodium ascendens	3.45	3.7	
1/4	462	Taxodium ascendens	6	6.3	
1/4	463	Taxodium ascendens	8.4	8.7	
1/4	464	Taxodium ascendens	3.05	3.3	
1/4	465	Taxodium ascendens	4.8	5	
1/4	466	Taxodium ascendens	4.2	4.5	
1/4	467	Taxodium ascendens	10.6	11.1	
1/4	468	Taxodium ascendens	4.4	4.5	
1/4	469	Taxodium ascendens	9.9	9.8	
1/4	470	Taxodium ascendens	5.5	5.8	
1/4	471	Taxodium ascendens	5.55	5.8	
1/4	472	Taxodium ascendens	6.25	6.4	
1/4	473	Taxodium ascendens	6	6.2	
1/4	474	Taxodium ascendens	3.25	3.5	
1/4	475	Taxodium ascendens	6.12	5.4	
1/4	476	Taxodium ascendens	4.9	5	
1/4	477	Taxodium ascendens	8.35	8.7	
1/4	478	Taxodium ascendens	7.1	7.3	
1/4	479	Taxodium ascendens	4.3	4.5	
1/4	480	Taxodium ascendens	4.45	4.6	
1/4	481	Taxodium ascendens	2.4	2.8	
1/4	482	Taxodium ascendens	4.55	4.7	
1/4	483	Taxodium ascendens	4.85	5	
1/4	484	Taxodium ascendens	6.4	6.6	
1/4	485	Taxodium ascendens	9.8	10.3	
1/4	486	Taxodium ascendens	5.35	5.6	
1/4	487	Taxodium ascendens	6.1	6.3	
1/4	488	Taxodium ascendens	17.77	18.2	
1/4	489	Taxodium ascendens	11.35	11.5	
1/4	704	Taxodium ascendens			
1/5	490	Taxodium ascendens	4.6	4.8	
1/5	491	Taxodium ascendens	24.24	24.7	
1/5	492	Taxodium ascendens	6.85	7	
1/5	493	Taxodium ascendens	13.6	13.8	
1/5	494	Taxodium ascendens	22.75	21.9	
1/5	495	Taxodium ascendens	2.8	3.1	
1/5	496	Taxodium ascendens	21.55	21.6	
1/5	497	Nyssa sylvatica	8.7	8.7	
1/5	498	Taxodium ascendens	12.3	12.3	
1/5	499	Taxodium ascendens	20.3	20.4	Down

TABLE B-8
Canopy and Subcanopy Importance Values for the Port Orange Wetland - September 27, 2000

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	1	0.54	4.21	18.52	3.85	0.17	14.29	7.45
Pinus taeda	2	0.44	3.43	37.04	7.69	0.17	14.29	8.47
Taxodium ascendens	23	11.9	92.37	425.93	88.46	0.83	71.43	84.09
Total	26	12.88	100.00	481.48	100.00	1.17	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	3	0.33	8.05	55.56	4.17	0.5	30.00	14.07
Pinus elliottii	1	0.13	3.16	18.52	1.39	0.17	10.00	4.85
Pinus taeda	4	0.4	9.66	74.07	5.56	0.17	10.00	8.4
Taxodium ascendens	64	3.29	79.14	1185.19	88.89	0.83	50.00	72.68
Total	72	12.88	100.00	1333.33	100.00	1.67	100.00	100.00

TABLE B-9

Canopy and Subcanopy Importance Values for the Port Orange Wetland - October 8, 2001

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	1	0.56	4.14	18.52	3.45	0.17	12.50	6.70
Pinus elliottii	1	0.18	1.29	18.52	3.45	0.17	12.50	5.75
Pinus taeda	3	0.66	4.87	55.56	10.34	0.17	12.50	9.24
Taxodium ascendens	24	12.22	89.69	444.44	82.76	0.83	62.50	78.32
Total	29	13.62	100.00	537.04	100.00	1.33	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	3	0.37	8.94	55.56	4.35	0.5	33.33	15.54
Pinus taeda	3	0.34	8.3	55.56	4.35	0.17	11.11	7.92
Taxodium ascendens	63	3.41	82.77	1166.67	91.3	0.83	55.56	76.54
Total	69	4.12	100.00	1277.78	100.00	1.5	100.00	100.00

Hydration Year 1 - Detailed Vegetation Data

TABLE B-10
Summary of Herbaceous Ground Cover Plots (1-Meter Squares) from the Port Orange Wetland - December 9, 2002

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover N1	N2	N3	N4	N5	N6	N7	Cover Percent	Cover Relative
Lycopus rubellus					1			0.14	0.29
Proserpinaca pectinata				1			10	1.57	3.19
Woodwardia virginica						10		1.43	2.90
Hypericum myrtifolium	40							5.71	11.59
Centella asiatica	3							0.43	0.87
Carex sp.	3							0.43	0.87
Amphicarpum muhlenbergianum	5							0.71	1.45
Xyris difformis	5	1						0.86	1.74
Eriocaulon decanqulare	20	2	15	15	15			9.57	19.42
Panicum commutatum	1							0.14	0.29
Scleria baldwinii	2							0.29	0.58
Drosera brevifolia	3							0.43	0.87
Dichromena colorata		5						0.71	1.45
Hypericum tetrapetalum		1						0.14	0.29
Rhynchospora corniculata							2	0.29	0.58
Andropogon virginicus		5						0.71	1.45
Panicum hemitomon						90	90	25.71	52.17
Total	82	14	15	16	16	100	102	49.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover C1	C2	C3	C4	C5	C6	C7	Cover Percent	Cover Relative
Salix caroliniana							2	0.29	0.80
Panicum commutatum		5					5	1.43	3.98
Xyris difformis	3						60	9.00	25.10
Proserpinaca pectinata				15			20	5.00	13.94
Panicum hemitomon			2		1	5	15	3.29	9.16
Eriocaulon compressum				5	15	5		3.57	9.96
Andropogon virginicus						3		0.43	1.20
Aristida stricta	1	30		30	5			9.43	26.29
Bulbostylis capillaris	1							0.14	0.40
Amphicarpum muhlenbergianum				2				0.29	0.80
Eriocaulon decanqulare	7		5					1.71	4.78
Elephantopus nudatus			2					0.29	0.80
Pinus sp.	1							0.14	0.40
Sarracenia minor	2							0.29	0.80
Ilex glabra	3							0.43	1.20
Hypericum myrtifolium	1							0.14	0.40
Total	19	35	9	52	21	13	102	35.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover S1	S2	S3	S4	S5	S6	S7	Cover Percent	Cover Relative
Amphicarpum muhlenbergianum	10			10				2.86	7.91
Eriocaulon decangulare	25	40		10	10			12.14	33.60
Eriocaulon compressum		10		40				7.14	19.76
Lachnanthes caroliniana	5							0.71	1.98
Hypericum fasciculatum	30							4.29	11.86
Pinus sp.	1							0.14	0.40
Unknown seedling	1							0.14	0.40
Schizachyrium scoparium					5			0.71	1.98
Aristida stricta		20	1	5				3.71	10.28
Proserpinaca pectinata		5	5	5	10		5	4.29	11.86
Total	72	75	6	70	25	0	5	36.14	100.00

TABLE B-11

Summary of Herbaceous Ground Cover Plots (1-Meter Squares) from the Port Orange Wetland - March 13, 2003

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Hypericum fasciculatum	28							4.00	12.90
Eriocaulon decangulare	10	4	10	1	9			4.86	15.67
Xyris sp.	3							0.43	1.38
Centella asiatica	1							0.14	0.46
Rhynchospora sp.	1							0.14	0.46
Aristida stricta		3	35	3				5.86	18.89
Unknown 1					1			0.14	0.46
Panicum hemitomon						45	25	10.00	32.26
Standing water - depth in inches		6	6	6	6	6	6	5.14	16.59
Woodwardia virginica						2		0.29	0.92
Total	43	13	51	10	16	53	31	31.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Xyris sp.	1						2	0.43	3.75
Eriocaulon decangulare	2			1	10	1		2.00	17.50
Aristida stricta		3		15				2.57	22.50
Panicum hemitomon			1					0.14	1.25
Rhynchospora sp.	1							0.14	1.25
Hypericum fasciculatum	2							0.29	2.50
Sarracenia minor	1							0.14	1.25
Lachnocaulon beyrichianum	1							0.14	1.25
Ilex glabra	2							0.29	2.50
Standing water - depth in inches	1	6	6	6	6	6	6	5.29	46.25
Total	11	9	7	22	16	7	8	11.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Hypericum fasciculatum	20							2.86	13.79
Magnolia virginiana	2							0.29	1.38
Xyris sp.	10							1.43	6.90
Eriocaulon decangulare	12	5		20	5			6.00	28.97
Andropogon virginicus		1			1			0.29	1.38
Aristida stricta		13	2	1				2.29	11.03
Panicum hemitomon			2			4	8	2.00	9.66
Panicum virgatum				2				0.29	1.38
Standing water - depth in inches	2	5	6	6	6	6	6	5.29	25.52
								0.00	0.00
Total	46	24	10	29	12	10	14	20.71	100.00

TABLE B-12
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - June 11, 2003

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Woodwardia virginica						2		0.29	0.40
Lycopus rubellus					1			0.14	0.20
Hypericum fasciculatum	40							5.71	8.02
Xyris sp.	30							4.29	6.01
Lachnocaulon sp.	10		7		3			2.86	4.01
Amphicarpum muhlenbergianum	10							1.43	2.00
Eriocaulon sp.	15	25	5	5	20			10.00	14.03
Drosera sp.	15							2.14	3.01
Unkown grass	2	5						1.00	1.40
Centella asiatica	1							0.14	0.20
Panicum erectifolium		5	2	1				1.14	1.60
Polygala ramosa		2	2					0.57	0.80
Aristida stricta			40	25			5	10.00	14.03
Panicum hemitomon				20		100	95	30.71	43.09
Taxodium ascendens				1				0.14	0.20
Pluchea rosea					5			0.71	1.00
Total	123	37	56	52	29	102	100	71.29	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Drosera sp.	3							0.43	0.80
Eriocaulon sp.	7							1.00	1.87
Panicum hemitomon		1	90	5		20	5	17.29	32.35
Panicum sp.							5	0.71	1.34
Hypericum hypericoides	5						10	2.14	4.01
Xyris sp.		5						0.71	1.34
Rhynchospora sp.	10			10	7	1		4.00	7.49
Pluchea rosea						2		0.29	0.53
Andropogon sp.		2			5	3		1.43	2.67
Lachnocaulon sp.					20	10		4.29	8.02
Aristida stricta		70		70				20.00	37.43
Sarracenia sp.	2							0.29	0.53
Eriocaulon decangulare	5							0.71	1.34
Pinus elliotii	1							0.14	0.27
Total	33	78	90	85	32	36	20	53.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Panicum hemitomon			100	5	10	60	70	35.00	48.51
Woodwardia virginica						2		0.29	0.40
Rhynchospora sp.	2			13	3	1		2.71	3.76
Hypericum fasciculatum	50							7.14	9.90
Xyris sp.	5							0.71	0.99
Eriocaulon decangulare	35	40		15				12.86	17.82
Amphicarpum muhlenbergianum	3				3			0.86	1.19
Panicum erectifolium	3	3		10				2.29	3.17
Scleria		5						0.71	0.99
Andropogon virginicus		5			5			1.43	1.98
Lachnocaulon sp.		10		35	5			7.14	9.90
Polygala ramosa					2			0.29	0.40
Aristida sp.					5			0.71	0.99
Total	98	63	100	78	33	63	70	72.14	100.00

TABLE B-13
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - December 9, 2002

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Aristida stricta	1.63	3.82	9.35	3.65	0.72		19.17	17.75	29.21	0.83	35.71	32.46
Eriocaulon decangulare	8.62	5.48	5.24	8.47	5.57		33.38	30.91	50.86	0.83	35.71	43.29
Hypericum fasciculatum	1.76		0.22				1.98	1.83	3.02	0.33	14.29	8.65
Panicum hemitomon					1.10	10.00	11.10	10.28	16.91	0.33	14.29	15.60
Total	12.01	9.30	14.81	12.12	7.39	10.00	65.63	60.77	100.00	2.33	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.48						1.48	1.37	1.74	0.17	5.88	3.81
Aristida stricta	5.65	11.20	1.84	3.64			22.33	20.68	26.31	0.67	23.53	24.92
Eriocaulon decangulare	7.17	9.46	4.35	7.81	2.29		31.08	28.78	36.61	0.83	29.41	33.01
Hypericum fasciculatum	0.25						0.25	0.23	0.29	0.17	5.88	3.09
Panicum hemitomon	0.37	2.92	2.35	8.92	8.87	6.32	29.75	27.54	35.04	1.00	35.29	35.17
Total	14.92	23.58	8.54	20.37	11.16	6.32	84.89	78.60	100.00	2.83	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Aristida stricta	13.53	12.70	4.63	2.39			33.25	30.79	49.26	0.67	33.33	41.30
Eriocaulon decangulare	7.68	3.57	2.65	5.79	2.58		22.27	20.62	32.99	0.83	41.67	37.33
Hypericum fasciculatum	0.57						0.57	0.53	0.84	0.17	8.33	4.59
Panicum hemitomon				10.72	0.69		11.41	10.56	16.90	0.33	16.67	16.79
Total	21.78	16.27	7.28	18.90	3.27	0.00	67.50	62.50	100.00	2.00	100.00	100.00

TABLE B-14
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - March 13, 2003

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	4.62	14.56	3.78	0.61	2.47		26.04	24.11	21.62	0.83	29.41	25.51
Aristida stricta		2.46	11.43	1.97			15.86	14.69	13.17	0.50	17.65	15.41
Eriocaulon decangulare	12.54	10.84	10.87	10.48	11.30		56.03	51.88	46.51	0.83	29.41	37.96
Hypericum fasciculatum	9.78						9.78	9.06	8.12	0.17	5.88	7.00
Panicum hemitomon				1.41	1.35	10.00	12.76	11.81	10.59	0.50	17.65	14.12
Total	26.94	27.86	26.08	14.47	15.12	10.00	120.47	111.55	100.00	2.83	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.59					3.42	5.01	4.64	5.12	0.33	10.53	7.82
Aristida stricta	6.45	8.41			5.03	0.71	20.60	19.07	21.03	0.67	21.05	21.04
Eriocaulon decangulare	7.12	9.07	7.47	13.81	15.74	1.69	54.90	50.83	56.05	1.00	31.58	43.82
Hypericum fasciculatum	2.78						2.78	2.57	2.84	0.17	5.26	4.05
Panicum hemitomon	1.12	0.29	0.52	6.26	4.22	2.24	14.65	13.56	14.96	1.00	31.58	23.27
Total	19.06	17.77	7.99	20.07	24.99	8.06	97.94	90.69	100.00	3.17	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	9.30	13.95	4.65	1.97	1.94		31.81	29.45	28.34	0.83	31.25	29.79
Eriocaulon decangulare	6.91	5.83	8.38	16.79	9.79	2.39	50.09	46.38	44.62	1.00	37.50	41.06
Hypericum fasciculatum	7.13						7.13	6.60	6.35	0.17	6.25	6.30
Panicum hemitomon			0.96	0.55	5.44	16.27	23.22	21.50	20.69	0.67	25.00	22.84
Total	23.34	19.78	13.99	19.31	17.17	18.66	112.25	103.94	100.00	2.67	100.00	100.00

TABLE B-15
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - June 11, 2003

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	3.01	1.23		0.52			4.76	4.41	3.81	0.50	15.79	9.80
Aristida stricta	3.60	12.67	16.30	5.18			37.75	34.95	30.20	0.67	21.05	25.63
Eriocaulon decangulare	7.59	3.81	4.51	6.15	4.78		26.84	24.85	21.48	0.83	26.32	23.90
Hypericum fasciculatum	2.04						2.04	1.89	1.63	0.17	5.26	3.45
Panicum hemitomon	11.61	11.00	1.75	8.80	2.43	18.00	53.59	49.62	42.88	1.00	31.58	37.23
Total	27.85	28.71	22.56	20.65	7.21	18.00	124.98	115.72	100.00	3.17	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	2.57	0.52	0.85	3.01	1.24	3.62	11.81	10.94	10.05	1.00	28.57	19.31
Aristida stricta	5.68	12.57	3.90	2.32			24.47	22.66	20.82	0.67	19.05	19.93
Eriocaulon decangulare	6.75	8.16	2.98	4.96	2.00		24.85	23.01	21.15	0.83	23.81	22.48
Hypericum fasciculatum	3.07						3.07	2.84	2.61	0.17	4.76	3.69
Panicum hemitomon		3.84	10.75	17.07	12.56	9.10	53.32	49.37	45.37	0.83	23.81	34.59
Total	18.07	25.09	18.48	27.36	15.80	12.72	117.52	108.81	100.00	3.50	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.65	0.33	0.16				2.14	1.98	1.59	0.50	17.65	9.62
Aristida stricta	11.19	12.50	0.40				24.09	22.31	17.93	0.50	17.65	17.79
Eriocaulon decangulare	7.46	3.65	2.35	6.60	2.49		22.55	20.88	16.78	0.83	29.41	23.10
Hypericum fasciculatum	7.83						7.83	7.25	5.83	0.17	5.88	5.85
Panicum hemitomon		5.75	18.00	18.00	18.00	18.00	77.75	71.99	57.87	0.83	29.41	43.64
Total	28.13	22.23	20.91	24.60	20.49	18.00	134.36	124.41	100.00	2.83	100.00	100.00

TABLE B-16
Shrub Values for the Port Orange Wetland - December 9, 2002

Species	Linear Distance						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Baccharis halmifolia			0.53				0.53	0.49	24.88	0.17	25.37	25.13
Hypericum fasciculatum	0.39						0.39	0.36	18.31	0.17	25.37	21.84
Taxodium ascendens			0.65	0.56			1.21	1.12	56.81	0.33	49.25	53.03
Total	0.39	0.00	1.18	0.56	0.00	0.00	2.13	1.97	100.00	0.67	100.00	100.00

TABLE B-17
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	Notes
1/1	401	Pinus taeda	13.9	15	15.89	Burned
1/1	402	Pinus taeda	7.35	8.5	9.52	
1/1	403	Pinus taeda	7.8	8.4	9.10	
1/1	404	Pinus taeda	9.05	10.5	11.85	
1/1	406	Taxodium ascendens	5.9	6	5.98	
1/1	407	Taxodium ascendens	7.7	7.9	7.68	
1/1	408	Taxodium ascendens	5.75	6	5.90	
1/1	409	Pinus taeda	10.5	11	11.40	
1/1	410	Taxodium ascendens	11.3	11.7	11.90	
1/1	411	Taxodium ascendens	12.4	12.6	12.92	
1/1	412	Pinus taeda	8.9	9.6	9.60	(still alive)
1/1	413	Pinus elliottii	9.5	11	11.40	Fallen
1/1	414	Taxodium ascendens	16.15	16.15	16.05	
1/1	415	Taxodium ascendens	7.5	7.5	7.38	
1/1	416	Taxodium ascendens	5.2	5.3	5.09	
1/2	417	Taxodium ascendens	5.5	5.7	5.60	
1/2	418	Taxodium ascendens	4.15	4.5	4.02	
1/2	419	Taxodium ascendens	3.7	4	3.60	
1/2	420	Taxodium ascendens	3.7	4	3.70	
1/2	421	Taxodium ascendens	8.7	0.9	8.78	
1/2	422	Taxodium ascendens	7.5	7.8	7.58	
1/2	423	Taxodium ascendens	16.55	16.6	16.65	
1/2	424	Taxodium ascendens	10.5	11	11.30	
1/2	425	Taxodium ascendens	5.65	6	5.85	
1/2	426	Taxodium ascendens	4.6	4.8	4.60	
1/2	427	Taxodium ascendens	6.35	6.8	6.82	
1/2	428	Taxodium ascendens	7.45	8	8.10	
1/2	429	Taxodium ascendens	5.55	6	5.60	
1/2	430	Taxodium ascendens	17.45	17.7	17.48	
1/2	431	Taxodium ascendens	6.15	6.3	6.12	
1/2	432	Taxodium ascendens	6.7	7.2	7.02	
1/2	433	Taxodium ascendens	16.77	16.6	16.48	
1/3	434	Taxodium ascendens	17.7	17.8	17.72	
1/3	435	Taxodium ascendens	18.98	19	18.70	
1/3	436	Taxodium ascendens	6.4	6.6	6.50	
1/3	437	Taxodium ascendens	7.75	8	7.92	
1/3	438	Taxodium ascendens	7.05	7.3	7.40	
1/3	439	Taxodium ascendens	5.85	6.2	6.15	
1/3	440	Taxodium ascendens	8.55	8.8	8.70	
1/3	441	Taxodium ascendens	4.65	4.8	4.70	
1/3	442	Taxodium ascendens	26	26.2	25.90	
1/3	443	Taxodium ascendens	4	4.1	3.95	
1/3	444	Taxodium ascendens	4.9	5	4.95	
1/3	445	Taxodium ascendens	4.5	4.8	4.80	
1/3	446	Taxodium ascendens	2.7	3.2	2.62	
1/3	447	Taxodium ascendens	6.53	7.4	7.49	
1/3	448	Taxodium ascendens	7.9	8.2	8.40	
1/3	449	Nyssa sylvatica	8	8.8	9.12	
1/3	450	Taxodium ascendens	6	6.3	6.10	
1/3	451	Taxodium ascendens	5.55	5.9	5.85	
1/3	452	Taxodium ascendens	6.4	6.8	6.82	
1/3	453	Taxodium ascendens	11.9	12.2	12.42	
1/3	454	Taxodium ascendens	27.1	27.3	27.10	
1/4	455	Taxodium ascendens	28.5	28.9	28.72	
1/4	456	Taxodium ascendens	27.5	27.5	27.52	
1/4	457	Nyssa sylvatica	19.3	19.7	20.00	

TABLE B-17
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	Notes
1/4	458	Nyssa sylvatica	9.5	10	10.28	
1/4	459	Taxodium ascendens	4.95	5.2	5.05	
1/4	460	Taxodium ascendens	4.05	4.8	4.38	
1/4	461	Taxodium ascendens	3.45	3.7	3.42	
1/4	462	Taxodium ascendens	6	6.3	6.55	
1/4	463	Taxodium ascendens	8.4	8.7	8.45	
1/4	464	Taxodium ascendens	3.05	3.3	3.00	
1/4	465	Taxodium ascendens	4.8	5	4.75	
1/4	466	Taxodium ascendens	4.2	4.5	4.20	
1/4	467	Taxodium ascendens	10.6	11.1	11.45	
1/4	468	Taxodium ascendens	4.4	4.5	4.38	
1/4	469	Taxodium ascendens	9.9	9.8	9.98	
1/4	470	Taxodium ascendens	5.5	5.8	6.00	
1/4	471	Taxodium ascendens	5.55	5.8	5.65	
1/4	472	Taxodium ascendens	6.25	6.4	6.20	
1/4	473	Taxodium ascendens	6	6.2	6.02	
1/4	474	Taxodium ascendens	3.25	3.5	3.09	
1/4	475	Taxodium ascendens	6.12	5.4	5.12	
1/4	476	Taxodium ascendens	4.9	5	5.00	
1/4	477	Taxodium ascendens	8.35	8.7	9.20	
1/4	478	Taxodium ascendens	7.1	7.3	7.35	
1/4	479	Taxodium ascendens	4.3	4.5	4.28	
1/4	480	Taxodium ascendens	4.45	4.6	4.55	
1/4	481	Taxodium ascendens	2.4	2.8	2.32	
1/4	482	Taxodium ascendens	4.55	4.7	4.45	
1/4	483	Taxodium ascendens	4.85	5	4.80	
1/4	484	Taxodium ascendens	6.4	6.6	6.65	
1/4	485	Taxodium ascendens	9.8	10.3	11.05	
1/4	486	Taxodium ascendens	5.35	5.6	5.32	
1/4	487	Taxodium ascendens	6.1	6.3	6.25	
1/4	488	Taxodium ascendens	17.77	18.2	18.62	
1/4	489	Taxodium ascendens	11.35	11.5	11.28	
1/5	490	Taxodium ascendens	4.6	4.8	4.68	
1/5	491	Taxodium ascendens	24.24	24.7	25.12	
1/5	492	Taxodium ascendens	6.85	7	7.20	
1/5	493	Taxodium ascendens	13.6	13.8	3.95	
1/5	494	Taxodium ascendens	22.75	21.9	22.55	
1/5	495	Taxodium ascendens	2.8	3.1	2.72	
1/5	496	Taxodium ascendens	21.55	21.6	21.65	
1/5	497	Nyssa sylvatica	8.7	8.7	8.68	
1/5	498	Taxodium ascendens	12.3	12.3	12.68	
1/5	499	Taxodium ascendens	20.3	20.4	20.89	Down
1/5	702	Taxodium ascendens			3.02	
1/5	703	Taxodium ascendens			3.58	Down
1/5	705	Taxodium ascendens			3.35	Down
1/5	389	Taxodium ascendens			13.62	

TABLE B-18

Canopy and Subcanopy Importance Values for the Port Orange Wetland - December 9, 2002

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	2	0.74	5.25	37.04	6.67	0.17	12.50	8.14
Pinus elliottii	1	0.19	1.35	18.52	3.33	0.17	12.50	5.73
Pinus taeda	3	0.76	5.43	55.56	10.00	0.17	12.50	9.31
Taxodium ascendens	24	12.32	87.97	444.44	80.00	0.83	62.50	76.82
Total	30	14.01	100.00	555.56	100.00	1.33	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	2	0.23	5.77	37.04	2.78	0.33	25.00	11.18
Pinus taeda	3	0.39	9.67	55.56	4.17	0.17	12.50	8.78
Taxodium ascendens	67	3.38	84.56	1240.74	93.06	0.83	62.50	80.04
Total	72	4.00	100.00	1333.33	100.00	1.33	100.00	100.00

Hydration Year 2 - Detailed Vegetation Data

TABLE B-19
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - December 03, 2003

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Amphicarpum muhlenbergianum		1						0.14	0.53
Andropogon virginicus	2						1	0.43	1.60
Aristida stricta	6		18	4				4.00	14.89
Centella asiatica	1							0.14	0.53
Drosera brevifolia	5							0.71	2.66
Eriocaulon compressum	3							0.43	1.60
Eriocaulon decangulare	12	8	10	7	22			8.43	31.38
Hypericum fasciculatum	35							5.00	18.62
Hypericum myrtifolium		1						0.14	0.53
Hypericum tetrapetalum	1							0.14	0.53
Panicum hemitomon	2	2		5		20	15	6.29	23.40
Pluchea rosea					1			0.14	0.53
Woodwardia virginica						5		0.71	2.66
Xyris defformis	1							0.14	0.53
Total	68	12	28	16	23	25	16	26.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Andropogon virginicus					1	1		0.29	1.20
Aristida stricta	1	12		24				5.29	22.29
Drosera brevifolia	1							0.14	0.60
Eriocaulon compressum	1							0.14	0.60
Eriocaulon decangulare	5		1		18	4		4.00	16.87
Hypericum tetrapetalum	2							0.29	1.20
Ilex glabra	1							0.14	0.60
Panicum commutatum							3	0.43	1.81
Panicum hemitomon			10	1	2	2	2	2.43	10.24
Sarracenia minor	1							0.14	0.60
Utricularia sp.					1	10	60	10.14	42.77
Xyris defformis	1	1						0.29	1.20
Total	13	13	11	25	22	17	65	23.71	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Aristida stricta	1	10	2					1.86	5.49
Eriocaulon decangulare	32	25		75	1			19.00	56.12
Hypericum fasciculatum	20							2.86	8.44
Osmunda regalis							1	0.14	0.42
Panicum commutatum				4				0.57	1.69
Panicum hemitomon			5		2	10	20	5.29	15.61
Pluchea rosea				1				0.14	0.42
Utricularia sp.					1	3	22	3.71	10.97
Xyris defformis	2							0.29	0.84
Total	55	35	7	80	4	13	43	33.86	100.00

TABLE B-20
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - April 6, 2004

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Aristida stricta		1	6					1.00	7.45
Centella asiatica	2							0.29	2.13
Drosera brevifolia	1							0.14	1.06
Eriocaulon compressum	4		2	1	1			1.14	8.51
Eriocaulon decangulare		5	5	1	1			1.71	12.77
Eupatorium capillifolium	1							0.14	1.06
Hypericum fasciculatum	23							3.29	24.47
Lycopus rubellus					1			0.14	1.06
Panicum hemitomon	1			1	1	5	10	2.57	19.15
Panicum scabriusculum		1						0.14	1.06
Pluchea rosea					2	1		0.43	3.19
Rhexia sp.	1							0.14	1.06
Rhynchospora sp.				1				0.14	1.06
Syngonanthus flavidulus	2							0.29	2.13
Utricularia sp.					1			0.14	1.06
Woodwardia virginica						2		0.29	2.13
Xyris defformis	10							1.43	10.64
Total	45	7	13	4	7	8	10	13.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Andropogon virginicus		1						0.14	2.86
Aristida stricta		1		3	1			0.71	14.29
Drosera brevifolia	2							0.29	5.71
Eriocaulon compressum				1	3	1	1	0.86	17.14
Eriocaulon decangulare	1							0.14	2.86
Gratiola sp.		1						0.14	2.86
Hypericum fasciculatum	1							0.14	2.86
Juncus repens						1	4	0.71	14.29
Panicum hemitomon			2	1				0.43	8.57
Pinus elliottii			1					0.14	2.86
Pluchea rosea						1		0.14	2.86
Rhexia sp.	1							0.14	2.86
Rhynchospora sp.	1				1			0.29	5.71
Sarracenia minor	1							0.14	2.86
Schizachyrium scoparium				1				0.14	2.86
Syngonanthus flavidulus	1							0.14	2.86
Xyris defformis	1	1						0.29	5.71
Total	9	4	3	6	5	3	5	5.00	100.00

TABLE B-20
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - April 6, 2004

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Andropogon virginicus					1			0.14	2.17
Aristida stricta		1	1	1				0.43	6.52
Eriocaulon compressum		2		5	1			1.14	17.39
Eriocaulon decangulare	2	5		3				1.43	21.74
Gratiola sp.				1				0.14	2.17
Hypericum fasciculatum	2							0.29	4.35
Lycopus rubellus		1						0.14	2.17
Panicum erectifolium	1			1				0.29	4.35
Panicum hemitomon			2		1	4	4	1.57	23.91
Persea palustris	1							0.14	2.17
Pinus elliottii	1							0.14	2.17
Pluchea rosea		1						0.14	2.17
Rhynchospora sp.				1	1			0.29	4.35
Schizachyrium scoparium		1						0.14	2.17
Xyris defformis	1							0.14	2.17
Total	8	11	3	12	4	4	4	6.57	100.00

TABLE B-21
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - June 10, 2004

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Amphicarpum muhlenbergianum	1							0.14	0.70
Andropogon virginicus					4			0.57	2.80
Eriocaulon compressum	16							2.29	11.19
Eriocaulon decangulare		18		9				3.86	18.88
Hypericum fasciculatum	1							0.14	0.70
Lachnocaulon beyrichianum		4		14				2.57	12.59
Panicum hemitomon			12		3	16	20	7.29	35.66
Panicum sp.	1	1		1				0.43	2.10
Persea palustris	1							0.14	0.70
Pinus elliottii	1							0.14	0.70
Pluchea rosea		1						0.14	0.70
Rhynchospora sp.	1			1	1	1		0.57	2.80
Sabatia bartramii			2					0.29	1.40
Schizachyrium scoparium		3			2			0.71	3.50
Scleria baldwinii		2						0.29	1.40
Woodwardia virginica							1	0.14	0.70
Xyris defformis	5							0.71	3.50
Total	27	29	14	25	10	17	21	20.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Amphicarpum muhlenbergianum	1			1	1	2	2	1.00	6.36
Andropogon virginicus		1		2	3	2		1.14	7.27
Dichromena colorata		2						0.29	1.82
Eriocaulon compressum	3							0.43	2.73
Eriocaulon decangulare			1					0.14	0.91
Hypericum fasciculatum	1							0.14	0.91
Hypericum tetrapetalum	1							0.14	0.91
Juncus repens							6	0.86	5.45
Lachnanthes caroliniana	1							0.14	0.91
Lachnocaulon beyrichianum		1		3	8	4		2.29	14.55
Lythrum sp.			1				22	3.29	20.91
Panicum hemitomon			10	1		3	2	2.29	14.55
Panicum sp.		1						0.14	0.91
Pinus elliottii			1					0.14	0.91
Pluchea rosea						1		0.14	0.91
Polygala ramosa		1						0.14	0.91
Rhynchospora sp.	2				1			0.43	2.73
Sabatia bartramii		1	1					0.29	1.82
Sarracenia minor	1							0.14	0.91
Schizachyrium scoparium		2		6				1.14	7.27
Scleria baldwinii					1			0.14	0.91
Syngonanthus flavidulus	5							0.71	4.55
Xyris defformis	1							0.14	0.91
Total	16	9	14	13	14	12	32	15.71	100.00

TABLE B-21
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - June 10, 2004

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Amphicarpum muhlenbergianum	1							0.14	0.74
Andropogon virginicus	1	1	1	3				0.86	4.44
Aristida stricta	2							0.29	1.48
Centella asiatica	1							0.14	0.74
Eriocaulon compressum	6							0.86	4.44
Eriocaulon decangulare		5	5	1	7			2.57	13.33
Hypericum fasciculatum	2							0.29	1.48
Hypericum tetrapetalum	1							0.14	0.74
Lachnocaulon beyrichianum			1					0.14	0.74
Lycopus rubellus					1			0.14	0.74
Panicum hemitomon				1		20	40	8.71	45.19
Panicum sp.	1	1						0.29	1.48
Pinus elliottii	2				1			0.43	2.22
Pluchea rosea			1		3			0.57	2.96
Polygala ramosa	1							0.14	0.74
Rhexia sp.	1							0.14	0.74
Rhynchospora sp.		1		2				0.43	2.22
Schizachyrium scoparium		1	7					1.14	5.93
Scleria baldwinii								0.00	0.00
Syngonanthus flavidulus	4							0.57	2.96
Woodwardia virginica						8		1.14	5.93
Xyris defformis	1							0.14	0.74
Total	24	9	15	7	12	28	40	19.29	100.00

TABLE B-22
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - December 3, 2003

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	2.00				2.57		4.57	4.23	3.25	0.33	11.11	7.18
Aristida stricta	4.20	10.73	11.93	9.17			36.03	33.36	25.66	0.67	22.22	23.94
Eriocaulon decangulare	8.14	4.96	5.08	8.98	6.35		33.51	31.03	23.87	0.83	27.78	25.82
Hypericum fasciculatum	2.15						2.15	1.99	1.53	0.17	5.56	3.54
Panicum hemitomon	9.09	7.64	18.99	8.79	1.63	18.00	64.14	59.39	45.68	1.00	33.33	39.51
Total	25.58	23.33	36.00	26.94	10.55	18.00	140.40	130.00	100.00	3.00	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	3.70		0.49		0.26	1.22	5.67	5.25	4.78	0.67	20.00	12.39
Aristida stricta	2.07	6.62	10.12	6.02	0.36		25.19	23.32	21.24	0.83	25.00	23.12
Eriocaulon decangulare	7.15	9.85	4.40	7.70	3.66		32.76	30.33	27.62	0.83	25.00	26.31
Hypericum fasciculatum	3.92						3.92	3.63	3.31	0.17	5.00	4.15
Panicum hemitomon		1.19	6.96	13.84	12.29	16.77	51.05	47.27	43.05	0.83	25.00	34.02
Total	16.84	17.66	21.97	27.56	16.57	17.99	118.59	109.81	100.00	3.33	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.71			0.58	0.31		2.60	2.41	2.12	0.50	17.65	9.88
Aristida stricta	11.33	12.31	7.02				30.66	28.39	25.02	0.50	17.65	21.33
Eriocaulon decangulare	7.41	3.48	2.94	9.03	3.65		26.51	24.55	21.64	0.83	29.41	25.52
Hypericum fasciculatum	7.21						7.21	6.68	5.88	0.17	5.88	5.88
Panicum hemitomon		1.19	3.72	15.45	17.19	18.00	55.55	51.44	45.34	0.83	29.41	37.37
Total	27.66	16.98	13.68	25.06	21.15	18.00	122.53	113.45	100.00	2.83	100.00	100.00

TABLE B-23
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - April 6, 2004

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.38						0.38	0.35	0.54	0.17	6.25	3.40
Aristida stricta	2.04	2.95	8.18	7.17			20.34	18.83	29.13	0.67	25.00	27.07
Eriocaulon decangulare	2.31	3.96	2.50	5.29	3.10		17.16	15.89	24.58	0.83	31.25	27.91
Hypericum fasciculatum	2.40						2.40	2.22	3.44	0.17	6.25	4.84
Panicum hemitomon	3.33	1.23		5.58	1.40	18.00	29.54	27.35	42.31	0.83	31.25	36.78
Total	10.46	8.14	10.68	18.04	4.50	18.00	69.82	64.65	100.00	2.67	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	4.12		0.78	0.64	0.90	0.10	6.54	6.06	5.67	0.83	25.00	15.34
Aristida stricta	4.50	10.14	9.22	3.78			27.64	25.59	23.97	0.67	20.00	21.99
Eriocaulon decangulare	1.40	6.16	8.90	6.68	1.50		24.64	22.81	21.37	0.83	25.00	23.19
Hypericum fasciculatum	4.62						4.62	4.28	4.01	0.17	5.00	4.50
Panicum hemitomon		0.75	3.10	15.00	15.00	18.00	51.85	48.01	44.97	0.83	25.00	34.99
Total	14.64	17.05	22.00	26.10	17.40	18.10	115.29	106.75	100.00	3.33	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus		0.40	0.75	1.80	1.65		4.60	4.26	6.94	0.67	21.05	14.00
Aristida stricta	2.95	5.95	1.35				10.25	9.49	15.47	0.50	15.79	15.63
Eriocaulon decangulare	4.41	1.22	2.01	5.43	2.00		15.07	13.95	22.75	0.83	26.32	24.53
Hypericum fasciculatum	5.40						5.40	5.00	8.15	0.17	5.26	6.71
Panicum hemitomon	0.08	0.10	1.40	4.20	8.94	16.20	30.92	28.63	46.68	1.00	31.58	39.13
Total	12.84	7.67	5.51	11.43	12.59	16.20	66.24	61.33	100.00	3.17	100.00	100.00

TABLE B-24
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - June 10, 2004

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.84	1.70					2.54	2.35	2.47	0.33	11.11	6.79
Aristida stricta	3.55	4.10	13.80	7.60			29.05	26.90	28.27	0.67	22.22	25.25
Eriocaulon decangulare	5.80	3.50	2.66	6.05	4.24		22.25	20.60	21.65	0.83	27.78	24.72
Hypericum fasciculatum	2.63						2.63	2.44	2.56	0.17	5.56	4.06
Panicum hemitomon	9.95	7.43	0.90	7.40	2.60	18.00	46.28	42.85	45.04	1.00	33.33	39.19
Total	22.77	16.73	17.36	21.05	6.84	18.00	102.75	95.14	100.00	3.00	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	2.01						2.01	1.86	2.02	0.17	5.88	3.95
Aristida stricta	4.58	5.69	2.15	4.05		0.55	17.02	15.76	17.06	0.83	29.41	23.24
Eriocaulon decangulare	5.10	6.44	1.58	4.00	1.44		18.56	17.19	18.61	0.83	29.41	24.01
Hypericum fasciculatum	3.17						3.17	2.94	3.18	0.17	5.88	4.53
Panicum hemitomon		1.66	9.86	16.05	13.42	18.00	58.99	54.62	59.14	0.83	29.41	44.27
Total	14.86	13.79	13.59	24.10	14.86	18.55	99.75	92.36	100.00	2.83	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus		0.20	1.35		1.28		2.83	2.62	6.64	0.50	25.00	15.82
Aristida stricta	8.70	9.57	0.70	1.40			20.37	18.86	47.78	0.67	33.33	40.56
Eriocaulon decangulare	2.50	2.00	2.35	5.05			11.90	11.02	27.91	0.67	33.33	30.62
Hypericum fasciculatum	7.53						7.53	6.97	17.66	0.17	8.33	13.00
Total	18.73	11.77	4.40	6.45	1.28	0.00	42.63	39.47	100.00	2.00	100.00	100.00

TABLE B-25
Shrub Values for the Port Orange Wetland - December 3, 2003

Species	Linear Distance						Total Linear Distance (m)	Cover		Frequency		Importance Value
	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
Salix caroliniana						0.47	0.47	0.44	100.00	0.17	100.00	100.00
Total	0.00	0.00	0.00	0.00	0.00	0.47	0.47	0.44	100.00	0.17	100.00	100.00

TABLE B-26
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	Notes
1/1	401	Pinus taeda	13.9	15	15.89	16.67	Burned
1/1	402	Pinus taeda	7.35	8.5	9.52	9.93	
1/1	403	Pinus taeda	7.8	8.4	9.10	9.55	
1/1	404	Pinus taeda	9.05	10.5	11.85	12.41	
1/1	406	Taxodium ascendens	5.9	6	5.98	6.70	
1/1	407	Taxodium ascendens	7.7	7.9	7.68	7.90	
1/1	408	Taxodium ascendens	5.75	6	5.90	6.05	
1/1	409	Pinus taeda	10.5	11	11.40	11.51	
1/1	410	Taxodium ascendens	11.3	11.7	11.90	12.20	
1/1	411	Taxodium ascendens	12.4	12.6	12.92	13.10	
1/1	412	Pinus taeda	8.9	9.6	9.60	9.95	(still alive)
1/1	413	Pinus elliottii	9.5	11	11.40	11.95	Fallen
1/1	414	Taxodium ascendens	16.15	16.15	16.05	16.15	
1/1	415	Taxodium ascendens	7.5	7.5	7.38	7.45	
1/1	416	Taxodium ascendens	5.2	5.3	5.09	5.20	
1/2	417	Taxodium ascendens	5.5	5.7	5.60	5.55	
1/2	418	Taxodium ascendens	4.15	4.5	4.02	4.05	
1/2	419	Taxodium ascendens	3.7	4	3.60	3.64	
1/2	420	Taxodium ascendens	3.7	4	3.70	4.15	
1/2	421	Taxodium ascendens	8.7	0.9	8.78	9.30	
1/2	422	Taxodium ascendens	7.5	7.8	7.58	7.62	
1/2	423	Taxodium ascendens	16.55	16.6	16.65	16.61	
1/2	424	Taxodium ascendens	10.5	11	11.30	11.45	
1/2	425	Taxodium ascendens	5.65	6	5.85	5.85	
1/2	426	Taxodium ascendens	4.6	4.8	4.60	4.60	
1/2	427	Taxodium ascendens	6.35	6.8	6.82	7.10	
1/2	428	Taxodium ascendens	7.45	8	8.10	8.15	
1/2	429	Taxodium ascendens	5.55	6	5.60	6.10	
1/2	430	Taxodium ascendens	17.45	17.7	17.48	17.41	
1/2	431	Taxodium ascendens	6.15	6.3	6.12	6.12	
1/2	432	Taxodium ascendens	6.7	7.2	7.02	7.10	
1/2	433	Taxodium ascendens	16.77	16.6	16.48	16.57	
1/3	434	Taxodium ascendens	17.7	17.8	17.72	17.82	
1/3	435	Taxodium ascendens	18.98	19	18.70	18.82	
1/3	436	Taxodium ascendens	6.4	6.6	6.50	6.60	
1/3	437	Taxodium ascendens	7.75	8	7.92	7.98	
1/3	438	Taxodium ascendens	7.05	7.3	7.40	7.40	
1/3	439	Taxodium ascendens	5.85	6.2	6.15	6.28	
1/3	440	Taxodium ascendens	8.55	8.8	8.70	8.98	
1/3	441	Taxodium ascendens	4.65	4.8	4.70	4.72	
1/3	442	Taxodium ascendens	26	26.2	25.90	25.85	
1/3	443	Taxodium ascendens	4	4.1	3.95	3.95	
1/3	444	Taxodium ascendens	4.9	5	4.95	5.03	
1/3	445	Taxodium ascendens	4.5	4.8	4.80	4.85	
1/3	446	Taxodium ascendens	2.7	3.2	2.62	2.65	
1/3	447	Taxodium ascendens	6.53	7.4	7.49	7.52	
1/3	448	Taxodium ascendens	7.9	8.2	8.40	8.40	
1/3	449	Nyssa sylvatica	8	8.8	9.12	9.15	
1/3	450	Taxodium ascendens	6	6.3	6.10	6.15	
1/3	451	Taxodium ascendens	5.55	5.9	5.85	5.82	
1/3	452	Taxodium ascendens	6.4	6.8	6.82	7.00	
1/3	453	Taxodium ascendens	11.9	12.2	12.42	12.62	
1/3	454	Taxodium ascendens	27.1	27.3	27.10	27.08	
1/4	455	Taxodium ascendens	28.5	28.9	28.72	28.65	
1/4	456	Taxodium ascendens	27.5	27.5	27.52	27.38	
1/4	457	Nyssa sylvatica	19.3	19.7	20.00	20.22	

TABLE B-26
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	Notes
1/4	458	Nyssa sylvatica	9.5	10	10.28	10.43	
1/4	459	Taxodium ascendens	4.95	5.2	5.05	5.18	
1/4	460	Taxodium ascendens	4.05	4.8	4.38	4.45	
1/4	461	Taxodium ascendens	3.45	3.7	3.42	3.45	
1/4	462	Taxodium ascendens	6	6.3	6.55	7.15	
1/4	463	Taxodium ascendens	8.4	8.7	8.45	8.45	
1/4	464	Taxodium ascendens	3.05	3.3	3.00	3.00	
1/4	465	Taxodium ascendens	4.8	5	4.75	4.80	
1/4	466	Taxodium ascendens	4.2	4.5	4.20	4.20	
1/4	467	Taxodium ascendens	10.6	11.1	11.45	11.80	
1/4	468	Taxodium ascendens	4.4	4.5	4.38	4.40	
1/4	469	Taxodium ascendens	9.9	9.8	9.98	10.25	
1/4	470	Taxodium ascendens	5.5	5.8	6.00	6.12	
1/4	471	Taxodium ascendens	5.55	5.8	5.65	5.50	
1/4	472	Taxodium ascendens	6.25	6.4	6.20	6.25	
1/4	473	Taxodium ascendens	6	6.2	6.02	6.12	
1/4	474	Taxodium ascendens	3.25	3.5	3.09	3.15	
1/4	475	Taxodium ascendens	6.12	5.4	5.12	5.12	
1/4	476	Taxodium ascendens	4.9	5	5.00	4.98	
1/4	477	Taxodium ascendens	8.35	8.7	9.20	9.48	
1/4	478	Taxodium ascendens	7.1	7.3	7.35	7.60	
1/4	479	Taxodium ascendens	4.3	4.5	4.28	4.28	
1/4	480	Taxodium ascendens	4.45	4.6	4.55	4.78	
1/4	481	Taxodium ascendens	2.4	2.8	2.32	2.40	
1/4	482	Taxodium ascendens	4.55	4.7	4.45	4.45	
1/4	483	Taxodium ascendens	4.85	5	4.80	4.88	
1/4	484	Taxodium ascendens	6.4	6.6	6.65	6.88	
1/4	485	Taxodium ascendens	9.8	10.3	11.05	11.40	
1/4	486	Taxodium ascendens	5.35	5.6	5.32	5.32	
1/4	487	Taxodium ascendens	6.1	6.3	6.25	6.32	
1/4	488	Taxodium ascendens	17.77	18.2	18.62	18.52	
1/4	489	Taxodium ascendens	11.35	11.5	11.28	11.50	
1/4	704	Taxodium ascendens				2.75	
1/5	490	Taxodium ascendens	4.6	4.8	4.68	4.80	
1/5	491	Taxodium ascendens	24.24	24.7	25.12	25.15	
1/5	492	Taxodium ascendens	6.85	7	7.20	7.74	
1/5	493	Taxodium ascendens	13.6	13.8	3.95	14.20	
1/5	494	Taxodium ascendens	22.75	21.9	22.55	22.60	
1/5	495	Taxodium ascendens	2.8	3.1	2.72	2.90	
1/5	496	Taxodium ascendens	21.55	21.6	21.65	21.73	
1/5	497	Nyssa sylvatica	8.7	8.7	8.68	8.88	
1/5	498	Taxodium ascendens	12.3	12.3	12.68	12.82	
1/5	499	Taxodium ascendens	20.3	20.4	20.89	20.72	Down
1/5	702	Taxodium ascendens			3.02	2.95	
1/5	703	Taxodium ascendens			3.58	3.55	Down
1/5	705	Taxodium ascendens			3.35	3.30	Down
1/5	389	Taxodium ascendens			13.62	13.79	

TABLE B-27

Canopy and Subacanopy Importance Values for the Port Orange Wetland - December 3, 2003

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	2	0.75	5.15	37.04	6.25	0.17	12.50	7.97
Pinus elliottii	1	0.21	1.42	18.52	3.13	0.17	12.50	5.68
Pinus taeda	3	0.82	5.62	55.56	9.38	0.17	12.50	9.16
Taxodium ascendens	26	12.83	87.81	481.48	81.25	0.83	62.50	77.19
Total	32	14.61	100.00	592.59	100.00	1.33	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	2	0.24	5.89	37.04	2.82	0.33	25.00	11.24
Pinus taeda	3	0.42	10.46	55.56	4.23	0.17	12.50	9.06
Taxodium ascendens	66	3.36	83.65	1222.22	92.96	0.83	62.50	79.70
Total	71	4.02	100.00	1314.81	100.00	1.33	100.00	100.00

Hydration Year 3 - Detailed Vegetation Data

TABLE B-28
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - October 21, 2004

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Aristida stricta	1	1	1					0.43	8.57
Eriocaulon compressum	1							0.14	2.86
Hypericum fasciculatum	*3*							0.43	8.57
Panicum hemitomon			3	1	2	8	7	3.00	60.00
Panicum sp.				1				0.14	2.86
Rhynchospora sp. #2				1				0.14	2.86
Schizachyrium scoparium	1	1			2			0.57	11.43
Unknown fern							1	0.14	2.86
Total	6	2	4	3	4	8	8	5.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Aristida stricta				1				0.14	3.57
Erianthus giganteus						1		0.14	3.57
Eriocaulon compressum	3							0.43	10.71
Hypericum fasciculatum	1							0.14	3.57
Lachnanthes caroliniana	1							0.14	3.57
Panicum hemitomon			3		1	1	4	1.29	32.14
Panicum sp.							1	0.14	3.57
Panicum sp. #1	1	1						0.29	7.14
Rhynchospora sp. #1	1							0.14	3.57
Rhynchospora sp. #2					2			0.29	7.14
Sarracenia minor	1							0.14	3.57
Schizachyrium scoparium		1		2	1	1		0.71	17.86
Total	8	2	3	3	4	3	5	4.00	100.00

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicum	1							0.14	3.45
Aristida stricta			1					0.14	3.45
Eriocaulon compressum	2							0.29	6.90
Eriocaulon decangulare	2		2		2			0.86	20.69
Hypericum fasciculatum	1							0.14	3.45
Panicum hemitomon				1		4	5	1.43	34.48
Panicum sp.		1						0.14	3.45
Pluchea sp.					1			0.14	3.45
Rhynchospora inundata				2				0.29	6.90
Rhynchospora latifolia		1						0.14	3.45
Schizachyrium scoparium		1		1				0.29	6.90
Woodwardia virginica						1		0.14	3.45
Total	6	3	3	4	3	5	5	4.14	100.00

TABLE B-29
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - April 27, 2005

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Amphicarpum muhlenbergianum	2							0.29	4.17
Andropogon virginicus		1			2			0.43	6.25
Aristida stricta		1						0.14	2.08
Eriocaulon compressum		5						0.71	10.42
Hypericum fasciculatum	1							0.14	2.08
Panicum hemitomon	1	1	4	1	2	7	12	4.00	58.33
Panicum sp.	1							0.14	2.08
Persea palustris	1							0.14	2.08
Pinus elliottii	2							0.29	4.17
Polygala cruciata	1							0.14	2.08
Rhynchospora sp.				2	1	1		0.57	8.33
Schizachyrium scoparium								0.00	0.00
Taxodium ascendens			1					0.14	2.08
Unknown grass							1	0.14	2.08
Unknown fern							1	0.14	2.08
Woodwardia virginica						1		0.14	2.08
Total	7	7	5	3	3	9	14	6.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Amphicarpum muhlenbergianum	1			1				0.29	5.41
Andropogon virginicus		1		1	1			0.43	8.11
Aristida stricta				2				0.29	5.41
Erianthus giganteus						1		0.14	2.70
Eriocaulon decangulare	2							0.29	5.41
Hypericum fasciculatum	1							0.14	2.70
Juncus repens							7	1.00	18.92
Lachnanthes caroliniana	1							0.14	2.70
Panicum hemitomon			3		1	2	3	1.29	24.32
Panicum ridigulum		1						0.14	2.70
Pinus elliottii	2							0.29	5.41
Pluchea sp.	1							0.14	2.70
Rhynchospora sp.	1				2	1		0.57	10.81
Sarracenia minor	1							0.14	2.70
Total	10	2	3	4	4	4	10	5.29	100.00

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover 1	2	3	4	5	6	7	Cover Percent	Cover Relative
Amphicarpum muhlenbergianum	1							0.14	1.41
Andropogon virginicus	1	1		2				0.57	5.63
Aristida stricta		1	1					0.29	2.82
Drosera brevifolia	1							0.14	1.41
Eriocaulon compressum			2					0.29	2.82
Eriocaulon decangulare	2							0.29	2.82
Hpericum hypericoides					1			0.14	1.41
Hypericum fasciculatum	1							0.14	1.41
Lachnanthes caroliniana	1							0.14	1.41
Panicum hemitomon				1		15	25	5.86	57.75
Panicum sp.					1			0.14	1.41
Pinus elliottii	1							0.14	1.41
Pluchea sp.					1			0.14	1.41
Polygala cruciata	1							0.14	1.41
Rhynchospora sp.				3				0.43	4.23
Taxodium ascendens				1				0.14	1.41
Woodwardia virginica						7		1.00	9.86
Total	9	2	3	7	3	22	25	10.14	100.00

TABLE B-30
Summary of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - July 12, 2005

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1	1						0.29	4.26
Andropogon virginicus		1			1			0.29	4.26
Aristida stricta		1						0.14	2.13
Hypericum fasciculatum	1							0.14	2.13
Panicum hemitomon			4	1	2	12	14	4.71	70.21
Panicum sp.	1						1	0.29	4.26
Persea palustris	1							0.14	2.13
Rhynchospora sp.				3	2	1		0.86	12.77
Taxodium ascendens			1					0.14	2.13
Unknown fern							1	0.14	2.13
Woodwardia virginica						1		0.14	2.13
Total	3	1	5	4	4	14	16	6.71	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum		1		1				0.29	5.41
Andropogon virginicus	1	1	1	1	1	1		0.86	16.22
Aristida stricta		1		1				0.29	5.41
Erianthus giganteus						1		0.14	2.70
Eriocaulon compressum	1							0.14	2.70
Hypericum fasciculatum	1							0.14	2.70
Juncus repens							4	0.57	10.81
Lachnanthes caroliniana	1							0.14	2.70
Leersia hexandra		1						0.14	2.70
Panicum hemitomon			2		1	2	5	1.43	27.03
Pluchea sp.	1							0.14	2.70
Rhynchospora sp.	1				3	2	1	1.00	18.92
Total	6	4	3	3	5	6	10	5.29	100.00

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1							0.14	1.61
Andropogon virginicus	1	1		1	1			0.57	6.45
Aristida stricta		1	1					0.29	3.23
Drosera brevifolia	1							0.14	1.61
Eriocaulon decangulare	2							0.29	3.23
Fuirena scirpoidea	1							0.14	1.61
Hpericum hypericoides					1			0.14	1.61
Hypericum fasciculatum	1							0.14	1.61
Lachnanthes caroliniana	1							0.14	1.61
Panicum hemitomon				1		14	20	5.00	56.45
Pluchea sp.					1			0.14	1.61
Rhynchospora sp.				5				0.71	8.06
Taxodium ascendens				1				0.14	1.61
Unknown Grass					1			0.14	1.61
Woodwardia virginica						5		0.71	8.06
Total	8	2	1	8	4	19	20	8.86	100.00

TABLE B-31
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - October 21, 2004

PORT ORANGE - NORTH

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Aristida stricta	1.94	1.77	4.25	1.85			9.81	9.08	14.34	0.67	26.67	20.50
Eriocaulon decangulare	2.17	1.00	1.37	3.10	2.92		10.56	9.78	15.43	0.83	33.33	24.38
Hypericum fasciculatum	0.87						0.87	0.81	1.27	0.17	6.67	3.97
Panicum hemitomon	9.90	8.50		8.60	2.19	18.00	47.19	43.69	68.96	0.83	33.33	51.15
Total	14.88	11.27	5.62	13.55	5.11	18.00	68.43	63.36	100.00	2.50	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus						0.25	0.25	0.23	0.37	0.17	6.67	3.52
Aristida stricta	2.16	5.35	3.15	2.95			13.61	12.60	19.93	0.67	26.67	23.30
Eriocaulon decangulare	1.00	1.49	0.75		0.70		3.94	3.65	5.77	0.67	26.67	16.22
Hypericum fasciculatum	0.95						0.95	0.88	1.39	0.17	6.67	4.03
Panicum hemitomon		1.35	5.40	16.35	8.45	18.00	49.55	45.88	72.55	0.83	33.33	52.94
Total	4.11	8.19	9.30	19.30	9.15	18.25	68.30	63.24	100.00	2.50	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Aristida stricta	7.30	6.20	3.00				16.50	15.28	11.04	0.50	21.43	16.23
Eriocaulon decangulare		0.30	7.60	13.00	2.30		23.20	21.48	15.52	0.67	28.57	22.05
Hypericum fasciculatum	4.05						4.05	3.75	2.71	0.17	7.14	4.93
Panicum hemitomon	15.70	18.00	18.00	18.00	18.00	18.00	105.70	97.87	70.73	1.00	42.86	56.79
Total	27.05	24.50	28.60	31.00	20.30	18.00	149.45	138.38	100.00	2.33	100.00	100.00

TABLE B-32

Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - April 27, 2005

PORT ORANGE - NORTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.16	4.34	4.24	0.60	1.70		12.04	11.15	21.10	0.83	35.71	28.41
Aristida stricta	1.07			0.45			1.52	1.41	2.66	0.33	14.29	8.47
Eriocaulon decangulare	3.31						3.31	3.06	5.80	0.17	7.14	6.47
Panicum hemitomon	6.61	5.26	1.02	5.45	3.86	18.00	40.20	37.22	70.43	1.00	42.86	56.65
Total	12.15	9.60	5.26	6.50	5.56	18.00	57.07	52.85	100.00	2.33	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.88	3.95	9.65	5.55	0.40		21.43	19.84	30.44	0.83	33.33	31.89
Aristida stricta	2.60	2.00	0.40	2.40			7.40	6.85	10.51	0.67	26.67	18.59
Eriocaulon decangulare	0.30						0.30	0.28	0.43	0.17	6.67	3.55
Panicum hemitomon		1.85	6.30	8.82	7.80	16.50	41.27	38.21	58.62	0.83	33.33	45.98
Total	4.78	7.80	16.35	16.77	8.20	16.50	70.40	65.19	100.00	2.50	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.95	1.00	3.84	6.80	3.85		17.44	16.15	25.55	0.83	33.33	29.44
Aristida stricta	3.10	1.55	1.85				6.50	6.02	9.52	0.50	20.00	14.76
Hypericum fasciculatum	2.56				0.60		3.16	2.93	4.63	0.33	13.33	8.98
Panicum hemitomon		0.52	3.41	9.54	9.70	18.00	41.17	38.12	60.30	0.83	33.33	46.82
Total	7.61	3.07	9.10	16.34	14.15	18.00	68.27	63.21	100.00	2.50	100.00	100.00

TABLE B-33

Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - July 12, 2005

PORT ORANGE - NORTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.80				1.60		2.40	2.22	3.18	0.33	16.67	9.92
Aristida stricta	2.90	9.70	3.40				16.00	14.81	21.21	0.50	25.00	23.10
Eriocaulon decangulare	2.90						2.90	2.69	3.84	0.17	8.33	6.09
Panicum hemitomon	16.00	6.40	0.80	11.40	1.55	18.00	54.15	50.14	71.77	1.00	50.00	60.88
Total	22.60	16.10	4.20	11.40	3.15	18.00	75.45	69.86	100.00	2.00	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.00	0.50	0.55	0.30	0.60	0.50	3.45	3.19	5.22	1.00	35.29	20.25
Aristida stricta	3.10	5.15	3.10	3.20			14.55	13.47	21.99	0.67	23.53	22.76
Eriocaulon decangulare	0.80						0.80	0.74	1.21	0.17	5.88	3.55
Hypericum fasciculatum	0.03						0.03	0.03	0.05	0.17	5.88	2.96
Panicum hemitomon		2.95	7.98	10.60	7.80	18.00	47.33	43.82	71.54	0.83	29.41	50.47
Total	4.93	8.60	11.63	14.10	8.40	18.50	66.16	61.25	100.00	2.83	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.65	0.40	2.55	1.40	1.90		7.90	7.31	11.02	0.83	31.25	21.13
Aristida stricta	3.25	2.75	4.65	2.40	1.00		14.05	13.01	19.59	0.83	31.25	25.42
Hypericum fasciculatum	2.46						2.46	2.28	3.43	0.17	6.25	4.84
Panicum hemitomon		3.00	6.30	10.70	9.30	18.00	47.30	43.80	65.96	0.83	31.25	48.61
Total	7.36	6.15	13.50	14.50	12.20	18.00	71.71	66.40	100.00	2.67	100.00	100.00

TABLE B-34
Shrub Values for the Port Orange Wetland - October 21, 2004

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Linear Distance F	Total Linear Distance (m)	Cover		Frequency		Importance Value
								Percent	Relative	Absolute	Relative	
Salix caroliniana					0.20	0.52	0.72	0.67	100.00	0.33	100.00	100.00
Total	0.00	0.00	0.00	0.00	0.20	0.52	0.72	0.67	100.00	0.40	100.00	100.00

TABLE B-35
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	10/21/04	Notes
1/1	401	Pinus taeda	13.9	15	15.89	16.67	17.20	Burned
1/1	402	Pinus taeda	7.35	8.5	9.52	9.93	10.40	
1/1	403	Pinus taeda	7.8	8.4	9.10	9.55	9.70	
1/1	404	Pinus taeda	9.05	10.5	11.85	12.41	13.20	
1/1	406	Taxodium ascendens	5.9	6	5.98	6.70	6.20	
1/1	407	Taxodium ascendens	7.7	7.9	7.68	7.90	7.90	
1/1	408	Taxodium ascendens	5.75	6	5.90	6.05	6.00	
1/1	409	Pinus taeda	10.5	11	11.40	11.51	12.00	
1/1	410	Taxodium ascendens	11.3	11.7	11.90	12.20	12.30	
1/1	411	Taxodium ascendens	12.4	12.6	12.92	13.10	13.20	
1/1	412	Pinus taeda	8.9	9.6	9.60	9.95	10.20	(still alive)
1/1	413	Pinus elliottii	9.5	11	11.40	11.95	12.30	Fallen
1/1	414	Taxodium ascendens	16.15	16.15	16.05	16.15	16.10	
1/1	415	Taxodium ascendens	7.5	7.5	7.38	7.45	7.50	
1/1	416	Taxodium ascendens	5.2	5.3	5.09	5.20	5.10	
1/2	417	Taxodium ascendens	5.5	5.7	5.60	5.55	5.60	
1/2	418	Taxodium ascendens	4.15	4.5	4.02	4.05	4.00	
1/2	419	Taxodium ascendens	3.7	4	3.60	3.64	3.60	
1/2	420	Taxodium ascendens	3.7	4	3.70	4.15	3.90	
1/2	421	Taxodium ascendens	8.7	0.9	8.78	9.30	9.00	
1/2	422	Taxodium ascendens	7.5	7.8	7.58	7.62	7.60	
1/2	423	Taxodium ascendens	16.55	16.6	16.65	16.61	16.70	
1/2	424	Taxodium ascendens	10.5	11	11.30	11.45	11.30	
1/2	425	Taxodium ascendens	5.65	6	5.85	5.85	5.80	
1/2	426	Taxodium ascendens	4.6	4.8	4.60	4.60	4.60	
1/2	427	Taxodium ascendens	6.35	6.8	6.82	7.10	7.10	
1/2	428	Taxodium ascendens	7.45	8	8.10	8.15		
1/2	429	Taxodium ascendens	5.55	6	5.60	6.10	5.60	
1/2	430	Taxodium ascendens	17.45	17.7	17.48	17.41	17.50	
1/2	431	Taxodium ascendens	6.15	6.3	6.12	6.12	6.10	
1/2	432	Taxodium ascendens	6.7	7.2	7.02	7.10	7.20	
1/2	433	Taxodium ascendens	16.77	16.6	16.48	16.57	16.60	
1/3	434	Taxodium ascendens	17.7	17.8	17.72	17.82	17.90	
1/3	435	Taxodium ascendens	18.98	19	18.70	18.82	18.90	
1/3	436	Taxodium ascendens	6.4	6.6	6.50	6.60	6.50	
1/3	437	Taxodium ascendens	7.75	8	7.92	7.98	7.90	
1/3	438	Taxodium ascendens	7.05	7.3	7.40	7.40	7.50	
1/3	439	Taxodium ascendens	5.85	6.2	6.15	6.28	6.30	
1/3	440	Taxodium ascendens	8.55	8.8	8.70	8.98	9.10	
1/3	441	Taxodium ascendens	4.65	4.8	4.70	4.72	4.70	
1/3	442	Taxodium ascendens	26	26.2	25.90	25.85	26.50	
1/3	443	Taxodium ascendens	4	4.1	3.95	3.95	3.90	
1/3	444	Taxodium ascendens	4.9	5	4.95	5.03	5.10	
1/3	445	Taxodium ascendens	4.5	4.8	4.80	4.85	5.00	
1/3	446	Taxodium ascendens	2.7	3.2	2.62	2.65	2.70	
1/3	447	Taxodium ascendens	6.53	7.4	7.49	7.52	7.60	
1/3	448	Taxodium ascendens	7.9	8.2	8.40	8.40	8.50	
1/3	449	Nyssa sylvatica	8	8.8	9.12	9.15	9.20	
1/3	450	Taxodium ascendens	6	6.3	6.10	6.15	6.20	
1/3	451	Taxodium ascendens	5.55	5.9	5.85	5.82	6.00	
1/3	452	Taxodium ascendens	6.4	6.8	6.82	7.00	7.00	
1/3	453	Taxodium ascendens	11.9	12.2	12.42	12.62	12.70	
1/3	454	Taxodium ascendens	27.1	27.3	27.10	27.08	27.10	
1/4	455	Taxodium ascendens	28.5	28.9	28.72	28.65	28.90	
1/4	456	Taxodium ascendens	27.5	27.5	27.52	27.38	27.80	
1/4	457	Nyssa sylvatica	19.3	19.7	20.00	20.22	20.90	

TABLE B-35
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	10/21/04	Notes
1/4	458	Nyssa sylvatica	9.5	10	10.28	10.43	10.70	
1/4	459	Taxodium ascendens	4.95	5.2	5.05	5.18	5.20	
1/4	460	Taxodium ascendens	4.05	4.8	4.38	4.45	4.50	
1/4	461	Taxodium ascendens	3.45	3.7	3.42	3.45	3.40	
1/4	462	Taxodium ascendens	6	6.3	6.55	7.15	7.10	
1/4	463	Taxodium ascendens	8.4	8.7	8.45	8.45	8.60	
1/4	464	Taxodium ascendens	3.05	3.3	3.00	3.00	3.10	
1/4	465	Taxodium ascendens	4.8	5	4.75	4.80	4.70	
1/4	466	Taxodium ascendens	4.2	4.5	4.20	4.20	4.20	
1/4	467	Taxodium ascendens	10.6	11.1	11.45	11.80	12.10	
1/4	468	Taxodium ascendens	4.4	4.5	4.38	4.40	4.50	
1/4	469	Taxodium ascendens	9.9	9.8	9.98	10.25	10.30	
1/4	470	Taxodium ascendens	5.5	5.8	6.00	6.12	6.30	
1/4	471	Taxodium ascendens	5.55	5.8	5.65	5.50	5.60	
1/4	472	Taxodium ascendens	6.25	6.4	6.20	6.25	6.30	
1/4	473	Taxodium ascendens	6	6.2	6.02	6.12	6.20	
1/4	474	Taxodium ascendens	3.25	3.5	3.09	3.15	3.40	
1/4	475	Taxodium ascendens	6.12	5.4	5.12	5.12	5.10	
1/4	476	Taxodium ascendens	4.9	5	5.00	4.98	5.00	
1/4	477	Taxodium ascendens	8.35	8.7	9.20	9.48	9.70	
1/4	478	Taxodium ascendens	7.1	7.3	7.35	7.60	7.70	
1/4	479	Taxodium ascendens	4.3	4.5	4.28	4.28	4.30	
1/4	480	Taxodium ascendens	4.45	4.6	4.55	4.78	4.80	
1/4	481	Taxodium ascendens	2.4	2.8	2.32	2.40	2.50	
1/4	482	Taxodium ascendens	4.55	4.7	4.45	4.45	4.50	
1/4	483	Taxodium ascendens	4.85	5	4.80	4.88	4.90	
1/4	484	Taxodium ascendens	6.4	6.6	6.65	6.88	6.90	
1/4	485	Taxodium ascendens	9.8	10.3	11.05	11.40	11.70	
1/4	486	Taxodium ascendens	5.35	5.6	5.32	5.32	5.40	
1/4	487	Taxodium ascendens	6.1	6.3	6.25	6.32	6.50	
1/4	488	Taxodium ascendens	17.77	18.2	18.62	18.52	18.60	
1/4	489	Taxodium ascendens	11.35	11.5	11.28	11.50	11.60	
1/4	704	Taxodium ascendens				2.75		
1/5	490	Taxodium ascendens	4.6	4.8	4.68	4.80	4.80	
1/5	491	Taxodium ascendens	24.24	24.7	25.12	25.15	25.30	
1/5	492	Taxodium ascendens	6.85	7	7.20	7.74	8.10	
1/5	493	Taxodium ascendens	13.6	13.8	3.95	14.20	14.20	
1/5	494	Taxodium ascendens	22.75	21.9	22.55	22.60	22.60	
1/5	495	Taxodium ascendens	2.8	3.1	2.72	2.90	2.90	
1/5	496	Taxodium ascendens	21.55	21.6	21.65	21.73	21.80	
1/5	497	Nyssa sylvatica	8.7	8.7	8.68	8.88	8.90	
1/5	498	Taxodium ascendens	12.3	12.3	12.68	12.82	13.00	
1/5	499	Taxodium ascendens	20.3	20.4	20.89	20.72		Down
1/5	702	Taxodium ascendens			3.02	2.95	3.00	
1/5	703	Taxodium ascendens			3.58	3.55		Down
1/5	705	Taxodium ascendens			3.35	3.30		Down
1/5	389	Taxodium ascendens			13.62	13.79	14.00	

TABLE B-36
Canopy and Subacanopy Importance Values for the Port Orange Wetland - October 21, 2004

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	3	1.31	8.93	55.56	9.09	0.17	12.50	10.17
Pinus elliottii	1	0.22	1.51	18.52	3.03	0.17	12.50	5.68
Pinus taeda	5	1.2	8.22	92.59	15.15	0.17	12.50	11.96
Taxodium ascendens	24	11.89	81.34	444.44	72.73	0.83	62.50	72.19
Total	33	14.62	100.00	611.11	100.00	1.33	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	1	0.12	3.41	18.52	1.54	0.17	14.29	6.41
Pinus taeda	1	0.14	3.79	18.52	1.54	0.17	14.29	6.54
Taxodium ascendens	63	3.35	92.81	1166.67	96.92	0.83	71.43	87.05
Total	65	3.61	100.00	1203.71	100.00	1.17	100.00	100.00

Hydration Year 4 - Detailed Vegetation Data

TABLE B-37
Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - October 27, 2005

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1	1						0.29	4.88
Aristida stricta		1	1					0.29	4.88
Hypericum fasciculatum	1							0.14	2.44
Leersia hexandra		1					1	0.29	4.88
Panicum hemitomon			3		2	10	15	4.29	73.17
Panicum sp				1	1			0.29	4.88
Persea palustris	1							0.14	2.44
Rhynchospora corniculata				1	1	1		0.43	7.32
unknown fern							1	0.14	2.44
Woodwardia virginica						1		0.14	2.44
Total	2	1	3	2	4	12	17	5.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Aristida stricta		1		1				0.29	8.33
Erianthus giganteus						1		0.14	4.17
Hypericum fasciculatum	1							0.14	4.17
Leersia hexandra						1		0.14	4.17
Panicum hemitomon			2	1		3	5	1.57	45.83
Panicum sp		1						0.14	4.17
Rhynchospora corniculata					1			0.14	4.17
Rhynchospora sp	4							0.57	16.67
Schizachyrium scoparium		1			1			0.29	8.33
Total	5	3	2	2	2	5	5	3.43	100.00

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Andropogon virginicus	2							0.29	0.94
Aristida stricta		3	1					0.57	1.88
Eriocaulon decangulare	13							1.86	6.10
Osmunda cinnamomea						3		0.43	1.41
Panicum erectifolium	1							0.14	0.47
Panicum hemitomon		4		4	1	90	70	24.14	79.34
Panicum sp					1			0.14	0.47
Pluchea rosea			1					0.14	0.47
Rhynchospora sp.			3	15				2.57	8.45
Xyris sp	1							0.14	0.47
Total	17	7	5	19	2	93	70	30.43	100.00

TABLE B-38

Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - March 15, 2006

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1				1			0.29	4.44
Andropogon virginicus	1	1						0.29	4.44
Aristida stricta		1						0.14	2.22
Drosera brevifolia	2							0.29	4.44
Eriocaulon compressum			3		1			0.57	8.89
Eriocaulon decangulare	5							0.71	11.11
Fuirena scirpoidea	1							0.14	2.22
Hypericum fasciculatum	1				1			0.29	4.44
Panicum hemitomon		1		1		6	10	2.57	40.00
Pluchea rosea					1			0.14	2.22
Rhynchospora corniculata				4				0.57	8.89
Woodwardia virginica						2		0.29	4.44
Xyris sp	1							0.14	2.22
Total	12	3	3	5	4	8	10	6.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1							0.14	1.79
Andropogon virginicus		1		1				0.29	3.57
Aristida stricta		1		1				0.29	3.57
Drosera brevifolia	1							0.14	1.79
Erianthus giganteus						1		0.14	1.79
Eriocaulon compressum		1						0.14	1.79
Eriocaulon decangulare	3							0.43	5.36
Hypericum fasciculatum	1							0.14	1.79
Juncus repens							20	2.86	35.71
Panicum hemitomon			4			2	6	1.71	21.43
Rhynchospora corniculata					2	1		0.43	5.36
Rhynchospora sp.	8							1.14	14.29
Syngonanthus flavidulus	1							0.14	1.79
Total	15	3	4	2	2	4	26	8.00	100.00

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	2							0.29	6.45
Blechnum serrulatum							2	0.29	6.45
Erianthus giganteus					1			0.14	3.23
Eriocaulon compressum		5						0.71	16.13
Gratiola sp			1					0.14	3.23
Hypericum fasciculatum	1							0.14	3.23
Panicum hemitomon			2	1	1	5	4	1.86	41.94
Rhynchospora corniculata				3	2			0.71	16.13
Rhynchospora sp.	1							0.14	3.23
Total	4	5	3	4	4	5	6	4.43	100.00

TABLE B-39
Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - July 5, 2006

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	3	1		1	1			0.86	7.14
Andropogon virginicus		1	1					0.29	2.38
Aristida stricta	1	1						0.29	2.38
Buchnera americana	1							0.14	1.19
Hypericum fasciculatum	1		1					0.29	2.38
Leersia hexandra		1					2	0.43	3.57
Panicum erectifolium	2							0.29	2.38
Panicum hemitomon			6	1	3	20	18	6.86	57.14
Polygala sp.			1					0.14	1.19
Rhynchospora inundata				7	4			1.57	13.10
Scleria baldwinii	1							0.14	1.19
Syngonanthus flavidulus		4						0.57	4.76
Woodwardia virginica						1		0.14	1.19
Total	9	8	9	9	8	21	20	12.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1							0.14	0.75
Andropogon virginicus		1		1	3			0.71	3.76
Aristida stricta				2				0.29	1.50
Erianthus giganteus						1		0.14	0.75
Eriocaulon decangulare	3							0.43	2.26
Hypericum fasciculatum	1							0.14	0.75
Hyptis alata			1					0.14	0.75
Juncus repens							40	5.71	30.08
Panicum hemitomon			6		2	15	35	8.29	43.61
Panicum sp.		2						0.29	1.50
Rhynchospora inundata					3	7	1	1.57	8.27
Rhynchospora sp.	6							0.86	4.51
Syngonanthus flavidulus		1						0.14	0.75
Xyris difformis	1							0.14	0.75
Total	12	4	7	3	8	23	76	19.00	100.00

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1				1			0.29	1.45
Andropogon virginicus	2		1	2	1			0.86	4.35
Aristida stricta		1						0.14	0.72
Eriocaulon decangulare	5							0.71	3.62
Fuirena scirpoidea	1							0.14	0.72
Hypericum fasciculatum	1							0.14	0.72
Lachnanthes caroliniana	1							0.14	0.72
Panicum erectifolium					2			0.29	1.45
Panicum hemitomon				2	2	18	65	12.43	63.04
Panicum sp.			2					0.29	1.45
Pluchea rosea					1			0.14	0.72
Rhynchospora inundata				20				2.86	14.49
Rhynchospora sp.	1							0.14	0.72
Syngonanthus flavidulus			2					0.29	1.45
Woodwardia virginica						5		0.71	3.62
Xyris difformis	1							0.14	0.72
Total	10	1	4	22	5	23	65	19.71	100.00

TABLE B-40
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - October 28, 2005

PORT ORANGE - NORTH

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	0.85		0.20		0.20		1.25	1.16	2.11	0.50	21.43	11.77
Aristida stricta	0.91	8.30	1.70	0.15			11.06	10.24	18.63	0.67	28.57	23.60
Eriocaulon decangulare	2.15						2.15	1.99	3.62	0.17	7.14	5.38
Panicum hemitomon	5.80	9.30	1.40	8.20	2.20	18.00	44.90	41.57	75.64	1.00	42.86	59.25
Total	9.71	17.60	3.30	8.35	2.40	18.00	59.36	54.96	100.00	2.33	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	0.60	0.30	1.80				2.70	2.50	4.82	0.50	21.43	13.13
Aristida stricta	3.20	2.20		2.80	0.40		8.60	7.96	15.36	0.67	28.57	21.96
Eriocaulon decangulare	0.30						0.30	0.28	0.54	0.17	7.14	3.84
Panicum hemitomon	3.10	2.90	5.20	6.40	8.80	18.00	44.40	41.11	79.29	1.00	42.86	61.07
Total	7.20	5.40	7.00	9.20	9.20	18.00	56.00	51.85	100.00	2.33	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	0.30						0.30	0.28	0.71	0.17	11.11	5.91
Aristida stricta	4.08	1.12					5.20	4.81	12.36	0.33	22.22	17.29
Hypericum fasciculatum	2.16						2.16	2.00	5.14	0.17	11.11	8.12
Panicum hemitomon		0.80	0.50	6.30	8.80	18.00	34.40	31.85	81.79	0.83	55.56	68.67
Total	6.54	1.92	0.50	6.30	8.80	18.00	42.06	38.94	100.00	1.50	100.00	100.00

TABLE B-41
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - March 15, 2006

PORT ORANGE - NORTH

Species	Linear Distance (m)						Total Linear Distance (m)	Cover		Frequency		Importance Value
	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
Andropogon virginicus	1.20	2.10	0.60	0.30	1.20		5.40	5.00	11.70	0.83	27.78	19.74
Aristida stricta	0.20	3.50	1.40	1.80			6.90	6.39	14.95	0.67	22.22	18.59
Eriocaulon decangulare	2.90	0.30					3.20	2.96	6.94	0.33	11.11	9.02
Hypericum fasciculatum			0.10				0.10	0.09	0.22	0.17	5.56	2.89
Panicum hemitomum	3.80	3.14	0.15	4.45	1.00	18.00	30.54	28.28	66.19	1.00	33.33	49.76
Total	8.10	9.04	2.25	6.55	2.20	18.00	46.14	42.72	100.00	3.00	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m)						Total Linear Distance (m)	Cover		Frequency		Importance Value
	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
Andropogon virginicus	1.08		1.15	0.30	0.45		2.98	2.76	6.23	0.67	26.67	16.45
Aristida stricta	2.10	2.50	2.55	3.85			11.00	10.19	23.00	0.67	26.67	24.83
Eriocaulon decangulare	1.85						1.85	1.71	3.87	0.17	6.67	5.27
Hypericum fasciculatum	0.20						0.20	0.19	0.42	0.17	6.67	3.54
Panicum hemitomum		0.01	0.78	7.00	6.00	18.00	31.79	29.44	66.48	0.83	33.33	49.91
Total	5.23	2.51	4.48	11.15	6.45	18.00	47.82	44.28	100.00	2.50	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m)						Total Linear Distance (m)	Cover		Frequency		Importance Value
	A	B	C	D	E	F		Percent	Relative	Absolute	Relative	
Andropogon virginicus	0.16	0.02	0.07				0.25	0.23	0.87	0.50	20.00	10.43
Aristida stricta	0.12	0.13	0.22				0.47	0.44	1.63	0.50	20.00	10.81
Eriocaulon decangulare	0.26						0.26	0.24	0.90	0.17	6.67	3.78
Hypericum fasciculatum	0.01			0.27			0.28	0.26	0.97	0.33	13.33	7.15
Panicum hemitomum	0.06	0.37	0.17	0.65	9.38	17.00	27.63	25.58	95.64	1.00	40.00	67.82
Total	0.61	0.52	0.46	0.92	9.38	17.00	28.89	26.75	100.00	2.50	100.00	100.00

TABLE B-42
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - July 5, 2006

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	7.00	15.25	4.30	2.50		1.50	30.55	28.29	36.26	0.83	41.67	38.96
Eriocaulon decangulare	3.00						3.00	2.78	3.56	0.17	8.33	5.95
Panicum hemitomum	14.00	6.20	7.10	4.40	1.00	18.00	50.70	46.94	60.18	1.00	50.00	55.09
Total	24.00	21.45	11.40	6.90	1.00	19.50	84.25	78.01	100.00	2.00	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	15.85	13.00	2.60				31.45	29.12	28.83	0.50	25.00	26.91
Aristida stricta	11.50	7.00					18.50	17.13	16.96	0.33	16.67	16.81
Eriocaulon decangulare	3.45						3.45	3.19	3.16	0.17	8.33	5.75
Panicum hemitomum	2.40	8.60	8.00	11.20	7.50	18.00	55.70	51.57	51.05	1.00	50.00	50.53
Total	33.20	28.60	10.60	11.20	7.50	18.00	109.10	101.02	100.00	2.00	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	10.00	7.50	1.75				19.25	17.82	22.69	0.50	27.27	24.98
Aristida stricta	13.10	5.50	2.00				20.60	19.07	24.28	0.50	27.27	25.78
Panicum hemitomum	3.00	7.00	9.00		8.00	18.00	45.00	41.67	53.03	0.83	45.45	49.24
Total	26.10	20.00	12.75	0.00	8.00	18.00	84.85	78.56	100.00	1.83	100.00	100.00

TABLE B-43
Shrub Values for the Port Orange Wetland - October 25, 2005

Species	Linear Distance A	Linear Distance B	Linear Distance C	Linear Distance D	Linear Distance E	Linear Distance F	Total Linear Distance (m)	Cover		Frequency		Importance Value
								Percent	Relative	Absolute	Relative	
Taxodium ascendens		0.25	0.50	0.30	0.70		1.75	1.62	100.00	0.67	100.00	100.00
Total	0.00	0.25	0.50	0.30	0.70	0.00	1.75	1.62	100.00	0.67	100.00	100.00

TABLE B-44
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	10/21/04	10/25/05	Notes
1/1	401	Pinus taeda	13.9	15	15.89	16.67	17.20	17.90	Burned
1/1	402	Pinus taeda	7.35	8.5	9.52	9.93	10.40	10.80	
1/1	403	Pinus taeda	7.8	8.4	9.10	9.55	9.70	10.20	
1/1	404	Pinus taeda	9.05	10.5	11.85	12.41	13.20	13.70	
1/1	406	Taxodium ascendens	5.9	6	5.98	6.70	6.20	6.50	
1/1	407	Taxodium ascendens	7.7	7.9	7.68	7.90	7.90	8.20	
1/1	408	Taxodium ascendens	5.75	6	5.90	6.05	6.00	6.30	
1/1	409	Pinus taeda	10.5	11	11.40	11.51	12.00	12.10	
1/1	410	Taxodium ascendens	11.3	11.7	11.90	12.20	12.30	12.80	
1/1	411	Taxodium ascendens	12.4	12.6	12.92	13.10	13.20	13.90	
1/1	412	Pinus taeda	8.9	9.6	9.60	9.95	10.20	10.40	(still alive)
1/1	413	Pinus elliottii	9.5	11	11.40	11.95	12.30	12.70	Fallen
1/1	414	Taxodium ascendens	16.15	16.15	16.05	16.15	16.10	16.50	
1/1	415	Taxodium ascendens	7.5	7.5	7.38	7.45	7.50	7.60	
1/1	416	Taxodium ascendens	5.2	5.3	5.09	5.20	5.10	5.30	
1/1	513	Taxodium ascendens						2.60	
1/1	514	Taxodium ascendens						2.60	
1/2	417	Taxodium ascendens	5.5	5.7	5.60	5.55	5.60	5.70	
1/2	418	Taxodium ascendens	4.15	4.5	4.02	4.05	4.00	4.10	
1/2	419	Taxodium ascendens	3.7	4	3.60	3.64	3.60	3.70	
1/2	420	Taxodium ascendens	3.7	4	3.70	4.15	3.90	4.10	
1/2	421	Taxodium ascendens	8.7	0.9	8.78	9.30	9.00	9.10	
1/2	422	Taxodium ascendens	7.5	7.8	7.58	7.62	7.60	7.70	
1/2	423	Taxodium ascendens	16.55	16.6	16.65	16.61	16.70	16.90	
1/2	424	Taxodium ascendens	10.5	11	11.30	11.45	11.30	12.00	
1/2	425	Taxodium ascendens	5.65	6	5.85	5.85	5.80	6.10	
1/2	426	Taxodium ascendens	4.6	4.8	4.60	4.60	4.60	4.70	
1/2	427	Taxodium ascendens	6.35	6.8	6.82	7.10	7.10	7.40	
1/2	428	Taxodium ascendens	7.45	8	8.10	8.15		8.50	
1/2	429	Taxodium ascendens	5.55	6	5.60	6.10	5.60	5.70	
1/2	430	Taxodium ascendens	17.45	17.7	17.48	17.41	17.50	17.70	
1/2	431	Taxodium ascendens	6.15	6.3	6.12	6.12	6.10	6.20	
1/2	432	Taxodium ascendens	6.7	7.2	7.02	7.10	7.20	7.20	
1/2	433	Taxodium ascendens	16.77	16.6	16.48	16.57	16.60	16.70	
1/3	434	Taxodium ascendens	17.7	17.8	17.72	17.82	17.90	18.10	
1/3	435	Taxodium ascendens	18.98	19	18.70	18.82	18.90	19.20	
1/3	436	Taxodium ascendens	6.4	6.6	6.50	6.60	6.50	6.70	
1/3	437	Taxodium ascendens	7.75	8	7.92	7.98	7.90	8.10	
1/3	438	Taxodium ascendens	7.05	7.3	7.40	7.40	7.50	7.80	
1/3	439	Taxodium ascendens	5.85	6.2	6.15	6.28	6.30	6.50	
1/3	440	Taxodium ascendens	8.55	8.8	8.70	8.98	9.10	9.30	
1/3	441	Taxodium ascendens	4.65	4.8	4.70	4.72	4.70	4.90	
1/3	442	Taxodium ascendens	26	26.2	25.90	25.85	26.50	26.30	
1/3	443	Taxodium ascendens	4	4.1	3.95	3.95	3.90	4.00	
1/3	444	Taxodium ascendens	4.9	5	4.95	5.03	5.10	5.30	
1/3	445	Taxodium ascendens	4.5	4.8	4.80	4.85	5.00	5.20	
1/3	446	Taxodium ascendens	2.7	3.2	2.62	2.65	2.70	3.20	
1/3	447	Taxodium ascendens	6.53	7.4	7.49	7.52	7.60	7.80	
1/3	448	Taxodium ascendens	7.9	8.2	8.40	8.40	8.50	8.80	
1/3	449	Nyssa sylvatica	8	8.8	9.12	9.15	9.20	9.40	
1/3	450	Taxodium ascendens	6	6.3	6.10	6.15	6.20	6.30	
1/3	451	Taxodium ascendens	5.55	5.9	5.85	5.82	6.00	6.10	
1/3	452	Taxodium ascendens	6.4	6.8	6.82	7.00	7.00	7.60	
1/3	453	Taxodium ascendens	11.9	12.2	12.42	12.62	12.70	13.30	
1/3	454	Taxodium ascendens	27.1	27.3	27.10	27.08	27.10	27.20	
1/4	455	Taxodium ascendens	28.5	28.9	28.72	28.65	28.90	29.20	
1/4	456	Taxodium ascendens	27.5	27.5	27.52	27.38	27.80	27.90	
1/4	457	Nyssa sylvatica	19.3	19.7	20.00	20.22	20.90	20.90	
1/4	458	Nyssa sylvatica	9.5	10	10.28	10.43	10.70	11.00	
1/4	459	Taxodium ascendens	4.95	5.2	5.05	5.18	5.20	5.50	
1/4	460	Taxodium ascendens	4.05	4.8	4.38	4.45	4.50	5.10	
1/4	461	Taxodium ascendens	3.45	3.7	3.42	3.45	3.40	3.60	

TABLE B-44
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	10/21/04	10/25/05	Notes
1/4	462	Taxodium ascendens	6	6.3	6.55	7.15	7.10	7.30	
1/4	463	Taxodium ascendens	8.4	8.7	8.45	8.45	8.60	8.70	
1/4	464	Taxodium ascendens	3.05	3.3	3.00	3.00	3.10	3.20	
1/4	465	Taxodium ascendens	4.8	5	4.75	4.80	4.70	4.80	
1/4	466	Taxodium ascendens	4.2	4.5	4.20	4.20	4.20	4.50	
1/4	467	Taxodium ascendens	10.6	11.1	11.45	11.80	12.10	12.80	
1/4	468	Taxodium ascendens	4.4	4.5	4.38	4.40	4.50	4.70	
1/4	469	Taxodium ascendens	9.9	9.8	9.98	10.25	10.30	10.70	
1/4	470	Taxodium ascendens	5.5	5.8	6.00	6.12	6.30	6.60	
1/4	471	Taxodium ascendens	5.55	5.8	5.65	5.50	5.60	5.60	
1/4	472	Taxodium ascendens	6.25	6.4	6.20	6.25	6.30	6.50	
1/4	473	Taxodium ascendens	6	6.2	6.02	6.12	6.20	6.50	
1/4	474	Taxodium ascendens	3.25	3.5	3.09	3.15	3.40	3.80	
1/4	475	Taxodium ascendens	6.12	5.4	5.12	5.12	5.10	5.20	
1/4	476	Taxodium ascendens	4.9	5	5.00	4.98	5.00	5.20	
1/4	477	Taxodium ascendens	8.35	8.7	9.20	9.48	9.70	10.20	
1/4	478	Taxodium ascendens	7.1	7.3	7.35	7.60	7.70	7.70	
1/4	479	Taxodium ascendens	4.3	4.5	4.28	4.28	4.30	4.40	
1/4	480	Taxodium ascendens	4.45	4.6	4.55	4.78	4.80	5.00	
1/4	481	Taxodium ascendens	2.4	2.8	2.32	2.40	2.50	2.50	
1/4	482	Taxodium ascendens	4.55	4.7	4.45	4.45	4.50	4.60	
1/4	483	Taxodium ascendens	4.85	5	4.80	4.88	4.90	5.20	
1/4	484	Taxodium ascendens	6.4	6.6	6.65	6.88	6.90	7.50	
1/4	485	Taxodium ascendens	9.8	10.3	11.05	11.40	11.70	12.20	
1/4	486	Taxodium ascendens	5.35	5.6	5.32	5.32	5.40	5.40	
1/4	487	Taxodium ascendens	6.1	6.3	6.25	6.32	6.50	7.10	
1/4	488	Taxodium ascendens	17.77	18.2	18.62	18.52	18.60	18.90	
1/4	489	Taxodium ascendens	11.35	11.5	11.28	11.50	11.60	12.00	
1/4	704	Taxodium ascendens				2.75		2.80	
1/5	490	Taxodium ascendens	4.6	4.8	4.68	4.80	4.80	5.40	
1/5	491	Taxodium ascendens	24.24	24.7	25.12	25.15	25.30	25.70	
1/5	492	Taxodium ascendens	6.85	7	7.20	7.74	8.10	8.80	
1/5	493	Taxodium ascendens	13.6	13.8	3.95	14.20	14.20	14.70	
1/5	494	Taxodium ascendens	22.75	21.9	22.55	22.60	22.60	23.00	
1/5	495	Taxodium ascendens	2.8	3.1	2.72	2.90	2.90	2.90	
1/5	496	Taxodium ascendens	21.55	21.6	21.65	21.73	21.80	22.30	
1/5	497	Nyssa sylvatica	8.7	8.7	8.68	8.88	8.90	9.30	
1/5	498	Taxodium ascendens	12.3	12.3	12.68	12.82	13.00	13.20	
1/5	499	Taxodium ascendens	20.3	20.4	20.89	20.72			Down
1/5	599	Taxodium ascendens						3.40	
1/5	702	Taxodium ascendens			3.02	2.95	3.00		
1/5	703	Taxodium ascendens			3.58	3.55			Down
1/5	705	Taxodium ascendens			3.35	3.30			Down
1/5	389	Taxodium ascendens			13.62	13.79	14.00	14.20	

TABLE B-45
Canopy and Subacanopy Importance Values for the Port Orange Wetland - October 25, 2005

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	3	1.33	8.54	55.56	8.57	0.17	11.26	9.46
Pinus elliottii	1	0.24	1.54	18.52	2.86	0.17	11.26	5.22
Pinus taeda	6	1.43	9.18	111.11	17.14	0.17	11.26	12.53
Taxodium ascendens	25	12.57	80.73	462.96	71.43	1.00	66.23	72.80
	35	15.57	100.00	648.15	100.00	1.51	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	1	0.13	3.49	18.52	1.49	0.17	14.53	6.51
Taxodium ascendens	66	3.59	96.51	1222.22	98.51	1.00	85.47	93.49
	67	3.72	100.00	1240.74	100.00	1.17	100.00	100.00

Hydration Year 5 - Detailed Vegetation Data

TABLE B-46

Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - October 27, 2005

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum	4	4		1				1.29	7.69
Andropogon virginicus		2						0.29	1.71
Aristida stricta		2						0.29	1.71
Coelorachis rugosa					5			0.71	4.27
Hypericum fasciculatum	1							0.14	0.85
Leersia hexandra		1						0.14	0.85
Panicum erectifolium	3	2		3				1.14	6.84
Panicum hemitomon			5	1	3	10	50	9.86	58.97
Panicum virgatum			2	1	3			0.86	5.13
Persea palustris	1							0.14	0.85
Rhynchospora corniculata				3	2			0.71	4.27
Scleria sp.	1							0.14	0.85
Syngonanthus flavidulus		6						0.86	5.13
Unknown fern							1	0.14	0.85
Total	10	17	7	9	13	10	51	16.71	100

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum				1				0.14	1.01
Andropogon virginicus	2							0.29	2.02
Aristida stricta				7				1.00	7.07
Coelorachis rugosa		1	1	5	2	1		1.43	10.10
Erianthus giganteus						4		0.57	4.04
Eriocaulon decangulare	3							0.43	3.03
Hypericum fasciculatum	2							0.29	2.02
Juncus repens							3	0.43	3.03
Lachnanthes caroliniana	1							0.14	1.01
Leersia hexandra						1		0.14	1.01
Lycopus rubellus			1					0.14	1.01
Nyssa biflora							1	0.14	1.01
Panicum erectifolium		1						0.14	1.01
Panicum hemitomon			7	1		10	20	5.43	38.38
Panicum rigidulum		3						0.43	3.03
Panicum virgatum		2		2	4			1.14	8.08
Rhynchospora corniculata						2	3	0.71	5.05
Rhynchospora sp	1				2			0.43	3.03
Scoparia dulcis							3	0.43	3.03
Syngonanthus flavidulus	1	1						0.29	2.02
Total	10	8	9	16	8	18	30	14.14	100

TABLE B-46
Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - October 27, 2005

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1	1						0.29	0.59
Andropogon virginicus	5				40			6.43	13.35
Aristida stricta			1					0.14	0.30
Coelorachis rugosa		10	3	5				2.57	5.34
Eriocaulon decangulare	8							1.14	2.37
Panicum hemitomon					4	70	70	20.57	42.73
Panicum rigidulum			10					1.43	2.97
Panicum virgatum			5		1	4		1.43	2.97
Pinguicula caerulea		1						0.14	0.30
Pluchea rosea			2		2			0.57	1.19
Rhynchospora corniculata				80				11.43	23.74
Syngonanthus flavidulus	1		2					0.43	0.89
Woodwardia virginica						10		1.43	2.97
Xyris sp	1							0.14	0.30
Total	16	12	23	85	47	84	70	48.14	100

TABLE B-47
Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - March 15, 2006

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	4	5		1	1			1.57	19.30
Andropogon virginicus		3						0.43	5.26
Aristida stricta		2	1					0.43	5.26
Coelorachis rugosa					4			0.57	7.02
Erechtites hieraciifolius			1			1		0.29	3.51
Hypericum fasciculatum	1							0.14	1.75
Panicum erectifolium	3	5		6				2.00	24.56
Panicum hemitomon			3		1	3	3	1.43	17.54
Panicum rigidulum		1	1					0.29	3.51
Rhynchospora corniculata				1	1			0.29	3.51
Rhynchospora sp.	1							0.14	1.75
Syngonanthus flavidulus		4						0.57	7.02
Total	9	20	6	8	7	4	3	8.14	100

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1	1						0.29	2.41
Andropogon virginicus	4				1			0.71	6.02
Aristida stricta				5				0.71	6.02
Coelorachis rugosa		3	2	7	7			2.71	22.89
Erianthus giganteus						9		1.29	10.84
Eriocaulon decangulare	1							0.14	1.20
Eupatorium capillifolium			1					0.14	1.20
Hypericum cistifolium	1							0.14	1.20
Hypericum fasciculatum	2							0.29	2.41
Panicum erectifolium		1		2				0.43	3.61
Panicum hemitomon			1		3	3	10	2.43	20.48
Panicum rigidulum		4			6			1.43	12.05
Pluchea rosea			1					0.14	1.20
Rhynchospora sp.	1			1	1	2	1	0.86	7.23
Syngonanthus flavidulus		1						0.14	1.20
Total	10	10	5	15	18	14	11	11.86	100

TABLE B-47
Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - March 15, 2006

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	2	1		1	6			1.43	18.52
Andropogon virginicus	2				6			1.14	14.81
Aristida stricta		1						0.14	1.85
Coelorachis rugosa		3		3				0.86	11.11
Erechtites hieraciifolius						1		0.14	1.85
Eriocaulon decangulare	4							0.57	7.41
Panicum erectifolium		2						0.29	3.70
Panicum hemitomon				1		5	8	2.00	25.93
Panicum rigidulum			2					0.29	3.70
Rhynchospora corniculata				1				0.14	1.85
Rhynchospora sp.				1				0.14	1.85
Syngonanthus flavidulus			1					0.14	1.85
Woodwardia virginica						2		0.29	3.70
Xyris sp	1							0.14	1.85
Total	9	7	3	7	12	8	8	7.714286	100

TABLE B-48

Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - July 5, 2006

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1	1		1				0.43	5.17
Andropogon virginicus		2						0.29	3.45
Aristida stricta		2						0.29	3.45
Coelorachis rugosa			1	1	4			0.86	10.34
Erechtites hieraciifolius			2			2		0.57	6.90
Eupatorium capillifolium				1				0.14	1.72
Hypericum fasciculatum	1							0.14	1.72
Lycopus rubellus			1					0.14	1.72
Panicum erectifolium	2	4		3	1			1.43	17.24
Panicum hemitomon			2	1	2	12	6	3.29	39.66
Persea palustris	1							0.14	1.72
Rhynchospora corniculata				1	1			0.29	3.45
Syngonanthus flavidulus		2						0.29	3.45
Total	5	11	6	8	8	14	6	8.29	100

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	1			1				0.29	2.82
Andropogon virginicus	1							0.14	1.41
Aristida stricta				2				0.29	2.82
Coelorachis rugosa		3	1	3	2	1		1.43	14.08
Erechtites hieraciifolius		1						0.14	1.41
Erianthus giganteus						1		0.14	1.41
Eriocaulon decangulare	2							0.29	2.82
Eupatorium capillifolium			1					0.14	1.41
Hypericum fasciculatum	1							0.14	1.41
Lycopus rubellus			1					0.14	1.41
Nyssa biflora							1	0.14	1.41
Panicum erectifolium		1		2	2			0.71	7.04
Panicum hemitomon			4		1	4	20	4.14	40.85
Panicum rigidulum		2						0.29	2.82
Rhynchospora corniculata					1	1		0.29	2.82
Rhynchospora sp	1							0.14	1.41
Scoparia dulcis							6	0.86	8.45
Syngonanthus flavidulus	1	1						0.29	2.82
Xyris sp.	1							0.14	1.41
Total	8	8	7	8	6	7	27	10.14	100

TABLE B-48
Summary Of Herbaceous 1-Meter Squares from the Port Orange Wellfield Wetland - July 5, 2006

1-METER SQUARE PLOTS -NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Amphicarpum muhlenbergianum	2	1			2			0.71	5.95
Andropogon virginicus	1	1			3			0.71	5.95
Aristida purpurascens			1					0.14	1.19
Aristida stricta		1						0.14	1.19
Coelorachis rugosa		4		5				1.29	10.71
Erechtites hieraciifolius						2		0.29	2.38
Eriocaulon decangulare	3							0.43	3.57
Eupatorium capillifolium				1				0.14	1.19
Fuirena scirpoidea	1							0.14	1.19
Lachnanthes caroliniana	1							0.14	1.19
Panicum erectifolium		3			2			0.71	5.95
Panicum hemitomon				1		9	25	5.00	41.67
Panicum rigidulum			3					0.43	3.57
Pinus elliottii	1							0.14	1.19
Pluchea rosea					1	1		0.29	2.38
Polygala cymosa		1						0.14	1.19
Rhynchospora corniculata				2				0.29	2.38
Syngonanthus flavidulus			1					0.14	1.19
Woodwardia virginica						4		0.57	4.76
Xyris sp	1							0.14	1.19
Total	10	11	5	9	8	16	25	12	100

TABLE B-49
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - October 24, 2006

PORT ORANGE - NORTH

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	3.95	3.60	2.50	1.30	3.80		15.15	14.03	24.17	0.83	29.41	26.79
Aristida stricta	0.50	0.70	3.30	3.20			7.70	7.13	12.29	0.67	23.53	17.91
Eriocaulon decangulare	1.90						1.90	1.76	3.03	0.17	5.88	4.46
Hypericum fasciculatum	0.02						0.02	0.02	0.03	0.17	5.88	2.96
Panicum hemitomon	8.50	4.90	0.20	3.80	2.50	18.00	37.90	35.09	60.48	1.00	35.29	47.88
Total	14.87	9.20	6.00	8.30	6.30	18.00	62.67	58.03	100.00	2.83	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	1.80		0.30	1.30			3.40	3.15	5.63	0.50	20.00	12.81
Aristida stricta	0.22	5.75	2.95	1.90			10.82	10.02	17.91	0.67	26.67	22.29
Eriocaulon decangulare	0.92						0.92	0.85	1.52	0.17	6.67	4.09
Hypericum fasciculatum	0.41						0.41	0.38	0.68	0.17	6.67	3.67
Panicum hemitomon	0.15	7.00	2.70	13.40	3.60	18.00	44.85	41.53	74.25	1.00	40.00	57.13
Total	3.50	12.75	5.95	16.60	3.60	18.00	60.40	55.93	100.00	2.50	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m) A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus			0.31	1.02			1.33	1.23	1.82	0.33	18.18	10.00
Aristida stricta	1.19	1.45					2.64	2.44	3.62	0.33	18.18	10.90
Hypericum fasciculatum	4.21						4.21	3.90	5.77	0.17	9.09	7.43
Panicum hemitomum	0.22	7.54	3.02	18.00	18.00	18.00	64.78	59.98	88.79	1.00	54.55	71.67
Total	5.62	8.99	3.33	19.02	18.00	18.00	72.96	67.56	100.00	1.83	100.00	100.00

TABLE B-50
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - April 5, 2007

PORT ORANGE - NORTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	5.09	0.95	1.70		0.25		7.99	7.40	15.22	0.67	28.57	21.90
Aristida stricta	0.31	3.65	1.26				5.22	4.83	9.94	0.50	21.43	15.69
Eriocaulon decangulare	2.92						2.92	2.70	5.56	0.17	7.14	6.35
Panicum hemitomon	2.90	1.70	3.30	3.25	9.21	16.00	36.36	33.67	69.27	1.00	42.86	56.06
Total	11.22	6.30	6.26	3.25	9.46	16.00	52.49	48.60	100.00	2.33	100.00	100.00

PORT ORANGE - CENTRAL

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	3.40	1.15	2.76	0.80			8.11	7.51	13.64	0.67	26.67	20.15
Aristida stricta	1.67	3.86	1.03	1.21			7.77	7.19	13.07	0.67	26.67	19.87
Eriocaulon decangulare	0.49						0.49	0.45	0.82	0.17	6.67	3.75
Hypericum fasciculatum	0.40						0.40	0.37	0.67	0.17	6.67	3.67
Panicum hemitomum		1.05	3.50	9.54	12.60	16.00	42.69	39.53	71.80	0.83	33.33	52.56
Total	5.96	6.06	7.29	11.55	12.60	16.00	59.46	55.06	100.00	2.50	100.00	100.00

PORT ORANGE - SOUTH

Species	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.22	0.17	0.63	1.31			2.33	2.16	4.78	0.67	28.57	16.67
Aristida stricta	1.02	1.61	0.40				3.03	2.81	6.21	0.50	21.43	13.82
Eriocaulon decangulare	0.13						0.13	0.12	0.27	0.17	7.14	3.70
Hypericum fasciculatum	2.00						2.00	1.85	4.10	0.17	7.14	5.62
Panicum hemitomum		2.09	0.26	7.14	15.80	16.00	41.29	38.23	84.65	0.83	35.71	60.18
Total	3.37	3.87	1.29	8.45	15.80	16.00	48.78	45.17	100.00	2.33	100.00	100.00

TABLE B-51
Summary of Herbaceous Ground Cover Belt Transects for the Port Orange Wetland - July 5, 2007

PORT ORANGE - NORTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	2.75	2.75		1.14			6.64	6.15	11.08	0.50	23.08	17.08
Aristida stricta	3.57	2.45	2.35				8.37	7.75	13.96	0.50	23.08	18.52
Eriocaulon decangulare	2.58						2.58	2.39	4.30	0.17	7.69	6.00
Panicum hemitomon	0.90	0.95	1.80	2.70	18.00	18.00	42.35	39.21	70.65	1.00	46.15	58.40
Total	9.80	6.15	4.15	3.84	18.00	18.00	59.94	55.50	100.00	2.17	100.00	100.00

PORT ORANGE - CENTRAL

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	0.75	0.50	1.16	2.00	0.97		5.38	4.98	9.50	0.83	31.25	20.37
Aristida stricta	2.26	1.10	1.31	1.73	4.35		10.75	9.95	18.98	0.83	31.25	25.11
Eriocaulon decangulare	0.21						0.21	0.19	0.37	0.17	6.25	3.31
Panicum hemitomon		0.50	3.40	9.80	8.60	18.00	40.30	37.31	71.15	0.83	31.25	51.20
Total	3.22	2.10	5.87	13.53	13.92	18.00	56.64	52.44	100.00	2.67	100.00	100.00

PORT ORANGE - SOUTH

	Linear Distance (m)						Total Linear	Cover		Frequency		Importance
Species	A	B	C	D	E	F	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	1.10	0.65	1.50	2.95	4.23		10.43	9.66	16.21	0.83	38.46	27.33
Aristida stricta	1.80	2.71					4.51	4.18	7.01	0.33	15.38	11.20
Hypericum fasciculatum	1.55						1.55	1.44	2.41	0.17	7.69	5.05
Panicum hemitomon		1.30	4.30	10.52	13.75	18.00	47.87	44.32	74.38	0.83	38.46	56.42
Total	4.45	4.66	5.80	13.47	17.98	18.00	64.36	59.59	100.00	2.17	100.00	100.00

TABLE B-52
Shrub Values for the Port Orange Wetland - October 25, 2005

Species	A	B	C	D	E	F	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
			Linear Distance									
Salix caroliniana						0.20	0.20	0.19	7.69	0.17	25.37	16.53
Taxodium ascendens			1.90	0.30		0.20	2.40	2.22	92.31	0.50	74.63	83.47
Total	0.00	0.00	1.90	0.30	0.00	0.40	2.60	2.41	100.00	0.67	100.00	100.00

TABLE B-53
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	10/21/04	10/25/05	10/24/06	Notes
1/1	401	Pinus taeda	13.9	15	15.89	16.67	17.20	17.90	17.90	Burned
1/1	402	Pinus taeda	7.35	8.5	9.52	9.93	10.40	10.80	10.70	
1/1	403	Pinus taeda	7.8	8.4	9.10	9.55	9.70	10.20	10.00	
1/1	404	Pinus taeda	9.05	10.5	11.85	12.41	13.20	13.70	13.90	
1/1	406	Taxodium ascendens	5.9	6	5.98	6.70	6.20	6.50	6.40	
1/1	407	Taxodium ascendens	7.7	7.9	7.68	7.90	7.90	8.20	8.00	
1/1	408	Taxodium ascendens	5.75	6	5.90	6.05	6.00	6.30	6.10	
1/1	409	Pinus taeda	10.5	11	11.40	11.51	12.00	12.10	12.10	
1/1	410	Taxodium ascendens	11.3	11.7	11.90	12.20	12.30	12.80	12.60	
1/1	411	Taxodium ascendens	12.4	12.6	12.92	13.10	13.20	13.90	13.60	
1/1	412	Pinus taeda	8.9	9.6	9.60	9.95	10.20	10.40	10.30	(still alive)
1/1	413	Pinus elliottii	9.5	11	11.40	11.95	12.30	12.70	12.20	Fallen
1/1	414	Taxodium ascendens	16.15	16.15	16.05	16.15	16.10	16.50	16.50	
1/1	415	Taxodium ascendens	7.5	7.5	7.38	7.45	7.50	7.60	7.50	
1/1	416	Taxodium ascendens	5.2	5.3	5.09	5.20	5.10	5.30	5.10	
1/1	513	Taxodium ascendens						2.60	2.60	
1/1	514	Taxodium ascendens						2.60	2.50	
1/2	417	Taxodium ascendens	5.5	5.7	5.60	5.55	5.60	5.70	5.60	
1/2	418	Taxodium ascendens	4.15	4.5	4.02	4.05	4.00	4.10	4.00	
1/2	419	Taxodium ascendens	3.7	4	3.60	3.64	3.60	3.70		
1/2	420	Taxodium ascendens	3.7	4	3.70	4.15	3.90	4.10	4.00	
1/2	421	Taxodium ascendens	8.7	0.9	8.78	9.30	9.00	9.10	9.20	
1/2	422	Taxodium ascendens	7.5	7.8	7.58	7.62	7.60	7.70	7.60	
1/2	423	Taxodium ascendens	16.55	16.6	16.65	16.61	16.70	16.90	16.70	
1/2	424	Taxodium ascendens	10.5	11	11.30	11.45	11.30	12.00	11.90	
1/2	425	Taxodium ascendens	5.65	6	5.85	5.85	5.80	6.10	5.90	
1/2	426	Taxodium ascendens	4.6	4.8	4.60	4.60	4.60	4.70	4.60	
1/2	427	Taxodium ascendens	6.35	6.8	6.82	7.10	7.10	7.40	7.30	
1/2	428	Taxodium ascendens	7.45	8	8.10	8.15		8.50	8.40	
1/2	429	Taxodium ascendens	5.55	6	5.60	6.10	5.60	5.70	5.60	
1/2	430	Taxodium ascendens	17.45	17.7	17.48	17.41	17.50	17.70	17.50	
1/2	431	Taxodium ascendens	6.15	6.3	6.12	6.12	6.10	6.20	6.10	
1/2	432	Taxodium ascendens	6.7	7.2	7.02	7.10	7.20	7.20	7.20	
1/2	433	Taxodium ascendens	16.77	16.6	16.48	16.57	16.60	16.70	16.50	
1/3	434	Taxodium ascendens	17.7	17.8	17.72	17.82	17.90	18.10	17.90	
1/3	435	Taxodium ascendens	18.98	19	18.70	18.82	18.90	19.20	19.00	
1/3	436	Taxodium ascendens	6.4	6.6	6.50	6.60	6.50	6.70	6.50	
1/3	437	Taxodium ascendens	7.75	8	7.92	7.98	7.90	8.10	8.10	
1/3	438	Taxodium ascendens	7.05	7.3	7.40	7.40	7.50	7.80	7.70	
1/3	439	Taxodium ascendens	5.85	6.2	6.15	6.28	6.30	6.50	6.50	
1/3	440	Taxodium ascendens	8.55	8.8	8.70	8.98	9.10	9.30	9.20	
1/3	441	Taxodium ascendens	4.65	4.8	4.70	4.72	4.70	4.90		
1/3	442	Taxodium ascendens	26	26.2	25.90	25.85	26.50	26.30	26.50	
1/3	443	Taxodium ascendens	4	4.1	3.95	3.95	3.90	4.00	3.90	
1/3	444	Taxodium ascendens	4.9	5	4.95	5.03	5.10	5.30	5.30	
1/3	445	Taxodium ascendens	4.5	4.8	4.80	4.85	5.00	5.20		
1/3	446	Taxodium ascendens	2.7	3.2	2.62	2.65	2.70	3.20	2.90	
1/3	447	Taxodium ascendens	6.53	7.4	7.49	7.52	7.60	7.80	7.90	
1/3	448	Taxodium ascendens	7.9	8.2	8.40	8.40	8.50	8.80	8.80	
1/3	449	Nyssa sylvatica	8	8.8	9.12	9.15	9.20	9.40	9.30	
1/3	450	Taxodium ascendens	6	6.3	6.10	6.15	6.20	6.30	6.20	
1/3	451	Taxodium ascendens	5.55	5.9	5.85	5.82	6.00	6.10	6.00	
1/3	452	Taxodium ascendens	6.4	6.8	6.82	7.00	7.00	7.60	7.50	
1/3	453	Taxodium ascendens	11.9	12.2	12.42	12.62	12.70	13.30	13.20	
1/3	454	Taxodium ascendens	27.1	27.3	27.10	27.08	27.10	27.20	27.10	
1/4	455	Taxodium ascendens	28.5	28.9	28.72	28.65	28.90	29.20	29.20	
1/4	456	Taxodium ascendens	27.5	27.5	27.52	27.38	27.80	27.90	27.80	
1/4	457	Nyssa sylvatica	19.3	19.7	20.00	20.22	20.90	20.90	21.10	
1/4	458	Nyssa sylvatica	9.5	10	10.28	10.43	10.70	11.00	11.00	
1/4	459	Taxodium ascendens	4.95	5.2	5.05	5.18	5.20	5.50	5.30	
1/4	460	Taxodium ascendens	4.05	4.8	4.38	4.45	4.50	5.10	5.00	
1/4	461	Taxodium ascendens	3.45	3.7	3.42	3.45	3.40	3.60	3.50	
1/4	462	Taxodium ascendens	6	6.3	6.55	7.15	7.10	7.30	7.20	
1/4	463	Taxodium ascendens	8.4	8.7	8.45	8.45	8.60	8.70	8.70	
1/4	464	Taxodium ascendens	3.05	3.3	3.00	3.00	3.10	3.20	3.30	
1/4	465	Taxodium ascendens	4.8	5	4.75	4.80	4.70	4.80	4.80	
1/4	466	Taxodium ascendens	4.2	4.5	4.20	4.20	4.20	4.50	4.40	

TABLE B-53
Raw Tree DBH (cm) Canopy and Subcanopy for Port Orange Wetland

Quad/Subquad	Tree #	Species	9/27/00	10/8/01	12/9/02	12/3/03	10/21/04	10/25/05	10/24/06	Notes
1/4	467	Taxodium ascendens	10.6	11.1	11.45	11.80	12.10	12.80	12.60	
1/4	468	Taxodium ascendens	4.4	4.5	4.38	4.40	4.50	4.70	4.50	
1/4	469	Taxodium ascendens	9.9	9.8	9.98	10.25	10.30	10.70	10.50	
1/4	470	Taxodium ascendens	5.5	5.8	6.00	6.12	6.30	6.60	6.60	
1/4	471	Taxodium ascendens	5.55	5.8	5.65	5.50	5.60	5.60	5.50	
1/4	472	Taxodium ascendens	6.25	6.4	6.20	6.25	6.30	6.50	6.40	
1/4	473	Taxodium ascendens	6	6.2	6.02	6.12	6.20	6.50	6.50	
1/4	474	Taxodium ascendens	3.25	3.5	3.09	3.15	3.40	3.80		
1/4	475	Taxodium ascendens	6.12	5.4	5.12	5.12	5.10	5.20	5.10	
1/4	476	Taxodium ascendens	4.9	5	5.00	4.98	5.00	5.20	5.10	
1/4	477	Taxodium ascendens	8.35	8.7	9.20	9.48	9.70	10.20		
1/4	478	Taxodium ascendens	7.1	7.3	7.35	7.60	7.70	7.70	7.60	
1/4	479	Taxodium ascendens	4.3	4.5	4.28	4.28	4.30	4.40	4.30	
1/4	480	Taxodium ascendens	4.45	4.6	4.55	4.78	4.80	5.00	4.90	
1/4	481	Taxodium ascendens	2.4	2.8	2.32	2.40	2.50	2.50	2.50	
1/4	482	Taxodium ascendens	4.55	4.7	4.45	4.45	4.50	4.60	4.60	
1/4	483	Taxodium ascendens	4.85	5	4.80	4.88	4.90	5.20	5.10	
1/4	484	Taxodium ascendens	6.4	6.6	6.65	6.88	6.90	7.50	7.40	
1/4	485	Taxodium ascendens	9.8	10.3	11.05	11.40	11.70	12.20	12.00	
1/4	486	Taxodium ascendens	5.35	5.6	5.32	5.32	5.40	5.40	5.40	
1/4	487	Taxodium ascendens	6.1	6.3	6.25	6.32	6.50	7.10	6.90	
1/4	488	Taxodium ascendens	17.77	18.2	18.62	18.52	18.60	18.90	18.90	
1/4	489	Taxodium ascendens	11.35	11.5	11.28	11.50	11.60	12.00	11.80	
1/4	704	Taxodium ascendens				2.75		2.80	2.70	
1/5	389	Taxodium ascendens			13.62	13.79	14.00	14.20	14.10	
1/5	490	Taxodium ascendens	4.6	4.8	4.68	4.80	4.80	5.40	5.30	
1/5	491	Taxodium ascendens	24.24	24.7	25.12	25.15	25.30	25.70	25.50	
1/5	492	Taxodium ascendens	6.85	7	7.20	7.74	8.10	8.80	8.60	
1/5	493	Taxodium ascendens	13.6	13.8	3.95	14.20	14.20	14.70	14.50	
1/5	494	Taxodium ascendens	22.75	21.9	22.55	22.60	22.60	23.00	22.90	
1/5	495	Taxodium ascendens	2.8	3.1	2.72	2.90	2.90	2.90	3.00	
1/5	496	Taxodium ascendens	21.55	21.6	21.65	21.73	21.80	22.30	22.30	
1/5	497	Nyssa sylvatica	8.7	8.7	8.68	8.88	8.90	9.30	9.30	
1/5	498	Taxodium ascendens	12.3	12.3	12.68	12.82	13.00	13.20	13.20	
1/5	499	Taxodium ascendens	20.3	20.4	20.89	20.72				Down
1/5	564	Taxodium ascendens							3.70	
1/5	599	Taxodium ascendens						3.40	3.40	
1/5	702	Taxodium ascendens			3.02	2.95	3.00			
1/5	703	Taxodium ascendens			3.58	3.55				Down
1/5	705	Taxodium ascendens			3.35	3.30				Down

TABLE B-54

Canopy and Subacanopy Importance Values for the Port Orange Wetland - October 24, 2006

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	3	1.34	8.97	55.56	9.09	0.17	12.50	10.19
Pinus elliottii	1	0.22	1.45	18.52	3.03	0.17	12.50	5.66
Pinus taeda	5	1.28	8.56	92.59	15.15	0.17	12.50	12.07
Taxodium ascendens	24	12.13	81.03	444.44	72.73	0.83	62.50	72.08
	33	14.97	100.00	611.11	100.00	1.33	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Density	Frequency (***)	Relative Frequency	Importance Value
Nyssa sylvatica	1	0.13	3.41	18.52	1.54	0.17	14.29	6.41
Pinus taeda	1	0.15	3.94	18.52	1.54	0.17	14.29	6.59
Taxodium ascendens	63	3.42	92.65	1166.67	96.92	0.83	71.43	87.00
	65	3.69	100.00	1203.70	100.00	1.17	100.00	100.00

Appendix C
Benthic Data

BENTHIC MACROINVERTEBRATES, PORT ORANGE, SEPTEMBER 28, 2001.

SPECIES	T.V.**	F.F.G.***	PO-BL
ARTHROPODA			
Crustacea			
Isopoda			
Asellidae	***8**	**SH**	
Caecidotea sp.	**9.11**	**CG**	38
Decapoda			
Cambaridae			
Procambarus sp.	**9.49**	**SH**	9
Insecta			
Ephemeroptera			
Baetidae			
Callibaetis sp.	**9.84**	**CG**	8
Odonata			
Coenagrionidae	***9**	**P**	
Enallagma sp.	**8.91**	**P**	3
Heteroptera			
Corixidae	**9**	**PI**	2
Belostomatidae			
Belostoma sp.	**9.8**	**P**	1
Notonectidae	**-**	**P**	
Notonecta sp.	**8.71**	**P**	3
Coleoptera			
Dytiscidae			
Coptotomus sp.	**9.26**	**P**	1
Diptera			
Chironomidae			
Beardius sp.			3
Polypedilum illinoense	**9**	**SH**	2
TOTAL NO. OF ORGANISMS			**70**
TOTAL NO. OF TAXA			**10**
Biotic Index			**9.23**
Ratio of Shredder to Total			**0.157**
EPT/chironomidae			**0.205**
EPT index			**1**
% contribution of dominant taxa			**54.29%**
Shannon diversity			**2.269**

BENTHIC MACROINVERTEBRATES, PORT ORANGE, SEPTEMBER 28, 2001.

Cell: A35

Comment: *Hilsenhoff Tolerance values used when North Carolina Tolerance values are not available.
**North Carolina Tolerance Values range form 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes.
***F.F.G.-Functional Feeding Groups:SH=Shredder, CG=Collector/Gatherer, FC=Filtering Collector, SC=Scraper, P=Predator and PI=Piercer

BENTHIC MCARTOINVERTEBRATES COLLECTED FROM PORT ORANGE, FL., MARCH 2003

SPECIES	T.V.*	F.F.G.**	Port Orange
NEMATODA	6.02		1
ANNELIDA			
Oligochaeta	*1	CG	
Haplotaxida			
Naididae	*8	CG	4
Dero sp.	10	CG	7
Tubificidae w.o.h.c.	7.11	CG	14
Lumbriculida			
Lumbriculidae	7.03	CG	14
Branchiobdellida			1
ARTHROPODA			
Crustacea			
Cladocera			
Daphnidae			
Ceriodaphnia sp.			28
Copepoda			53
Ostracoda			7
Isopoda			
Caecidotea sp.	9.11	CG	132
Amphipoda			
Crangonyctidae			
Crangonyx sp.	7.87	CG	39
Insecta			
Odonata			
Coenagrionidae	*9	P	3
Hemiptera			
Corixidae	9	PI	2
Neuroptera			
Sisyridae	*1	-	
Climacia sp.	8.4		1
Trichoptera			
Hydroptilidae	*4	PI	
Oxyethira sp.	2.22	PI	1
Leptoceridae	*4	CG	
Oecetis sp.	4.7	P	11
Coleoptera			
Dytiscidae	*5	P	4
Haliplidae			
Haliplus sp.	8.71	SH	1
Hydrophilidae		P	
Berosus sp.	8.43	CG	1
Lepidoptera			
Pyralidae	2	SH	
Petrophila sp.	2.09	SC	2
Diptera			
Ceratopogonidae	*5	P	
Bezzia/Palpomyia gp.	6.86	P	8
Chironomidae			4
Ablabesmyia rhamphe gp.	*6	P	55
Chironomus sp.	9.63	CG	4

Pennington and Associates, Inc.

BENTHIC MCARTOINVERTEBRATES COLLECTED FROM PORT ORANGE, FL., MARCH 2003

SPECIES	T.V.*	F.F.G.**	Port Orange
Cladopelma sp.	3.49	CG	2
Corynoneura sp.	6.01	CG	6
Cryptochironomus sp.	6.4	P	9
Dicrotendipes sp.	8.1	CG	4
Glyptotendipes sp.	9.07	FC	4
Parachironomus chaetoulus gp.	9.42	CG	4
Polypedilum illinoense	9	SH	23
Procladius sp.	9.1	P	51
Rheocricotopus tuberculatus	5.14	CG	2
Tanytarsus sp.	9.19	FC	19
Thienemannimyia gp.	*6	P	11
TOTAL NO. OF ORGANISMS			532
TOTAL NO. OF TAXA			35
BIOTIC INDEX			8.01
RATIO OF SHREDDERS/TOTAL			4.51%
EPT /CHIRONOMIDAE			0.03
% CONTRIBUTION DOM. TAXA			24.81%
SHANNON DIVERSITY			3.933

BENTHIC MCARTOINVERTEBRATES COLLECTED FROM PORT ORANGE, FL., OCTOBER 2003

SPECIES	T.V.*	F.F.G.**	PO-1
ANNELIDA			
Oligochaeta	***1**	**CG**	
Tubificida			
Tubificidae w.h.c.	**7.11**	**CG**	1
Lumbriculida			
Lumbriculidae	**7.03**	**CG**	5
Branchiobdellida			
Hirudinea			
Erpobdellidae			1
ARTHROPODA			
Crustacea			
Cladocera			
Chydoridae			1
Ostracoda			1
Isopoda			
Caecidotea sp.	**9.11**	**CG**	36
Amphipoda			
Crangonyctidae			
Crangonyx sp.	**7.87**	**CG**	20
Decapoda			
Cambaridae			
Procambarus sp.	**7**	**SH**	4
Insecta			
Ephemeroptera			
Baetidae			
Centroptilum sp.	**6.6**	**CG**	2
Caenidae			
Caenis sp.	**7.4**	**CG**	2
Odonata			
Coenagrionidae			
Enallagma sp.	**8.9**	**P**	9
Libellulidae			
Pachydiplax longipennis	**9.9**	**P**	2
Plecoptera			
Nemouridae			1
Trichoptera			
Hydroptilidae			
Oxyethira sp.	**2.22**	**PI**	1
Coleoptera			
Curculionidae			6
Hydrophilidae		**P**	
Berosus sp.	**8.43**	**CG**	1
Diptera			
Chironomidae			
Ablabesmyia rhamphe gp.	***6**	**P**	2
Chironomus sp.	**9.63**	**CG**	7
Coelotanypus sp.	**8**	**P**	1
Dicrotendipes sp.	**8.1**	**CG**	2
Fittkauimyia serta			2
Larsia sp.	**9.3**		8

BENTHIC MCARTOINVERTEBRATES COLLECTED FROM PORT ORANGE, FL., OCTOBER 2003

SPECIES	T.V.*	F.F.G.**	PO-1
Polypedilum illinoense	**9**	**SH**	3
Tanypus sp.	**9.2**	**P**	5
Tanytarsus sp.	**9.19**	**FC**	1
Tipulidae			
Tipula sp.	**7.3**		1
CHORDATA****			
Osteichthyes			1
TOTAL NO. OF ORGANISMS			**125**
TOTAL NO. OF TAXA			**26**
FLORIDA INDEX			**4.00**
BIOTIC INDEX			**8.51**
MARGALEF			**3.589**
MENHINICK			**2.326**
SIMPSON			**0.877**
SHANNON			**3.7**
HILL (N1)			**12.996**
HILL (N2)			**8.115**
PIELOU			**0.787**
SHELDON			**0.5**
HEIP			**0.48**
HILL			**0.624**
HILL MOD.			**0.593**

SPECIES	T.V.	F.F.G.	PO-1
MOLLUSCA			
Gastropoda			
Basommatophora			
Physidae			
Physella sp.	**8.8**	**CG**	1
ANNELIDA			
Oligochaeta	***1**	**CG**	
Tubificida			
Naididae	***8**	**CG**	
Dero sp.	**10**	**CG**	2
ARTHROPODA			
Crustacea			
Cladocera			
Daphnidae			
Ceriodaphnia sp.			2
Isopoda			
Caecidotea sp.	**9.11**	**CG**	16
Amphipoda			
Crangonyctidae			
Crangonyx sp.	**7.87**	**CG**	2
Decapoda			
Cambaridae			
Procambarus sp.	**7**	**SH**	2
Insecta			
Ephemeroptera			
Baetidae		**CG**	3
Caenidae		**CG**	
Caenis sp.	**7.4**	**CG**	2
Odonata			
Aeshnidae		**P**	
Coryphaeschna sp.			1
Coenagrionidae		**P**	
Ischnura sp.	**9.5**		1
Libellulidae		**P**	
Erythemis sp.			1
Hemiptera			
Corixidae	**9**	**PI**	7
Trichoptera			
Hydroptilidae			
Coenagrionidae	**2.22**	**PI**	6
Leptoceridae		**CG**	
Oecetis sp.	**4.7**	**P**	2
Coleoptera			
Curculionidae			1
Noteridae		**P**	
Hydrocanthus sp.	**7.1**	**CG**	1
Diptera			
Ceratopogonidae		**P**	
Bezzia/Palpomyia gp.	**6.9**	**P**	1
Chironomidae			1

SPECIES	T.V.	F.F.G.	PO-1
Cladopelma sp.	**3.5**	**CG**	1
Conchapelopia sp.	**8.4**	**P**	4
Dicrotendipes sp.	**8.1**	**CG**	2
Endochironomus nigricans	**7.8**		1
Fittkauimyia serta			1
TOTAL NO. OF ORGANISMS			**61**
TOTAL NO. OF TAXA			**23**
FLORIDA INDEX			**4**
BIOTIC INDEX			**7.64**
MARGALEF			**3.71**
MENHINICK			**2.945**
SIMPSON			**0.906**
SHANNON			**3.867**
HILL (N1)			**14.586**
HILL (N2)			**10.64**
PIELOU			**0.855**
SHELDON			**0.634**
HEIP			**0.618**
HILL			**0.729**
HILL MOD.			**0.71**

BENTHIC MACROINVERTEBRATES COLLECTED FROM PORT ORANGE, VOLUSIA CO., FL, OCTOBER 2005.

SPECIES	T.V.	F.F.G.	PO-1
MOLLUSCA			
Gastropoda			
Basommatophora			
Physidae			
Physella sp.	**8.8**	**CG**	10
ANNELIDA			
Oligochaeta			
Tubificida			
Naididae			
Dero sp.	**10**	**CG**	100
ARTHROPODA			
Crustacea			
Copepoda			5
Cladocera			
Daphnidae			
Ceriodaphnia sp.			10
Isopoda			
Caecidotea sp.	**9.11**	**CG**	20
Amphipoda			
Crangonyctidae			
Crangonyx sp.	**7.87**	**CG**	5
Insecta			
Ephemeroptera			
Baetidae	***4**	**CG**	10
Caenidae			
Caenis sp.	**7.4**	**CG**	45
Odonata			
Coenagrionidae			15
Ischnura sp.	**9.5**		15
Libellulidae			10
Celithemis sp.	***2**	**P**	10
Pachydiplax longipennis	**9.9**		5
Hemiptera			
Belostomatidae			
Belostoma sp.	**9.8**	**P**	5
Corixidae	**9**	**PI**	10
Trichoptera			
Hydroptilidae			
Oxyethira sp.	**2.2**	**PI**	105
Leptoceridae			
Oecetis sp.	**4.7**	**P**	5
Coleoptera			
Curculionidae			
Gyrinidae		**P**	
Dineutus sp.	**5.5**	**P**	5
Gyrinus sp.	**6.2**	**P**	5
Haliplidae			
Peltodytes sp.	**8.7**	**SH**	10
Hydrophilidae		**P**	10
Noteridae			

Hydrocanthus sp.	**7.1**		5
Diptera			
Ceratopogonidae			
Bezzia/Palpomyia gp.	**6.9**	**P**	5
Chironomidae			
Cladopelma sp.	**3.5**	**CG**	115
Chironomini genus III			220
Clinotanypus sp.	**8.74**	**P**	5
Endochironomus sp.	***6**	**SH**	105
Fittkauimyia serta			5
Nilotanypus sp.	**3.9**	**P**	5
Microchironomus sp.			10
Microtendipes pedellus gp.	**5.5**	**CG**	5
Procladius sp.	**9.1**	**P**	5
Tanytarsus sp.	**6.8**	**FC**	250
Tanypus sp.	**9.2**	**P**	5
Thienemannimyia gp.	**8.42**	**P**	10

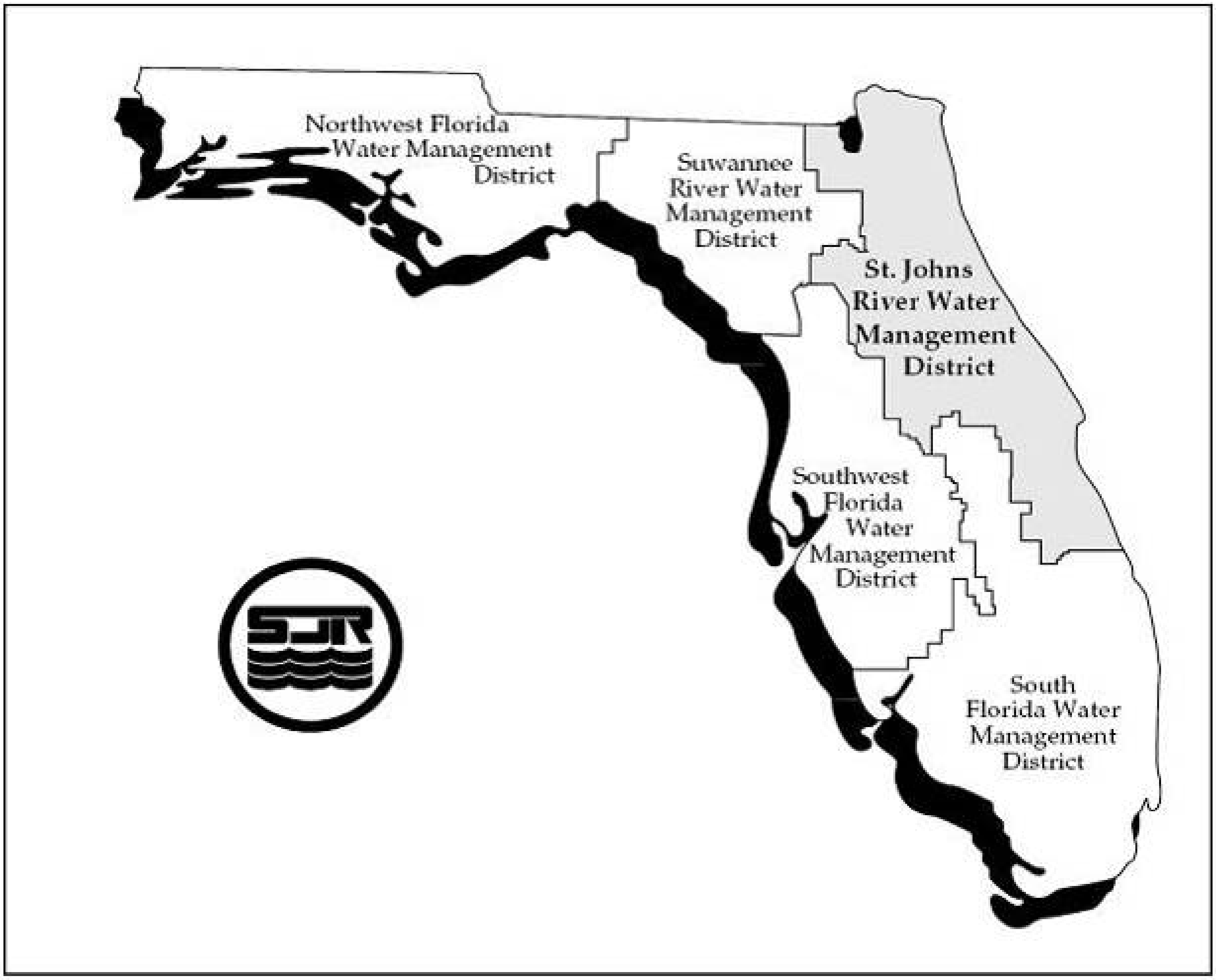
TOTAL NO. OF ORGANISMS	**1165**
TOTAL NO. OF TAXA	**35**
FLORIDA INDEX	**3**
BIOTIC INDEX	**6.25**
MARGALEF	**3.338**
MENHINICK	**1.025**
SIMPSON	**0.883**
SHANNON	**3.73**
HILL (N1)	**13.265**
HILL (N2)	**8.515**
PIELOU	**0.727**
SHELDON	**0.379**
HEIP	**0.361**
HILL	**0.642**
HILL MOD.	**0.613**

Appendix E - City of Titusville Parkland Wetland Control Weir Operational Conditions: Fifth Annual Report

DEMONSTRATION PROJECT NO. 4, BREVARD COUNTY, FLORIDA
CITY OF TITUSVILLE PARKLAND WETLAND
CONTROL WEIR OPERATIONAL CONDITIONS
FIFTH ANNUAL REPORT

St. Johns River Water Management District
Palatka, Florida

August 2009
(Originally prepared November 2007; revised September 2008)



The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 18 counties in northeast Florida. The mission of SJRWMD is to ensure the sustainable use and protection of water resources for the benefit of the people of the District and the state of Florida. SJRWMD accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

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EXECUTIVE SUMMARY

This report summarizes the activities of the Demonstration Pilot Project No. 4 – Surface Water Detention in the Parkland Wetland Wellfield from its inception in August 1999 through April 2007. The purpose of the demonstration project is to evaluate the potential to avoid ecological impacts from wellfield drawdown by increasing the water storage within the wetland. The Parkland Wetland was selected based on its proximity to a newly developed section of the City of Titusville's Wellfield. Modeling performed by the St. Johns River Water Management District (SJRWMD) projected potential impacts to the wetland from wellfield drawdown. When the study began, the Parkland Wetland was not considered to be ecologically impacted from the wellfield. The baseline period (August 1999 through April 2002) provided background information on the wetland hydrology and biological community. The operational period began May 1, 2002 with the completion of the control weir and continued for 5 years through April 2007. This report provides a comparison of the results from the baseline period with the fifth year of operation.

The Parkland Wetland is located within the City of Titusville in Brevard County, Florida, and is an integral part of the Bay Meadows Parkland Street ditch drainage basin (Stottler, Starmer & Associates [SSA] 1997). It currently provides important water management functions including the attenuation of peak flood flows, wetland habitat, and surficial aquifer recharge. The Parkland Wetland is a 100-acre scrub-shrub wetland located in a developed area, and is immediately adjacent to the City of Titusville Wellfield.
The Parkland Wetland was selected to be part of the District's demonstration program - *Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District* -because it corresponds to the program's objective of evaluating the potential effectiveness of water supply alternatives and approaches for minimizing impacts to wetlands (CH2M HILL 1997). The City of Titusville Water Resources Department (1996) proposed this surface water detention project to the District in September 1996 as an impact avoidance strategy for their Consumptive Use Permit (CUP [1998]) No. 2-009-0008UM2GR2. Although not directly tied to the City's CUP, the water level data recorded under this demonstration project is directly applicable to Special Condition No. 20a of the City's CUP:

20. The permittee must continue to operate under the Area II Wellfield Management Plan submitted to the District in January 1997 with the following conditions:

a) *Continuous surface water and shallow ground water monitoring devices must be installed to monitor water levels within the Parkland Wetland. The proposed wells near the Parkland Wetland should be pumped when the wetland water level is at or above 13.5 feet NGVD[29] during the wet season (June through October) and at or above 11.5 NGVD[29] during the dry season (November through May). Pumping from these wells is not authorized when the Parkland Wetland water levels fall below these elevations. The permittee must install water level control devices (e.g. float valves) on each well to ensure that water levels do not fall below the prescribed elevations. After the proposed wells have been operated for one year, the initial pumping level elevations may be adjusted based upon a review of the associated wetland monitoring plan by District staff.*

Water levels were above the wetland ground surface of 12.17 feet National Geodetic Vertical Datum (NGVD29) for 326 days (89% of the year) during Year 5 of operation; however, the average water level for the entire operational period (5 years) met the permit-stipulated wet-season level of 13.5 feet (NGVD29) 99% of the time, as compared to 48% during the baseline period. The permit-stipulated dry-season elevation 11.5 feet (NGVD29) was exceeded 100% of the time during the 5-year operational period and 84% during the baseline period. The water levels in the wetland fell below these permit conditions during the operational period for one month in June 2002. Exceedence values were similar between 5 years of the operational period.

The Parkland Wetland rehydration demonstration project is designed to be a passive water detention system. As such, there will be no active augmentation with groundwater (no direct pumping or discharge to the wetland). In April 2002, a weir was constructed by the City of Titusville in a ditch draining out of the north side of the wetland. The objective of the Parkland weir is to hold back a greater volume of surface water within the system for a longer duration by raising the outlet elevation without increasing flooding during major storms. The control weir does not maintain the wetland at a set water level; rather it provides an opportunity to lengthen the duration of saturation after a major rainfall event. This hydrologic enhancement strategy is rainfall dependent. The wetland will dry down during normal dry periods, and water depth and duration will fluctuate with rainfall. During a dry period in the baseline years, the water was several feet below the ground surface. Subsequently rainfall amounts returned to normal, and then exceeded normal in the hurricane season of 2004 and 2005. The highest total monthly rainfall at the Parkland Wetland during the entire operational period was recorded in October 2005. Continued above-average rainfall has kept the wetland above its normal seasonal high, despite the weir height being lowered during extreme events.

During the January 2006 field event, when water levels fell below the height of the weir in the Parkland Street Ditch, damage to the weir from vandalism was discovered. The City of Titusville and the SJRWMD were notified and it was agreed that a new, more secure weir would be installed. The new weir was installed on April 13, 2006 to a height of 16.0 feet NGVD29, which was 0.11 foot higher than the previous weir height.

BASELINE PERIOD

The baseline period from August 1999 through April 2002 included design, installation, and monitoring efforts. Two shallow groundwater wells (piezometers) were installed at upland and wetland ends of a 50-meter long vegetation transect. The scope of work called for a one-time baseline sampling of the vegetation communities, benthic macroinvertebrates, fish, and water quality. However, at the time of the first sampling event, the water depth was too deep to sample adequately all of the parameters, thus subsequent trips were made. Baseline data were sampled and characterized over multiple sampling events, which were conducted in September 1999, March 2000, and October 2001. Water quality was sampled twice (September 1999 and March 2000) to provide more data points for comparison during the operational period. The monitoring was suspended (except for water depth recording) while the project experienced delays during the permitting and construction of the weir. The water levels were monitored continuously during the baseline period.

An analysis of the baseline period showed that water levels in the Parkland Wetland were above the ground surface 71% of the time. Mean monthly water level elevations were 13.2 feet (NGVD29) during the 33-month period.

Trees, shrubs, and emergent vegetation coverage was dominated by obligate wetland species. Emergent species occurred infrequently, except in areas of open canopy, where they occurred in high densities. In areas of dense shrub and/or canopy, the herbaceous layer of emergent species was sparse due to insufficient sunlight at the ground surface; whereas, the herbaceous layer was dominated by floating aquatic plants (when standing water was present). Benthic macroinvertebrates and fish were dominated by species characteristic of lentic, low dissolved-oxygen water bodies. The water quality was typical for a wetland receiving runoff from developed areas.

Amphibian populations were surveyed by University of Florida graduate students Ryan Means and Steve Johnson. Frog species observed in the Parkland Wetland during the baseline period were typical of Florida urban wetlands.

OPERATIONAL PERIOD

Subsequent to the installation of the weir, water levels exceeded the wetland ground surface 99% of the time. Average groundwater elevations increased approximately 1.92, 1.58, 2.54, 2.11, and 1.55 feet during the 5 years of operation respectively compared to the baseline period. The mean monthly water level elevation was 14.8 feet (NGVD29) during the 60-month operational period. Water levels fell below the surface of the wetland surface from mid-May 2002 to mid-June 2002, for six days in mid-August 2006, and from mid-March 2007 to the end of the operational period in April 2007.

In previous years, there were problems with the dataloggers at the wetland-end of the transect. Several units were installed and replaced. Additionally, and unrelated to equipment replacement, the analysis showed an inconsistency in the data points from the wetland piezometer location. Several attempts were made to correlate the wetland recorder's data points to the data points of the upland recorder and the three nearby staff gauges. It was possible that this recorder (or the adjacent staff gauge) shifted with seasonal changes in water levels and with the drying/inundation of the soils. The recorder and gauge stabilized during the operational period when water levels were consistently above the ground surface and wetland soils could not become desiccated.

After approximately 15 months of high water levels in the Parkland Wetland following the 2004 and 2005 hurricane seasons, water levels in the wetland receded and access to the wetland recorder and wetland ends of the monitoring transects was again possible. It was discovered that the wetland datalogger had malfunctioned and was no longer collecting data. The wetland datalogger was replaced in March 2006 with another Infinities USA unit recording 12 readings per day.

Several events of damage to the weir in the Parkland Street Ditch from vandalism occurred during the 60-month operational period. The first occurrence of vandalism occurred prior to April 2005, at which time the damage was discovered and the top board of the weir was replaced. During the January 2006 field event, when water levels receded and the weir became visible, it was observed that the top board (12 inches) had again been damaged and removed. It is unknown when, exactly, the weir was vandalized, or how long the weir height had effectively been lowered. The City of Titusville and the SJRWMD were notified of the vandalism and a new, more secure weir was completed on April 13, 2006. The new weir raised the control height in the Parkland Street ditch from the previous 15.89 to 16.00 feet (NGVD29).

October 2005 produced the greatest rainfall, as recorded by the City of Titusville's water treatment plant, since the beginning of the project in August 1999. Subsequently, water levels in the wetland rose to their maximum recorded value (17.65 feet NGVD29) on October 25, 2005, 0.44 foot above the previous year's maximum record. Floodwater overtopped the control weir from October 5, 2005 until December 17, 2005 (73 days).

A historical hydrograph was generated by using available indicators of hydrology at the Parkland Wetland. The historical hydrograph most closely approximated conditions during the baseline period (2.5 years of data) and was moderately below the stage exceedence curve of the hydration period (5 years of data). With above average rainfall, the stage frequency curve has risen above the target curve. Thus, the site does not appear to be adversely affected by groundwater withdrawals.

Vegetation was sampled nine times during the operational period: December 2002, March 2003, December 2003, April 2004, April 2005, January 2006, March 2006, October 2006, and March 2007. High water from the 2004 hurricane season prevented the safe and effective monitoring of vegetation during the October 2004 event and limited monitoring during the April 2005 event. High water levels from the 2005 hurricane season postponed the October 2005 monitoring of shrubby and herbaceous vegetation until January 2006 and prevented monitoring of the tree plot. The most notable difference in the vegetation between the operational and baseline periods has been the absence of most target monitoring species during Years 3 and 4 of the operational period. During Year 5 of operational monitoring, the number of total species and target species increased particularly at the upland end of the transects where water levels had fallen beneath the ground surface. The wetland hydrology returned to more normal hydroperiod during Year 5. Species previously flooded by surface waters, germinated again once the water receded.

As in the previous operational monitoring years, benthic macroinvertebrates were dominated by midges. Midges are expected to be the dominant invertebrate taxon in this wetland type because they are indicators of low-dissolved oxygen. Low dissolved oxygen is typical for wetland systems with still or very slow-moving water. Benthic macroinvertebrates reported both their lowest density and lowest diversity during April 2005 in Year 3 of operation. Benthic macroinvertebrate densities were again low during Year 5 of the operational monitoring and ranged greatly during the entire study period. Water quality in the Parkland Wetland remained typical for a water body receiving runoff from developed areas.

Amphibian surveys were conducted by the Coastal Plains Institute, Inc. (CPI) each year from January through September. Amphibian surveys were completed (after 4 years of operational data collection) in September 2006. A full account of the amphibian surveys conducted by CPI is presented in a separate report *Assessment of Amphibian Response to Wetlands Augmentation Fifth Annual Report* (Means 2007).

RECOMMENDATIONS

This completes the fifth and final year of operational monitoring period of the Parkland Wetland in Titusville. A separate final report synthesizing the results and effects of hydration or surface water diversion on the study wetlands of the four pilot projects will be submitted when the program ends in September 2008.

CONTENTS

APPENDIXES

TABLES

FIGURES

Acronyms and Abbreviations

˚C	degrees Celsius
CompQAP	Comprehensive Quality Assurance Plan
CPI	Coastal Plains Institute, Inc.
CUP	Consumptive Use Permit
dbh	diameter at breast height
EPA	U.S. Environmental Protection Agency
ERP	Environmental Resource Permit
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
FDEP	Florida Department of Environmental Protection
HEC-RAS	Hydrologic Engineering Center – River Analysis System
MG	million gallons
mg/L	milligrams per liter
MOU	Memorandum of Understanding
msl	mean sea level
NGVD29	National Geodetic Vertical Datum of 1929
NRCS	Natural Resources Conservation Service
OBL	obligate
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
SJRWMD	St. Johns River Water Management District
SSA	Stottler, Starmer & Associates
UPL	upland
USACE	U.S. Army Corps of Engineers

INTRODUCTION

PROJECT BACKGROUND AND RATIONALE

This pilot project is part of Phase 2 of TASK E of the *Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District*. The recommended duration of this demonstration project is a 5-year operational period. The study will provide an assessment of the feasibility of avoiding projected impacts to native vegetation and wildlife resulting from the projected increases in groundwater withdrawals. The project is a partnership between the St. Johns River Water Management District (SJRWMD) and the City of Titusville Utilities. The Parkland Wetland Demonstration Project is one of four projects being conducted by the SJRWMD to test impact avoidance strategies in various ways.

Avoiding impacts to wetlands is an approach to balancing impact and resource development. One impact avoidance strategy is to compensate for altered hydrology due to water table decline by indirectly augmenting water levels in the affected wetlands. This project, for example, is designed to increase the average high water and increase the duration of inundation/saturation of the wetland by using a control weir in the outlet drainage ditch. Water that would otherwise be drained by the ditch is held back in the wetland, thereby restoring a more natural condition for the wetland. Likewise, the augmentation of water levels can be used as a means to avoid impacts to wetlands for which there is concern regarding future impacts from groundwater withdrawal.

Projecting the water table impacts of aquifer withdrawals on a regional scale can be difficult and is associated with a high degree of uncertainty. However, developing water supplies without regard for impacts to wetland and aquatic systems, and then mitigating later, is likely to be a very costly alternative. In comparison to the pump and mitigate strategy, impact avoidance strategies are likely to be more cost effective.

At the completion of the 5-year program, general conclusions about this type of augmentation will be drawn from the data analysis, within the limits of the contracted scope of work. General conclusions about this type of augmentation will be in terms of water quantity, efficiency, ecological responses, cost-benefits, and operation and maintenance.

PARKLAND WETLAND

The Parkland Wetland is located in Brevard County, Florida. The area is located approximately 2,000 feet east of I-95 and 4,000 feet north of SR 406 (Garden Street) in Titusville (Figures 1 and 2). The adjacent land uses are primarily single-family residential areas, Astronaut High School, and Madison Junior High School. Surface outflow from the wetland discharges to the north into the Crescent Street ditch and then into the Parkland Street ditch. The western edge of the wetland is approximately 200 feet from wells 50 and 51 of the City of Titusville's Area II Wellfield (Figure 2). Wells 52 and 53 are approximately 600 feet and 200 feet, respectively, from the wetland's eastern edge.

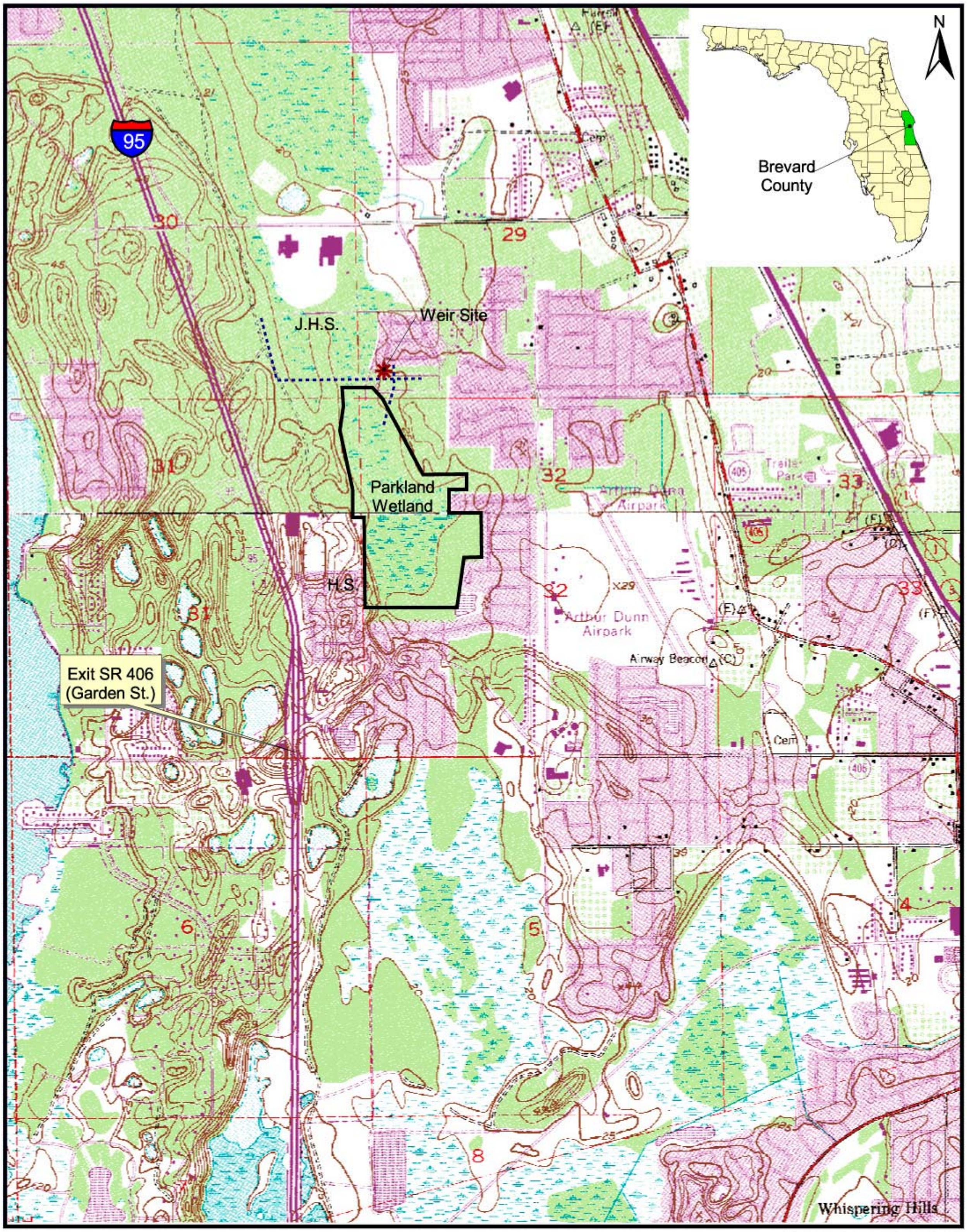
Encompassing approximately 100 acres, the wetland is characterized as a scrub-shrub thicket dominated by low stature Carolina willow, with depressional areas vegetated by monospecific cattail stands. The Parkland Wetland is underlain with a hydric soil, Tomoka muck (*Tw*), as mapped by the Natural Resources Conservation Service (NRCS) (Soil Survey of Brevard County, 1974). Tomoka muck is described by the NRCS as nearly level, very poorly drained muck soil in flat marshes, small depressions, and swamps.

The Parkland Wetland was selected to be part of the demonstration program for the following reasons:

- The District's models indicate that drawdowns in excess of 10 feet could occur in the intermediate aquifer due to the absence of a solid confining layer in the area.
- Anticipated effects of withdrawals from the City's Area II Wellfield might include induced drawdowns in the Parkland Wetland.
- The City's Water Resources Department proposed this surface water diversion project in September 1996 as an impact avoidance strategy.
- A control weir could easily be located in the city-maintained drainage ditch on the north side of the wetland; and the City of Titusville Utilities Department is a willing participant in the study.

PURPOSE

This Annual Report summarizes the results of the 33-month baseline period (August 1, 1999 to April 30, 2002) and 60 months of operation (May 1, 2002 to April 30, 2007). The report presents the fifth evaluation of the effects of operation on water elevations and any changes in flora or fauna.



CH2MHILL

Figure 1. Titusville project location, Brevard County, Florida

Figure 2. Parkland Wetland project location map

METHODS

CONTROL WEIR

The Parkland Wetland rehydration demonstration project is designed to be a passive water detention system. The objective of the Parkland weir is to hold back more surface water within the system for a longer duration by raising the outlet elevation without increasing flooding during major rain events. Hydrologic evaluations and weir design were performed by CH2M HILL hydrologist Ron Wycoff and engineer Mandy Parks. The As-Built Drawing of the Parkland control weir, as permitted by the SJRWMD (2001) Environmental Resource Permit (ERP), No. 40-009-70442-1 and by the U.S. Army Corps of Engineers (USACE [2001]) (NW permit No. 200102706), is shown in Figure 3. Photographs of the weir are presented in Figure 4. The top of the control weir is at elevation 16.00 feet National Geodetic Vertical Datum of 1929 (NGVD29).

Feasibility Analysis and Conceptual Design of the Control Weir

The Parkland Wetland is an integral part of the Bay Meadows – Parkland ditch drainage basin (Stottler, Starmer & Associates [SSA] 1997). It currently provides important water management functions including attenuation of peak flood flows, wetland habitat, and surficial aquifer recharge. The Bay Meadows – Parkland drainage basin is almost fully urbanized and the additional surface water retention must be accomplished without inducing adverse flooding impacts. The basin size is approximately 1,050 acres and the Parkland Wetland, whose size is approximately 100 acres, is located near the center of the basin. The wetland provides local recharge to the surficial aquifer, which also serves as a water supply source for the City of Titusville. Surficial aquifer water supply wells are located around the perimeter of the wetland.

Sources of Information

This hydrologic and hydraulic evaluation, and conceptual weir design, is based on the drainage basin and flood characteristics (flows and elevations) presented in the SSA report (1997). Important characteristics of the Parkland Wetland, including the current range of water levels and existing hydraulic controls, are based on the CH2M HILL (1999) first quarterly Parkland Wetlands demonstration project monitoring report, as well as on selected channel cross sections surveyed as part of the demonstration project.

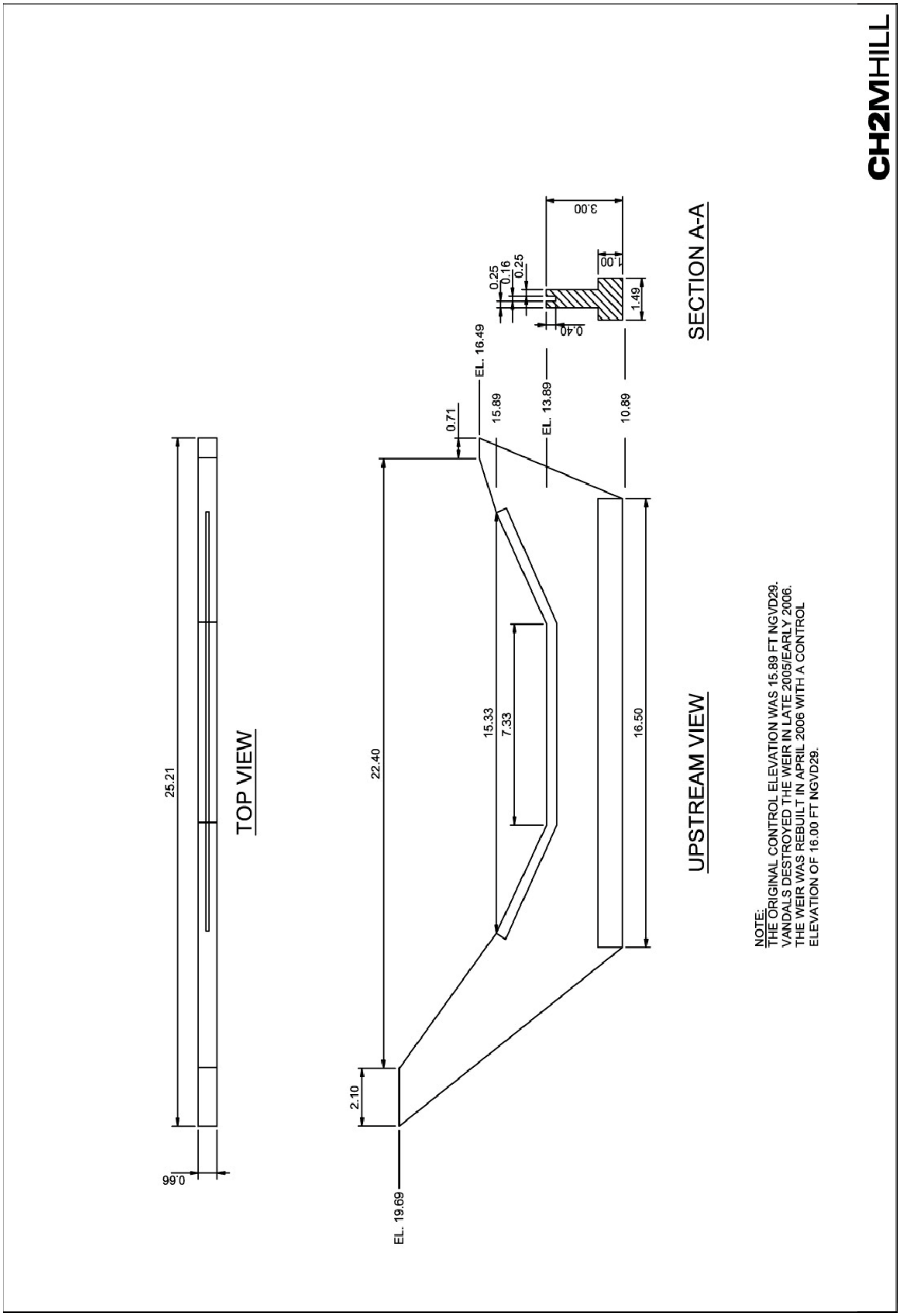


Figure 3. Parkland Wetland outlet control weir as-built, Brevard County, Section 29, T21S, R35E

April 2002. Newly constructed outlet control weir in the Parkland Street ditch

March 2003.

December 2003.

October 2004. Flooded after hurricanes

April 2005.Damaged weir

April 2006. Repaired and reinforced weir

Figure 4. Photographs of Parkland Wetland outlet control weir; flow direction toward foreground

Drainage Patterns

Surface water fills the wetland from all directions until outflow occurs to the north and west (Figure 2). The immediate outlet channel is the Crescent Street ditch, which joins the Parkland Street ditch downstream. The ultimate discharge is to the St. Johns River basin. The outlet channels are roughly trapezoidal in shape. The top widths range from about 20 to 30 feet, the bottom width is generally from 5 to 10 feet, and the channel depth is approximately 4 to 5 feet.

Parkland Street ditch channel invert elevation data indicate that water will fill the Parkland Wetland until an elevation of 13.89 feet NGVD29 is reached. Above this elevation, the outflow will occur. The control elevation was also confirmed by water level data obtained during the initial quarter of the baseline monitoring. The measured channel invert elevation is about the same as the maximum water surface elevation recorded by the wetland water table monitoring well reached in October 1999 after significant rainfall.

An extensive analysis of the flood hydrology of the Bay Meadows – Parkland drainage basin is presented in the SSA (1997) report. This report indicates that significant floodwater storage occurs in the vicinity of the Parkland Wetland during major flood events including the 2-year flood, and the 25-year flood. The estimated maximum water surface elevations for the Parkland Wetland are 19.05 feet mean sea level (msl) for the 2-year flood, and 21.92 feet msl for the 25-year flood (SSA 1997). These flood elevations are controlled primarily by floodwater flow constrictions downstream from the wetland rather than by local hydraulic constraints (SSA 1997).

Hydraulic Modeling

Under normal rainfall conditions, significant quantities of additional surface water could be retained within the Parkland Wetland to avoid potential wellfield drawdown by raising the outlet control elevation in the ditch.
A small-scale hydraulic modification consisting of construction of a variable (stop log) control weir and local channel widening was investigated. The weir was built to control flow such that the wetland discharge elevation could be raised 2 feet (Figure 3). This would yield nearly 50% more water (approximately 65 million gallons [MG]) that could be retained within the wetland before outflow occurs. An adjustable weir was used to allow flexibility in operation and to accommodate a lower control elevation should experience indicate that the maximum 15.89 feet control elevation cannot be sustained or is unnecessary.

To investigate the feasibility of increasing the outlet elevation without affecting existing flood characteristics, a hydraulic model of the outlet channels under existing and proposed conditions was constructed and run. A simple computer model of the outlet channels was constructed using Hydrologic Engineering Center – River Analysis System (HEC-RAS), a model developed by the USACE Hydrologic Engineering Center. The model assumes a steady state flow, and uses a backwater step iterative method to calculate a water surface profile. The existing channel was first modeled using five surveyed cross-sections: two cross sections across the Crescent Street ditch and three across the Parkland Street ditch. A weir was then inserted at the control section and checked at incremental heights to retain more surface water in the wetland. To offset any loss in channel conveyance caused by the weir, the channel was enlarged.

The model results indicate that it is possible to offset fully the effects of a 2-foot high weir by increasing the channel width by 2 feet with a side slope ratio of 1 to 3. To minimize bank disturbance, the canal was widened on one side only. Results from the model showed that weir and channel modification had no effect on upstream flood levels, due in part to backwater from downstream hydraulic restrictions and the complete submergence of the weir under flood flow conditions.

The complete channel widening was applied for a total channel length of 30 feet. A 6-to-1 transition section was constructed at either end of the modified section to transition back to the existing channel section. Photographs taken of the weir are shown in Figure 4.

CH2M HILL provided the City of Titusville with an "augmentation system operation schedule and guidelines" in accordance with the Memorandum of Understanding (MOU) between the SJRWMD and the City of Titusville dated June 11, 1999, page 12 of 14, Subtask 4.0 OPERATION, 4.1 Project Management. The system operational schedule mandates keeping the boards in place in order to retain surface water in the wetland for as long as possible without affecting flooding. The weir was designed to allow the flow to overtop the boards during significant rainfall events; however, at the City's discretion, the boards can be removed (by authorized City staff) prior to a hurricane. Also, CH2M HILL will continue to download the water level recorders and record staff gauge elevations periodically (approximately every 60 days), and perform periodic inspections of the weir for the duration of the project.

DATA COLLECTION

Data collection for the City of Titusville Parkland Wetland impact avoidance demonstration project included hydrologic, water quality, floral, and faunal sampling. CH2M HILL was responsible for all sampling except that of the amphibian community, which was performed independently by Coastal Plains Institute, Inc. (CPI). Primary field investigators during this period of the project for all parameters except amphibians were CH2M HILL biologists Steve Eakin and Anthony Davanzo. CPI herpetologist Ryan C. Means monitored amphibians through September 2006.

Sampling Transect Design

The monitoring transect location was selected after a site visit on June 22, 1999. The location was selected based on property ownership, ease of access, and habitat representative of the wetland. The transect was set up on July 26 and 27, 1999. The set up included installation of polyvinyl chloride (PVC) markers, two recording groundwater monitoring wells, and two staff gauges. Figure 5 presents a sketch of the monitoring transect set up.

One main monitoring transect with two adjacent parallel groundcover transects were set-up in an area that provides an adequate range of water depths and representative vegetative communities. The transects are 50 meters long running from the upland edge to an interior deep zone. PVC markers, placed over rebar, were used to mark the end points and intermediate points on the transects, and corners of each sampling plot (tree, shrub, groundcover).

Ground surface elevations at 3-meter intervals along the length of the main transect were surveyed. Elevations of staff gauges and at the top of casing and ground surface at each piezometer were surveyed.

Photo Stations

Three photo stations were established along the main transect in the center of each of the shrub plots. The photographs cover four quadrants (north, south, east, and west) surrounding the station. Photographs were taken at each station in the fall and the spring.

Sampling Schedule

The scope of work required a one-time baseline sampling event of the vegetation communities, benthic macroinvertebrates, fish, and water quality. However, at the time of the event, the water depth was too deep to sample all the parameters adequately. For this reason, subsequent trips were made. Various baseline parameters were sampled and characterized in September 1999, March 2000, and October 2001. The parameter list and sampling schedule as performed for the project are presented in Table 1.

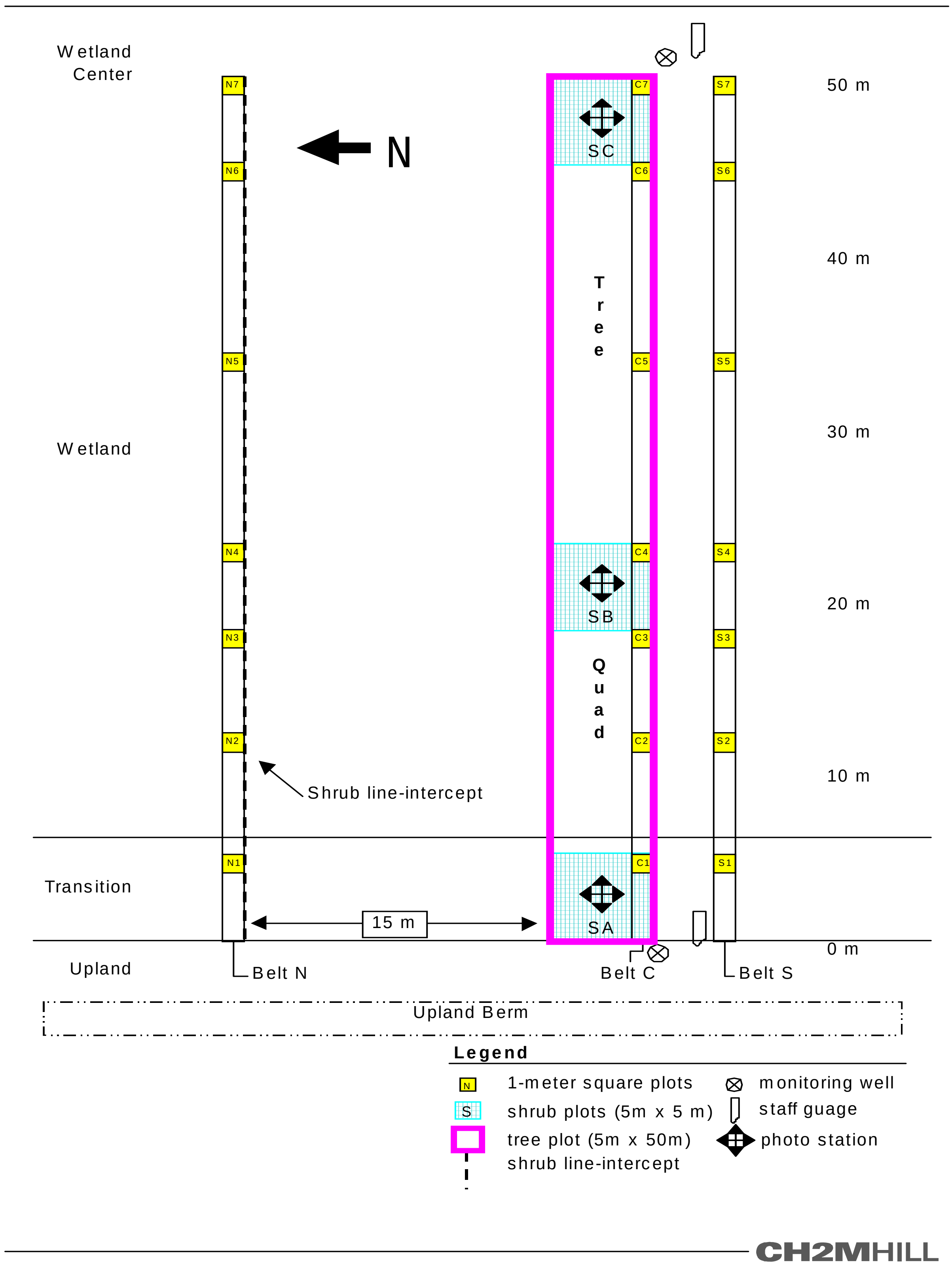


Figure 5. Parkland Wetland transect site map

Table 1. Parkland Wetland sampling plan

Parameter	Baseline Period				Operational Period									
	Sep 99	**Nov 99**	**Mar 00**	**Oct 01**	**Dec 02**	**Mar 03**	**Oct 03**	**Apr 04**	**Oct 04**	**Apr 05**	**Oct 05**	**Mar 06**	**Oct 06**	**Mar 07**
BIOTA														
Trees (Annual In Fall)	X			X	X		X[1]		**		**		X	
Herbs			X	X	X	X	X[1]	X	**	X	X[3]	X	X	X
Shrubs (Annual In Fall)	X			X	X		X[1]		**		X[3]		X	
Benthic Macroinvertebrates	**	X	X		X	X	X	X	X	X	X	X	X	
Fish (Annual in Fall)	X				*1	*2	X		X		X		*1	
Amphibians	Surveyed quarterly by CPI													
T & E Plant and Animal	X		X	X	X	X	X	X	X	X	X	X	X	X
SURFACE WATER SAMPLES														
Alkalinity as $CaCO_3$	X		X		X	X	X	X	X	X	X	X	X	
Ammonia (NH_3)	X		X		X	X	X	X	X	X	X	X	X	
Cadmium	X		X		X	X	X	X	X	X	X	X	X	
Calcium	X		X		X	X	X	X	X	X	X	X	X	
Chloride	X		X		X	X	X	X	X	X	X	X	X	
Color	X		X		X	X	X	X	X	X	X	X	X	
Conductivity	X		X		X	X	X	X	X	X	X	X	X	
Copper	X		X		X	X	X	X	X	X	X	X	X	
Iron	X		X		X	X	X	X	X	X	X	X	X	
Lead	X		X		X	X	X	X	X	X	X	X	X	
Magnesium	X		X		X	X	X	X	X	X	X	X	X	
Nickel	X		X		X	X	X	X	X	X	X	X	X	
Nitrate+Nitrite NO_3+$N0_2$ as N	X		X		X	X	X	X	X	X	X	X	X	
Orthophosphate, Low	X		X		X	X	X	X	X	X	X	X	X	
Potassium	X		X		X	X	X	X	X	X	X	X	X	
Sodium	X		X		X	X	X	X	X	X	X	X	X	
Sulfate	X		X		X	X	X	X	X	X	X	X	X	
Total Dissolved Solids	X		X		X	X	X	X	X	X	X	X	X	
Total Kjeldahl Nitrogen	X		X		X	X	X	X	X	X	X	X	X	
Total Organic Carbon	X		X		X	X	X	X	X	X	X	X	X	
Total Phosphorus, Low	X		X		X	X	X	X	X	X	X	X	X	
Total Suspended Solids	X		X		X	X	X	X	X	X	X	X	X	
Turbidity	X		X		X	X	X	X	X	X	X	X	X	
Zinc	X		X		X	X	X	X	X	X	X	X	X	
FIELD PARAMETERS														
Dissolved Oxygen	X		X		X	X	X	X	X	X	X	X	X	
Temperature	X		X		X	X	X	X	X	X	X	X	X	
Conductivity	X		X		X	X	X	X	X	X	X	X	X	
pH	X		X		X	X	X	X	X	X	X	X	X	
Water Level and Stage	X		X	X	X	X	X	X	X	X	X	X	X	X
Photographs		X[2]	X	X	X	X	X	X	X	X		X	X	X
SUBSTRATE SAMPLES														
Soil Description**													X[4]	

Note:
*1 - Sampled, but no fish present.
*2 - Not sampled, but fish were observed.
** Partly performed in July 2006.
X[1] Sampled in Dec 2003. X[2] sampled in Oct 1999. X[3] sampled in Jan 2006. X[4] sampled in July 2006.

Additional data for water quality, benthic macroinvertebrates, and herbaceous cover were collected in March 2000 to provide more data points, for comparison during the operational period. Ecological monitoring was suspended while the project experienced delays during the permitting and construction of the weir. Water levels were monitored continuously during the baseline period. Semi-annual sampling was performed for the operational period.

Stage and Rainfall

Two recording piezometers and staff gauges (Figure 6) were installed along the main monitoring transect. One set was installed near the upland boundary and the second in the wetland interior. The piezometers were set approximately 6 to 8 feet in the ground.

Each piezometer contains a data logger that is programmed to collect and record water levels at a minimum of 6-hour intervals. At present, the data loggers associated with the upland and wetland piezometers are Infinities USA Dataloggers and have a scrolling memory for 3,900 readings. Data are downloaded every 8 to 12 weeks. During each site visit, staff gauge measurements are recorded to verify that the data loggers are functioning properly.

Rainfall monitoring gauges located near the Parkland Wetland are at the City of Titusville's Mourning Dove and Blue Heron water treatment plants, although exact locations were not provided. Daily rainfall is recorded by plant staff and provided to CH2M HILL. Daily rainfall amounts are averaged between the two recording stations.

Figure 6. Photographs of transect upland end (left, October 2004) shows the City of Titusville and CH2M HILL staff gages; and wetland end (right, December 2003) recording well

Water Quality Sampling

Analytical samples for surface water quality were collected twice for the baseline period and four times during the first 24 months of the operational period. A grab sample was collected from the surface water for analysis for the range of water quality parameters listed in Table 1. Temperature, dissolved oxygen, pH, total depth, and conductivity were measured and recorded during field sampling. Dissolved oxygen and temperature were measured at depths 5 to 8 centimeters below the water surface and within 8 to 10 centimeters of the ground surface.

All of the samples were kept on ice below 4 degrees Celsius (°C) until arrival at the analytical laboratory. A field blank composed of analyte free water was also collected and analyzed for all parameters. Specific sample containers, holding times, and preservation techniques are based on the approved quality assurance plan.

Quality Assurance and Quality Control

The Quality Assurance and Quality Control (QA / QC) techniques used during the monitoring at Titusville have been approved by the Quality Assurance Section of the Florida Department of Environmental Protection (FDEP). The techniques used are accepted protocol for each type of sampling procedure. CH2M HILL field personnel followed procedures outlined in CH2M HILL's Comprehensive Quality Assurance Plan (CompQAP) No. 910036G for the execution of field activities, proper completion of chain-of-custody forms, sample preservation requirements, proper handling of samples, and certified laboratory analytical services. Strict adherence of holding times for all parameters was observed.

The laboratory analytical work was conducted by Columbia Environmental Laboratories, Inc. according to their CompQAP No.930298G. Beginning in March 2003, the water quality samples were sent to Advanced Environmental Laboratories, Inc. in Jacksonville, Florida. Laboratory personnel followed the procedures outlined in the laboratory's CompQAP for sample kit preparation, tracking and analysis of samples, and data validation.

Approved instrument maintenance and calibration procedures were followed by the field team in accordance with the manufacturer's recommendations, and were consistent with standard procedures outlined in CH2M HILL's CompQAP. Calibration results were recorded on the field data sheets. During each sampling event, one field blank was collected.

Soils

An investigation of the soil profile along the main transect was conducted in July 2006, after a prolonged period of high water. The purpose of the investigation was to determine the elevation and thickness of the surficial organic soil horizon, referred to as the histic epipedon (if the muck layer was >8 inches thick) and a histosol (if the muck layer was >16 inches thick). The surficial sediments comprise the principal zone of biological activity, where the augmentation efforts are likely to have ecological effects. These soil observations along with other short- and long-term indicators of hydrology were used to create a historical hydrograph. The hydrograph was compared to the stage-duration curves (baseline and operational), which were prepared from water level data collected throughout the study at the Parkland Wetland. The elevation at the top of the muck layer was evaluated by wading along the transect line and taking a depth-to-muck measurement in an undisturbed spot. The muck layer thickness was then measured by digging a small pit to a depth of at least 24 inches (60 centimeters.). Several pits were excavated along the main monitoring transect.

Vegetation Sampling

Sampling was conducted along the transects running from the upland edge to the interior of the wetland. Vegetative community sampling included three main strata: herbaceous groundcover, shrubs/saplings, and canopy/ subcanopy. Herbaceous groundcover sampling was conducted semi-annually. Canopy/subcanopy and shrub/sapling data collection was conducted annually.

Herbaceous Groundcover. The herbaceous groundcover community included all annual plants, soft-stemmed perennials, and woody seedlings less than 0.3 meter in height. Two sampling methods were used to characterize the herbaceous plant stratum: 21 plots (1 meter by 1 meter) and three belt intercept transects (1 meter by 50 meters).

(1) One-Square meter Plots

Ground cover data were recorded along the main transect and along the two additional transects, each with seven plots (1 meter by 1 meter). Within each of the 21 one-square meter plots, species composition and percent cover of herbaceous species and woody seedlings (< 0.3 meter tall) were determined.

(2) Belt-Intercept Transects

A modified line-intercept technique was used to evaluate herbaceous plant occurrences along the three belt transects (1 meter by 50 meters). The line intercept technique was used to monitor changes in aerial cover and zonation of target indicator species along an upland-to-wetland gradient.

Occurrence of selected target species along the belt transect was recorded as the linear distance covered by a species within five intervals along the belt. For each target species, the belt-intercept linear distance of cover was used to generate estimates of percent cover and frequency (number of 10-meter intervals in which the species occurred), which are converted to relative vegetative cover and relative frequency. The values for each plant species are added and averaged to yield an importance value as shown in Table 2.

Table 2. Plant cover and frequency statistics for herbaceous groundcover measurements

Statistic		Formula
Linear Cover Distance for Species A	=	Sum of all belt-intercept distances for Species A
Percent Cover	=	(Linear distance of Species A **/** Total transect distance) x 100
Relative Percent Cover	=	(Linear distance of Species A / Total linear distance of all species) x 100
Frequency	=	Number of intervals in which Species A occurred **/** Total number of intervals
Relative Frequency	=	(Frequency of Species A **/** Sum of the frequencies of all species) x 100
Importance Value	=	(Relative percent cover + relative frequency) / 2

Shrubs and Saplings. The shrub/sapling stratum is defined as all woody vascular plant species as well as sapling trees and sucker shoots of larger trees (that are less than 1 meter in height and less than 2.5 centimeters diameter at breast height [dbh]). Two sampling methods were used to characterize the shrub/sapling stratum: three plots (5 meters by 5 meters) and one line intercept transect (50 meters).

(1) 25-Square Meter Plots

Three plots were regularly spaced (5 meters by 5 meters) along the centerline of the main transect. All woody plants within the size class and rooted in or overhanging the plot were identified and recorded. For shrub and sapling species, the percent cover was determined. For sapling species, stem density was determined.

(2) Line Intercept

A line-intercept transect was established along the northern belt transect to monitor the occurrence and percent cover of shrub/sapling strata. A tape measure is placed along the length of the transect and the linear intercept distance of each species lying vertically over, under, or touching the tape are recorded. The 50-meter transect is subdivided into 10-meter intervals for measuring frequency.

For the shrub stratum, the line-intercept linear distance data were used to generate estimates of percent cover and frequency, which are converted to relative vegetative cover and relative frequency. The values for each plant species are summed and averaged to yield an importance value as described above for each species.

Canopy/Subcanopy. One 5-meter by 50-meter plot was used to characterize the canopy/subcanopy stratum. All trees rooted within the tree plot were identified to species, and measured for dbh at approximately 1.4 meters above the ground surface within each 10-meter interval along the 50-meter transect.

The canopy and subcanopy stratum was defined as those woody specimens greater than 1 meter in height and greater than, or equal to 2.5 centimeters dbh. This includes dominant and subdominant hardwood and softwood trees, sapling trees, and larger sucker shoots main trunks and branches of trees. Canopy trees included those greater than, or equal to 10.2 centimeters dbh. Subcanopy trees included those greater than, or equal to 2.5 and less than 10.2 centimeters dbh.

All trees were marked with a permanent numbered aluminum tag. Subsequent measurements were made at the bottom edge of the hanging tag to maintain consistency between annual measurements. The canopy/subcanopy data were collected annually.

Species composition, density and dominance (basal area), importance value, and stand size structure can be assessed from the data collected. Importance values for the canopy/subcanopy species were calculated from dominance, density, and frequency data as shown in Table 3.

Long term monitoring allows for an assessment of the annual growth, recruitment, mortality, and observable changes in health or character of the canopy over time.

Table 3. Dominance, density, and frequency statistics for canopy/subcanopy measurements

Statistic		Formula
Dominance	=	Total basal area of Species A
Relative Dominance	=	(Total basal area of Species A / Total basal area of all species) x 100
Density	=	Number of individuals of Species A
Relative Density	=	(Density of Species A / Total density of all species) x 100
Frequency	=	Number of intervals in which Species A occurred / Total number of intervals
Relative Frequency	=	(Frequency of Species A / Sum of the frequencies of all species) x 100
Importance Value	=	(Relative Dominance + Relative Density + Relative Frequency) / 3

Animals

Benthic Macroinvertebrates. Sampling was conducted within the various habitats found along the monitoring transect. Benthic macroinvertebrate populations were monitored in accordance with the FDEP Standard Operating Procedure BA-7 (July 11. 1996), which is based on the U.S. Environmental Protection Agency (EPA) rapid bioassessment protocols. The method includes sweep net sampling of all micro-habitats within the sampling area by two field personnel. Sampling is limited to a fixed number of sweeps at each site. All individual organisms collected are sorted and subsequently identified according to species, or the nearest practical taxonomic unit, by a sub consultant.

Fish. Fish populations were sampled near the transect using a 0.94-square meter Wegner Ring. Sampling is limited by the presence of standing water. If standing surface water is present then the number of tosses will vary depending on fish densities.

Amphibians. During the baseline period, amphibian populations were surveyed by University of Florida biologists L. Richard Franz, Ryan C. Means, and Steve A. Johnson. A modest sampling effort was conducted at the site to evaluate the amphibian community. During the operational period, researchers Ryan C. Means and Rebecca P. Meegan (CPI) conducted the amphibian surveys at the site.

Monitoring was limited to four times a year using a variety of methods including dip netting, aural surveys, and incidental captures. Typical trapping methods (drift fence array with screen funnel traps, coverboards, and PVC pipes) were not possible to maintain due to repeated vandalism. The Parkland Wetland is adjacent to Astronaut High School and is surrounded by residential development.

RESULTS

TOPOGRAPHIC SURVEY

A topographic survey along the main transect of the Parkland Wetland was performed in December 2000, more than a year after the baseline data collection had began. Until the survey was completed, water level data were presented relative to the wetland ground surface. After the weir was constructed in April 2002 and surveyed by the City of Titusville using NGVD29 datum, an error of 0.07 foot was discovered in the survey datum previously used. Also in 2002, the City of Titusville installed staff gauges on the upstream (wetland) side of the weir and at the upland end of the monitoring transect, using NGVD29 datum. In order to draw direct comparisons between the City's survey data and CH2M HILL data, all the water level and equipment elevations were converted to NGVD29 datum. Differences between CH2M HILL survey datum and the City of Titusville survey datum were quantified when standing water was present at both the wetland and upland ends of the monitoring transect. The difference between the City's staff gauge and CH2M HILL's was measured and used to correct other survey measurements along the transect. The corrections were then made to the water level elevation database to reflect the City of Titusville's survey.

The average elevation of the wetland along the monitoring transect (Figure 7), 12.6 feet NGVD29, was estimated by averaging all of the measurement points shown in the figure, excluding the upland edge. The upland edge of the wetland at the beginning of monitoring transect began at elevation 13.6 feet.

RAINFALL

Rainfall data collection began in July 1999 and continued through the end of the operational period. Figure 8 presents the period of record rainfall for the region. Data was unavailable from the Titusville area rainfall monitoring stations for the months of August 2000 and November and December 2001. Data from the National Weather Service from the City of Melbourne airport (approximately 45 miles south of the Parkland Wetland) was substituted for the missing data. Average annual rainfall during the baseline period from August 1999 through April 2002 was 51 inches, which was consistent with the yearly average rainfall values for the area (48 to 50 inches).

Operational period average annual rainfall from May 2002 through April 2007 was 58 inches, above the long-term yearly average and the baseline period.

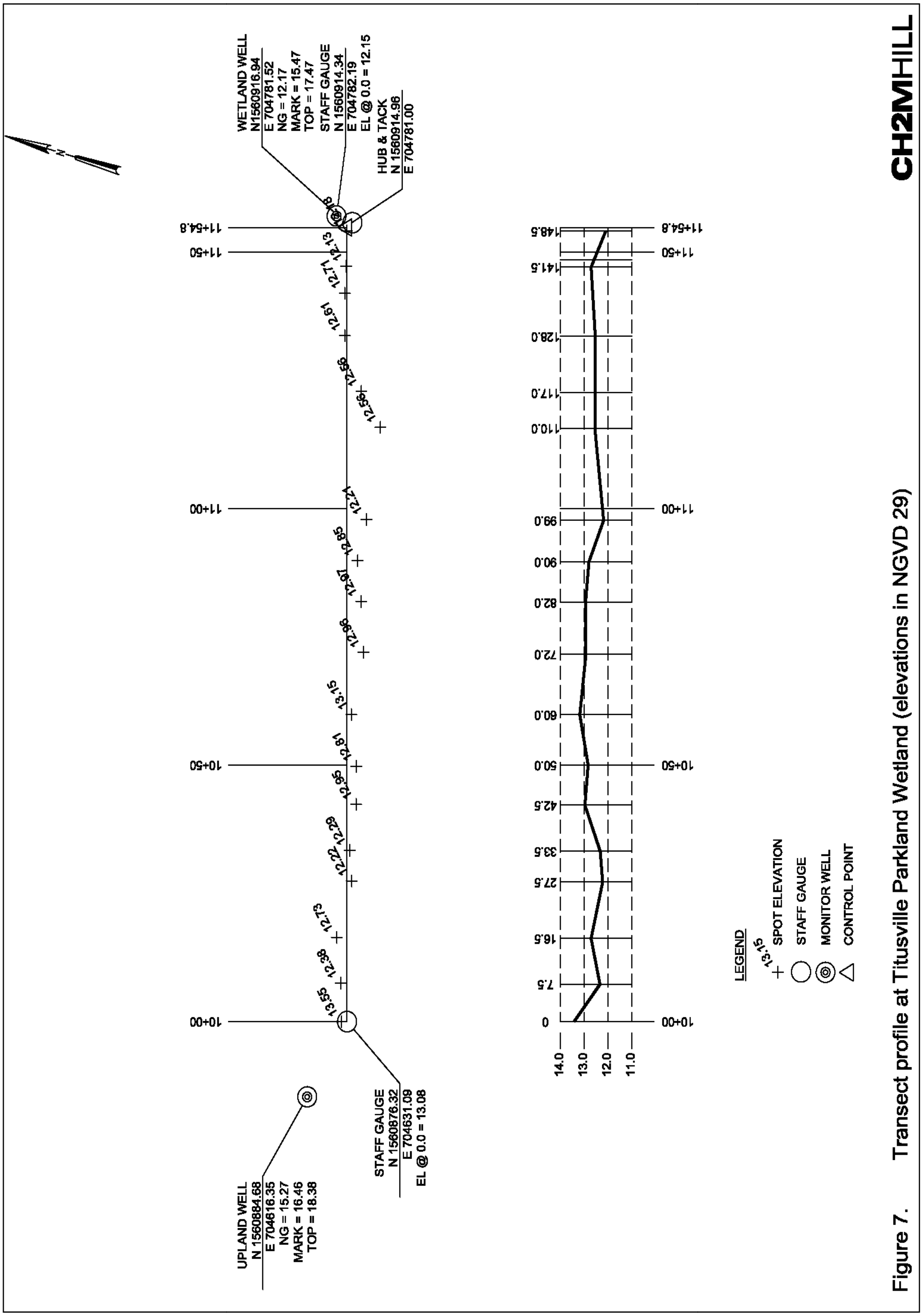


Figure 7. Transect profile at Titusville Parkland Wetland (elevations in NGVD 29)

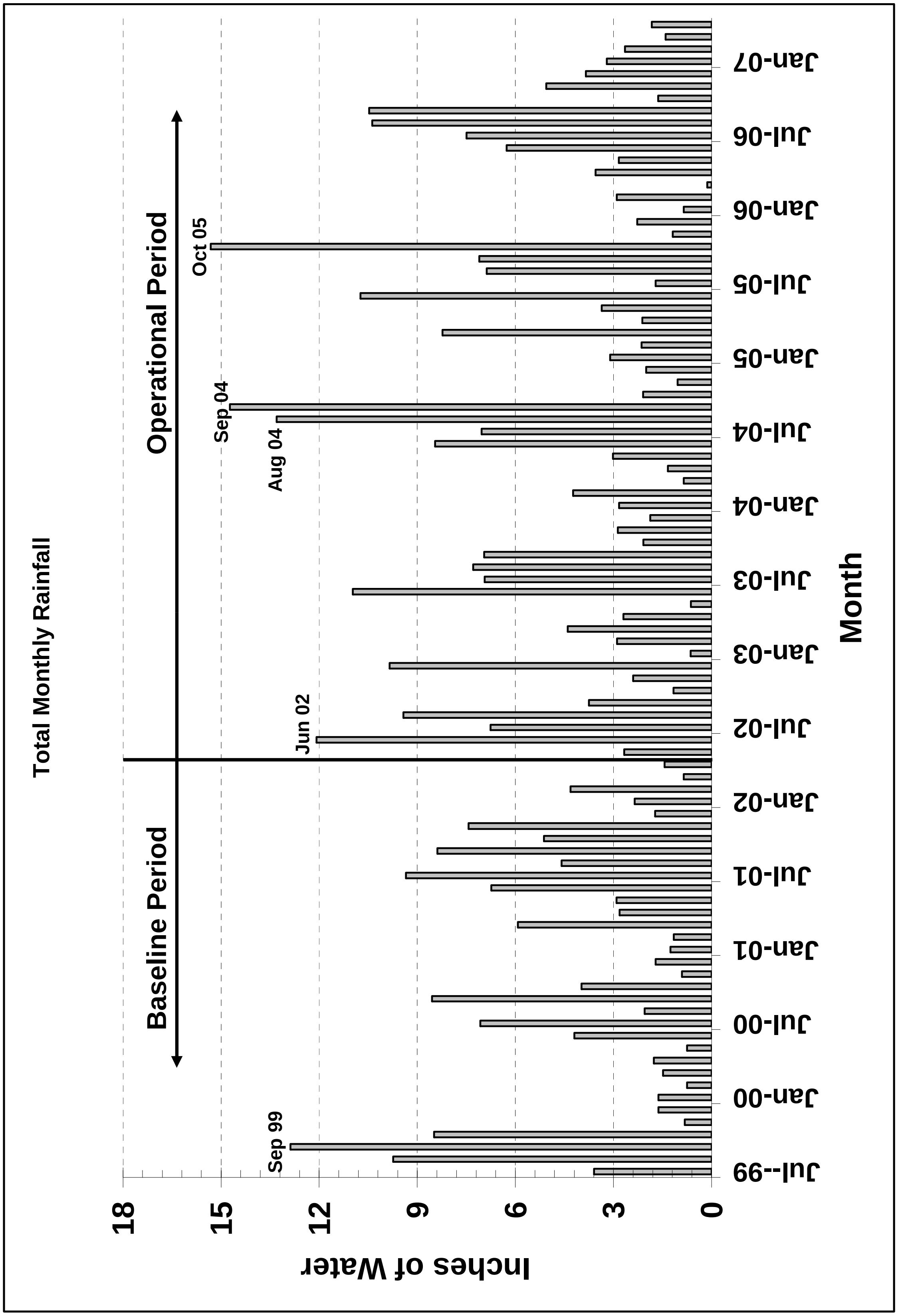


Figure 8. Rainfall amounts

The 2005 hurricane season was the most active in recorded history and produced five named storms that hit the State of Florida, tropical storm Arlene (June 2005), hurricane Dennis (July 2005), hurricane Katrina (August 2005), tropical storm Tammy (October 2005), hurricane Wilma (October 2005). The only storm that produced a significant rainfall amount that fell within the Parkland Wetland watershed was hurricane Wilma on October 24, 2005. Rainfall total for that month was the highest recorded at the City of Titusville water treatment plants (15.3 inches) since the project began in August 1999.

Monthly rainfall totals collected during the project period from the City of Titusville's Blue Heron and Mourning Dove water treatment plants were compared to average monthly totals from two long-term (1971 – 2000) local data sets. The first data set included records from a nearby Titusville rainfall station obtained from the Southeast Regional Climate Center Web site. The second data set was an average of five regional sites that included data from stations at the Daytona Beach International Airport, Titusville, Sanford, Crescent City, and Deland, which was obtained from the previously mentioned website. By summing individual monthly departure values from normal values presented from the two data sets, the cumulative departure from normal precipitation was calculated. The cumulative departure from normal precipitation was used to develop trends in precipitation. An increasing trend in cumulative departure from normal rainfall indicates wetter conditions while decreasing trends in cumulative departure from normal rainfall indicate dryer conditions.

Figure 9 shows the cumulative departure from the mean monthly rainfall total of the two long-term data sets. After an initial 8-month period (September 1999 to April 2000) in the beginning of the project when rainfall amounts were above average, the average monthly rainfall totals were below the long-term average of both data sets for 53 months (April 2000 to September 2004). These 53 months comprised the majority of the baseline period and all of the first 2 years of the operational period. During this time, the average monthly rainfall totals between the two data sets remained close, and the period was dryer than normal with cumulative rainfall below the average precipitation expected.

Near the beginning of Year 3of operation, average monthly rainfall exceeded the long-term average of both data sets and continued along this trend through the monitoring Year 5.

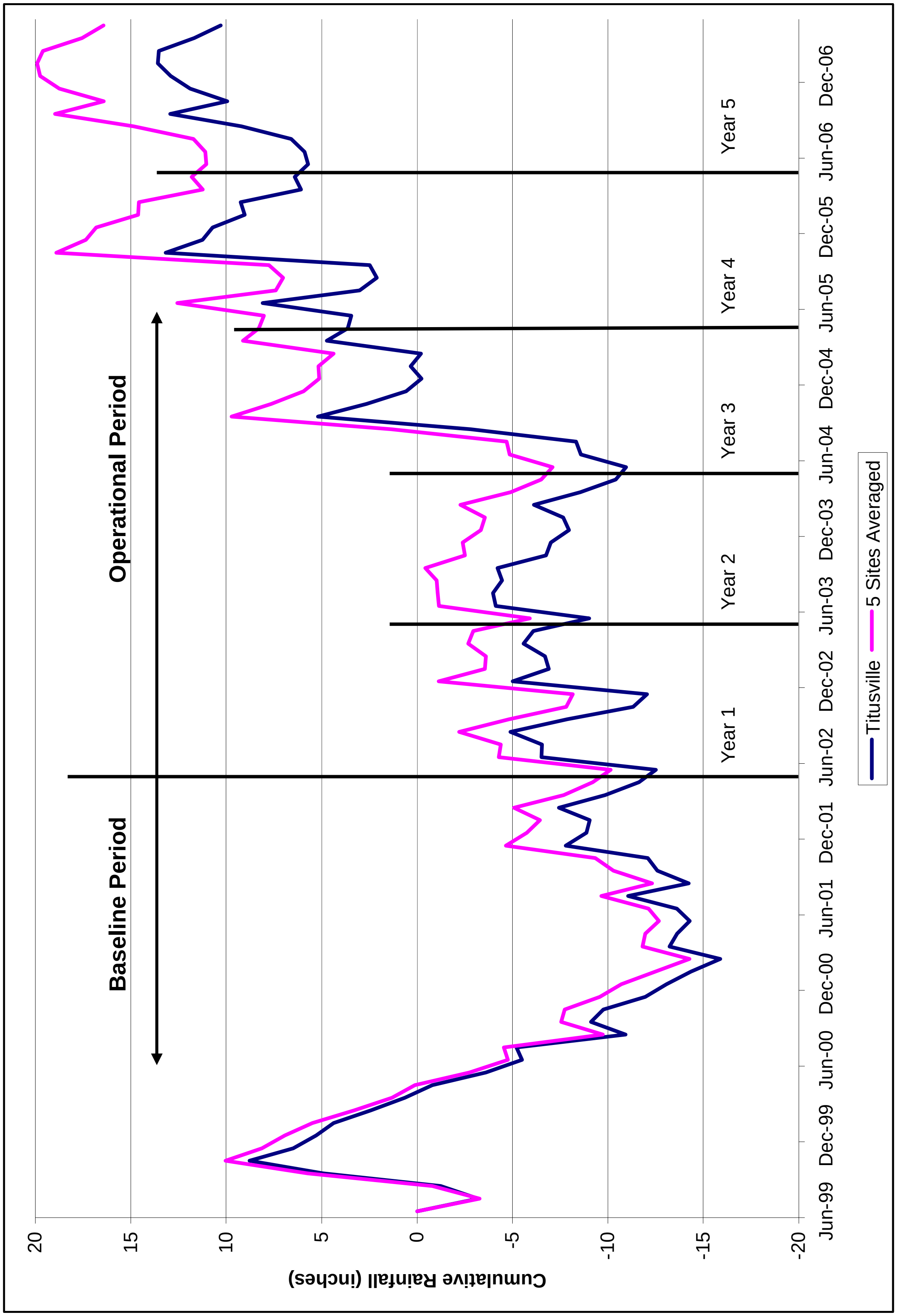


Figure 9. Cumulative departure from average monthly precipitation

SURFACE WATER ELEVATIONS

The installation of the weir in April 2002 blocked the primary low water outflow of the Parkland Wetland without changing the flood conditions. The weir was designed to raise the water levels to a maximum 15.89 feet (NGVD29) and to increase the volume of water stored in the wetland. During the operational period, the surface water was held at higher elevations and for longer periods of time than during the baseline period. On April 13, 2006, a new weir was installed due to repeated vandalism and the control height "as built" was raised to an elevation of 16.00 feet (NGVD29).

The 2005 hurricane season produced greater than average monthly rainfall amounts for the month of October 2005 resulting in above average annual rainfall inputs to the Parkland Wetland. Water levels in the wetland rose to their maximum recorded value (17.65 feet [NGVD29]) on October 25, 2005, 0.44 feet above the previous maximum record, which occurred in September the year before. Floodwater overtopped the control weir again from October 5, 2005 until December 17, 2005 (73 days). These two high water events occurred in operational Years 4 and 5. Surface water within the wetland stayed below the top of the control weir during operational Year 5.

Figure 10 depicts water levels as recorded by upland and wetland data loggers associated with piezometers for the baseline and operational periods. Water elevation monitoring was initiated in August 1999 and data loggers were set to record water levels on a 6-hour interval. However, several equipment malfunctions, repairs, and replacements have resulted in data gaps. The wetland datalogger also became inaccessible throughout the 2004 and 2005 hurricane seasons due to high water levels. The last successful download of the wetland recorder was June 10, 2004. The wetland datalogger was finally accessed during the January 2006 field event and was non-functioning. It was replaced with another Infinities USA datalogger during the March 2006 field event.

Data from the upland datalogger was used for analysis in place of the wetland datalogger data from June 10, 2004 through April 2006. During this time period, surface water between the upland and wetland recorders was contiguous until February 19, 2006 when surface water levels fell below the soil surface at the upland datalogger. Data collection from the wetland recorder was resumed on May 3, 2006 and continued until both the upland and wetland recorders were removed on March 28, 2007. Water levels in the wetland fell beneath the ground surface at the wetland recorder briefly during August 2006 and again on March 23, 2007 through the end of the monitoring period.

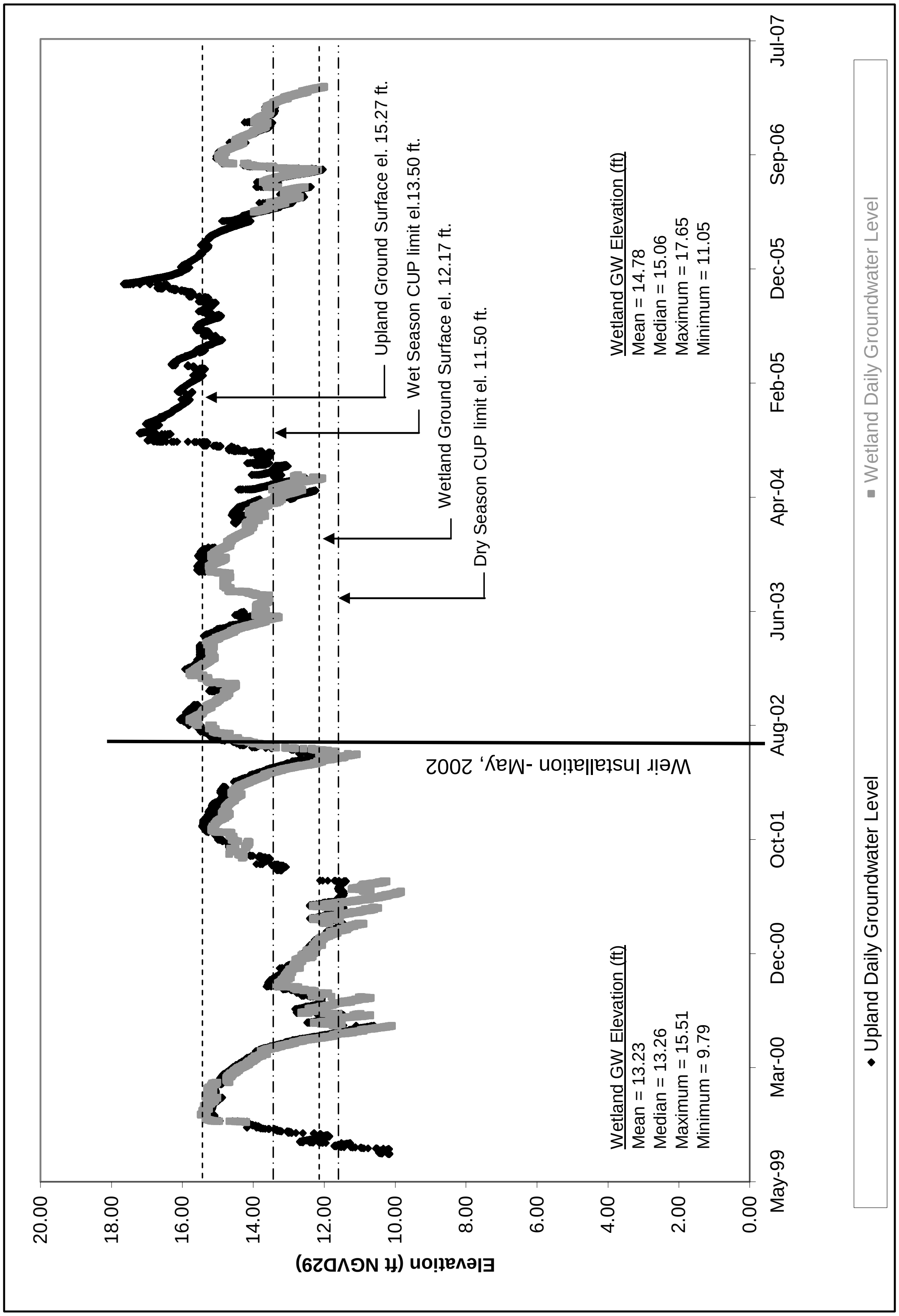


Figure 10. Daily ground water elevations in the Parkland Wetland
Note: Wetland ground surface elevation (12.17 feet [NGVD29]) is a spot elevation of the natural ground at the wetland recording piezometer located waterward of the deep end of the transect.

The upland datalogger consistently provided reliable data from its installation in July 1999 until November 2003, after which it experienced intermittent failure. Data from the upland recorder between December 2, 2003 and February 3, 2004 was deemed unreliable and so, excluded from the database. The datalogger was replaced in April 2004.

Average monthly baseline and operational periods daily water elevations differed by a mean value of 1.5 feet (Table 4). Maximum values during the operational period exceeded the baseline period values (Figure 10). Minimum daily values were 1.3 feet greater in elevation during the operational period compared to baseline period observations. Changes in water levels occurred more gradually and fluctuated less during the operational period.

Data from the baseline and operational stage exceedence curves show an increase in stage exceedence once the weir was installed. Water levels were above the natural ground surface (elevation 12.17 feet) at the wetland recorder for 99% of the operational period (Figure 11); and 71% of the baseline period. The baseline period exceedence curve closely resembled the estimated historical exceedence curve produced from available hydrologic indicator data. The similarity between these two curves reinforces the premise that the Parkland Wetland was not showing signs of ecological impact during the baseline period. Thus, the increase in the operational period exceedence curve by the installation of the control weir shows that impacts have the potential to be avoided.

Interference from control structures further downstream of the control weir on the Parkland Ditch may have contributed to the increase in the operational period exceedence curve. On several occasions during flood events when water overtopped the control weir, water in the Parkland Ditch was observed flowing opposite to the ditch gradient, towards the wetland and other ditch branches. Any control structure that is above 16.00 feet (NGVD29) downstream of the control weir is beyond the scope of the hydraulic modeling conducted for this project. The stage exceedence curves show that the elevation of 16.00 feet (NGVD29) was exceeded 0% and 9% during the baseline and operational periods, respectively.

SURVEY OF HYDROLOGIC INDICATORS

Field measurements of soil and available vegetative indicators of hydrology were collected by CH2M HILL biologists in July 2006. The goal of the investigation was to establish a historical hydrograph to which stage-duration curves from water level data collected during the study period at the Parkland Wetland could be compared. The estimated historical hydrograph along with comparisons of rainfall to long-term records were used to determine if water levels within the wetland were above or below historical conditions.

Table 4. Mean groundwater elevations by month for baseline and operational periods, October 1999 to April 2007, Parkland Wetland, Titusville

	Groundwater Elevation (feet NGVD29)												
	Baseline Period					Operational Period							Mean Difference
Month	1999	2000	2001	2002	Mean	2002	2003	2004	2005	2006	2007	Mean	Operational – Baseline Periods
Jan		15.11	12.23	14.77	**14.04**		15.60*	14.19	15.92	15.44	13.57	**14.94**	0.90
Feb		14.63	11.89	14.52	**13.68**		15.23	14.10	15.65	15.31	13.26	**14.71**	1.03
Mar		14.17	11.44	14.34	**13.32**		15.23	13.85	15.58	14.83	12.54	**14.41**	1.09
Apr		13.65	11.29	13.57	**12.84**		14.86	13.17	15.99	14.25		**14.57**	1.73
May		12.46	11.26		**11.86**	12.23	13.97	12.95	15.31	13.41		**13.57**	1.71
Jun		11.08	10.58		**10.83**	12.2	13.74	13.33	15.30	12.86		**13.49**	2.66
Jul		11.69	10.45*		**11.69**	14.38	13.71	13.70	15.41	13.31		**14.10**	2.41
Aug	*	11.79	*		**11.79**	15.29	14.56	14.45	15.25	12.80		**14.47**	2.68
Sep	*	12.01	14.37*		**12.01**	15.61	14.79	16.66	15.41	14.73		**15.44**	3.43
Oct	15.17*	13.13	14.34		**13.74**	15.11	15.12	16.89	16.49	14.65		**15.65**	1.91
Nov	15.38	12.91	14.92		**14.40**	14.76	15.01	16.44	16.37	14.24		**15.36**	0.96
Dec	15.23	12.59	14.95		**14.26**	15.68	14.66	15.95	15.85	13.71		**15.17**	0.91
Mean	13.18					14.66							1.48
Median	13.13					15.06							1.93

* Less than a full month of data due to equipment malfunction.

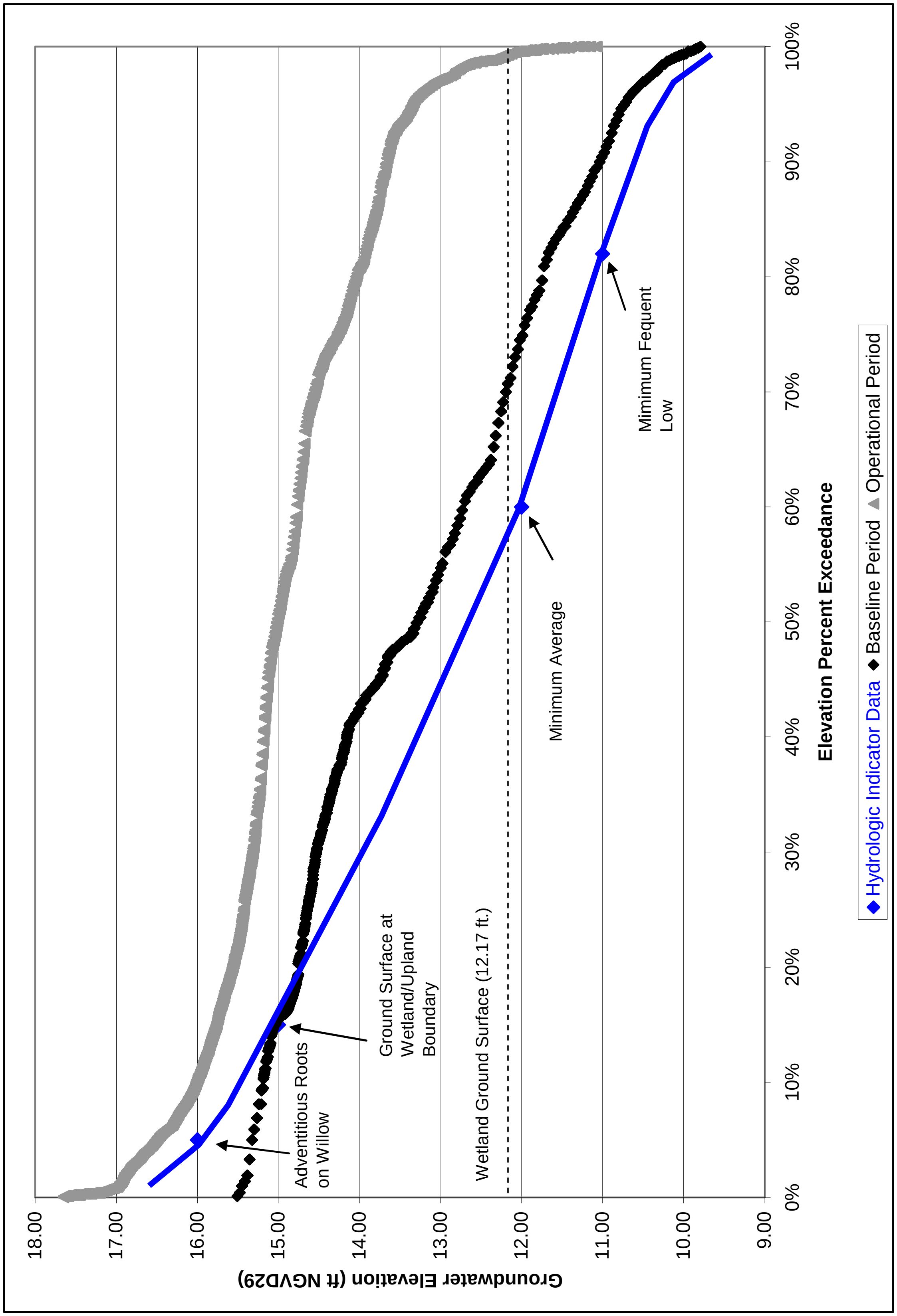


Figure 11. Stage exceedence curves

Hydrologic indicators were surveyed while standing surface water was present at the Parkland Wetland. The elevations of the available indicators were measured relative to the elevation of the surface water as measured by the upland and wetland piezometers and then converted to NGVD29 datum.

Indicators of hydrology surveyed at the Parkland Wetland included the elevation and thickness of the surficial organic horizon along a gradient of water depth, elevation of the ground surface at the wetland / upland boundary, and elevation of adventitious roots on Carolina willow (*Salix caroliniana*). Other vegetative indicators typically used to assess short-term and long-term hydrologic conditions (lichen lines, moss collars, fetterbush root crown, or cypress buttresses) were not present at or near the monitoring transect.

Following the SJRWMD Minimum Flows and Levels Assessment protocols used for the Bennett Swamp pilot project (CH2M HILL 2002), the elevation minimum average (mean wetland soil surface less 0.25 foot) and minimum frequent low water levels (mean wetland soil surface less 1.66 feet) were calculated. A mean water elevation no lower than 0.25 foot below the mean surface elevation of organic soils has been used to protect peat soils in south Florida (Stephens 1974; professional opinion of SJRWMD and CH2M HILL staff based on unpublished data).

This same depth below the muck surface has been found to correspond to the water elevation that is exceeded about 50 to 60% of the time (Brooks and Lowe 1984; Hall 1987). The minimum frequent low elevation was estimated in a similar fashion, as the mean organic soil elevation described above minus 1.67 feet. This is considered a minimum dry season depth necessary to maintain the organic soil profile and other wetland functions and structures (Mace 2001). The minimum frequent low has been found to occur at about the 75 to 90% exceedence range (Sonny Hall, Personal Communication 2001). The Parkland Wetland minimum average and minimum frequent low were estimated at elevations 12.00 and 11.00 feet NGVD29, respectively.

The elevation of the ground surface at the wetland / upland boundary (15.00 feet [NGVD29)] was used as an estimate of the frequent high water (15% exceedence level). The mean elevation of adventitious roots on the Carolina willow (16.00 feet [NGVD29]) was used as an estimate of the infrequent high water level (5% exceedence level). This elevation is considered a short-term indicator of hydrology and most likely is the result of high water from the 2004 and 2005 hurricane seasons.

The calculated soil and vegetation indicator elevations were plotted as the target minimum stage exceedence curve (Figure 11) for the wetland, which can then be compared to exceedence curves from the baseline and operational monitoring periods. The target curve provides an estimate of the lower limits of the flooding regime needed to maintain this wetland community. The target exceedence curve most closely approximated conditions during the baseline period (2.5 years of data) and was moderately below the stage exceedence curve of the hydration period (5 years of data). Water level elevations along the middle range of the historical stage exceedence curve (50% exceedence) were difficult to interpret due to the lack of available hydrologic indicators and the weak relationship between some of the indicators. Modeling is beyond the scope of this project. However, elevations at the low and high exceedence ranges did provide evidence that the wetland was near the estimated minimum levels during the baseline period. With water level management and above average rainfall, the stage frequency curve has risen above the target curve.

As stated earlier, rainfall during the baseline period was characterized by below long-term average rainfall from November 1999 to February 2001 followed by greater than average rainfall until the installation of the weir in May 2002 (Figure 9). The operational period experienced above long-term average rainfall during Years 1, 3, 4, and 5 of monitoring. These greater than average periods of rainfall resulted in water levels within the wetland well above both the estimated minimum stage duration curve and baseline period exceedence curve. Conditions during the operational period are considered wetter than the target curve as reflected by the stage chart (Figure 10) and exceedence curves (Figure 11).

At the inception of this project, the Parkland Wetland was selected for this pilot study because of the potential to be ecologically impacted from a lowered hydrologic regime due to groundwater withdrawals from four new wells (Area II – Wells 50-53) permitted for installation adjacent to the wetland. At that time the wetland was not considered impacted by drawdown as water levels were above the wetland surface 71 percent of the time. Potential future impacts to the wetland might be avoided by increasing water storage in the wetland by retaining surface water. Since the installation of the weir, storage in the wetland has increased beyond targeted minimum conditions due to above long-term average rainfall in the region.

Field sampling crews have also noted a backwater effect from downstream during the last few wet seasons. After the hurricane season of 2004 and 2005, it was evident that another control structure farther downstream in the drainage canal system hydraulically controlled water levels in the wetland during the wet season, and especially during periods of above average rainfall. Under high water conditions the main canal back floods the outlet ditch, overtops the weir, and floods the wetland.

WATER QUALITY

The project is not adding any new runoff to the wetland. The weir is designed to retain some of the base flow that would otherwise discharge from the wetland. No changes are being made to the inflow sources or quality.

Water quality was sampled twice during the baseline period and nine times during the operational period (Table 5). Copies of the laboratory reports including blank field data and detection limits from the operational period are included in Appendix A.

Overall results for both baseline and operational periods show that the water quality in the wetland is comparable to that in the surface water systems in Brevard County and adjacent areas in central Florida (FDEP 1996, 1997a, 1997b, 1998a, 1998b, 2000). The Parkland Wetland exhibits water quality typical of Class III Surface Waters and a wetland that receives runoff from an urban area.

For most of the parameters, the baseline and operational periods water quality results were similar (Table 5). For several parameters (pH, color, and sulfate), the baseline period values were higher than those measured during the operational period. Ammonia, total nitrogen, phosphorus, metals, conductivity, and total dissolved solids levels are moderate in value for an urban wetland relative to a pristine condition (a wetland not receiving urban runoff). Concentrations for nickel and zinc were variable with values spread over two orders of magnitude.

Also, typical of urban area wetlands is low dissolved oxygen, less than 5 milligrams per liter (mg/L). High inputs of organic matter coupled with long hydraulic residence times, create oxygen deficits from the metabolism of microorganisms in wetlands (Mitsch and Gosselink 1993). Chloride, turbidity, and total suspended solids were low relative to many surface waters in central Florida, which is better than expected for an urban wetland. Color was high but typical of Florida wetlands where water has been colored by dissolved organic material resulting from the breakdown of plant detritus within the watershed (Kadlec and Knight 1996).

Table 5. City of Titusville – Parkland Wetland water quality summary

	Baseline Period		Operational Period								
Parameter, Unit	09/29/99	03/14/00	12/10/02	03/20/03	10/21/03	4/07/04	10/20/04	4/28/05	10/25/05	03/28/06	10/25/06
Dissolved Oxygen [A], mg/L	0.14	4.34	1.12	2.30	0.37	0.24	2.74	3.15	1.89	3.10	1.64
Temperature [A], °C	25.26	23.5	19.1	24.6	22.5	16.6	21.1	18.89	21.8	18.33	16.57
ph [A], units	6.92	7.02	4.6	4.7	3.54	6.73	6.94	6.97	5.40	5.23	7.86
Conductivity, µmhos/cm	296	481	270	116	252	190	210	240	275	317	280
Color, units	200	200	130	125	100	180	150	70	100	100	200
Alkalinity as $CaCO_3$, mg/L	62.0	180	130.0	98.0	100	82	78	100	62	130	100
TSS, mg/L	11	5.5	6.5	5.0	68	6.0	44	3.0	10	13	6.8
TDS, mg/L	330	362	220	184	190	160	170	200	79	220	220
TOC, mg/L	20.3	28.5	16.0	25.0	<0.50	13	30	20	11	22	23
Turbidity, ntu	4.22	1.67	3.9	2.3	6.9	24	4.1	3.2	4.6	23	29
Ammonia – N, mg/L	0.23	<0.1	<0.1	0.05	<0.019	<0.026	0.040	<0.026	0.034	<0.026	<0.026
Total Kjeldahl – N, mg/L	1.97	1.91	2.40	1.40	6.4	1.1	1.2	0.77	0.79	1.3	1.2
Nitrate + Nitrite – N, mg/L	<0.2	0.32	<0.2	0.05	0.098	<0.027	0.90	<0.027	<0.027	0.036	<0.027
Total Nitrogen, mg/L	2.07	2.23	2.50	1.45	6.5	1.11	2.10	0.78	0.80	1.34	1.21
Total Phosphorus-P, mg/L	0.16	0.065	0.12	0.15	0.51	<0.043	0.39	<0.043	0.11	<0.043	<0.043
Ortho-Phosphate-P, mg/L	<0.01	0.044	0.04	0.09	0.014	<0.013	0.12	<0.013	0.054	<0.013	0.16
Sulfate, mg/L	53.1	31.6	3.4	2.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Chloride, mg/L	17.9	29.6	12.0	13.0	16	16	19	20	8.2	24	25
Cadmium, mg/L	<0.0005	<0.0005	<0.0005	0.0013	0.00061	0.0016	<0.00021	<0.000051	<0.000051	0.000078	0.00016
Calcium, mg/L	46	85.5	56	39	42	34	34	37	27	53	43
Copper, mg/L	<0.001	<0.002	<0.002	0.003	0.0020	<0.0071	<0.0071	<0.00096	0.0022	0.0054	0.0053
Iron, mg/L	2.62	0.89	1.0	1.70	2.9	2.6	2.4	0.37	1.9	4.5	3.7
Lead, mg/L	<0.001	<0.001	<0.001	0.0	0.0017	0.0082	0.0025	<0.0019	<0.0019	<0.0019	<0.0019
Magnesium, mg/L	1.36	2.98	1.81	1.50	1.7	1.3	1.7	1.6	1.3	1.5	1.8
Nickel, mg/L	<0.001	<0.002	0.011	0.00085	<0.00085	<0.0026	<0.0026	<0.0016	<0.0016	<0.0016	<0.0016
Potassium, mg/L	5.1	2.13	2.0	2.90	3.7	1.1	2.6	1.2	1.5	0.95	2.5
Sodium, mg/L	7.6	14.6	7.7	7.4	7.8	8.4	9.6	9.7	6.5	12	14
Zinc, mg/L	0.17	<0.025	<0.01	0.025	0.0090	0.013	0.010	0.011	0.011	0.012	0.0061

[a] Measurement taken in field

VEGETATION

Seventeen plant species were identified during the baseline period and 27 during operational period (Table 6). Fifteen of these species were found during both periods. Thirty plant species in all have been identified in the Parkland Wetland during the entire monitoring period. Six species not previously recorded during the baseline period or the first 4 years of the operational period were recorded during Year 5 of the operational period. Two of these species, Chinese tallow (*Sapium sebiferum*) and Brazilian pepper (*Schinus terebinthifolius*), are consider invasive exotic species. New species were observed near the upland end of the monitoring transects when water had receded below the ground surface. Detailed data tables for both the periods are provided in Appendix B.

Monitoring of the vegetation community was suspended during the October 2004 event and delayed during October 2005 due to high water levels from the 2004 and 2005 hurricane seasons. Surface water from the upland to the wetland end of the transects completely submerged target species except for cattail and made plant enumeration impossible. During those events, water levels in the wetland were too deep for CH2M HILL biologists to monitor the herbaceous groundcover safely and effectively. Once water levels receded, it was possible to access the vegetation transects and monitoring was resumed in January 2006.

Herbaceous Groundcover

One-Square-Meter Plots. Results of the observations of herbaceous groundcover within the 21 one-square-meter plots are averaged across the three transects and presented in Table 7. Details of Table 7 data summaries are provided in Appendix B.

Species diversity within the plots was similar between the baseline and the operational periods. During the baseline period, diversity ranged from one to six species; with most of the plots having two to four species each. Across the transect, species diversity ranged from 10 (October 2001) to 15 (September 1999). During the operational period, species diversity within the plots ranged from one to 11 species; with most of the plots having three to five species each. Across the transect, species diversity –over the five operational years– ranged from five (January 2006) to 14 (March 2007).

Table 6. Vegetative species observed in the Parkland Wetland – City of Titusville wellfield

Common Name	Species Name	Form	Wetland Indicator Status	Baseline Period		Operational Period									
				Sep 99	Oct 01	Dec 02	Mar 03	Dec 03	Apr 04	Oct 04	Apr 05	Jan 06	Mar 06	Oct 06	Mar 07
Red Maple	*Acer rubrum*	Tree	FACW											X	X
Peppervine	*Ampelopsis arborea*	Herb	UPL	X	X	X	X	X	X	X	X			X	X
Aster, Climbing	*Aster carolinianus*	Herb	OBL	X	X	X			X		X				X
Mosquito Fern	*Azolla caroliniana*	Herb	OBL								X				
False-Willow, Eastern	*Baccharis halimifolia*	Shrub	FAC	X											X
False Nettle	*Boehmeria cyclindrica*	Herb	OBL		X										
Buttonbush	*Cephalanthus occidentalis*	Shrub	OBL	X	X			X	X	X	X	X			
Small Dogfennel	*Eupatorium capillifolium*	Herb	FAC	X	X			X	X	X	X			X	X
Morning glory (unidentified)	*Ipomoea sp.*	Herb	FACW - FACU												X
Duckweed	*Lemna sp.*	Herb	OBL		X	X	X	X	X	X	X	X	X	X	X
Frogs Bit	*Limnobium spongia*	Herb	OBL								X				
Primrose willow	*Ludwigia peruviana*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Hempweed, Climbing	*Mikania scandens*	Herb	NI	X	X	X	X		X		X		X	X	X
Florida pellitory	*Parietaria floridana*	Herb	FAC												X
Passion flower	*Passiflora incarnata*	Herb	[1]FACW+	X											
Camphorweed, Rosy	*Pluchea rosea*	Herb	FACW	X											
Smartweed, Dotted	*Polygonum punctatum*	Herb	OBL	X	X	X	X	X	X		X			X	X
Smartweed	*Polygonum sp.*	Herb	OBL					X	X		X				
Blackberry	*Rubus sp.*	Herb	OBL	X					X	X	X				
Cupscale, American	*Sacciolepis striata*	Herb	OBL	X		X	X	X						X	
Willow, Carolina	*Salix caroliniana*	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Water Spangles	*Salvinia minima*	Herb	OBL								X	X	X	X	X
Elderberry	*Sambucus canadensis*	Herb	FAC	X						X	X				
Chinese Tallow	*Sapium sebiferum*	Tree	FAC											X	
Brazilian Pepper	*Schinus terebinthifolius*	Shrub	FAC											X	
Eastern Poison ivy	*Toxicodendron radicans*	Herb	FAC												X
Cattail, Southern	*Typha domingensis*	Herb	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Bladderwort, Eastern Purple	*Utricularia purpurea*	Herb	OBL				X	X	X					X	
Water Meals	*Wolfia sp.*	Herb	OBL				X			X	X	X	X		
Mud Midgets	*Wolfiella sp.*	Herb	OBL				X	X	X	X	X	X	X	X	X

[1] Federal indicator, No state indicator given
NI = no federal or state indicator given.
UPL = plant almost always occurs in uplands FAC = plant equally likely to occur in wetlands 34% to 66% of the time;
OBL = obligate; plant almost always occurs in wetlands; FACW = Plant usually occurs in wetlands 67 to 99% of the time.

During the baseline period, averaged from September 1999 and October 2001 events, the four most common groundcover species accounted for 65.2% of the total relative cover. These species were climbing hempweed (*Mikania scandens*) 18.7%, dotted smartweed (*Polygonum punctatum*) 18.3%, southern cattail (*Typha domingensis*) 15.8%, and Carolina aster (*Aster carolinianus*) 12.4%.

Year 1 - During the December 2002 event, the two most common groundcover species, Carolina aster and climbing hempweed, accounted for 49.0 and 32.4% of the relative cover, respectively. During the March 2003 event, the four most common groundcover species accounted for 85.1% of the relative cover. These species were eastern purple bladderwort (*Utricularia purpurea*) (40.0%), duckweed (*Lemna* sp.) (18.3%), Carolina aster (14.2%), and climbing hempweed (12.6%).

Year 2 - During December 2003 and April 2004, the two most common species were duckweed and southern cattail. Relative cover by duckweed was 67% and 65% in December and April, respectively. Southern cattail relative cover was 25% and 21%, respectively.

Year 3 - During the third year of operational monitoring, high water prevented access to the transect in October 2004. By the spring event in April 2005, (Figure 12) only the first four meter-square plots along each transect were monitored due to the depth of surface water. Duckweed, a floating aquatic species, was the most common herbaceous species observed (92% relative cover).

Year 4 – During the January and March 2006 events, duckweed was the most common species observed (65% and 67% relative cover, respectively).

Figure 12. Photograph taken in April 2005, shows high water covered with duckweed (*Lemna* sp.) and Carolina willow (*Salix caroliniana*) in the Parkland Wetland

Most herbaceous species were inundated except for cattail, especially near the wetland end of the transect (relative percent cover of 26% and 27% in January and March, respectively). Notably reduced in cover were the climbing vine species Carolina aster and climbing hempweed, along with dotted smartweed; all three were dominants during the baseline period.

Year 5 – During October 2006 and March 2007, the most common species were southern cattail, duckweed, water spangles (*Salvinia minima*) and dotted smartweed. Relative percent cover by southern cattail was 23.8% in October 2006, which increased to 70.1% in March 2007. Duckweed and water spangles were the dominants in October 2006, with 37.4% and 35.8% relative cover, respectively; and reduced to 1.6% and 2.2%, respectively, during the March 2007 event. Dotted smartweed was the second most dominant in March 2007 with a relative cover of 13.5%. The March 2007 event showed the greatest number of species (14) recorded during the operational period.

Table 7. Summary of herbaceous groundcover square-meter transect data during the baseline and operational periods for the Parkland Wetland, City of Titusville

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
September 1999 - Baseline									
Ampelopsis arborea		10						1.4	2.45
Aster carolinianus	5	2	8	10	37	2	2	9.2	15.79
Baccharis halimifolia						3		0.5	0.82
Eupatorium capillifolium	5	3	3	5	3	2	15	5.1	8.84
Ludwidgia peruviana							3	0.5	0.82
Mikania scandens			2					0.2	0.41
Passiflora incarnata		3						0.5	0.82
Pluchea rosea							2	0.2	0.41
Polygonum densiflorum					2			0.2	0.41
Polygonum punctatum	16	22	7	3	4	4	18	10.6	18.17
Rubus sp.	2							0.2	0.41
Sacciolepis striata			2	5		2		2.7	4.66
Sambucus canadensis				2				0.2	0.41
Salix caroliniana							3	0.5	0.82
Typha domingensis		7			43	80	52	26.0	44.76
Total	**28**	**47**	**20**	**34**	**89**	**93**	**96**	**58.2**	**100.00**
October 2001 - Baseline									
Ampelopsis arborea	15			3				2.7	6.78
Aster carolinianus			30	20	8			8.4	21.31

Table 7 — *Continued*

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
Boehmeria cyclindrica	<1	1	5					0.9	2.18
Eupatorium sp.		<1						0.1	0.12
Lemna sp.							<1	0.1	0.12
Ludwigia peruviana	12							1.7	4.24
Mikania scandens	2	15	15	7	33	23	7	14.5	36.92
Polygonum punctatum	23	13	<1	1	2	<1	11	7.2	18.40
Salix caroliniana		3	5	6	2	3		2.9	7.38
Typha domingensis					<1	2	5	1	2.54
Total	**53**	**32**	**56**	**38**	**46**	**28**	**23**	**39.3**	**100.00**
December 2002 - Year 1									
Ampelopsis arborea				1				0.1	1.24
Aster carolinianus	17		18	3	1	1		5.6	48.96
Green algae		<1						0.0	0.41
Lemna sp.	1	1	1	1	1	<1	<1	0.8	6.64
Ludwigia peruviana	2		<1					0.3	2.49
Mikania scandens	1	3	10	5	5	1	2	3.7	32.37
Polygonum punctatum			1	<1				0.2	1.66
Sacciolepis striata			<1			1		0.1	1.24
Salix caroliniana	<1							0.0	0.41
Typha domingensis						2	2	0.5	4.56
Total	**21**	**5**	**30**	**11**	**6**	**5**	**4**	**11.5**	**100.00**
March 2003 - Year 1									
Algal mat					<1	1	3	0.5	1.49
Aster carolinianus	13		20	1	<1			5.0	14.21
Lemna sp.	5	7	11	9	8	4	1	6.5	18.34
Ludwigia peruviana	<1							0.02	0.07
Mikania scandens	2	2	16	3	3	1	1	4.0	12.62
Polygonum punctatum		1		<1				0.1	0.45
Sacciolepis striata			<1					0.05	0.15
Typha domingensis						3	4	1.0	3.29
Utricularia purpurea	12	14	17	23	17	4	3	12.8	40.03
Wolfia			<1	<1	<1	<1	1	0.3	1.05
Wolfiella	1	1	2	1	4	1	1	1.5	4.78
Total	**33**	**26**	**68**	**35**	**33**	**9**	**10**	**31.9**	**100.00**
December 2003 - Year 2									
Lemna sp.	28	40	19	32	32	20	12	26.1	66.79
Ludwigia peruviana	2			<1				0.3	0.73
Polygonum sp.		<1	1	<1				0.2	0.49

Table 7 — *Continued*

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
Sacciolepis striata					<1			0.1	0.12
Typha domingensis	2				1	31	37	10.0	25.46
Utricularia purpurea				<1				0.1	0.12
Wolfiella sp.	4	3	2	6	1	1	1	2.5	6.33
Total	**36**	**43**	**22**	**38**	**34**	**52**	**49**	**39.1**	**100.00**
April 2004 - Year 2									
Aster carolinianus	1		1	<1	1			0.4	1.49
Cephalanthus occidentalis	<1							0.1	0.19
Lemna sp.	20	39	23	14	10	7	3	16.6	64.87
Ludwigia peruviana		<1						0.1	0.19
Mikania scandens	1	1	2	1	2	1	<1	1.2	4.65
Polygonum sp.	<1	<1	1	<1				0.2	0.93
Salix caroliniana	1	1	<1		<1	<1		0.3	1.30
Typha domingensis						7	32	5.5	21.38
Wolfiella sp.	1	2	2	1	1	1	1	1.3	5.02
Total	**23**	**44**	**29**	**17**	**14**	**16**	**36**	**25.6**	**100.00**
October 2004 - Year 3									
Transects Inaccessible Due To High Water									
April 2005 - Year 3									
Ampelopsis arborea				3	**Transects Inaccessible Due To High Water**			0.7	0.86
Aster carolinianus	<1		<1	<1				0.3	0.32
Azolla caroliniana	<1	<1						0.2	0.22
Lemna sp.	65	67	68	83				70.7	91.68
Limnobium spongia	<1							0.1	0.11
Ludwigia peruviana	1							0.3	0.43
Polygonum sp.		<1						0.1	0.11
Salvinia minima	<1		<1					0.2	0.22
Typha domingensis	2							0.4	0.54
Wolfiella sp.	4	6	4	4				4.3	5.51
Total	**73**	**73**	**73**	**89**				**77.1**	**100.00**
January 2006 - Year 4									
Lemna sp.	90	63	63	90	63	37	37	63.3	65.07
Salvinia minima	1	1	1	1	1	1	1	1.0	1.03
Typha domingensis		25	25		25	50	50	25.0	25.68
Wolfia sp.	4	4	4	4	4	4	4	4.0	4.11
Wolfiella sp.	4	4	4	4	4	4	4	4.0	4.11
Total	**99**	**97**	**97**	**99**	**97**	**96**	**96**	**97.3**	**100.00**

Table 7 — *Continued*

Species	Percent Cover							Cover	
	1	2	3	4	5	6	7	Percent	Relative
March 2006 - Year 4									
Lemna sp.	70	32	57	82	95	52	20	58.1	66.74
Ludwigia peruviana	11							1.6	1.81
Mikania scandens				<1		<1		0.2	0.22
Salvinia minima	2	1						0.4	0.44
Typha domingensis	3	8		2	20	67	67	23.8	27.35
Wolfia sp.	1	1	1	1	1	1	1	1.0	1.15
Wolfiella sp.	2	2	2	2	2	2	2	2.0	2.30
Total	**89**	**44**	**60**	**87**	**118**	**122**	**90**	**87.1**	**100.00**
October 2006 - Year 5									
Ampelopsis arborea	<1							0.1	0.05
Eupatorium capillifolium	1							0.2	0.21
Lemna sp.	2	27	33	45	38	42	47	33.3	37.39
Ludwigia peruviana	3	<1						0.5	0.53
Mikania scandens	1	1	1	1	<1			0.6	0.64
Polygonum punctatum		1	3					0.6	0.64
Salvinia minima	35	22	33	45	32	37	20	32.0	35.84
Typha domingensis		2			2	55	90	21.2	23.77
Utricularia purpea					<1			0.1	0.05
Wolfiella sp.		<1	1	1	1	1	1	0.8	0.85
Total	**42**	**52**	**72**	**92**	**73**	**134**	**158**	**89.1**	**100**
March 2007 - Year 5									
Acer rubrum	<1			<1				0.1	0.40
Ampelopsis arborea	<1							0.1	0.20
Aster carolinianus	1		1	1				0.3	1.41
Baccharis halimifolia		<1						0.1	0.20
Eupatorium capillifolium	1	1						0.2	1.01
Ipomoea sp.	<1							0.1	0.20
Lemna sp.		3						0.4	1.61
Ludwigia peruviana	1							0.2	0.81
Mikania scandens	1	2	3	2	1	<1		1.3	5.44
Parietaria floridana	<1	3						0.5	2.22
Polygonum punctatum	<1	10	10		2			3.2	13.51
Salvinia minima	1	3						0.5	2.22
Toxicodendron radicans	<1							0.1	0.20
Typha domingensis		1		1	4	55	55	16. 7	70.56
Total	**7**	**23**	**14**	**4**	**7**	**55**	**55**	**23.6**	**100.00**

Belt Transects (1-meter wide) Target Species. The species composition along the three 1-meter wide belt transects was not diverse enough to meet the nine species goal in September 1999. Rather, three obligate, two facultative, and one upland species in the herbaceous stratum were found along the transects.

The occurrence of the six target species along the belt transect was recorded as the linear distance covered by a species within five equidistant intervals along the belt. Presence / absence information for each sampling event is provided in Table 8.

Table 8. Presence of indicator herbaceous species along belt transect

Species Name	Baseline Period		Operational Period									
	Sep 99	Oct 01	Dec 02	Mar 03	Dec 03	Apr 04	Oct 04	Apr 05	Jan 06	Mar 06	Oct 06	Mar 07
Obligate (OBL)												
Polygonum punctatum	X	X	X	X	X	X		X			X	X
Sacciolepis striata	X		X	X	X							
Typha domingensis	X	X	X	X	X	X	*	X	X	X	X	X
Facultative (FAC)												
Eupatorium capillifolium	X	X				X	*				X	X
Rubus sp.	X						*					
Upland (UPL)												
Ampelopsis arborea	X	X	X	X	X	X	*	X			X	X

* Transects inaccessible due to high water. Species identifiable above the water level.

The results of the belt transect observations during the baseline and operational periods are presented in Table 9. The percent cover of each target species found along the three belts was averaged. Details of Table 9 summaries are provided in Appendix B. During the baseline period, six target species were recorded. During Year 4 of operational monitoring, only one species, southern cattail, was observed within the wetland due to high water levels. During Year 5 of operational monitoring, four of the six target species were observed again, including the upland (UPL) species peppervine.

Data from the October 2004 event was unavailable due to high water levels from the 2004 hurricane season. During the April 2005 event, water levels were still high enough to prevent complete monitoring of the herbaceous transect; only the first 30 meters from the upland edge was investigated. High water also caused the delay of the October 2005 event; and the transects were accessed in January and March 2006.

Table 9. Summary of herbaceous groundcover belt transects for target species at Parkland Wetland, City of Titusville

Species	Indicator	Mean Linear Distance (3 transects) Belt Transect Zone					Mean Percent Cover		Mean Frequency		Importance Value
		A	B	C	D	E	Absolute	Relative	Absolute	Relative	
September 1999 – Baseline											
Ampelopsis arborea	UPL	1.23	0.17				2.88	1.82	0.20	5.66	3.74
Eupatorium capillifolium	FAC	4.54	6.87	5.37	2.73	2.67	45.52	28.83	0.80	22.64	25.73
Rubus sp.	FAC	0.94	0.10	0.40			2.95	1.87	0.20	5.66	3.76
Polygonum punctatum	OBL	4.90	6.10	5.20	4.37	4.04	50.55	32.01	1.00	28.30	30.16
Sacciolepis striata	OBL	1.17	1.10	2.53		1.30	12.54	7.94	0.47	13.21	10.57
Typha domingensis	OBL	2.47	0.13	5.17	5.90	7.50	43.48	27.53	0.87	24.53	26.03
Total		15.25	14.47	18.67	13.01	15.51	157.92	100.00	3.53	100.00	100.00
Indicator Summary											
UPL		1.23	0.17				2.88	1.82	0.20	5.66	3.74
FAC		5.47	6.97	5.77	2.73	2.67	48.47	30.70	1.00	28.30	29.50
OBL		8.55	7.33	12.90	10.27	12.84	106.56	67.48	2.33	66.04	66.76
Total		**15.25**	**14.47**	**18.67**	**13.01**	**15.51**	**157.92**	**100.00**	**3.53**	**100.00**	**100.00**
October 2001 – Baseline											
Ampelopsis arborea	UPL	1.59	0.92	0.32			5.80	13.74	0.27	12.90	13.32
Eupatorium capillifolium	FAC	0.47			0.01		0.99	2.34	0.13	6.45	4.39
Rubus sp.	FAC	0.22					0.44	1.05	0.07	3.23	2.14
Polygonum punctatum	OBL	3.35	2.87	0.48	1.44	3.00	22.89	54.24	0.87	41.94	48.09
Sacciolepis striata	OBL			0.18			0.37	0.88	0.13	6.45	3.66
Typha domingensis	OBL	0.44	0.15	0.11	2.85	2.16	11.71	27.75	0.60	29.03	28.39
Total		6.07	3.94	1.09	4.30	5.16	42.20	100.00	2.07	100.00	100.00
Indicator Summary											
UPL		1.59	0.92	0.32			5.80	13.74	0.27	12.90	13.32
FAC		0.69			0.01	0.00	1.43	3.39	0.20	9.68	6.53
OBL		3.79	3.02	0.77	4.29	5.16	34.97	82.87	1.60	77.42	80.15
Total		**6.07**	**3.94**	**1.09**	**4.30**	**5.16**	**42.20**	**100.00**	**2.07**	**100.00**	**100.00**

Table 9 — *Continued*

Species	Indicator	Mean Linear Distance (3 transects) Belt Transect Zone A	B	C	D	E	Percent Cover Absolute	Percent Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
December 2002 – Year 1											
Ampelopsis arborea	UPL	2.22					4.57	33.40	0.20	23.08	28.24
Polygonum punctatum	OBL		0.24	0.30		0.08	1.27	9.31	0.40	46.15	27.73
Sacciolepis striata	OBL		0.17		0.19		0.75	5.46	0.13	15.38	10.42
Typha domingensis	OBL					3.45	7.08	51.83	0.13	15.38	33.61
Total		2.22	0.42	0.30	0.19	3.53	13.67	100.00	0.87	100.00	100.00
Indicator Summary											
UPL		2.22					4.57	33.40	0.20	23.08	28.24
FAC							0.00	0.00	0.00	0.00	0.00
OBL			0.42	0.30	0.19	3.53	9.10	66.60	0.67	76.92	71.76
Total		**2.22**	**0.42**	**0.30**	**0.19**	**3.53**	**13.67**	**100.00**	**0.87**	**100.00**	**100.00**
March 2003 – Year 1											
Ampelopsis arborea	UPL	2.26		0.05			4.74	28.92	0.20	23.08	26.00
Polygonum punctatum	OBL	0.47	0.47	1.30	0.08		4.76	29.01	0.40	46.15	37.58
Sacciolepis striata	OBL		0.03			0.20	0.47	2.84	0.13	15.38	9.11
Typha domingensis	OBL				0.60	2.53	6.43	39.23	0.13	15.38	27.31
Total		2.73	0.49	1.35	0.68	2.73	16.40	100.00	0.87	100.00	100.00
Indicator Summary											
UPL		2.26		0.05			4.74	28.92	0.20	23.08	26.00
FAC							0.00	0.00	0.00	0.00	0.00
OBL		0.47	0.49	1.30	0.68	2.73	11.66	71.08	0.67	76.92	74.00
Total		**2.73**	**0.49**	**1.35**	**0.68**	**2.73**	**16.40**	**100.00**	**0.87**	**100.00**	**100.00**

Table 9 — *Continued*

Species	Indicator	Mean Linear Distance (3 transects) Belt Transect Zone					Percent Cover		Frequency		Importance Value
		A	B	C	D	E	Absolute	Relative	Absolute	Relative	
October 2003 – Year 2											
Ampelopsis arborea	UPL	0.28					0.57	4.02	0.13	9.52	6.77
Polygonum punctatum	OBL	1.02	0.58	0.29	0.45	0.14	5.10	35.63	0.87	61.90	48.77
Sacciolepis striata	OBL				0.44	0.40	1.72	12.05	0.13	9.52	10.79
Typha domingensis	OBL	0.07			0.37	2.93	6.91	48.30	0.27	19.05	33.67
Total		1.37	0.58	0.29	1.26	3.47	14.31	100.00	1.40	100.00	100.00
Indicator Summary											
UPL		0.28					0.57	4.02	0.13	9.52	6.77
FAC								0.00		0.00	0.00
OBL		1.09	0.58	0.29	1.26	3.47	13.74	95.98	1.27	90.48	93.23
Total		**1.37**	**0.58**	**0.29**	**1.26**	**3.47**	**14.31**	**100.00**	**1.40**	**100.00**	**100.00**
April 2004 – Year 2											
Ampelopsis arborea	UPL	0.47				0.67	2.33	24.75	0.13	14.29	19.52
Eupatorium capillifolium	FAC	0.02					0.03	0.36	0.07	7.14	3.75
Polygonum punctatum	OBL	0.84	0.53	0.42	0.25	0.38	4.98	52.76	0.60	64.29	58.52
Typha domingensis	OBL				0.15	0.87	2.09	22.13	0.13	14.29	18.21
Total		1.33	0.53	0.42	0.40	1.92	9.43	100.00	0.93	100.00	100.00
Indicator Summary											
UPL		0.47				0.67	2.33	24.75	0.13	14.29	19.52
FAC		0.02					0.03	0.36	0.07	7.14	3.75
OBL		0.84	0.53	0.42	0.40	1.25	7.06	74.89	0.73	78.57	76.73
Total		**1.33**	**0.53**	**0.42**	**0.40**	**1.92**	**9.43**	**100.00**	**0.93**	**100.00**	**100.00**
October 2004 – Year 3											
Transects Inaccessible Due To High Water											

Table 9 — *Continued*

Species	Indicator	Mean Linear Distance (3 transects)					Percent Cover		Frequency		Importance Value
		Belt Transect Zone									
		A	B	C	D	E	Absolute	Relative	Absolute	Relative	
April 2005 – Year 3											
Ampelopsis arborea	UPL	0.71		0.50	**Transects Inaccessible Due To High Water**		4.02	38.84	0.33	30.00	34.42
Polygonum punctatum	OBL	0.17	0.70	0.17			3.44	33.26	0.33	30.00	31.63
Typha domingensis	OBL	0.67	0.15	0.05			2.89	27.90	0.44	40.00	33.95
Total		1.54	0.85	0.72			10.36	100.00	1.11	100.00	100.00
Indicator Summary											
UPL		0.71		0.50	**Transects Inaccessible Due To High Water**		4.02	38.84	0.33	30.00	34.42
FAC							0.00	0.00	0.00	0.00	0.00
OBL		0.83	0.85	0.22			6.33	61.16	0.78	70.00	65.58
Total		**1.54**	**0.85**	**0.72**			**10.36**	**100.00**	**1.11**	**100.00**	**100.00**
January 2006 – Year 4											
Typha domingensis	OBL	3.33	3.67		6.67	6.67	41.75	100.00	0.47	100.00	100.00
Total		3.33	3.67		6.67	6.67	41.75	100.00	0.47	100.00	100.00
Indicator Summary											
UPL								0.00		0.00	0.00
FAC								0.00		0.00	0.00
OBL		3.33	3.67		6.67	6.67	41.75	100.00	0.47	100.00	100.00
Total		**3.33**	**3.67**	**0.00**	**6.67**	**6.67**	**41.75**	**100.00**	**0.47**	**100.00**	**100.00**
March 2006 – Year 4											
Typha domingensis	OBL	1.67	1.67	0.10	5.67	8.33	35.80	100.00	0.53	100.00	100.00
Total		1.67	1.67	0.10	5.67	8.33	35.80	100.00	0.53	100.00	100.00
Indicator Summary											
UPL								0.00		0.00	0.00
FAC								0.00		0.00	0.00
OBL		1.67	1.67	0.10	5.67	8.33	35.80	100.00	0.53	100.00	100.00
Total		**1.67**	**1.67**	**0.10**	**5.67**	**8.33**	**35.80**	**100.00**	**0.53**	**100.00**	**100.00**

Table 9 — *Continued*

Species	Indicator	Mean Linear Distance (3 transects) Belt Transect Zone					Percent Cover		Frequency		Importance Value
		A	B	C	D	E	Absolute	Relative	Absolute	Relative	
October 2006 – Year 5											
Ampelopsis arborea	UPL	0.04					0.08	0.19	0.07	7.14	3.67
Eupatorium capillifolium	FAC	0.07					0.14	0.32	0.07	7.14	3.73
Polygonum punctatum	OBL		0.20	0.48	0.15		1.71	4.05	0.20	21.43	12.74
Typha domingensis	OBL	0.57	0.05	2.37	6.67	10.00	40.36	95.44	0.60	64.29	79.86
Total		0.68	0.25	2.85	6.82	10.00	42.29	100.00	0.93	100.00	100.00
Indicator Summary											
UPL		0.04					0.08	0.19	0.07	7.14	3.67
FAC		0.07					0.14	0.32	0.07	7.14	3.73
OBL		0.57	0.25	2.85	6.82	10.00	42.07	99.48	0.80	85.71	92.60
Total		**0.68**	**0.25**	**2.85**	**6.82**	**10.00**	**42.29**	**100.00**	**0.93**	**100.00**	**100.00**
March 2007 – Year 5											
Ampelopsis arborea	UPL	0.11					0.23	0.49	0.07	5.56	3.02
Eupatorium capillifolium	FAC	1.05					2.16	4.52	0.13	11.11	7.81
Polygonum punctatum	OBL	1.72	1.88	0.26	0.27		8.49	17.73	0.33	27.78	22.76
Typha domingensis	OBL		0.26	2.11	6.48	9.17	37.01	77.26	0.67	55.56	66.41
Total		2.88	2.15	2.38	6.75	9.17	47.90	100.00	1.20	100.00	100.00
Indicator Summary											
UPL		0.11					0.23	0.49	0.07	5.56	3.02
FAC		1.05					2.16	4.52	0.13	11.11	7.81
OBL		1.72	2.15	2.38	6.75	9.17	45.50	95.00	1.00	83.33	89.17
Total		**2.88**	**2.15**	**2.38**	**6.75**	**9.17**	**47.90**	**100.00**	**1.20**	**100.00**	**100.00**

[1]Three transects were averaged for a total length of 48.7 meters.

The only UPL target plant peppervine (*Ampelopsis arborea)* has shown some increase in importance value until Year 4 of operational monitoring when it was notably absent. Peppervine returned during Year 5of operational monitoring although with minimal percent cover. The relationship of peppervine to increased water levels is unclear since it is a vine and occurs in the wetland canopy.

Facultative (FAC) species that were recorded during the baseline period were rarely recorded along the belt transects during the operational period until Year 5 when FAC species were observed at low percent cover. During Year 5 of operational monitoring, dogfennel (*Eupatorium capillifolium*) (FAC) was recorded near the upland end of the monitoring transect where water levels had receded below the ground surface permitting seedlings to successfully germinate. During the baseline period, FAC species were dominated by dogfennel.

Obligate (OBL) wetland species dominated the herbaceous layer for the entire study period and their importance values increased as water levels increased. Obligate species occurred more often and over a greater linear distance than other target species during both baseline events. During the September 1999 and October 2001 baseline monitoring events, dotted smartweed reported the greatest importance value (30.16 and 48.09, respectively). Southern cattail reported the second most importance value in the baseline period (26.03 in September 1999 and 28.39 in October 2001).

During the operational period, for all transects combined, southern cattail occurred for the greatest total linear distance followed by dotted smartweed. Cattail exhibited its greatest importance value (100.00) in the January 2006 and March 2006 events, because it was the only target species observed. Increases in cattail percent cover were greatest near the wetland end of the transects where the species is establishing a near monotypic stand.

Dotted smartweed exhibited its greatest importance value (58.52) of the 60-month operational period in April 2004 occurring in each of the 5 zones along the transect. Dotted smartweed was also the most frequently occurring target species from the baseline period through April 2004 monitoring event; subsequently, cattail was the most frequently occurring target species.

Shrubs/Sapling Community

For the purpose of data analysis and discussion, the canopy species were subdivided into three size classes:

- Shrub/sapling <2.5 centimeters dbh and > 0.3 meter tall
- Subcanopy ≥2.5 centimeters to < 10.0 centimeters dbh
- Canopy ≥10.0 centimeters dbh

Shrub/sapling sampling is conducted annually in conjunction with canopy/subcanopy sampling. Data were collected twice during the baseline period (September 1999 and October 2001) and four times during the operational period (December 2002, December 2003, January 2006, and October 2006). No data was obtained for the shrub and sapling community from the October 2004 event due to high water levels from the 2004 hurricane season. Deep water covered all of the transect and meter-square plots making monitoring unsafe and ineffective.

25-Square-Meter Shrub/Sapling Plots. Two shrub species, Carolina willow and buttonbush (*Cephalanthus occidentalis*), were identified in the 25-square-meter shrub plots during the baseline-monitoring event. Percent cover of Carolina willow was highest near the upland edge (plot SA) and lower within the other plots (Table 10).

Carolina willow dominated the shrub plots during the first 12 months of the operational period (December 2002). Percent cover of Carolina willow dropped to zero during the December of 2003 event and only buttonbush was recorded within plot B (2%). During the January 2006 event, Carolina willow was again absent from the shrub plots; and buttonbush was again the only species recorded within plot B (4%) however it was observed in other locations outside the shrub plots. Percent cover of Carolina willow may have been suppressed due to longer periods of deeper standing water during the operational period compared to the baseline period, preventing new saplings from germinating.

During the October 2006 event, four shrub species were recorded within plots A and B. Shrub total percent cover was low and two species recorded, Chinese tallow (*Sapium sebiferum*) and Brazilian pepper (*Schinus terebinthifolius*), are considered invasive exotic species.

Table 10. Shrub/sapling 25-square-meter plot at the Parkland Wetland

Shrub Plot 5m x 5m	Scientific Name	Percent Cover	Total
September 1999 - Baseline			
SA	*Salix caroliniana*	69	
	Cephalanthus occidentalis	1	
Plot Total			**70**
SB	*Salix caroliniana*	4	
	Cephalanthus occidentalis	1	
Plot Total			**5**
SC	*Salix caroliniana*	5	**5**
October 2001 - Baseline			
SA	*Salix caroliniana*	40	
	Cephalanthus occidentalis	2	
Plot Total			**42**
SB	*Salix caroliniana*	30	
	Cephalanthus occidentalis	3	
Plot Total			**33**
SC	*Salix caroliniana*	10	**10**
December 2002 – Year 1			
SA	*Salix caroliniana*	2	**2**
SB	*Salix caroliniana*	10	**10**
SC	*Salix caroliniana*	8	**8**
December 2003 – Year 2			
SA		0	**0**
SB	*Cephalanthus occidentalis*	2	**2**
SC		0	**0**
October 2004 – Year 3			
Transects Inaccessible Due To High Water			
January 2006 – Year 4			
SA		0	**0**
SB	*Cephalanthus occidentalis*	4	**4**
SC		0	**0**
October 2006 – Year 5			
SA	*Acer rubrum*	1	
	Salix caroliniana	4	
	Sapium sebiferum	1	
	Schinus terebinthifolius	1	
Plot Total			**7**
SB	*Cephalanthus occidentalis*	16	**16**
SC		0	**0**

Line Intercept Analysis. Carolina willow was the only shrub species identified along the 50-meter line-intercept transect during the baseline period. Both Carolina willow and buttonbush were recorded during the operational monitoring events (Table 11). However, Carolina willow has been noticeably absent from the shrub line intercept transect since the December 2003 monitoring event. Carolina willow occurred most frequently (1.00) and over the greatest linear distance (26.50 meters) during the October 2001 baseline monitoring event. The October 2001 event occurred after a prolonged period of low water elevations during the summer growing season. Low water conditions allowed Carolina willow to produce new growth of branches at lower points on the trunk, which resulted in greater percent cover.

During most of the operational monitoring, when average monthly water levels where higher, the total linear distance covered by Carolina willow was low (3.68 meters, December 2002) and dropped to zero (December 2003). Carolina willow was recorded again during Year 5 of operational monitoring at a moderate total linear distance (12.81 meters). During most of the operational events, lower branches of the Carolina willow were covered by standing water and not included as part of the total shrub linear distance. The percent cover of shrub species during the operational period has been reduced compared to values observed during the baseline years of 8.91 meters (1999) and 26.50 meters (2001). Buttonbush was recorded during December of 2003 but at a very low frequency (0.20) and low total linear distance (1.33 meters). Buttonbush was again the only shrub species recorded in January 2006 after monitoring was suspended due to high water during the October 2004 event. Buttonbush was absent from the shrub line intercept during Year 5 of operational monitoring.

Table 11. Summary of shrub/sapling line intercept transect at the Parkland Wetland

		Linear Distance (10 meter Interval, total transect 50 meters)										
Fall	**Species**	**A**	**B**	**C**	**D**	**E**	**Total Distance**	**Percent Cover**	**Relative Cover**	**Absolute Frequency**	**Relative Frequency**	**Importance Value**
1999	*Salix caroliniana*	2.50	3.80	0.01		2.60	8.91	17.82	100.00	0.80	100.00	100.00
2001	*Salix caroliniana*	8.65	3.15	4.85	7.10	2.75	26.50	53.00	100.00	1.00	100.00	100.00
2002	*Salix caroliniana*	2.33	0.90	0.15	0.30		3.68	7.36	100.00	0.80	100.00	100.00
2003	*Cephalanthus occidentalis*					1.33	1.33	2.66	100.00	0.20	100.00	100.00
2004	**Transects Inaccessible Due To High Water**											
2005	*Cephalanthus occidentalis*					1.69	1.69	3.38	100.00	0.20	100.00	100.00
2006	*Salix caroliniana*	3.00	0.20	2.80	6.10	0.71	12.81	25.62	100.00	1.00	100.00	100.00

Each Interval is approximately 10 meters. “A” is at the upland end and “E” is at the deep end of the transect.

Canopy/Subcanopy

The Canopy / Subcanopy stratum was sampled twice in the fall during the baseline period (September 1999 and October 2001) and three times in the fall during the operational period (December 2002, December 2003, and December 2006). No data was collected from the canopy / subcanopy strata during the fall of 2004 and 2005 monitoring events due to high water levels from the previous two hurricane seasons. Tree tags remained below the surface of the water and monitoring during that time deemed ineffective.

A total of 102 trees were tagged during the initial plot setup in September 1999 (Table 12). All of the trees tagged were subcanopy-sized trees (less than 10 centimeters dbh). All of the specimens were Carolina willow; thus, relative dominance, relative density, relative frequency, and importance values are given a value of 100. The basal area of the subcanopy trees (or dominance) was 6.43 square meters per hectare (28.0 square feet per acre). The density was 4,080 individuals per hectare (1,651.1 per acre).

Table 12. Importance values for canopy and subcanopy at Parkland Wetland

Sampling Event	No.	Dominance		Density		Frequency		Importance Value
		(m^2/ha)	Relative	(#/ha)	Relative	Absolute	Relative	
Subcanopy	All species ***Salix caroliniana***							
Sep 1999 – Baseline	102	6.43	100.00	4080.00	100.00	1.00	100.00	100.00
Oct 2001 – Baseline	105	9.60	100.00	4200.00	100.00	1.00	100.00	100.00
Dec 2002 - Year 1	87	10.27	100.00	3480.00	100.00	1.00	100.00	100.00
Dec 2003 - Year 2	66	7.86	100.00	2640.00	100.00	1.00	100.00	100.00
Oct 2004 - Year 3	Transects Inaccessible Due To High Water							
Oct 2005 - Year 4	Tree Tags Below Water							
Dec 2006 - Year 5	79	8.30	100.00	3160.00	100.00	1.00	100.00	100.00
Canopy	All species ***Salix caroliniana***							
Sep 1999 – Baseline	0	All specimens were less than 10 cm dbh						
Oct 2001 – Baseline	2	0.75	100.00	80.00	100.00	0.20	100.00	100.00
Dec 2002 - Year 1	8	3.27	100.00	320.00	100.00	0.80	100.00	100.00
Dec 2003 - Year 2	10	4.62	100.00	400.00	100.00	0.80	100.00	100.00
Oct 2004 - Year 3	Transects Inaccessible Due To High Water							
Oct 2005 - Year 4	Tree Tags Below Water							
Dec 2006 - Year 5	9	5.37	100.00	360.00	100.00	0.80	100.00	100.00

Note: Frequency given as a number of subquadrants in which the species occurs divided by the total number of subquadrants (5).

During October 2001 of the baseline period, 107 trees were identified within the tree plot, five more than in the previous event (September 1999). All of the specimens were Carolina willow. The canopy stratum (dbh greater than 10 centimeters) recruited two trees from the subcanopy stratum. The dominance of both the canopy and subcanopy trees increased from September 1999 to October 2001. The basal area dominance of the canopy-size trees was 0.75 square meter per hectare (3.3 square feet per acre) and density was 80 individuals per hectare (32.4 per acre). The frequency was 0.20, because both trees occurred in one of the subquadrants. The subcanopy stratum (dbh greater than, or equal to 2.5 centimeters) also recruited 21 new trees while losing 16 trees to mortality. The dominance of the subcanopy trees was 9.60 square meters per hectare (41.8 square feet per acre) and density was 4,200 individuals per hectare (1,699.7 per acre).

A total of 95 trees were measured during the December 2002 operational monitoring event, seven less than the maximum recorded (107) in October 2001. All of the specimens identified were Carolina willow. Dominance of both the canopy and subcanopy trees was greater than that recorded during the baseline events. The dominance of the canopy trees was 3.27 square meters per hectare (14.2 square feet per acre) and density was 320 individuals per hectare (129.5 per acre). Frequency was increased to 0.80 from the October 2001 (0.20) event because more canopy-size trees were identified in more subquadrants. The dominance of the subcanopy trees was 10.27 square meters per hectare (44.7 square feet per acre) and density was 3,480 individuals per hectare (1,408.3 per acre).

During the December 2003 operational monitoring event, 76 trees were identified within the tree plot, 29 less than in the maximum recorded in October 2001. All specimens identified were Carolina willow (Figure 13). The canopy stratum recruited 10 trees from the subcanopy stratum since the end of the baseline period. The dominance and density of the canopy trees increased compared to that recorded during the baseline events. Dominance of the canopy trees was 4.62 square meters per hectare (20.1 square feet per acre) and density was 400 individuals per hectare (161.9 per acre). Frequency increased to 0.60 from the October 2001 (0.20) event because more canopy-size trees were identified in more subquadrants.

The subcanopy stratum lost a total 36 trees to mortality and to canopy recruitment since the end of the baseline period. The dominance of the subcanopy trees was 7.86 square meters per hectare (34.2 square feet per acre) and density was 2,640 individuals per hectare (1,068.4 per acre).

Figure 13. Photograph taken in December 2003, shows tagged trees (Carolina willow, *Salix caroliniana*) monitored in the Parkland Wetland

The death of subcanopy-size trees or in most cases subcanopy-size branches, along with and the recruitment into the canopy stratum reduced the dominance and density of trees within the tree plot when compared to the baseline period observations.

During the October 2006 operational monitoring event when water levels had receded enough for tree monitoring to resume, 88 trees (all Carolina willow) were identified within the tree plot. The total number of trees was slightly greater (12 more) than that recorded 2 years prior, but 19 less than the maximum recorded in October 2001. The canopy stratum recruited a net nine trees from the subcanopy stratum since the end of the baseline period through the end of the operational period. The dominance and density of the canopy trees increased compared to that recorded during the baseline events. Dominance of the canopy trees was 5.37 square meters per hectare (23.4 square feet per acre) and density was 360 individuals per hectare (145.7 per acre). Frequency of canopy-size trees was similar to previous events. The subcanopy stratum lost a net of 26 trees to mortality and to canopy recruitment since the end of the baseline period. The dominance of the subcanopy trees was 8.30 square meters per hectare (36.2 square feet per acre) and density was 3,160 individuals per hectare (1,279.4 per acre). Details for individual tree dbh measurements are included in Appendix B.

ANIMALS

Benthic Macroinvertebrates

Samples were collected twice during the baseline period and nine times during the operational period. Benthic samples were analyzed to the nearest taxon possible (usually Genus) by Pennington & Associates, Inc. Densities and taxa richness during the operational period were similar to data collected during the baseline period. Benthic macroinvertebrate laboratory results are presented in Appendix C.

Habitat types at the Parkland Wetland Transect are moderately diverse and include woody snags, emergent vegetation, and a thick layer of detritus. Most of the identified benthic taxa were of the larvae of the family Chironomidae (midges), classified as highly tolerant of low dissolved oxygen concentrations and low pH values common to southeastern swamps with colored water and low or at times no flow conditions. Midge larvae typically favor organic soils and detritus packs and are important food sources for other invertebrates and fish. Other significant contributing taxa included members of Oligochaeta (worms), Ostracods (seed shrimp), and Gastropods (snails).

A total of 1,494 individuals were collected during November 1999, representing 15 taxa. The most abundant taxon represented was a small crustacean, the Ostracoda or "mussel or seed shrimp," with 770 individuals comprising 52% of the total. The second most abundant group was the insect class with 574 individuals (or 38% of the total). Of this insect group, the majority (367) were midges (*Chironomus*) (sometimes called blind mosquitoes). The midges comprised 25% of the total benthic organisms collected.

A total of 1,061 individuals were collected during March 2000, representing 31 taxa. The most abundant taxon represented was the freshwater snail species *Physella* with 201 individuals comprising 19% of the total. The second most abundant taxon was the *Chironomus* species with 185 individuals (or 17% of the total). The family Chironomidae comprised 45% of the total benthic organisms and 10 out of the 31 taxons collected.

A total of 802 individuals were collected in December 2002, representing 20 taxa. The most abundant taxon was represented by the genus *Dero sp.* (36%, 290 individuals). *Dero sp.* is a member of the Naididae Family (Oligochaetes) of the Order Haplotaxida (earthworms) and is usually

indicative of high organic enrichment. Other taxa identified included other Naididae species and many species within the Order Diptera (true flies).
A total of 1,282 individuals were collected in March 2003, (Figure 14) representing 16 taxa. The most abundant taxon was represented by the genus *Chironomus sp.* (38%, 490 individuals). Families in this taxonomic family are considered an indicator of poor water quality, as these macroinvertebrates have a high tolerance for degraded water quality. Dipterans constituted 8 out of the 16 benthic macroinvertebrate taxa collected. The second most abundant taxon was *Dero sp.*

A total of 197 individuals were collected in October 2003, representing 18 taxa. The most abundant taxon was represented by the genus *Chironomus sp.* (22%, 42 individuals). Dipterans constituted 10 out of the 18 benthic macroinvertebrate taxa collected. The second most abundant taxon was *Tanytarsus sp.*

A total of 4,932 individuals were collected in April 2004, representing 26 taxa. The most abundant taxon was represented by the genus *Chironomus sp.* (59%, 2,900 individuals). Dipterans constituted 10 out of the 26 benthic macroinvertebrate taxa collected. The second most abundant taxon was *Tanytarsus sp.* One species within the order Ephemeroptera, *Centroptilum sp.* was collected but were low in density (0.2%, 10 individuals). The April 2004 sampling event was the first time a species from the order Ephemeroptera was collected.

Figure 14. Photograph of sampling for benthic macro-invertebrates in March 2003 in the Parkland Wetland

A total of 2,522 individuals were collected in October 2004, representing 16 taxa. The most abundant taxon was represented by the genus *Polypedilum illinoense* (52%, 1,320 individuals) followed by *Tanytarsus sp.* (12%, 290 individuals). The October 2004 event was dominated by benthic invertebrates from the order Diptera (92%, 2,330 individuals) with only a few representatives from the orders Oligochaeta, Odonata, Hemiptera, and Coleoptera. During this event, only the first few meters from the upland edge of the wetland were swept for benthic samples due to high water from the 2004 hurricane season. The dense stand of cattail at the wetland end of the monitoring transects could not be sampled. Emergent vegetation is a substrate type that has been consistently sampled at the Parkland Wetland during the study period. The absence of this substrate type from the benthic sweeps may be responsible for the absence of some species from the sample.

A total of 59 individuals were collected in April 2005, representing 10 taxa. The April 2005 event represented the lowest number of benthic organisms collected during both the baseline and the operational periods. The most abundant taxon was represented by the genus *Pseudochironomus sp.* (53%, 31 individuals). High water again prevented the entire monitoring transect from being sampled for benthic macroinvertebrates. Only the upland edge out to about 30 meters was accessible.

A total of 174 individuals were collected in October 2005, representing 11 taxa. The most abundant taxon was represented by the genus *Tanytarsus sp.* (39%, 67 individuals) followed by the genus *Polypedilum illinoense* (37%, 64 individuals). High water again prevented the entire monitoring transect from being sampled for benthic macroinvertebrates. Only the upland edge out to about 30 meters was accessible.

A total of 1,666 individuals were collected in March 2006, representing 17 taxa. The most abundant taxa were represented by the genus *Tanytarsus sp.* (35%, 580 individuals) and by the genus *Polypedilum illinoense* (35%, 580 individuals). During the March 2006 event, water levels had receded enough to allow sampling of benthic macroinvertebrates from the entire transect length.

A total of 276 individuals were collected in October 2006, representing 18 taxa. The most abundant taxa were represented by the genus *Polypedilum illinoense* (29%, 80 individuals) and by the genus *Tanytarsus sp.* (16%, 42 individuals). While total number of individual macroinvertebrates varied greatly during both the baseline and operational periods, the total numbers of taxa represented were more consistent. Specific taxa present within the Parkland wetland were consistent over the entire study period.

Fish

The fish community was sampled once along the main transect during the baseline period and five times during the operational period. During the baseline events, approximately 50 specimens of mosquito fish (*Gambusia affinis*) were collected with five tosses of the Wegener Ring. The fish survey data is presented in Table 13.

No fish were collected during the December 2002 sampling event. Fish were later observed at the Parkland Wetland during the March 2003 event but not collected according to the sampling schedule. The fish observed were the common wetland species mosquito fish, and were consistent with those recorded during baseline monitoring.

During the October 2003 sampling event, 122 fish specimens were collected from three species. Average fish density was greater (26.0 individuals per square meter) compared to the baseline event (10.7 individuals per square meter). Species collected included mosquito fish, least killifish (*Heterandria formosa),* and sailfin molly (*Poecilia latipinna).* Least killifish occurred in the greatest average densities (16.6 individuals per square meter) follow by mosquito fish (9.2 individuals per square meter) and sailfin molly (0.2 individual per square meter). All species collected are typical of those found in wetland environments.

During the October 2004 sampling event, 52 fish specimens were collected of one species, mosquito fish. Average fish density was similar (11.1 individuals per square meter) compared to the baseline event (10.7 individuals per square meter). During this event, only the first few meters from the upland edge of the wetland were sampled due to high water from the 2004 hurricane season. Some of the species previously recorded during the baseline and other operational events were likely present but missed since most of the wetland was inaccessible.

During the October 2005 sampling event, 103 fish specimens were collected of one species, mosquito fish. Average fish density was higher (21.9 individuals per square meter) compared to the baseline event (10.7 individuals per square meter). During this event, only the first few meters from the upland edge of the wetland were sampled due to high water from the 2005 hurricane season. Some of the species previously recorded during the baseline and other operational events were likely present but missed since most of the wetland was inaccessible.

Table 13. Summary of fish sampling data from the Parkland Wetland

		Depth		Fish				Dissolved Oxygen (mg/L)		Temperature (C)	
Time	Toss	meters	feet	Species Name	Common Name	Count	Density (#/m^2)	Surface	Bottom	Surface	Bottom
October 2001 – Baseline											
9:30	1	0.70	2.30	*Gambusia affinis*	Mosquito fish	31	33.0	0.85	0.70	20.9	20.8
11:05	2	0.61	2.00	*Gambusia affinis*	Mosquito fish	6	6.4	0.30	0.27	20.9	20.8
11:15	3	0.63	2.08	*Gambusia affinis*	Mosquito fish	1	1.1	0.31	0.24	20.9	20.9
11:25	4	0.56	1.84	*Gambusia affinis*	Mosquito fish	11	11.7	0.31	0.14	21.2	21.0
11:40	5	0.79	2.60	*Gambusia affinis*	Mosquito fish	1	1.1	0.75	0.50	21.4	21.3
Average		**0.66**	**2.16**			**10**	**10.7**	**0.50**	**0.37**	**21.1**	**21.0**
December 2002 – Year 1 No Fish Observed											
October 2003 – Year 2											
14:30	1	0.64	2.09	*Gambusia affinis*	Mosquito fish	8	8.5	1.12	0.18	25.4	25.0
14:40	2	0.59	1.95	*Gambusia affinis*	Mosquito fish	15	16.0	0.84	0.20	25.8	25.1
				Heterandria formosa	Least Killifish	24	25.5				
14:45	3	0.64	2.10	*Gambusia affinis*	Mosquito fish	7	7.5	0.40	0.11	25.8	25.1
				Heterandria formosa	Least Killifish	21	22.3				
14:55	4	0.66	2.15	*Gambusia affinis*	Mosquito fish	7	7.5	0.64	0.22	25.8	25.3
				Heterandria formosa	Least Killifish	15	16.0				
				Poecilia latipinna	Sailfin molly	1	1.1				
15:05	5	0.52	1.69	*Gambusia affinis*	Mosquito fish	6	6.4	0.85	0.27	25.5	25.0
				Heterandria formosa	Least Killifish	18	19.2				
Average	**0.61**	**2.00**				**24**	**26.0**	**0.77**	**0.20**	**25.7**	**25.1**

Table 13 — *Continued*

Time	Toss	Depth		Fish				Dissolved Oxygen (mg/L)		Temperature (C)	
		meters	feet	Species Name	Common Name	Count	Density (#/m^2)	Surface	Bottom	Surface	Bottom
October 2004 – Year 3											
10:30	1	0.78	2.57	*Gambusia affinis*	Mosquito fish	12	12.8	2.39	0.75	20.3	18.8
10:40	2	0.64	2.10	*Gambusia affinis*	Mosquito fish	3	3.2	2.02	0.69	20.8	19.1
10:50	3	0.59	1.95	*Gambusia affinis*	Mosquito fish	18	19.1	2.15	0.36	20.6	18.9
11:00	4	0.96	3.15	*Gambusia affinis*	Mosquito fish	10	10.6	2.91	0.71	19.9	18.9
11:10	5	0.93	3.04	*Gambusia affinis*	Mosquito fish	9	9.6	2.42	0.55	20.3	19.0
Average		**0.78**	**2.56**			**10**	**11.1**	**0.77**	**0.20**	**25.7**	**25.1**
October 2005 – Year 4											
10:12	1	0.42	1.38	*Gambusia affinis*	Mosquito fish	16	17.0	1.57	0.46	21.2	17.4
10:25	2	0.55	1.80	*Gambusia affinis*	Mosquito fish	25	26.6	1.03	0.33	21.4	16.9
10:45	3	0.55	1.80	*Gambusia affinis*	Mosquito fish	29	30.9	1.44	0.25	21.4	17.1
11:03	4	0.61	2.00	*Gambusia affinis*	Mosquito fish	17	18.1	1.50	0.61	21.7	17.3
11:27	5	0.82	2.69	*Gambusia affinis*	Mosquito fish	16	17.0	1.39	0.40	21.6	17.1
Average		**0.59**	**1.93**			**21**	**21.9**	**1.39**	**0.41**	**21.5**	**17.2**
October 2006 – Year 5											
13:30	1	0.39	1.28	*Gambusia affinis*	Mosquito fish	4	4.3	1.70	0.23	16.50	13.78
13:47	2	0.40	1.31	*Gambusia affinis*	Mosquito fish	11	11.7	1.92	0.59	16.60	13.68
14:02	3	0.67	2.20	*Gambusia affinis*	Mosquito fish	6	6.4	1.73	0.52	16.48	13.74
14:30	4	0.54	1.78	*Gambusia affinis*	Mosquito fish	2	2.1	1.88	0.45	16.54	13.69
14:44	5	0.68	2.23	*Gambusia affinis*	Mosquito fish	13	13.8	2.02	0.42	16.55	14.05
Average		**0.54**	**1.76**			**7**	**7.7**	**1.85**	**0.44**	**16.53**	**13.79**

* Note: Fish sampling conducted with five 0.94-square-meter Wegener Ring tosses along center transect.

During the October 2006 sampling event, 36 fish specimens were collected of one species, mosquito fish. This represented the lowest number of fish collected during both the baseline and operational periods. Average fish density was lower (7.7 individuals per square meter) compared to the baseline event (10.7 individuals per square meter). The species least killifish (*Heterandria formosa*) was again absent from samples.

Amphibians

A complete draft report by CPI biologists Ryan C. Means is submitted to the District in November of each year. A summary of the preliminary results are included in the final annual report. Data collected in 2007 will be included when it is made available in November 2007. Six species of amphibians, all expected occurrences, were documented in 2006 by Means. Through 2005, total number of species observed and species observed calling steadily increased; however, in 2006, these numbers dropped off to near baseline levels (Means 2006). This reduction probably resulted from persistent dry conditions during important spring and early summer breeding months for resident amphibians.

Means (2006) report that preliminary comparisons based on 2 years of baseline and 4 years of post-operational data at the Parkland Wetland, it appears that species richness increased with increased rainfall and decreased with decreased rainfall. Means stated that making any definitive scientific conclusion is not possible because of the lack of quantitative amphibian sampling at the wetland. Water retention may have helped as a secondary factor, perhaps boosting amphibian activity and reproduction. Water retention did not appear to be a detriment to amphibian populations.

Table 14 presents a list of the species observed at or near the ecological monitoring portion of the Parkland Wetland during the baseline and operational periods. Sampling was restricted to incidental collecting, dip netting, and aural surveys because of continual vandalism of sampling devices during the baseline survey period (Franz and Means 2001; Means 2006).

Table 14. Amphibian species observed at or near the Parkland Wetland, Titusville, Florida

Scientific Name	Common Name	Baseline Period	Operational Period				
			2003	2004	2005	2006	2007
Salamanders							
Notophthalmus viridescens	Central newt		X				
Amphiuma means	Two-toed Amphiuma	X					
Frogs							
Acris gryllus	Florida cricket frog		X		X		
Bufo terrestris	Southern toad		X	X	X		
Eleutherodactylus planirostris	Greenhouse frog*			X	X	X	
Gastrophryne carolinensis	Eastern narrowmouth	X	X	X	X	X	
Hyla cinerea	Green treefrog	X	X	X	X	X	
Hyla squirella	Squirrel treefrog	X	X	X	X	X	
Osteopilus septentrionalis	Cuban treefrog*			X	X		
Rana gryllio	Pig frog		X	X	X	X	
Rana sphenocephala	Southern leopard frog	X	X	X	X	X	
Number of species (richness)		5	8	8	9	6	

Note:

*Denotes exotic species

Baseline Period: the Parkland Wetland was surveyed in September and October 1998, January and May 1999, June and July 2000, and May 2001 (Franz and Means 2001).

Operational Period: the Parkland Wetland was surveyed one day each in February, April, July, and September (Means 2006).

General Wildlife Observed

Wildlife within the wetland and utilizing adjacent upland areas were recorded as observed during each sampling event. General wildlife observations include zebra longwing (*Heliconius charitonius*) and zebra swallowtail (*Eurytides Marcellus*) butterflies, bullfrog (*Rana catesbeiana*) and green treefrog (*Hyla cinerea*), and green anole (*Anoles carolinensis*). Bird species were observed in the wetland during the monitoring events include red shouldered hawk (*Buteo lineatus*), osprey (*Pandion haliaetus*), cattle egret (*Bubulcus ibis*), boat-tailed grackle (*Quiscalus major*) and white ibis (*Eudocimus albus*). Observations during past events include red-wing blackbird (*Agelaius phoeniceus*), blue jay (*Cyanocitta cristata*), Florida scrub jay (*Aphelocoma coerulescens*), yellow-rumped warbler (*Dendroica virens*), tricolored heron (*Egretta tricolor*), and green heron (*Butorides striatus*). During the March 2006 event, a juvenile raccoon (*Procyon rotor*) was observed near the edge of the wetland.

PHOTO STATIONS

Photos of the Parkland Wetland were taken twice during the baseline period and seven times during the operational period. Photo stations were not accessible during the October 2004 event due to high water from the 2004 hurricane season. Photos from the April 2005 event only include photo stations A and B due to deep water towards the wetland end of the monitoring transect. Photos taken from the center of the 5-meter by 5-meter shrub plots are included with the appendixes to this final report.

SUMMARY

The baseline period investigation provided background information on the wetland hydrology and biological community. The operational period began May 1, 2002, with the completion of the control weir. The Fifth Annual Report provides a comparison of the results from the baseline period with the first 5 years of operation.

In April 2002, a weir was constructed by the City of Titusville in a ditch draining to the north from the wetland. The objective of the Parkland weir is to retain a greater volume of surface water within the system for a longer duration by raising the outlet elevation without increasing flooding during major storms. The weir can increase the wetland's outlet elevation 2 feet, thereby retaining a significant volume of water. The control weir does not maintain the wetland at a set water level; rather it provides an opportunity to lengthen the duration of saturation after a major storm event. This hydrologic enhancement strategy is rainfall dependent.

With the weir in place and the return of normal rainfall patterns, water levels and the duration of inundation in the wetland have increased significantly relative to the baseline period. Mean monthly water levels were 1.48 feet higher respectively during the first 60 months of the operational period compared to the baseline period.

The greatest rainfall totals since the beginning of the project in August 1999 occurred in October 2005, as recorded by the City of Titusville's water treatment plants. Subsequently, water levels in the wetland rose to their maximum recorded value (17.65 feet [NGVD29]) on October 25, 2005; which was 0.44 foot above the previous year's maximum record. Flood water overtopped the control weir from October 5, 2005 until December 17, 2005 (73 days).

During the January 2006 field event, when water levels fell below the height of the weir in the Parkland Street Ditch, damage to the weir from vandalism was observed. The City of Titusville and the SJRWMD were notified and it was agreed that a new, more secure weir would be installed. The new weir was installed on April 13, 2006 to a height of 16.0 feet (NGVD29). Another incidence of vandalism had already occurred prior to April 2005 when the damage was observed and the top of the weir replaced.

Water levels were above the wetland ground surface of 12.17 feet (NGVD29) for 326 days (89% of the year) during Year 5 of operation. Water levels were

above the wetland ground surface of 12.17 feet 100% of the time during both Years 3 and 4 of operation. Water levels in the wetland met and exceeded the City of Titusville's Consumptive Use Permit (CUP) minimum conditions for pumping more often in the operational period than in the baseline period. Water levels exceeded the CUP wet-season elevation of 13.5 feet (NGVD29) during the operational period 99% of the time, as compared to 48%during the baseline period. The CUP dry-season elevation, 11.5 feet (NGVD29), was exceeded 100% of the time during the operational period and 84% during the baseline period. During the first 12 months of the operational period, the water levels in the wetland fell below these permit conditions for just one month in June 2002. More recently, water levels in the wetland fell beneath the ground surface at the wetland recorder briefly during August 2006 and again on March 23, 2007 and stayed below the surface through the end of the monitoring period.

A historical hydrograph was generated by using available indicators of hydrology at the Parkland Wetland. The historical hydrograph most closely approximated conditions during the baseline period (2.5 years of data) and was moderately below the stage exceedence curve of the hydration period (5 years of data). With water level management and above average rainfall, the stage frequency curve has risen above the target curve. Thus, the site does not appear to be adversely affected by groundwater withdrawals.

Water quality was sampled twice during the baseline period and nine times during the operational period. Overall, the results for both periods show a water quality that is comparable to that of wetlands and surface waters receiving urban/suburban stormwater runoff. Concentrations of metals, nutrients, and dissolved and suspended solids are elevated relative to pristine conditions, as is expected for this land use setting. Several chemical parameters showed reduced concentrations during the operational period apparently due to dilution effects of the increased water volume.

The wetland vegetation, both woody and herbaceous, is dominated by obligate wetland species. The plant communities are monitored in permanent plots and all strata (canopy, subcanopy, shrub, and groundcover) are sampled. High water from the 2005 hurricane season delayed the monitoring of any of the vegetation communities until January 2006. Shrub plots and line intercepts could be monitored at that time but high water levels continued to prevent the monitoring of the tree plot. Trees were measured in October 2006 during Year 5 of the operational period.

During both the October 2006 and March 2007 monitoring events, four target species was observed along the line intercept transects including the UPL species peppervine (*Ampelopsis arborea*). The increase in total species number and occurrence of target species was greatest near the upland end of the transects where water levels had receded beneath the ground surface allowing plants previously inundated by surface waters to germinate. Southern cattail continued to dominate the wetland end of the transect.

The tree plot was dominated by subcanopy-size trees of one species, Carolina willow throughout the entire monitoring period. Very few canopy-size trees were observed. The total number of trees was less during the operational period compared to baseline. During Year 5 of the operational period, Carolina willow was the dominant shrub/sapling species along the transect.

The results of benthic macroinvertebrate sampling show an assemblage of organisms that are highly tolerant of low dissolved oxygen concentrations and low pH values common to southeastern swamps with colored water and low or at times no flow conditions. Benthic macroinvertebrate populations were dominated by midges, worms, seed shrimp, and snails during both the baseline and operational periods. Densities and diversity of benthic macroinvertebrate populations continue to fluctuate within the Parkland Wetland.

Six species of amphibians, all expected occurrences, were documented in 2006 by Means. In 2006, total number of species observed and species observed calling decreased to near baseline levels. This reduction probably resulted from persistent dry conditions during important spring and early summer breeding months for resident amphibians (Means 2006). Amphibian data collected in 2007 will be presented in the final report in December 2007.

RECOMMENDATIONS

This completes the fifth and final year of operational monitoring period of the Parkland Wetland in Titusville. A separate final report synthesizing the results and effects of hydration or surface water diversion on the study wetlands of the four pilot projects will be submitted when the program ends in September 2008.

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Appendix A
Water Quality Laboratory Results

Columbia Analytical Services INC.

An Employee-Owned Company

November 01, 1999

Service Request No. J9902924

Certification Numbers:	
Florida DEP:	930298G
Florida HRS:	E82502; 82483
Massachusetts:	M-FL937
New Hampshire:	294297-A; 294297-B
North Carolina:	527
South Carolina:	96021001
A2LA	0490-02

Ron Clarke
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Project No.: 147556.1A.TV
Project Name: Titusville

Dear Ron Clarke:

Enclosed are the results of the samples(s) submitted to our laboratory on September 29, 1999. For your reference, these analyses have been assigned our service request number: J9902924.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in the entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Paul Gunsaulies

Paul Gunsaulies
Project Chemist

PG/jg

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J9902924
Project:	Titusville / 147556.1A.TV	**Date Collected:**	9/28/99
Sample Matrix:	Surface Water / Water QC	**Date Received:**	9/29/99
		Date Extracted:	10/1/99

Total Metals
Units: mg/L(ppm)

		Sample Name:	**STN 1**	**FB**	**Method Blank**
		Lab Code:	J9902924-01	J9902924-02	J991001-MB
		Date Analyzed:	10/12-26/99	10/12-26/99	10/12-26/99
Analyte	**EPA Method**	**MRL**			
Cadmium	200.8	0.0005	U	U	U
Calcium	215.1	0.5	46	U	U
Copper	200.8	0.001	U	U	U
Iron	200.7	0.05	2.62	U	U
Lead	200.8	0.001	U	U	U
Magnesium	200.7	0.1	1.36	U	U
Nickel	200.8	0.001	U	U	U
Potassium	200.7	2	5.10	U	U
Sodium	273.1	0.5	7.6	U	U
Zinc	200.8	0.005	0.170	U	U

U Not detected at or above the MRL.

Approved By: Paul Kanaukis Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J9902924
Project:	Titusville	**Date Collected:**	9/28/99 1056
Sample Matrix:	Surface Water	**Date Received:**	9/29/99
		Date Extracted:	NA

Inorganic Parameters

				Sample Name:	**STN 1**	**FB**	**Method Blank**
				Lab Code:	J9902924-01	J9902924-02	J990929-MB
Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**			
Alkalinity, Total as $CaCO_3$	mg/L (ppm)	310.1	5	10/4/99 1100	62.0	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	10/20/99 1700	0.23	U	U
Chloride	mg/L (ppm)	300.0	0.4	9/29/99 1918	17.9	U	U
Color	Color Units	110.2	5	9/30/99 1009	200	U	U
Conductivity	uMHOS/cm	120.1	2	9/30/99 1907	296	U	U
Nitrate+Nitrite as N	mg/L (ppm)	353.2	0.2	9/29/99 1918	U	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	9/30/99 0815	U	U	U
Sulfate	mg/L (ppm)	300.0	1	9/29/99 1918	53.1	U	U
Solids, Total Dissolved	mg/L (ppm)	160.1	10	10/2/99 1400	330	U	U
TKN	mg/L (ppm)	351.4	0.5	10/5/99 0951	1.97	U	U
TOC	mg/L (ppm)	415.1	1.0	10/1/99 1038	20.3	U	U
Phosphorus, Total	mg/L (ppm)	365.3	0.01	10/1/99 1100	0.16	U	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	10/1/99 1030	11.0	U	U
Turbidity	NTU	180.1	0.1	9/30/99 0937	4.22	U	U

U Not detected at or above the MRL.

Approved By: Paul Gonsalves Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J9902924
Project:	Titusville / 147556.1A.TV	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Extracted:	10/1/99
		Date Analyzed:	10/12-26/99

Duplicate Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**EPA Method**	**MRL**	**Sample Result**	**Duplicate Sample Result**	**Average**	**Relative Percent Difference**	**Result Note**
Cadmium	200.8	0.0005	0.475	0.448	0.462	6	
Calcium	215.1	0.5	480	480	480	<1	
Copper	200.8	0.001	0.510	0.487	0.498	5	
Iron	200.7	0.05	2.12	2.12	2.12	<1	
Lead	200.8	0.001	0.457	0.457	0.457	<1	
Magnesium	200.7	0.1	14.6	14.6	14.6	<1	
Nickel	200.8	0.001	0.518	0.490	0.504	6	
Potassium	200.7	2	9.38	9.50	9.44	1	
Sodium	273.1	0.5	12	12	12	<1	
Zinc	200.8	0.005	0.503	0.504	0.504	<1	

U Not detected at or above the MRL.

Approved By: Paul Gunsaulies Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville / 147556.1A.TV
Sample Matrix: Water

Service Request: J9902924
Date Collected: NA
Date Received: NA
Date Extracted: 10/1/99
Date Analyzed: 10/12-26/99

Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptanc Limits	Result Note
Cadmium	200.8	0.0005	0.50	U	0.475	95	80-120	
Calcium	215.1	0.5	10	580	NC	NA	80-120	a
Copper	200.8	0.001	0.50	U	0.510	102	80-120	
Iron	200.7	0.05	2.0	0.22	2.12	95	80-120	
Lead	200.8	0.001	0.50	U	0.457	91.4	80-120	
Magnesium	200.7	0.1	10.0	4.70	14.6	99	80-120	
Nickel	200.8	0.001	0.50	U	0.518	103.6	80-120	
Potassium	200.7	2	10.0	U	9.38	93.8	80-120	
Sodium	273.1	0.5	10	2.3	12	97	80-120	
Zinc	200.8	0.005	0.50	U	0.503	101	80-120	

U Not detected at or above the MRL.
a Not Applicable because of the sample matrix. Accuracy of spike recovery value is reduced since the sample concentration is greater than four times the amount spiked.

Approved By: Paul Gursanbias Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J9902924
Project:	Titusville / 147556.1A.TV	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	10/12-26/99

Laboratory Control Sample Summary
Total Metals
Units: mg/L(ppm)

Analyte	**EPA Method**	**TRUE VALUE**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Cadmium	200.8	0.50	0.499	100	80-120
Calcium	215.1	10	9.8	98	80-120
Copper	200.8	0.50	0.484	97	80-120
Iron	200.7	2.0	1.94	97	80-120
Lead	200.8	0.50	0.456	91	80-120
Magnesium	200.7	10.0	9.47	95	80-120
Nickel	200.8	0.50	0.538	108	80-120
Potassium	200.7	10.0	9.47	95	80-120
Sodium	273.1	10	10	100	80-120
Zinc	200.8	0.50	0.428	86	80-120

Approved By: Paul Gunsaulies Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville
Sample Matrix: Surface Water

Service Request: J9902924
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 9/29-10/5/99

Duplicate Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	Units	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	133	132	133	0.75
Ammonia as N	mg/L (ppm)	350.3	0.1	3.93	4.03	3.98	2.51
Color	Color Units	110.2	5	200	200	200	<1
Conductivity	uMHOS/cm	120.1	2	296	290	293	2.05
Nitrate+Nitrite as N	mg/L (ppm)	353.2	0.2	0.35	0.34	0.345	2.90
Orthophosphate as P	mg/L (ppm)	365.3	0.01	1.00	1.00	1.00	<1
Solids, Total Dissolved	mg/L (ppm)	160.1	10	215	208	212	3.30
TKN	mg/L (ppm)	351.4	0.5	0.99	0.91	0.95	8.42
TOC	mg/L (ppm)	415.1	1.0	48.8	49.4	49.1	1.22
Phosphorus, Total	mg/L (ppm)	365.3	0.01	0.70	0.70	0.70	<1
Solids, Total Suspended	mg/L (ppm)	160.2	5	U	U	U	<1
Turbidity	NTU	180.1	0.1	4.22	4.19	4.21	0.71

U Not detected at or above the MRL.

Approved By: Paul Gonsalves Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J9902924
Project:	Titusville	**Date Collected:**	NA
Sample Matrix:	Surface Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	9/29-10/5/99

Matrix Spike Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**Units**	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Ammonia as N	mg/L (ppm)	350.3	0.1	5	3.93	9.15	104.4	75-125
Nitrate+Nitrite as N	mg/L (ppm)	353.2	0.2	5	0.35	4.75	88	85-115
Orthophosphate as P	mg/L (ppm)	365.3	0.01	1	1.00	2.10	110	75-125
TKN	mg/L (ppm)	351.4	0.5	5	0.99	5.46	89.4	75-125
TOC	mg/L (ppm)	415.1	1.0	20	48.8	67.2	92	75-125
Phosphorus, Total	mg/L (ppm)	365.3	0.01	1	0.70	1.70	100	75-125

Approved By: Paul Gunsaulis Date: 11/1/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville
Sample Matrix: Water

Service Request: J9902924
Date Collected: NA
Date Received: NA
Date Analyzed: 9/29-10/5/99

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	Units	EPA Method	TRUE Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	17.7	20.0	113	75-125
Ammonia as N	mg/L (ppm)	350.3	15.6	17.2	110	75-125
Chloride	mg/L (ppm)	300.0	10	9.68	97	90-110
Color	Color Units	110.2	25	25.0	100	75-125
Conductivity	uMHOS/cm	120.1	168	167	99	75-125
Nitrate+Nitrite as N	mg/L (ppm)	353.2	10	9.64	96	90-110
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.51	102	75-125
Sulfate	mg/L (ppm)	300.0	10	9.99	100	90-110
Solids, Total Dissolved	mg/L (ppm)	160.1	300	300	100	75-125
TKN	mg/L (ppm)	351.4	8.99	7.72	86	75-125
TOC	mg/L (ppm)	415.1	141	144	102	75-125
Phosphorus, Total	mg/L (ppm)	365.3	0.5	0.50	100	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	88.0	110	75-125
Turbidity	NTU	180.1	5	5.34	107	75-125

Approved By: Paul Gunsaulies Date: 11/1/99

Columbia Analytical Services, Inc.
Cooler Receipt and Preservation Form

Client: CH2M Hill Work order: J9902924

Project: Titusville / 147556.1A.TV

Cooler received on 9/29/99 1100 and opened on 9/29/99 1100 by THT

		Yes	No	N/A
1	Were custody seals on outside of cooler?	☒	☐	☐
	If yes, how many and where? One on lid			☐
	Were signature and date correct?	☒	☐	☐
2	Were custody papers properly filled out (ink, signed, etc....)?	☒	☐	☐
3	Did all bottles arrive in good condition (unbroken, etc....)?	☒	☐	☐
4	Were all bottle labels correct (analysis, preservation, etc....)?	☒	☐	☐
5	Did all bottle labels and tags agree with custody papers?	☒	☐	☐
6	Were correct bottles used for test indicated?	☒	☐	☐
7	Were VOA vials checked for absence of air bubbles, and noted?	☐	☐	☒
8	Temperature of cooler upon receipt	2.9` Degrees C		

Explain any discrepancies:

		Yes	No
pH	Reagent		
12	NaOH		
2	HNO_3	X	
2	H_2SO_4	X	

Yes = all samples OK

No = Samples were preserved at lab as listed

Comments:

Sample I.D.	Reagent	Vol.

Columbia Analytical Services INC.
An Employee-Owned Company

8540 Baycenter Rd. • Jacksonville, FL 32256 • (904) 739-2277 • 800-695-7222 • FAX (904) 739-2011

CHAIN OF CUSTODY/LABORATORY ANALYSIS REPORT FORM

DATE 9/28/99 PAGE 1 OF 1

PROJECT NAME Titusville
PROJECT # 147556.IA.TV
COMPANY/ADDRESS CH2M Hill
3011 SW Williston Road
Gainesville FL 32608 PHONE 352 335 5877
REPORT TO: Ron Clarke

ANALYSIS REQUEST

SAMPLE I.D.	DATE	TIME	SAMPLE MATRIX	NUMBER OF CONTAINERS	TOC	Cl⁻, Color, Cond, NO_3+NO_2	SO_4	Alk, OP, TDS, TSS, Turb	NH_3, TKN, TP	Metals (10)											REMARKS
STN 1	9/28/99	1056	SW	5	1	1	1	1	1	1											
FB	9/28/99	1115	SW	5	1	1	1	1	1	1											

RELINQUISHED BY:
Signature: Ron Clarke
Printed Name: Ron Clarke
Firm: CH2M Hill
Date/Time: 9/28/99 1350

RECEIVED BY:
Signature: Travis Trader
Printed Name: Travis Trader
Firm: CAS
Date/Time: 9/29/99 1100

TURNAROUND REQUIREMENTS
___ 24 hr. ___ 48 hr. ___ 5 day
___ Standard (7-10 working days)
___ Provide Verbal Preliminary Results
___ Provide FAX Preliminary Results
Requested Report Date ___

REPORT REQUIREMENTS
___ I. Routine Report
___ II. Report (includes DUP.MAS. MSD, as required, may be charged as samples)
___ III. Data Validation Report (includes All Raw Data)
___ IV. CLP Deliverable Report

INVOICE INFORMATION:
P.O.# ___
Bill To ___

SAMPLE RECEIPT:
Shipping VIA: ___
Shipping to: ___
Condition: ___
Lab No: ___

RELINQUISHED BY:
Signature
Printed Name
Firm
Date/Time

RECEIVED BY:
Signature
Printed Name
Firm
Date/Time

SPECIAL INSTRUCTIONS/COMMENTS:
Metals:
Cd, Ca, Cu, Fe, Pb, Mg, Ni, K, Na, Zn

J9902924

SAMPLER'S SIGNATURE: Ron Clarke

DISTRIBUTION: WHITE - return to originator; YELLOW - lab; PINK - retained by originator

Columbia Analytical Services INC.
An Employee-Owned Company

April 14, 2000

Service Request No. J2000851

Certification Numbers:

Florida DEP:	930298G
Florida HRS:	E82502; 82483
Massachusetts:	M-FL937
New Hampshire:	294297-A; 294297-B
North Carolina:	527
South Carolina:	96021001

Rosanne Prager
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Project No.: 147556.IA.TV
Project Name: Titusville

Dear Rosanne Prager:

Enclosed are the results of the samples(s) submitted to our laboratory on March 16, 2000. For your reference, these analyses have been assigned our service request number: J2000851.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in the entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Paul Gunsaulies

Paul Gunsaulies
Project Manager

PG/jg

84 8540 Baycenter Rd. ▪ Jacksonville, FL 32256 ▪ (904) 739-2277 ▪ Fax (904) 739-2011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2000851
Project:	Titusville / 147556.IA.TV	**Date Collected:**	3/15/00
Sample Matrix:	Surface Water	**Date Received:**	3/16/00
		Date Extracted:	3/20/00

Total Metals
Units: mg/L(ppm)

		Sample Name:	**TV-1**	**Method Blank**
		Lab Code:	J2000851-01	J200320-MB
		Date Analyzed:	3/20-22/00	3/20-22/00
Analyte	**EPA Method**	**MRL**		
Cadmium	200.8	0.0005	U	U
Calcium	200.7	0.5	85.5	U
Copper	200.8	0.002	U	U
Iron	200.7	0.1	0.89	U
Lead	200.8	0.001	U	U
Magnesium	200.7	0.5	2.98	U
Nickel	200.8	0.002	U	U
Potassium	200.7	2.00	2.13	U
Sodium	200.7	0.5	14.6	U
Zinc	200.8	0.025	U	U

SE
5/24/00

U Not detected at or above the MRL.

Approved By: Paul Ginsaulis Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2000851
Project:	Titusville/147556.IA.TV	**Date Collected:**	3/15/00 1450
Sample Matrix:	Surface Water	**Date Received:**	3/16/00 1030
		Date Extracted:	NA

Inorganic Parameters

Sample Name: **TV-1**
Lab Code: J2000851-01

Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**	
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	03/17/00 1300	180
Ammonia as N	mg/L (ppm)	350.3	0.1	03/24/00 1528	U
Chloride	mg/L (ppm)	300.0	0.4	03/28/00 1834	29.6
Color	Color Units	110.2	5	03/17/00 0851	200
Conductivity	uMHOS/cm	120.1	2	03/16/00 1430	481
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	03/16/00 1940	0.32
Orthophosphate as P	mg/L (ppm)	365.3	0.01	03/16/00 1601	0.044
Sulfate	mg/L (ppm)	300.0	1	04/03/00 0220	31.6
Solids, Total Dissolved	mg/L (ppm)	160.1	10	03/17/00 1500	362
TKN	mg/L (ppm)	351.4	0.5	04/05/00 1225	1.91
TOC	mg/L (ppm)	415.1	1.0	03/29/00 0851	28.5
Phosphorus, Total	mg/L (ppm)	365.3	0.01	03/23/00 1614	0.065
Solids, Total Suspended	mg/L (ppm)	160.2	5	03/20/00 1015	5.50
Turbidity	NTU	180.1	0.1	03/17/00 0854	1.67

SK
5/26/00

U Not detected at or above the MRL.

Approved By: Paul [signature] Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2000851
Project:	Titusville / 147556.IA.TV	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Extracted:	3/20/00
		Date Analyzed:	3/20-22/00

Duplicate Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Note
Cadmium	200.8	0.0005	0.010	0.010	0.010	<1	
Calcium	200.7	0.5	48.9	48.8	48.8	<1	
Copper	200.8	0.002	0.022	0.021	0.022	5	
Iron	200.7	0.1	2.84	3.09	2.86	9	
Lead	200.8	0.001	0.022	0.025	0.024	13	
Magnesium	200.7	0.5	18.2	18.0	18.1	1	
Nickel	200.8	0.002	NA	NA	NA	<1	a
Potassium	200.7	2.00	14.7	14.2	14.4	4	
Sodium	200.7	0.5	28.1	27.3	27.7	3	
Zinc	200.8	0.025	0.040	0.041	0.040	2	

U Not detected at or above the MRL.
a Analysis performed on sample and sample duplicate.

Approved By: Paul Gonsalves Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville / 147556.IA.TV
Sample Matrix: Water

Service Request: J2000851
Date Collected: NA
Date Received: NA
Date Extracted: 3/20/00
Date Analyzed: 3/20-22/00

Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptanc Limits**	**Result Note**
Cadmium	200.8	0.0005	0.010	U	0.010	100	80-120	
Calcium	200.7	0.5	10.0	38.1	48.9	108	80-120	
Copper	200.8	0.002	0.020	U	0.022	110	80-120	
Iron	200.7	0.1	2.00	0.61	2.84	112	80-120	
Lead	200.8	0.001	0.020	U	0.022	110	80-120	
Magnesium	200.7	0.5	10.0	7.81	18.2	104	80-120	
Nickel	200.8	0.002	0.040	U	0.037	92	80-120	
Potassium	200.7	2.00	10.0	4.23	14.7	105	80-120	
Sodium	200.7	0.5	10.0	16.9	28.1	112	80-120	
Zinc	200.8	0.025	0.040	U	0.040	100	80-120	

U Not detected at or above the MRL.

Approved By: Paul Gunsaulies Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2000851
Project:	Titusville / 147556.IA.TV	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	3/20-22/00

Laboratory Control Sample Summary
Total Metals
Units: mg/L(ppm)

Analyte	**EPA Method**	**TRUE VALUE**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Cadmium	200.8	0.010	0.010	100	80-120
Calcium	200.7	10.0	11.0	110	80-120
Copper	200.8	0.020	0.022	110	80-120
Iron	200.7	2.00	2.27	114	80-120
Lead	200.8	0.020	0.022	110	80-120
Magnesium	200.7	10.0	10.4	104	80-120
Nickel	200.8	0.040	0.043	108	80-120
Potassium	200.7	10.0	10.6	106	80-120
Sodium	200.7	10.0	10.8	108	80-120
Zinc	200.8	0.040	0.044	110	80-120

Approved By: [signature] Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2000851
Project:	Titusville/147556.IA.TV	**Date Collected:**	NA
Sample Matrix:	Surface Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	03/16-04/05/0

Duplicate Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**Units**	**EPA Method**	**MRL**	**Sample Result**	**Duplicate Sample Result**	**Average**	**Relative Percent Difference**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	76.0	76.0	76.0	<1
Ammonia as N	mg/L (ppm)	350.3	0.1	0.29	0.29	0.29	<1
Chloride	mg/L (ppm)	300.0	0.4	31.1	30.8	30.95	<1
Color	Color Units	110.2	5	200	200	200	<1
Conductivity	uMHOS/cm	120.1	2	481	483	482	<1
Orthophosphate as P	mg/L (ppm)	365.3	0.01	1.41	1.44	1.425	2.11
Sulfate	mg/L (ppm)	300.0	1	31.6	31.2	31.4	1.27
Solids, Total Dissolved	mg/L (ppm)	160.1	10	427	424	425.5	<1
TKN	mg/L (ppm)	351.4	0.5	1.91	2.04	1.975	6.58
TOC	mg/L (ppm)	415.1	1.0	1.07	1.08	1.075	0.93
Phosphorus, Total	mg/L (ppm)	365.3	0.01	0.065	0.066	0.067	1.49
Solids, Total Suspended	mg/L (ppm)	160.2	5	5.20	U	NA	NA
Turbidity	NTU	180.1	0.1	1.67	1.61	1.64	3.66

U Not detected at or above the MRL.
NA High RPD is because the duplicate sample results are less than three times the method reporting limit.

Approved By: Paul Gunsaulis Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville/147556.IA.TV
Sample Matrix: Surface Water

Service Request: J2000851
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 03/16-04/05/0

Matrix Spike Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	**Units**	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	84.3	76.0	162	102.0	75-125
Ammonia as N	mg/L (ppm)	350.3	0.1	5	0.29	5.29	100.0	75-125
Chloride	mg/L (ppm)	300.0	0.4	25	31.1	57.4	105.2	85-115
Orthophosphate as P	mg/L (ppm)	365.3	0.01	2	1.41	3.11	85.0	75-125
Sulfate	mg/L (ppm)	300.0	1	5	31.6	34.7	NA	85-115
TKN	mg/L (ppm)	351.4	0.5	5	1.91	6.54	92.6	75-125
TOC	mg/L (ppm)	415.1	1.0	20	1.07	19.7	93.2	75-125
Phosphorus, Total	mg/L (ppm)	365.3	0.01	1.0	0.065	0.959	89.4	75-125

NA Not Applicable because of the sample matrix. Accuracy of spike recovery value is reduced since the sample concentration was greater than four times the amount spiked.

Approved By: Paul Hunsaulis Date: 4/15/00

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville/147556.IA.TV
Sample Matrix: Water

Service Request: J2000851
Date Collected: NA
Date Received: NA
Date Analyzed: 03/16-04/05/00

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	**Units**	**EPA Method**	**TRUE Value**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	84.3	80.0	94.9	75-125
Ammonia as N	mg/L (ppm)	350.3	16.6	18.5	111.4	75-125
Chloride	mg/L (ppm)	300.0	10	10.3	103.0	90-110
Color	Color Units	110.2	25	25.0	100.0	75-125
Conductivity	uMHOS/cm	120.1	168	171	101.8	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.503	100.6	75-125
Sulfate	mg/L (ppm)	300.0	10	9.09	90.9	90-110
Solids, Total Dissolved	mg/L (ppm)	160.1	300	292	97.3	75-125
TKN	mg/L (ppm)	351.4	15	16.9	112.7	75-125
TOC	mg/L (ppm)	415.1	141	139	98.6	75-125
Phosphorus, Total	mg/L (ppm)	365.3	0.5	0.458	91.6	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	84.0	105.0	75-125
Turbidity	NTU	180.1	5	4.93	98.6	75-125

Approved By: Paul Gunsaulies Date: 4/15/00

Columbia Analytical Services, Inc.
Cooler Receipt and Preservation Form

Client: CH2M Hill Work order: J2000851

Project: Titusville / 147556.IA.TV

Cooler received on 3/16/00 1030 and opened on 3/16/00 1030 by THT

		Yes	No	N/A
1	Were custody seals on outside of cooler?	☒	☐	☐
	If yes, how many and where? One on lid			☐
	Were signature and date correct?	☒	☐	☐
2	Were custody papers properly filled out (ink, signed, etc....)?	☒	☐	☐
3	Did all bottles arrive in good condition (unbroken, etc....)?	☒	☐	☐
4	Were all bottle labels correct (analysis, preservation, etc....)?	☒	☐	☐
5	Did all bottle labels and tags agree with custody papers?	☒	☐	☐
6	Were correct bottles used for test indicated?	☒	☐	☐
7	Were VOA vials checked for absence of air bubbles, and noted?	☐	☐	☒
8	Temperature of cooler upon receipt	3.4 Degrees C		

Explain any discrepancies:

		Yes	No
pH	Reagent		
12	NaOH		
2	HNO_3	X	
2	H_2SO_4	X	

Yes = all samples OK
No = Samples were preserved at lab as listed

Comments:

Sample I.D.	Reagent	Vol.

Columbia Analytical Services INC.
An Employee-Owned Company

CHAIN OF CUSTODY/LABORATORY ANALYSIS REPORT FORM

8540 Baycenter Rd. • Jacksonville, FL 32256 • (904) 739-2277 • 800-695-7222 • FAX (904) 739-2011

DATE 3/15/00 PAGE 1 OF 1

PROJECT NAME Titusville
PROJECT # 147556. IA. TV
COMPANY/ADDRESS CH2M HILL Inc.
3011 SW Williston Rd.
Gainesville, FL 32608 PHONE (352) 335-5877
REPORT TO: Rosanne Prager

ANALYSIS REQUEST

SAMPLE I.D.	DATE	TIME	SAMPLE MATRIX	NUMBER OF CONTAINERS	TOC	Cl⁻, Color, Cond, NO_3, NO_2, SO_4	Alk, OP, TDS, TSS, Turb	NH_3, TKN, TP	Metals													REMARKS
TV-1	3/15/00	1450	WTR	5	X	X	X	X	X													

RELINQUISHED BY:
Signature [signature]
Printed Name Ron Clarke
Firm CH2M Hill
Date/Time 1550

RECEIVED BY:
Signature Travis Trader
Printed Name Travis Trader
Firm CAS
Date/Time 3/16/00 1030

TURNAROUND REQUIREMENTS
___ 24 hr. ___ 48 hr. ___ 5 day
✓ Standard (7-10 working days)
___ Provide Verbal Preliminary Results
___ Provide FAX Preliminary Results
Requested Report Date ______

REPORT REQUIREMENTS
✓ I. Routine Report
___ II. Report (includes DUP.MAS. MSD, as required, may be charged as samples)
___ III. Data Validation Report (includes All Raw Data)
___ IV. CLP Deliverable Report

INVOICE INFORMATION:
P.O.# ______
Bill To ______

SAMPLE RECEIPT:
Shipping VIA: ______
Shipping to: ______
Condition: ______
Lab No: ______

RELINQUISHED BY:
Signature
Printed Name
Firm
Date/Time

RECEIVED BY:
Signature
Printed Name
Firm
Date/Time

SPECIAL INSTRUCTIONS/COMMENTS:
Metals:
Cadmium, Copper, Iron, Lead,
Magnesium, Nickel, Potassium,
Sodium, Zinc

SAMPLER'S SIGNATURE [signature]

851

DISTRIBUTION: WHITE - return to originator; YELLOW - lab; PINK - retained by originator

ACCREDITED IN ACCORDANCE WITH nelac

Columbia Analytical Services INC.
An Employee-Owned Company

January 03, 2003

Service Request No. J2203849

Steve Eakin
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Test Report for
Project No.: 147556.IA.TV
Project Name: Titusville

Dear Steve Eakin:

Enclosed are the results of the samples(s) submitted to our laboratory on December 11, 2002. For your reference, these analyses have been assigned our service request number: J2203849.

All analyses were performed according to our laboratory's quality assurance program. NELAP requirements were met unless footnotes in each sample report indicate otherwise. Estimates regarding the degree of uncertainty in measurements can be inferred from the accuracy limits in the laboratory QA manual. However, these limits do not account for possible matrix effects. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Joe Wiegel

Joe Wiegel
Project Manager

CAS Jacksonville is NELAC-accredited by the State of Florida (E82502). Other state accreditations include: AR, AR; LA, AI 30759; MA, M-FL937; NC, 527; SC, 96021; WA, C278.

8540 Baycenter Rd. ▪ Jacksonville, FL 32256 ▪ (904) 739-2277 ▪ Fax (904) 739-2011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill		**Service Request:**	J2203849
Project:	Titusville / 147556.IA.TV		**Date Collected:**	12/10/2002
Sample Matrix:	Water		**Date Received:**	12/11/2002
			Date Extracted:	12/13/2002

Total Metals
Units: mg/L(ppm)

		Sample Name:	**Stn-1**	**FB**	**Method Blank**
		Lab Code:	J2203849-001	J2203849-002	J221213-MB
		Date Analyzed:	12/15-19/02	12/15-19/02	12/15-19/02
Analyte	**EPA Method**	**MRL**			
Cadmium	200.8	0.0005	U	U	U
Calcium	200.7	0.5	56	U	U
Copper	200.8	0.002	U	U	U
Iron	200.7	0.1	1.0	U	U
Lead	200.8	0.001	U	U	U
Magnesium	200.7	0.1	1.81	U	U
Nickel	200.8	0.002	0.011	U	U
Potassium	200.7	2	2.0	U	U
Sodium	200.7	0.5	7.7	U	U
Zinc	200.8	0.01	U	U	U

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2203849
Project:	Titusville/147556.IA.TV	**Date Collected:**	12/10/2002
Sample Matrix:	Water	**Date Received:**	12/11/2002
		Date Extracted:	NA

Inorganic Parameters

				Sample Name:	**Stn-1**	**FB**	**Method Blank**
				Lab Code:	J2203849-001	J2203849-002	J221211-MB
Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**			
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	5	12/16/02 0910	130	U	U
Ammonia as N	mg/L (ppm)	350.3	0.1	12/18/02 1000	U	U	U
Chloride	mg/L (ppm)	300.0	0.2	12/11/02	12	U	U
Color	Color Units	110.2	5	12/11/02 1420	130	U	U
Conductivity	uMHOS/cm	120.1	2	12/27/02 0900	270	U	U
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	12/11/02	U	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	12/11/02 1600	0.04	U	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.05	12/31/02-1/3/03	0.12	U	U
Solids, Total Dissolved	mg/L (ppm)	160.1	10	12/16/02 0935	220	U	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	12/13/02	6.5	U	U
Sulfate	mg/L (ppm)	300.0	0.2	12/11/02	3.4	U	U
TKN	mg/L (ppm)	351.4	0.5	12/19/02 1120	2.4	U	U
TOC	mg/L (ppm)	415.1	1.0	12/17/02 0920	16	U	U
Turbidity	NTU	180.1	0.1	12/11/02 1345	3.9	U	U

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2203849
Project:	Titusville / 147556.IA.TV	**Date Collected:**	12/10/2002
Sample Matrix:	Water	**Date Received:**	12/11/2002
		Date Extracted:	12/13/2002
		Date Analyzed:	12/15-19/02

Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Stn-1
Lab Code: J2203849-001

Analyte	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**	**Result Note**
Cadmium	200.8	0.0005	0.0500	U	0.0448	90	70-130	
Calcium	200.7	0.5	20.0	56.1	75.0	95	70-130	
Copper	200.8	0.002	0.0500	U	0.0416	83	70-130	
Iron	200.7	0.1	2.00	1.04	2.83	90	70-130	
Lead	200.8	0.001	0.0500	U	0.0510	102	70-130	
Magnesium	200.7	0.1	10.0	1.81	12.1	103	70-130	
Nickel	200.8	0.002	0.0500	0.0110	0.0517	81	70-130	
Potassium	200.7	2	50.0	2.03	50.5	97	70-130	
Sodium	200.7	0.5	10.0	7.71	17.7	100	70-130	
Zinc	200.8	0.01	0.100	U	0.0804	80	70-130	

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2203849
Project:	Titusville / 147556.IA.TV	**Date Collected:**	12/10/2002
Sample Matrix:	Water	**Date Received:**	12/11/2002
		Date Extracted:	12/13/2002
		Date Analyzed:	12/15-19/02

Duplicate Matrix Spike Summary
Total Metals
Units: mg/L(ppm)

Sample Name: Stn-1
Lab Code: J2203849-001

Analyte	**EPA Method**	**MRL**	**Sample Result**	**Duplicate Sample Result**	**Average**	**Relative Percent Difference**	**Result Note**
Cadmium	200.8	0.0005	0.0448	0.0436	0.0442	3	
Calcium	200.7	0.5	75.0	77.0	76.0	3	
Copper	200.8	0.002	0.0416	0.0412	0.0414	1	
Iron	200.7	0.1	2.83	2.90	2.87	2	
Lead	200.8	0.001	0.0510	0.0505	0.0508	1	
Magnesium	200.7	0.1	12.1	12.1	12.1	<1	
Nickel	200.8	0.002	0.0517	0.0516	0.0517	<1	
Potassium	200.7	2	50.5	51.1	50.8	1	
Sodium	200.7	0.5	17.7	18.1	17.9	2	
Zinc	200.8	0.01	0.0804	0.0790	0.0797	2	

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill		**Service Request:**	J2203849
Project:	Titusville / 147556.IA.TV		**Date Collected:**	NA
Sample Matrix:	Water		**Date Received:**	NA
			Date Analyzed:	12/15-19/02

Laboratory Control Sample Summary
Total Metals
Units: mg/L(ppm)

Analyte	**EPA Method**	**TRUE VALUE**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Cadmium	200.8	0.0500	0.0441	88	85-115
Calcium	200.7	20.0	20.9	105	85-115
Copper	200.8	0.0500	0.0490	98	85-115
Iron	200.7	2.00	1.96	98	85-115
Lead	200.8	0.0500	0.0520	104	85-115
Magnesium	200.7	10.0	10.4	104	85-115
Nickel	200.8	0.0500	0.0504	101	85-115
Potassium	200.7	50.0	48.7	97	85-115
Sodium	200.7	10.0	10.3	103	85-115
Zinc	200.8	0.100	0.0880	88	85-115

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville/147556.IA.TV
Sample Matrix: Water

Service Request: J2203849
Date Collected: 12/10/2002
Date Received: 12/11/2002
Date Extracted: NA
Date Analyzed: 12/11/02-1/3/03

Duplicate Summary
Inorganic Parameters

Sample Name: Stn-1
Lab Code: J2203849-001

Analyte	**Units**	**EPA Method**	**MRL**	**Sample Result**	**Duplicate Sample Result**	**Average**	**Relative Percent Difference**
Ammonia as N	mg/L (ppm)	350.3	0.1	U	U	U	<1
Color	Color Units	110.2	5	125	125	125	<1
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	0.124	0.123	0.124	1
TOC	mg/L (ppm)	415.1	1.0	15.6	17.8	16.7	13
Turbidity	NTU	180.1	0.1	3.90	3.80	3.85	3

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville/147556.IA.TV
Sample Matrix: Water

Service Request: J2203849
Date Collected: 12/10/2002
Date Received: 12/11/2002
Date Extracted: NA
Date Analyzed: 12/11-31/02

Duplicate Summary
Inorganic Parameters

Sample Name: FB
Lab Code: J2203849-002

Analyte	Units	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Orthophosphate as P	mg/L (ppm)	365.3	0.01	U	U	U	<1
Solids, Total Suspended	mg/L (ppm)	160.2	5	U	U	U	<1
TKN	mg/L (ppm)	351.4	0.5	U	U	U	<1

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Titusville/147556.IA.TV
Sample Matrix: Water

Service Request: J2203849
Date Collected: 12/10/2002
Date Received: 12/11/2002
Date Extracted: NA
Date Analyzed: 12/11/02-1/3/03

Matrix Spike Summary
Inorganic Parameters

Sample Name: Stn-1
Lab Code: J2203849-001

Analyte	Units	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Ammonia as N	mg/L (ppm)	350.3	0.1	10	U	10.2	102	75-125
TOC	mg/L (ppm)	415.1	1.0	60	15.6	73.6	97	75-125

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2203849
Project:	Titusville/147556.IA.TV	**Date Collected:**	12/10/2002
Sample Matrix:	Water	**Date Received:**	12/11/2002
		Date Extracted:	NA
		Date Analyzed:	12/11-31/02

Matrix Spike Summary
Inorganic Parameters

Sample Name: FB
Lab Code: J2203849-002

Analyte	**Units**	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Orthophosphate as P	mg/L (ppm)	365.3	0.01	0.5	U	0.507	101	75-125
TKN	mg/L (ppm)	351.4	0.5	10	U	9.6	96	75-125

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill		**Service Request:**	J2203849
Project:	Titusville/147556.IA.TV		**Date Collected:**	NA
Sample Matrix:	Water		**Date Received:**	NA
			Date Analyzed:	12/11/02-1/3/03

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	**Units**	**EPA Method**	**TRUE Value**	**Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Alkalinity, Total as CaCO3	mg/L (ppm)	310.1	24.5	24.2	99	75-125
Ammonia as N	mg/L (ppm)	350.3	10	9.84	98	75-125
Chloride	mg/L (ppm)	300.0	10	9.5	95	90-110
Color	Color Units	110.2	25	25	100	75-125
Conductivity	uMHOS/cm	120.1	168	160	95	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.505	101	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.5	0.517	103	75-125
Solids, Total Dissolved	mg/L (ppm)	160.1	300	295	98	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	83	104	75-125
Sulfate	mg/L (ppm)	300.0	10	9.01	90	90-110
TKN	mg/L (ppm)	351.4	10	10.9	109	75-125
TOC	mg/L (ppm)	415.1	50	48.6	97	75-125
Turbidity	NTU	180.1	5	5.06	101	75-125

Columbia Analytical Services

JACKSONVILLE LABORATORY
CONDITION UPON RECEIPT FORM

Client: CH2M Hill Project name: Titusville

Date received: 12/11/02 10:20 Service request number: J2203849

Received by: Cf CUR completed by: Cf

Cooler/Shipping Information:

Courier: ☐ CAS ☐ Client ☐ UPS ☐ Airborne ☑ FedEx ☐ Other (describe): airbill attached

Type: ☑ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	3.2				
Temp taken from	☐ Temp blank ☑ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any "NO" responses or discrepancies should be explained in the "Comments" section below or an NCM if so required. If an NCM was initiated, write the NCM number in the appropriate space.

CHECKLIST	YES	NO	NA	NCM #
1. Were custody seals on shipping container(s) intact? **If "No", NCM required.**	✓			
2. Were custody papers properly included with samples?	✓			
3. Were custody papers properly filled out (ink, signed, match labels)?	✓			
4. Did all bottles arrive in good condition (unbroken)?	✓			
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓			
6. Did the sample labels agree with the chain of custody?	✓			
7. Were correct bottles used for the tests indicated?	✓			
8. Were proper sample preservation techniques indicated on the label?	✓			
9. Were samples received within holding times? **If "No," NCM required.**	✓			
10. Were all VOA vials checked for the presence of air bubbles? **If "No", NCM required.**			✓	
11. Were there air bubbles present in the VOA vials? **If "Yes", NCM required.**			✓	
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓			
13. Was the cooler temperature less than 6°C?	✓			
14. Were sample pHs checked and recorded by Sample control? Checks are on reverse side of form. *NOTE: VOA samples are checked by laboratory analysts.*			✓	
15. Were the sample containers provided by CAS?	✓			
16. Were samples accepted into the laboratory?	✓			

Comments:

Columbia Analytical Services

Jacksonville Laboratory
Condition Upon Receipt - Sample pH

SR #: J 2203849 Date: 12/11/02 Initials: GP

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A check mark in any space under the appropriate column headings for the selected sample indicates that the pH was checked and met the required pH criterion listed in the column heading.

Bottle Code

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Container	40-mL	40-mL	125-mL	250-mL	500-mL	1-L	250-mL	1-L	2-oz	4-oz	8-oz	16-oz	5 g	100-mL	250-mL	500-mL	1-L	1-L	250-mL	500-mL	1-L	250-mL	250-mL	1.75-L	500-mL	Misc.
	G	G	P	P	P	P	G	G	G	G	G	G	ENC	P	P	P	P	G	P	P	P	G	P	P	P	Misc.
Pres.	HCl		HCl											Sodium Thiosulfate	H2SO4	H2SO4	H2SO4	H2SO4	HNO3	HNO3	HNO3	HNO3	NaOH	NaOH	ZnAcetate NaOH	
Req. pH	<2	N/A	<2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<2	<2	<2	<2	<2	<2	<2	<2	>12	>12	>9	N/A
Sample #	-	-	- ✓	-	-	-	-	-	-		-	-	-	-	-	- ✓	-	-	-	-	- ✓	-	-	-	-	-
-001			✓		✓	✓										✓					✓					
-002			✓		✓	✓										✓					✓					
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-039																										
-040																										

For aqueous samples with multiple containers, only 1 bottle is checked for pH
N[illegible]OA pH checks are performed by the analytical area, not sample control

Columbia Analytical Services INC.
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CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

J2203849

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Project Name: Titusville	Project Number: 147556 IA.TV
Project Manager: Rosann Prager	Report CC: Steve Eakin
Company/Address: CH2M HILL Inc, 3011 SW Williston Rd., Gainesville, FL 32601	
Phone #: (352) 335-7991	FAX#: (352) 335-2859
Sampler's Signature: [signature]	Sampler's Printed Name: Steve B. Eakin

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

Preservative Key: 0. NONE 1. HCL 2. HNO_3 3. H_2SO_4 4. NaOH 5. Zn. Acetate 6. MeOH 7. $NaHSO_4$ 8. Other ______

CLIENT SAMPLE ID	LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NUMBER OF CONTAINERS	TOC	Cl⁻, Color, Cond.	NO2+NO3, SO4	Alk, OP, TDS, TSS	Turb, NH3, TKN	TP, TOC	Metals *							REMARKS/ ALTERNATE DESCRIPTION
Stn-1		12/10/02	0930	SW	5	X	X	X	X	X	X	X							
FB		12/10/02	0915	SW	5	X	X	X	X	X	X	X							

SPECIAL INSTRUCTIONS/COMMENTS

*Metals:
Cd, Cu, Fe, Pb, Mg, Ni, K, Na, Zn, Ca,

See QAPP ☐

TURNAROUND REQUIREMENTS
____ RUSH (SURCHARGES APPLY)
X STANDARD
REQUESTED FAX DATE ______
REQUESTED REPORT DATE ______

REPORT REQUIREMENTS
____ I. Results Only
X II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
____ III. Results + QC and Calibration Summaries
____ IV. Data Validation Report with Raw Data
____ V. Speicalized Forms / Custom Report
Edata ____ Yes ____ No

INVOICE INFORMATION
PO#
BILL TO:

SAMPLE RECEIPT: CONDITION/COOLER TEMP: ______ CUSTODY SEALS: Y N

	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	Steve B. Eakin	Chris Ferguson				
Printed Name	CH2M HILL	CHRIS FERGUSON				
Firm	12/10/02 1200	CAS				
Date/Time		12/11/02 10:20				

Distribution: Whi[te - Ret]urn to Originator; Yellow - Lab Copy; Pink - Retained by Client

Florida DEP Data Qualifiers

B Results based upon colony counts outside the acceptable range.

D Measurement was made in the field.

H Value based on field kit determination; results may not be accurate.

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

J Estimated value (one of the following reasons is discussed in the project case narrative).

1. The result may be inaccurate because the surrogate recovery limits have been exceeded.
2. No known quality control criteria exists for the component.
3. The reported value failed to meet the established quality control criteria for either precision or accuracy.
4. The sample matrix interfered with the ability to make any accurate determination (e.g., primary and confirmation results show greater than 40% RPD).
5. The data is questionable because of improper laboratory or field protocols (e.g., GC/MS Tune did not meet method criteria).

K Off scale low. The value is less than the lowest calibration standard but greater than the method reporting limit (MRL).

L Off scale high. The analyte is above the upper limit of the linear calibration range.

M The MDL/MRL has been elevated because the analyte could not be accurately quantified due to matrix interference.

N Presumptive evidence of the analyte. Confirmation was not performed.

Q Sample held beyond the accepted holding time.

T Value reported is less than the laboratory method detection limit. The value is reported for informational purposes only.

U Indicates that the compound was analyzed for but not detected.

V Indicates that the analyte was detected in both the sample and the associated method blank.

Y The laboratory analysis was from an improperly preserved sample.

Z Too many colonies were present (TNTC). The numeric value represents the filtration volume.

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J031552
Project Name:	Titusville	**Date Sampled:**	3/20/2003
Project Number:	147556.03.TV	**Date Received:**	3/21/03 10:30
		Date Reported:	4/10/2003

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: ______________________

[redacted]

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 3 + 2 COC

Figure 1. B

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J031552
Date/Time Received: 3/21/03 10:30

Lab Code: J031552-01
Client Sample ID: TV1
Site: Wetland Surface Water Sample
Matrix: Water

Date/Time Sampled: 3/20/2003 10:30
Sampled By: Steve Eakin
Shipping Method: Fed Ex

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.05	0.05	**0.05**	mg/L	U	E350.1		T
Color	1	5	5	**125**	Color Units		SM2120B		J
Conductivity	1	2	2	**194**	µmhos/cm		E120.1		J
Nitrate + Nitrite (as N)	1	0.05	0.05	**0.05**	mg/L	U	SM4500NO3-F		T
Ortho-phosphate (as P)	1	0.09	0.09	**0.09**	mg/L	U	E365.2		J
Sulfate (as SO4)	1	2.5	2.5	**2.5**	mg/L	U	E375.4		T
Total Alkalinity (as CaCO3)	1	5	5	**98**	mg/L		E310.1		T
Total Chlorides	1	2.5	2.5	**13**	mg/L		E325.1		T
Total Dissolved Solids	1	10	10	**184**	mg/L		E160.1		J
Total Kjeldahl Nitrogen (as N)	1	0.05	0.05	**1.4**	mg/L		E351.2		T
Total Organic Carbon	1	1	1	**25**	mg/L		E415.1		T
Total Phosphorus (as P)	1	0.05	0.05	**0.15**	mg/L	i	E365.4		T
Total Suspended Solids (TSS)	1	4	4	**5**	mg/L		E160.2		J
Turbidity	1	1	1	**2.3**	NTU		E180.1		

Total Metals

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00036	0.00036	**0.0013**	mg/L	i	E200.7		J
Calcium	1	0.018	0.018	**39**	mg/L		E200.7		J
Copper	1	0.0011	0.0011	**0.0033**	mg/L	i , V	E200.7		J
Iron	1	0.019	0.019	**1.7**	mg/L		E200.7		J
Lead	1	0.00091	0.00091	**0.0033**	mg/L	i	E200.7		J
Magnesium	1	0.016	0.016	**1.5**	mg/L		E200.7		J
Nickel	1	0.00085	0.00085	**0.00085**	mg/L	U	E200.7		J
* Potassium	1	0.11	0.11	**2.9**	mg/L		E200.7		J
Sodium	1	0.049	0.049	**7.4**	mg/L		E200.7		J
Zinc	1	0.0025	0.0025	**0.025**	mg/L		E200.7		J

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Potassium – Analyzed 3-31-03 due to reanalysis.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville

Report No.: J031552

Date/Time Received: 3/21/03 10:30

Sample Cross Reference Information

Lab Code: J031552-01

Client Sample Number: TV1

Site: Wetland Surface Water Sa

Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT033103NH3	3/31/2003 12:34	NBM		
Color	SM2120B	NONE	WCJ-032103-COLO	3/21/2003 11:50	KDC		
Conductivity	E120.1	NONE	WCJ-032403-COND	3/24/2003 13:55	KDC		
Nitrate + Nitrite (as N)	SM4500NO3-F	NONE	WCT032503NO3	3/25/2003 12:13	JH		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-032103-ORTH	3/21/2003 13:45	KDC		
Sulfate (as SO4)	E375.4	NONE	wct032703so4	3/27/2003 17:30	SB		
Total Alkalinity (as CaCO3)	E310.1	NONE	wct032603alk	3/26/2003 10:00	MC		
Total Chlorides	E325.1	NONE	wct040303cl	4/3/2003 13:50	NBM		
Total Dissolved Solids	E160.1	NONE	WCJ-032503-TDS	3/25/2003 11:00	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT040903TKN	4/9/2003 07:37	SS		
Total Metals	E200.7	METHOD	M032403-3010 #1	3/25/2003 14:13	DS	M032403-3010 #1	3/24/2003 15:50:
Total Organic Carbon	E415.1	NONE	wct040303toc	4/3/2003 11:00	DLS		
Total Phosphorus (as P)	E365.4	NONE	WCT040203TP	4/2/2003 13:52	SS		
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-032503-TSS	3/25/2003 15:10	KDC		
Turbidity	E180.1	NONE	WCJ-032103-TURB	3/21/2003 13:50	KDC		

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
ll results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with an 'i' qualifier

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J031552
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J031552-01	TU1	Total Phosphorus (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03	1	250mL Poly (H2SO4)
J031552-01	TU1	TOC (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03	1	250mL Poly (H2SO4)
J031552-01	TU1	TKN (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03		250mL Poly (H2SO4)
J031552-01	TU1	Sulfate (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03		250mL Poly (unpres.)
J031552-01	TU1	Nitrate + Nitrite (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03		250mL Poly (H2SO4)
J031552-01	TU1	Chlorides (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03	1	250mL Poly (unpres.)
J031552-01	TU1	Ammonia (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03		250mL Poly (H2SO4)
J031552-01	TU1	Alkalinity (T)	Water	3/20/03	10:30	3/21/03 10:30	4/1/03		250mL Poly (unpres.)

Jacksonville Relinquisher: Machols　　Shipping Receiver: Pony Express　　Date/Time: 3/24/03 1600 ~~[illegible] AM~~

Shipping Relinquisher: ______　　Tampa Receiver: [signature]　　Date/Time: 3-25-03 0840

COC 1

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

J031552

COC 2

CLIENT NAME: CH2M HILL Inc

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608

PHONE: (352)335-7991 FAX: (352)335-4946

CONTACT: Steven Eakin

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.TV

PROJECT LOCATION: FL

SAMPLED BY: S. Eakin

TURN AROUND TIME:
☑ STANDARD
❑ RUSH ____

REMARKS / SPECIAL INSTRUCTIONS:
*Metals: Cd, Ca, Cu, Fe, Pb, Mg, Ni, K, Na, Zn & Nutrients

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alkalinity, Ammonia, Cl⁻, | Color, Cond., NO2+NO3 | Ortho P, SO_4^{2-}, TDS, | TKN, TOC, TP, TSS | Turbidity, | *Metals & Nutrients

LAB NUMBER

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Alkalinity, Ammonia, Cl⁻	Color, Cond., NO2+NO3	Ortho P, SO_4^{2-}, TDS	TKN, TOC, TP, TSS	Turbidity	*Metals & Nutrients		LAB NUMBER
TV1	Wetland Surface Water Sample	Grab	3/20/03		SW	5	X	X	X	X	X	X		

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB ____	D/T ____
		AB ____	D/T ____
Ret: /	Via: ____	Trip Bl.	

	Relinquished by:	Date	Time	Received by:	Date	Time
1	S. E. [signature]	3/20/03		April Ferguson	3/21/03	1030
2						
3						
4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J035992
Project Name:	Titusville	**Date Sampled:**	10/21/2003
Project Number:	147556.03.TV	**Date Received:**	10/22/03 08:55
		Date Reported:	11/6/2003

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5+2 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville
Report No.: J035992
Date/Time Received: 10/22/03 08:55

Lab Code: J035992-01
Client Sample ID: TV-1
Site:
Matrix: Water
Date/Time Sampled: 10/21/2003 14:30
Shipping Method: Client drop off
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.019	0.019	**0.019**	mg/L	U	E350.1		*T*
* Color	2	5.0	10	**100**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**190**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.013	**0.014**	mg/L	i	E365.1		*J*
Sulfate (as SO4)	1	5.0	5.0	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**100**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	0.50	**16**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	5	0.034	0.17	**6.4**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.50	0.50	**0.50**	mg/L	U	E415.1		*T*
Total Phosphorus (as P)	1	0.037	0.037	**0.51**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**68**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**6.9**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.027	**0.098**	mg/L	i	E353.2		*J*

TDS

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**190**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
* Cadmium	1	0.00036	0.00036	**0.00061**	mg/L	i	SW6010B		*J*
Calcium	1	0.018	0.018	**42**	mg/L		SW6010B		*J*
* Copper	1	0.0011	0.0011	**0.0020**	mg/L	i	SW6010B		*J*
Iron	1	0.019	0.019	**2.9**	mg/L		SW6010B		*J*
Lead	1	0.00091	0.00091	**0.0017**	mg/L	i	SW6010B		*J*
Magnesium	1	0.016	0.016	**1.7**	mg/L		SW6010B		*J*
* Nickel	1	0.00085	0.00085	**0.00085**	mg/L	U	SW6010B		*J*
Potassium	1	0.11	0.11	**3.7**	mg/L		SW6010B		*J*
Sodium	1	0.049	0.049	**7.8**	mg/L		SW6010B		*J*
* Zinc	1	0.0025	0.0025	**0.0090**	mg/L	i	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Cadmium -- Analyzed 10-27-03 due to reanalysis.
* Comment for Color -- Color pH = 7.16
* Comment for Copper -- Analyzed 10-27-03 due to reanalysis.
* Comment for Nickel -- Analyzed 10-27-03 due to reanalysis.
* Comment for Zinc -- Analyzed 10-27-03 due to reanalysis.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville

Report No.: J035992

Date/Time Received: 10/22/03 08:55

Sample Cross Reference Information

Lab Code: J035992-01

Site:

Client Sample Number: TV-1

Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102303nh3-2	10/23/2003 11:30	SS		
Color	E110.2	NONE	WCJ-102203-COLO	10/22/2003 13:05	KDC		
Conductivity	SW9050A	NONE	WCJ-102203-COND	10/22/2003 11:30	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-102203-NITR	10/22/2003 11:23	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102203-ORTH	10/22/2003 09:07	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-110303-SO41	11/3/2003 11:35	AGF		
TDS	E160.1	NONE	WCJ-102403-TDS	10/24/2003 14:00	AGF		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-102403-ALK	10/24/2003 12:00	AA		
Total Chlorides	E325.2	NONE	WCJ-102403-CL	10/24/2003 09:30	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	wct110503tkn1	11/5/2003 10:41	CLB	PB110403TPTKN	11/4/2003 12:00:
Total Metals	SW6010B	METHOD	M102303-3010 #1	10/23/2003 19:13	KC	M102303-3010 #1	10/23/2003 08:11
Total Metals	SW6010B	SW3010A	M102303-3010 #1	10/23/2003 15:45	KC	M102303-3010 #1	10/23/2003 08:11
Total Metals	SW6010B	SW3010A	M102303-3010 #1	10/23/2003 19:13	KC	M102303-3010 #1	10/23/2003 08:11
Total Organic Carbon	E415.1	NONE	wct102803toc	10/28/2003 10:30	DLS		
Total Phosphorus (as P)	E365.4	NONE	WCT110503TP1	11/5/2003 13:31	CLB	PB110403TPTKN	11/4/2003 12:00:
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102703-TSS2	10/27/2003 12:10	AGF		
Turbidity	E180.1	NONE	WCJ-102303-TUR	10/23/2003 09:35	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill | **Report No.:** J035992
Project Name: Titusville | **Date/Time Received:** 10/22/03 08:55

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102303-3010 #1	Cadmium	Method Blank	SW6010B	0.00036	0.00036	mg/L	U
M102303-3010 #1	Calcium	Method Blank	SW6010B	0.018	0.029	mg/L	I
M102303-3010 #1	Copper	Method Blank	SW6010B	0.0011	0.0011	mg/L	U
M102303-3010 #1	Iron	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102303-3010 #1	Lead	Method Blank	SW6010B	0.00091	0.00091	mg/L	U
M102303-3010 #1	Magnesium	Method Blank	SW6010B	0.016	0.017	mg/L	I
M102303-3010 #1	Nickel	Method Blank	SW6010B	0.00085	0.00085	mg/L	U
M102303-3010 #1	Potassium	Method Blank	SW6010B	0.11	0.11	mg/L	U
M102303-3010 #1	Sodium	Method Blank	SW6010B	0.049	0.049	mg/L	U
M102303-3010 #1	Zinc	Method Blank	SW6010B	0.0025	0.0025	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102203-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102203-NIT	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102203-ORT	Ortho-phosphate (as P)	Method Blank	E365.1	0.10	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102303-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102403-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102403-CL	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102403-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102703-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110303-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102803toc	Total Organic Carbon	Method Blank	E415.1	0.50	0.50	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill　　**Report No.:** J035992

Project Name: Titusville　　**Date/Time Received:** 10/22/03 08:55

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110503tkn1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.034	0.034	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT110503TP1	Total Phosphorus (as P)	Method Blank	E365.4	0.037	0.037	mg/L	U

Quality Assurance Qualifiers:

I　The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U　The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J035992
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J035992-01	TV-1	Total Phosphorus (T)	Water	10/21/03	14:30	10/22/03 8:55	11/5/03		250mL Poly
J035992-01	TV-1	TKN (T)	Water	10/21/03	14:30	10/22/03 8:55	11/5/03		250mL Poly
J035992-01	TV-1	Ammonia (T)	Water	10/21/03	14:30	10/22/03 8:55	11/5/03		250mL Poly
J035992-01	TV-1	TOC (T)	Water	10/21/03	14:30	10/22/03 8:55	11/5/03		250mL Poly

Jacksonville Relinquisher: Omachols **Shipping Receiver:** PE **Date/Time:** 10/22/03 10:40:18 AM

Shipping Relinquisher: PE **Tampa Receiver:** [signature] **Date/Time:** 10/23/03 8:15

Advanced Environmental Laboratories, Inc.

❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 3
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 6
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352

CHAIN OF CUSTOI

J035992

ER:

Page ______ of ______

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd
Gainesville, FL 32608

PHONE: 352-335-1991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.TV

PROJECT LOCATION: Titusville, FL

SAMPLED BY: Steve Eakin

TURN AROUND TIME:
X STANDARD
❑ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:
* Cd, Ca, Cu, Fe, Pb, Mg, Ni, K, Na, Zn
1.4°

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	SIZE & TYPE / ANALYSIS REQUIRED / Preserv	Cl^-, SO_4^{2-}, color, cond., turb.	ortho - P	TDs / TSS	NO_2 + NO_3	TOC	Alk, NH_3, TKN, TP	* Metals	LAB NUMBER
~~[illegible]~~TV-1		Grab	10/21/03	1430	SW	7		X	X	X	X	X	X	X	01
~~[illegible]~~															

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #		Relinquished by:	Date	Time	Received by:	Date	Time
Out: / /	Via:	RB	D/T	1	FedX	10-22-03	855	Chris Ferguson	10-22-03	8:55
		AB	D/T	2						
Ret: / /	Via:	Trip Bl.		3						
		❑	❑	4						

Received on ice: X yes ❑ no QC ❑ sent ❑ received

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J042042
Project Name:	Titusville	**Date Sampled:**	4/7/04
Project Number:	147556.03.TV	**Date Received:**	4/8/04 09:27
		Date Reported:	4/26/04

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5+3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J042042
Date/Time Received: 4/8/04 09:27

Lab Code: J042042-01
Client Sample ID: Titus-1
Site: Wetland Surface Water
Matrix: Water

Date/Time Sampled: 4/7/04 09:30
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.026	**0.026**	mg/L	U	E350.1		*T*
* Color	4	5.0	20	**180**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**190**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.013	**0.013**	mg/L	U	E365.1		*J*
Sulfate (as SO4)	1	5.0	5.0	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**82**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	0.50	**16**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.048	**1.1**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.73	0.73	**13**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.043	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**6.0**	mg/L		E160.2		*J*
Turbidity	5	1.0	5.0	**24**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.027	**0.027**	mg/L	U	E353.2		*J*

TDS

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**160**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00021	0.00021	**0.0016**	mg/L		SW6010B		*J*
Calcium	1	0.014	0.014	**34**	mg/L		SW6010B		*J*
* Copper	1	0.0071	0.0071	**0.0071**	mg/L	U	SW6010B		*J*
* Iron	1	0.016	0.016	**2.6**	mg/L		SW6010B		*J*
* Lead	1	0.00092	0.00092	**0.0082**	mg/L	, V	SW6010B		*J*
Magnesium	1	0.0074	0.0074	**1.3**	mg/L		SW6010B		*J*
Nickel	1	0.0026	0.0026	**0.0026**	mg/L	U	SW6010B		*J*
Potassium	1	0.024	0.024	**1.1**	mg/L		SW6010B		*J*
Sodium	1	0.0084	0.0084	**8.4**	mg/L		SW6010B		*J*
Zinc	1	0.0072	0.0072	**0.013**	mg/L	i	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)
* Comment for Color -- Color pH = 6.88
* Comment for Copper -- Analyzed 04-16-04 due to reanalysis.
* Comment for Iron -- Analyzed 04-16-04 due to reanalysis.
* Comment for Lead -- Analyzed 04-16-04 due to reanalysis.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J042042
Date/Time Received: 4/8/04 09:27

Sample Cross Reference Information

Lab Code: J042042-01
Client Sample Number: Titus-1

Site: Wetland Surface Water
Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT040904NH3-1	4/9/04	12:00	SS		
Color	E110.2	NONE	WCJ-040804-COL	4/8/04	17:45	AGF		
Conductivity	SW9050A	NONE	WCJ-042004-COND	4/20/04	08:45	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-040904-N	4/9/04	09:58	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-040804-OP	4/8/04	14:48	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-041304-SULF	4/13/04	10:00	AGF		
TDS	E160.1	NONE	WCJ-041404-TDS	4/14/04	09:10	AGF		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-042004-ALK	4/20/04	08:45	AA		
Total Chlorides	E325.2	NONE	WCJ-041504-CL	4/15/04	14:51	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct041904tkn	4/19/04	10:00	CLB	pb041504tptkn	4/16/04
Total Metals	SW6010B	SW3010A	M040904-3010-1	4/12/04	08:26	KC	M040904-3010-1	4/9/04 09:00:00
Total Metals	SW6010B	SW3010A	M040904-3010-1	4/12/04	13:54	KC	M040904-3010-1	4/9/04 09:00:00
Total Organic Carbon	E415.1	NONE	WCT041304TOC	4/13/04	11:00	DLS		
Total Phosphorus (as P)	E365.4	METHOD	wct041904tp1	4/19/04	14:01	CLB	pb041504tptkn	4/16/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-041304-TSS2	4/13/04	14:15	AA		
Turbidity	E180.1	NONE	WCJ-040804-TURB	4/8/04	18:10	AGF		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J042042

Project Name: Titusville **Date/Time Received:** 4/8/04 09:27

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M040904-3010-1	Cadmium	Method Blank	SW6010B	0.00021	0.00021	mg/L	U
M040904-3010-1	Calcium	Method Blank	SW6010B	0.014	0.046	mg/L	I
M040904-3010-1	Copper	Method Blank	SW6010B	0.0071	0.0071	mg/L	U
M040904-3010-1	Iron	Method Blank	SW6010B	0.016	0.016	mg/L	U
M040904-3010-1	Lead	Method Blank	SW6010B	0.00092	0.0068	mg/L	
M040904-3010-1	Magnesium	Method Blank	SW6010B	0.0074	0.021	mg/L	I
M040904-3010-1	Nickel	Method Blank	SW6010B	0.0026	0.0026	mg/L	U
M040904-3010-1	Potassium	Method Blank	SW6010B	0.024	0.084	mg/L	I
M040904-3010-1	Sodium	Method Blank	SW6010B	0.0084	0.047	mg/L	
M040904-3010-1	Zinc	Method Blank	SW6010B	0.0072	0.0072	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040804-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040804-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040804-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040904-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-041304-SUL	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-041304-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-041404-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-041504-CL	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042004-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042004-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	µmhos/cm	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J042042

Project Name: Titusville **Date/Time Received:** 4/8/04 09:27

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT040904NH3-	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT041304TOC	Total Organic Carbon	Method Blank	E415.1	0.73	0.73	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct041904tkn	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct041904tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill **Project name:** Titusville

Date/Time Rcvd: 4-8-04 9 27 **Log-in request number:** J042042

Received by: [signature] **Completed by:** [signature]

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☑ FedEx ☐ Other (describe): ______

Type: ☑ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	0.4				
Temp taken from	☐ Temp blank ☑ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?	✓		
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*	✓		
15. Were the sample containers provided by AEL?	✓		
16. Were samples accepted into the laboratory?	✓		
17. Was it necessary to split samples into other bottles?		✓	

Comments:

C:\Documents and Settings\JOconnor\Desktop\Login Shortcuts\CUR form.doc (2/2/04)

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
5810-D Breckinridge Parkway
Tampa, FL 33610
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J042042
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J042042-01	Titus-1	Total Phosphorus (T)	Water	4/7/2004	9:30	4/8/04 9:27	**4/22/2004**	____	250mL Poly	
J042042-01	Titus-1	TOC (T)	Water	4/7/2004	9:30	4/8/04 9:27	**4/22/2004**	____	250mL Poly	
J042042-01	Titus-1	TKN (T)	Water	4/7/2004	9:30	4/8/04 9:27	**4/22/2004**	____	250mL Poly	
J042042-01	Titus-1	Ammonia (T)	Water	4/7/2004	9:30	4/8/04 9:27	**4/22/2004**	____	250mL Poly	

4-8-04 cf

Jacksonville Relinquisher: Chris Ferguson **Shipping Receiver:** ~~UPS~~ PE **Date/Time:** 4/8/2004 4:50:49 PM

Shipping Relinquisher: PE **Tampa Receiver:** [illegible] **Date/Time:** 04/09/04 9:00

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

CHAIN OF CUSTODY RECORD

L

J042042

130

CLIENT NAME: CH2M HILL	PROJECT NAME: Titusville
ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.TV
PHONE: (352) 335-7991 FAX: (352) 335-2879	PROJECT LOCATION: Brevard
CONTACT: Steve Eakin	SAMPLED BY: S. Eakin

TURN AROUND TIME:
☑ STANDARD
❑ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS: 6010B
* Cd, Ca, Cl, Cu, Fe, Pb, Mg, Ni, K, Na, Zn
0.4°C

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alkalinity, NH3, Color, | Cond., NO2+NO3, | Ortho P, SO4 2-, TDS, | TKN, TOC, TP, | TSS, Turbidity | * See Notes

LAB NUMBER

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Alkalinity, NH3, Color	Cond., NO2+NO3	Ortho P, SO4 2-, TDS	TKN, TOC, TP	TSS, Turbidity	* See Notes		LAB NUMBER
Titus-1	Wetland Surface Water	Grab	4/7/04	0930	SW	~~12~~ 8	X	X	X	X	X	X		

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB ____	D/T ____
		AB ____	D/T ____
Ret: / /	Via: ____	Trip Bl. ❑ ❑	

	Relinquished by:	Date	Time	Received by:	Date	Time
1	Steve E.	4/7/04	1200	April Ferguson	4/8/04	927
2						
3						
4						

Received on ice: ☒ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J046848
Project Name:	Titusville	**Date Sampled:**	10/20/04
Project Number:	147556.03.TV	**Date Received:**	10/21/04 10:25
		Date Reported:	10/29/04

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 6+3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville
Report No.: J046848
Date/Time Received: 10/21/04 10:25

Lab Code: J046848-01
Client Sample ID: Titusville
Site: Wetland Surface Water
Matrix: Water
Date/Time Sampled: 10/20/04 10:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.040**	mg/L	i	E350.1		*T*
* Color	5	25	25	**150**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**210**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.12**	mg/L		E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**78**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**19**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.2**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.73	2.9	**30**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.39**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**44**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**4.1**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.90**	mg/L		E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**170**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00021	0.00084	**0.00021**	mg/L	U	SW6010B		*J*
Calcium	1	0.014	0.056	**34**	mg/L		SW6010B		*J*
Copper	1	0.0071	0.028	**0.0071**	mg/L	U	SW6010B		*J*
Iron	1	0.016	0.064	**2.4**	mg/L		SW6010B		*J*
Lead	1	0.00092	0.0037	**0.0025**	mg/L	i , V	SW6010B		*J*
Magnesium	1	0.0074	0.030	**1.7**	mg/L		SW6010B		*J*
Nickel	1	0.0026	0.010	**0.0026**	mg/L	U	SW6010B		*J*
Potassium	1	0.024	0.096	**2.6**	mg/L		SW6010B		*J*
Sodium	1	0.0084	0.034	**9.6**	mg/L		SW6010B		*J*
Zinc	1	0.0072	0.029	**0.010**	mg/L	i	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 6.32

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville
Report No.: J046848
Date/Time Received: 10/21/04 10:25

Lab Code: J046848-02
Client Sample ID: Port Orange
Site: Wetland Surface Water
Matrix: Water
Date/Time Sampled: 10/20/04 13:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	10	50	50	**200**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**60**	µmhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**5.0**	mg/L	U	E310.1		*J*
Total Chlorides	1	0.50	2.0	**17**	mg/L		E325.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.30**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.73	2.9	**24**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.054**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**6.0**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**1.0**	NTU	U	E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.030**	mg/L	i	E353.2		*J*

TDS

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Total Dissolved Solids	1	10	10	**81**	mg/L		E160.1		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.00021	0.00084	**0.00021**	mg/L	U	SW6010B		*J*
Calcium	1	0.014	0.056	**2.7**	mg/L		SW6010B		*J*
Copper	1	0.0071	0.028	**0.0071**	mg/L	U	SW6010B		*J*
Iron	1	0.016	0.064	**0.55**	mg/L		SW6010B		*J*
Lead	1	0.00092	0.0037	**0.0012**	mg/L	i , V	SW6010B		*J*
Magnesium	1	0.0074	0.030	**1.0**	mg/L		SW6010B		*J*
Nickel	1	0.0026	0.010	**0.0026**	mg/L	U	SW6010B		*J*
Potassium	1	0.024	0.096	**1.0**	mg/L		SW6010B		*J*
Sodium	1	0.0084	0.034	**7.4**	mg/L		SW6010B		*J*
Zinc	1	0.0072	0.029	**0.0072**	mg/L	U	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 5.01

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J046848

Project Name: Titusville **Date/Time Received:** 10/21/04 10:25

Sample Cross Reference Information

Lab Code: J046848-01 **Site: Wetland Surface Water**

Client Sample Number: Titusville **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT102204NH3-2	10/22/04	16:30	SS		
Color	E110.2	NONE	WCJ-102204-COL	10/22/04	08:50	AA		
Conductivity	SW9050A	NONE	WCJ-102504-COND	10/25/04	13:25	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-102204-N	10/22/04	09:38	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102104-OP	10/21/04	09:31	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-102104-SO4b	10/21/04	16:40	AA		
TDS	E160.1	NONE	WCJ-102504-TDS	10/25/04	09:00	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-102204-ALK	10/22/04	10:30	AA		
Total Chlorides	E325.2	NONE	WCJ-102504-CL	10/25/04	13:13	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT102804TKN1	10/28/04	10:32	AJ	pb102404tptkn	10/24/04
Total Metals	SW6010B	SW3010A	M102104-3010-1	10/22/04	14:06	KC	M102104-3010-1	10/21/04 16:45:0
Total Organic Carbon	E415.1	NONE	WCT102604TOC	10/26/04	12:00	DLS		
Total Phosphorus (as P)	E365.4	NONE	WCT102704TP1	10/27/04	15:36	AJ	pb102404tptkn	10/24/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102504-TSS2	10/25/04	13:30	LM		
Turbidity	E180.1	NONE	WCJ-102204-TURB	10/22/04	08:50	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J046848-02 **Site: Wetland Surface Water**

Client Sample Number: Port Orange **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT102204NH3-2	10/22/04	16:30	SS		
Color	E110.2	NONE	WCJ-102204-COL	10/22/04	08:50	AA		
Conductivity	SW9050A	NONE	WCJ-102504-COND	10/25/04	13:25	KDC		
Nitrate + Nitrite	E353.2	NONE	WCJ-102204-N	10/22/04	09:38	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102104-OP	10/21/04	09:31	KDC		
Sulfate (as SO4)	E375.4	NONE	WCJ-102104-SO4b	10/21/04	16:40	AA		
TDS	E160.1	NONE	WCJ-102504-TDS	10/25/04	09:00	LM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-102204-ALK	10/22/04	10:30	AA		
Total Chlorides	E325.2	NONE	WCJ-102504-CL	10/25/04	13:13	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT102804TKN1	10/28/04	10:32	AJ	pb102404tptkn	10/24/04
Total Metals	SW6010B	SW3010A	M102104-3010-1	10/22/04	14:06	KC	M102104-3010-1	10/21/04 16:45:0
Total Organic Carbon	E415.1	NONE	WCT102604TOC	10/26/04	12:00	DLS		
Total Phosphorus (as P)	E365.4	NONE	WCT102704TP1	10/27/04	15:36	AJ	pb102404tptkn	10/24/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102504-TSS2	10/25/04	13:30	LM		
Turbidity	E180.1	NONE	WCJ-102204-TURB	10/22/04	08:50	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J046848
Date/Time Received: 10/21/04 10:25

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102104-3010-1	Cadmium	Method Blank	SW6010B	0.00021	0.00021	mg/L	U
M102104-3010-1	Calcium	Method Blank	SW6010B	0.014	0.10	mg/L	
M102104-3010-1	Copper	Method Blank	SW6010B	0.0071	0.0071	mg/L	U
M102104-3010-1	Iron	Method Blank	SW6010B	0.016	0.016	mg/L	U
M102104-3010-1	Lead	Method Blank	SW6010B	0.00092	0.0011	mg/L	I
M102104-3010-1	Magnesium	Method Blank	SW6010B	0.0074	0.0098	mg/L	I
M102104-3010-1	Nickel	Method Blank	SW6010B	0.0026	0.0026	mg/L	U
M102104-3010-1	Potassium	Method Blank	SW6010B	0.024	0.024	mg/L	U
M102104-3010-1	Sodium	Method Blank	SW6010B	0.0084	0.026	mg/L	I
M102104-3010-1	Zinc	Method Blank	SW6010B	0.0072	0.0072	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102204-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-CL	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-CO	Conductivity	Method Blank	SW9050A	2.0	2.0	µmhos/cm	U

TDS

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102504-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J046848

Project Name: Titusville **Date/Time Received:** 10/21/04 10:25

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102204NH3-	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102604TOC	Total Organic Carbon	Method Blank	E415.1	0.73	0.73	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102704TP1	Total Phosphorus (as P)	Method Blank	E365.4		0.043	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102804TKN1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2		0.048	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill
Project name: Titusville
Date/Time Rcvd: 10/21/04 1025
Log-In request number: J0410848
Received by: als
Completed by: als

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ Other (describe):

Type: ☒ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	0.0°C				
Temp taken from	☐ Temp blank ☒ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?	✓		
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*	✓		
15. Were the sample containers provided by AEL?	✓		
16. Were samples accepted into the laboratory?	✓		
17. Was it necessary to split samples into other bottles?		✓	

Comments:

C:\Documents and Settings\Login_Jax\Desktop\Login Shortcuts\CUR form.doc (2/2/04)

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J046848
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J046848-01	Titusville	Total Phosphorus (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-01	Titusville	TOC (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-01	Titusville	TKN (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-01	Titusville	Ammonia (T)	Water	10/20/2004	10:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-02	Port Orange	Total Phosphorus (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-02	Port Orange	TOC (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-02	Port Orange	TKN (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly
J046848-02	Port Orange	Ammonia (T)	Water	10/20/2004	13:00	10/21/04 10:25	**11/4/2004**		250mL Poly

Jacksonville Relinquisher: [signature] **Shipping Receiver:** Pony Express **Date/Time:** 10/21/2004 10:43:31 AM

Shipping Relinquisher: VE **Tampa Receiver:** VR **Date/Time:** 10-22-04 830

Advanced Environmental Laboratories, Inc.

CHAIN OF CUSTODY RECORD

LAB NUMBER **J046848**

- ☒ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
- ☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
- ☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
- ☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.TV

PROJECT LOCATION: Brevard County, FL

SAMPLED BY: SBB. EL

TURN AROUND TIME: ☑ STANDARD ☐ RUSH ____

REMARKS / SPECIAL INSTRUCTIONS: *Metals: Cd, Ca, Cl, Cu, Fe, Pb, Mg, Ni, K, Na, Zn
a Nutrients

WW= waste water **SW**=surface water **GW**=ground water **DW**=drinking water **OIL** **A**=air **SO**=soil **SL**=sludge

BOTTLE SIZE & TYPE / ANALYSIS REQUIRED / Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Alkalinity, NH_3, Color	Conductivity, NO_2+NO_3	Ortho P, SO_4, TDS	TKN, TOC, TP, TSS	Turbidity	Metals		LAB NUMBER
Titusville	Wetland Surface Water	Grab	10/20/04	1000	SW		X	X	X	X	X	X		
Port Orange	Wetland Surface Water	Grab	10/20/04	1300	SW		X	X	X	X	X	X		

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ____	RB ____	D/T ____
		AB ____	D/T ____
Ret: / /	Via: ____	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SBB EL	10/21/04	1200	[signature]	10/21/04	1025
2						
3						
4						

Received on ice ☒ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J052931
Project Name:	Titusville	**Date Sampled:**	4/28/05
Project Number:	147556.03.TV	**Date Received:**	4/29/05 08:50
		Date Reported:	5/23/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5+3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville
Report No.: J052931
Date/Time Received: 4/29/05 08:50

Lab Code: J052931-01
Client Sample ID: TV-1
Site: Wetland/Surface Water
Matrix: Water
Date/Time Sampled: 4/28/05 10:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	2	10	10	**70**	Color Units		E110.2		*J*
Conductivity	1	2.0	2.0	**240**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**100**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**20**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**200**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.77**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**20**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**3.0**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**3.2**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000051**	mg/L	U	SW6010B		*J*
Calcium	1	0.019	0.076	**37**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.00096**	mg/L	U	SW6010B		*J*
Iron	1	0.011	0.044	**0.37**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**1.6**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**1.2**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**9.7**	mg/L		SW6010B		*J*
Zinc	1	0.0016	0.0064	**0.011**	mg/L	, V	SW6010B		*J*

U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- The pH was 7.06.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville

Report No.: J052931

Date/Time Received: 4/29/05 08:50

Sample Cross Reference Information

Lab Code: J052931-01

Site: Wetland/Surface Water

Client Sample Number: TV-1

Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct050905nh3-1	5/9/05	13:11	AJ		
Color	E110.2	NONE	WCJ-042905-COL	4/29/05	14:55	MSA		
Conductivity	SW9050A	NONE	WCJ-052005-CON1	5/20/05	15:55	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-050505-N2	5/5/05	14:35	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-042905-O1	4/29/05		MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-051105-SO4	5/11/05	11:46	MSA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-051205-ALK	5/12/05	12:00	AK		
Total Chlorides	E325.2	NONE	WCJ-051005-C1	5/10/05	18:05	MSA		
Total Dissolved Solids	E160.1	NONE	WCJ-050205-TDS1	5/2/05	14:27	MSA		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct051005tkn1	5/10/05	09:19	AJ	pb050905tptkn	5/9/05
Total Metals	SW6010B	SW3010A	M050205-ICP-1	5/3/05	14:59	CDC	M050205-ICP-1	5/2/05 09:30:00
Total Organic Carbon	E415.1	NONE	WCT051305TOC	5/13/05	12:00	JH		
Total Phosphorus (as P)	E365.4	METHOD	wct051005tp1	5/10/05	12:27	AJ	pb050905tptkn	5/9/05
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-050305-TSS5	5/3/05	18:03	AK		
Turbidity	E180.1	NONE	WCJ-042905-TURB	4/29/05	10:40	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J052931

Project Name: Titusville **Date/Time Received:** 4/29/05 08:50

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M050205-ICP-1	Cadmium	Method Blank	SW6010B	0.000051	0.00017	mg/L	I
M050205-ICP-1	Calcium	Method Blank	SW6010B	0.019	0.030	mg/L	I
M050205-ICP-1	Copper	Method Blank	SW6010B	0.00096	0.00096	mg/L	U
M050205-ICP-1	Iron	Method Blank	SW6010B	0.011	0.014	mg/L	I
M050205-ICP-1	Lead	Method Blank	SW6010B	0.0019	0.0020	mg/L	I
M050205-ICP-1	Magnesium	Method Blank	SW6010B	0.012	0.018	mg/L	I
M050205-ICP-1	Nickel	Method Blank	SW6010B	0.0016	0.0016	mg/L	U
M050205-ICP-1	Potassium	Method Blank	SW6010B	0.029	0.029	mg/L	U
M050205-ICP-1	Sodium	Method Blank	SW6010B	0.019	0.026	mg/L	I
M050205-ICP-1	Zinc	Method Blank	SW6010B	0.0016	0.0097	mg/L	

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042905-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042905-O1	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042905-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-050205-TDS	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-050305-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-051005-C1	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-051105-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-051205-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-052005-CO	Conductivity	Method Blank	SW9050A		2.0	umhos/cm	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Report No.: J052931
Project Name: Titusville
Date/Time Received: 4/29/05 08:50

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct050905nh3-1	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct051005tkn1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct051005tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT051305TOC	Total Organic Carbon	Method Blank	E415.1	0.47	0.47	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

LB Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill

Project name: Titusville

Date/Time Rcvd: 4/29/05 0800

Log-In request number: J052931

Received by: WS

Completed by: WS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ AES ☐ ASAP ☐ Other (describe):

Type: ☒ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	-1				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J052931

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J052931-01	TV-1	Total Phosphorus (T)	Water	04/28/2005	10:00	4/29/05 08:50	**05/10/2005**		250mL Poly
J052931-01	TV-1	TOC (T)	Water	04/28/2005	10:00	4/29/05 08:50	**05/10/2005**		250mL Poly
J052931-01	TV-1	TKN (T)	Water	04/28/2005	10:00	4/29/05 08:50	**05/10/2005**		250mL Poly
J052931-01	TV-1	Ammonia (T)	Water	04/28/2005	10:00	4/29/05 08:50	**05/10/2005**		250mL Poly

Jacksonville Relinquisher: D. Salter

Shipping Receiver: FedEx ~~Pony Express~~

Date/Time:)5/03/2005 17:09:24

Shipping Relinquisher:

Tampa Receiver: K. Mandella

Date/Time: 5/4/03 12:30

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
❑ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

J052931

CLIENT NAME: CHam HILL

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608

PHONE: (352) 335-7991 FAX:

CONTACT: Steven Eckm

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.TV

PROJECT LOCATION: Brevard County

SAMPLED BY: Steve Eckm

TURN AROUND TIME:
❑ STANDARD
❑ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS: *Cd, Ca, Cl, Cu, Fe, Pb, Mg, Ni, K, Na, Zn

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Alk, NH3, Color, Cond | NO2+NO3, Ortho P | SO4, TDS, TKN, TOC | TP, TSS, Turb. | *Nutrients + Metals

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Preserv	Alk, NH3, Color, Cond	NO2+NO3, Ortho P	SO4, TDS, TKN, TOC	TP, TSS, Turb.	*Nutrients + Metals				LAB NUMBER
TV-1	Wetland / Surface Water	Grab	4/28/05	1000	SW	7		X	X	X	X	X				

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ______	RB ______	D/T ______
		AB ______	D/T ______
Ret: / /	Via: ______	Trip Bl. ❑	❑

	Relinquished by:	Date	Time	Received by:	Date	Time
1	Steve Eckm	4/28/05	1200	FEDEX		
2	FEDEX	4/29/05	0850	[illegible]	4/29/05	0850
3						
4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J057201
Project Name:	Port Orange/Titusville	**Date Sampled:**	10/25/05
Project Number:	14755603PO	**Date Received:**	10/26/05 08:45
		Date Reported:	11/7/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Port Orange/Titusville

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 6+3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange/Titusville
Report No.: J057201
Date/Time Received: 10/26/05 08:45

Lab Code: J057201-01
Client Sample ID: 1
Site: Port Orange Wetland Sample
Matrix: Water
Date/Time Sampled: 10/25/05 12:00
Shipping Method: Fed Ex
Sampled By: CLIENT
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	10	50	50	**150**	Color Units		E110.2		*J*
Conductivity	1	1.0	1.0	**24**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.035**	mg/L	i	E365.2		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**8.0**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**5.8**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**22**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.61**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**18**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**6.5**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**1.0**	NTU	U	E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000062**	mg/L	i , V	SW6010B		*J*
Calcium	1	0.019	0.076	**4.3**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.0026**	mg/L	i , V	SW6010B		*J*
Iron	1	0.011	0.044	**0.65**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**0.85**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**0.38**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**5.1**	mg/L		SW6010B		*J*
Zinc	1	0.0016	0.0064	**0.0095**	mg/L		SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 6.03.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Port Orange/Titusville
Report No.: J057201
Date/Time Received: 10/26/05 08:45

Lab Code: J057201-02
Client Sample ID: 2
Site: Titusville Wetland Surface Water
Matrix: Water
Date/Time Sampled: 10/25/05 09:00
Shipping Method: Fed Ex
Sampled By: CLIENT
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.034**	mg/L	i	E350.1		*T*
* Color	10	50	50	**100**	Color Units		E110.2		*J*
Conductivity	1	1.0	1.0	**100**	umhos/cm		SW9050A		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.054**	mg/L	i	E365.2		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**62**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**8.2**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**79**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.79**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**11**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.11**	mg/L	i	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**10**	mg/L		E160.2		*J*
Turbidity	1	1.0	1.0	**4.6**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000051**	mg/L	U	SW6010B		*J*
Calcium	1	0.019	0.076	**27**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.0022**	mg/L	i , V	SW6010B		*J*
Iron	1	0.011	0.044	**1.9**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**1.3**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**1.5**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**6.5**	mg/L		SW6010B		*J*
Zinc	1	0.0016	0.0064	**0.011**	mg/L		SW6010B		*J*

i — The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U — The compound was analyzed for but not detected.
V — Indicates that the analyte was detected in both the sample and the associated method blank.
J — DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T — DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 6.39.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J057201

Project Name: Port Orange/Titusville **Date/Time Received:** 10/26/05 08:45

Sample Cross Reference Information

Lab Code: J057201-01 **Site: Port Orange Wetland Sam**

Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102705nh3-2	10/27/05 14:21	AJ		
Color	E110.2	NONE	WCJ-102705-COL	10/27/05 08:50	MSA		
Conductivity	SW9050A	NONE	WCJ-102705-CON1	10/27/05 16:00	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-102805-N2	10/28/05 14:37	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-102605-O1	10/26/05 14:10	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-103105-SO4	10/31/05 10:00	AA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-110105-ALK	11/1/05 09:45	AA		
Total Chlorides	E325.2	NONE	WCJ-110105-C1	11/1/05 14:03	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-102705-tds	10/27/05 16:15	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct110305tkn-1	11/3/05 16:50	AJ	PB110205TPTKN	11/2/05
Total Metals	SW6010B	SW3010A	M102605-ICP-1	10/28/05 10:35	CDC	M102605-ICP-1	10/26/05 08:30:0
Total Organic Carbon	E415.1	NONE	wct102705toc	10/27/05 18:30	JH		
Total Phosphorus (as P)	E365.4	METHOD	wct110305tp-1	11/3/05 12:13	AJ	PB110205TPTKN	11/2/05
Total Suspended Solids (TSS)	E160.2	NONE	wcj-102805-tss3	10/28/05 14:56	AB		
Turbidity	E180.1	NONE	WCJ-102605-TURB	10/26/05 16:00	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Lab Code: J057201-02 **Site: Titusville Wetland Surface**

Client Sample Number: 2 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102705nh3-3	10/27/05 14:41	AJ		
Color	E110.2	NONE	WCJ-102705-COL	10/27/05 08:50	MSA		
Conductivity	SW9050A	NONE	WCJ-102705-CON1	10/27/05 16:00	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-102805-N2	10/28/05 14:37	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-102605-O1	10/26/05 14:10	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-103105-SO4	10/31/05 10:00	AA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-110105-ALK	11/1/05 09:45	AA		
Total Chlorides	E325.2	NONE	WCJ-110105-C1	11/1/05 14:03	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-102705-tds	10/27/05 16:15	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct110305tkn-1	11/3/05 16:50	AJ	PB110205TPTKN	11/2/05
Total Metals	SW6010B	SW3010A	M102605-ICP-1	10/28/05 10:35	CDC	M102605-ICP-1	10/26/05 08:30:0
Total Organic Carbon	E415.1	NONE	wct102705toc	10/27/05 18:30	JH		
Total Phosphorus (as P)	E365.4	METHOD	wct110305tp-1	11/3/05 12:13	AJ	PB110205TPTKN	11/2/05
Total Suspended Solids (TSS)	E160.2	NONE	wcj-102805-tss3	10/28/05 14:56	AB		
Turbidity	E180.1	NONE	WCJ-102605-TURB	10/26/05 16:00	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Port Orange/Titusville

Report No.: J057201

Date/Time Received: 10/26/05 08:45

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102605-ICP-1	Cadmium	Method Blank	SW6010B	0.000051	0.000069	mg/L	I
M102605-ICP-1	Calcium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102605-ICP-1	Copper	Method Blank	SW6010B	0.00096	0.0024	mg/L	I
M102605-ICP-1	Iron	Method Blank	SW6010B	0.011	0.011	mg/L	U
M102605-ICP-1	Lead	Method Blank	SW6010B	0.0019	0.0019	mg/L	U
M102605-ICP-1	Magnesium	Method Blank	SW6010B	0.012	0.015	mg/L	I
M102605-ICP-1	Nickel	Method Blank	SW6010B	0.0016	0.0016	mg/L	U
M102605-ICP-1	Potassium	Method Blank	SW6010B	0.029	0.029	mg/L	U
M102605-ICP-1	Sodium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102605-ICP-1	Zinc	Method Blank	SW6010B	0.0016	0.0016	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102605-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102705-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102705-CO	Conductivity	Method Blank	SW9050A	2.0	1.0	umhos/cm	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-102705-tds	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102805-N2	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-102805-tss3	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-103105-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110105-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110105-C1	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J057201

Project Name: Port Orange/Titusville **Date/Time Received:** 10/26/05 08:45

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705nh3-2	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705nh3-3	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705toc	Total Organic Carbon	Method Blank	E415.1	0.47	0.47	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110305tkn-1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110305tp-1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill/J'ville

Project name: Port Orange/Titusville

Date/Time Rcvd: 10/26/05 0845

Log-In request number: J057201

Received by: LDS

Completed by: LDS

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☑ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ______

Type: ☑ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	0				
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☑ Sample Bottle ☐ Cooler
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J057201

CustomerName: CH2M Hill

Collector: CLIENT

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J057201-01	1	Total Phosphorus (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005			
J057201-01	1	TKN (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-01	1	Ammonia (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-01	1	TOC (T)	Water	10/25/2005	12:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-02	2	Total Phosphorus (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005			
J057201-02	2	TKN (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-02	2	Ammonia (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005		250mL Poly	
J057201-02	2	TOC (T)	Water	10/25/2005	09:00	10/26/05 08:45	10/31/2005		250mL Poly	

Jacksonville Relinquisher: [signature]

Shipping Receiver: B/S DHL ~~Pony Express~~

Date/Time: 10/26/2005 ~~10:46:24~~ 17:00

Shipping Relinquisher:

Tampa Receiver: K. Mandelle

Date/Time: 10-27-05 10:00

Advanced Environmental Laboratories, Inc.

- ☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
- ☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
- ☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
- ☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

L

J057201

CLIENT NAME: CH2M HILL	PROJECT NAME: Port Orange / Titusville
ADDRESS: 3011 SW Williston Rd. Gainesville FL 32605	P.O. NUMBER / PROJECT NUMBER: 147556.03.PO
PHONE: (352) 335-7991 FAX:	PROJECT LOCATION: Volusia / Brevard Counties Florida
CONTACT: Steve Eakin	SAMPLED BY: [signature]
TURN AROUND TIME: ☑ STANDARD ☐ RUSH ____	REMARKS / SPECIAL INSTRUCTIONS: * Ortho phosphate samples not filtered in field

BOTTLE SIZE & TYPE — ANALYSIS REQUIRED — LAB NUMBER

WW= waste water **SW**=surface water **GW**=ground water **DW**=drinking water **OIL** **A**=air **SO**=soil **SL**=sludge

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Preserv	Ortho P *	TOC	NO2+NO3	Metals	NH3/TKN/TP	Chl/SO4/Color/Cond	Turb/Alk	TDS/TSS
Port Orange	Wetland Surface Water	Grab	10/25/05	12:00	SW	7		X	X	X	X	X	X	X	X
Titusville	Wetland Surface Water	Grab	10/25/05	9:00	SW	7		X	X	X	X	X	X	X	X

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #		Relinquished by:	Date	Time	Received by:	Date	Time
Out: / /	Via: ____	RB____	D/T____	1	[signature]	10/25/05	13:00	F/E		
		AB____	D/T____	2	F/E	10/26/05	0845	D. Salter	10/26/05	0845
Ret: / /	Via: ____	Trip Bl.		3						
		☐	☐	4						

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J062158
Project Name:	Titusville	**Date Sampled:**	3/28/06
Project Number:	147556.03.TV	**Date Received:**	3/29/06 09:23
		Date Reported:	4/18/06

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5+3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville
Report No.: J062158
Date/Time Received: 3/29/06 09:23

Lab Code: J062158-01
Client Sample ID: 1
Site: Titusville Wetland Surface Water
Matrix: Water
Date/Time Sampled: 3/28/06 12:00
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* Color	5	25	25	**100**	Color Units		E110.2		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.013**	mg/L	U	E365.1		*J*
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		*J*
Total Alkalinity (as CaCO3)	1	5.0	5.0	**130**	mg/L		E310.1		*J*
Total Chlorides	1	0.50	2.0	**24**	mg/L		E325.2		*J*
Total Dissolved Solids	1	10	10	**220**	mg/L		E160.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.3**	mg/L		E351.2		*T*
Total Organic Carbon	1	0.47	1.9	**22**	mg/L		E415.1		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**13**	mg/L		E160.2		*J*
Turbidity	5	5.0	5.0	**23**	NTU		E180.1		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.036**	mg/L	i	E353.2		*J*

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.000078**	mg/L	i , V	SW6010B		*J*
Calcium	1	0.019	0.076	**53**	mg/L		SW6010B		*J*
Copper	1	0.00096	0.0038	**0.0054**	mg/L		SW6010B		*J*
Iron	1	0.011	0.044	**4.5**	mg/L		SW6010B		*J*
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		*J*
Magnesium	1	0.012	0.048	**1.5**	mg/L		SW6010B		*J*
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		*J*
Potassium	1	0.029	0.12	**0.95**	mg/L		SW6010B		*J*
Sodium	1	0.019	0.076	**12**	mg/L		SW6010B		*J*
* Zinc	1	0.0016	0.0064	**0.012**	mg/L	, V	SW6010B		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 6.60.
* Comment for Zinc -- Analyzed 4/4/06 due to reanalysis.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville

Report No.: J062158

Date/Time Received: 3/29/06 09:23

Sample Cross Reference Information

Lab Code: J062158-01 **Site: Titusville Wetland Surface**

Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE			15:36			
Color	E110.2	NONE	WCJ-033006-COL	3/30/06	11:18	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-033006-N1	3/30/06	09:45	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-032906-O2	3/29/06	12:55	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-041106-SO4	4/11/06	10:00	AA		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-033006-ALK	3/30/06	14:00	AA		
Total Chlorides	E325.2	NONE	WCJ-041106-C1	4/11/06	15:04	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-040306-tds	4/3/06	15:30	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD			09:48			
Total Metals	SW6010B	SW3010A	M032906-ICP-2	3/30/06	20:08	CDC	M032906-ICP-2	3/29/06 10:55:00
Total Organic Carbon	E415.1	NONE			22:45			
Total Phosphorus (as P)	E365.4	METHOD			14:55			
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-040306-TSS1	4/3/06	14:46	LM		
Turbidity	E180.1	NONE	WCJ-033006-TURB	3/30/06	10:45	AA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J062158

Project Name: Titusville **Date/Time Received:** 3/29/06 09:23

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M032906-ICP-2	Cadmium	Method Blank	SW6010B	0.000051	0.00011	mg/L	I
M032906-ICP-2	Calcium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M032906-ICP-2	Copper	Method Blank	SW6010B	0.00096	0.00096	mg/L	U
M032906-ICP-2	Iron	Method Blank	SW6010B	0.011	0.24	mg/L	
M032906-ICP-2	Lead	Method Blank	SW6010B	0.0019	0.0019	mg/L	U
M032906-ICP-2	Magnesium	Method Blank	SW6010B	0.012	0.012	mg/L	U
M032906-ICP-2	Nickel	Method Blank	SW6010B	0.0016	0.0016	mg/L	U
M032906-ICP-2	Potassium	Method Blank	SW6010B	0.029	0.029	mg/L	U
M032906-ICP-2	Sodium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M032906-ICP-2	Zinc	Method Blank	SW6010B	0.0016	0.0046	mg/L	I

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-032906-O2	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033006-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033006-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033006-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033006-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-040306-tds	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040306-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-041106-C1	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-041106-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville

Report No.: J062158

Date/Time Received: 3/29/06 09:23

Quality Assurance Qualifiers:

I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U	The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

La Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill

Project name: Titusville

Date/Time Rcvd: 03/29/06 09:23

Log-In request number: J0602158

Received by: [signature]

Completed by: [signature]

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Pony Express ☑ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ______

Type: ☑ Cooler ☐ Box ☐ Other (describe) ______

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	2°				
Temp taken from	☐ Sample Bottle ☑ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J062158
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type	(Pres.)
J062158-01	1	Total Phosphorus (T)	Water	03/28/2006	12:00	3/29/06 09:23	**04/12/2006**		250mL Poly	
J062158-01	1	TKN (T)	Water	03/28/2006	12:00	3/29/06 09:23	**04/12/2006**		250mL Poly	
J062158-01	1	Ammonia (T)	Water	03/28/2006	12:00	3/29/06 09:23	**04/12/2006**		250mL Poly	
J062158-01	1	TOC (T)	Water	03/28/2006	12:00	3/29/06 09:23	**04/12/2006**		250mL Poly	

Jacksonville Relinquisher: [signature]
Shipping Receiver: BS ~~Pony Express~~
Date/Time: 03/29/2006 ~~15:54:46~~ 17:00

Shipping Relinquisher:
Tampa Receiver: K. Maddle
Date/Time: 3/30/06 09:!

Advanced Environmental Laboratories, Inc.
☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (81
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fa
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (40

CHAIN OF CUS

J062158

UMBER:

164

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32605

PHONE: (352)335-7991 FAX:

CONTACT: Steve Eaken

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.03.TV

PROJECT LOCATION: Brevard County

SAMPLED BY: S. Eaken

TURN AROUND TIME:
☑ STANDARD
☐ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:
* Metals: Cd, Cu, Fe, Pb, Mg, Ni, Zn

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

BOTTLE SIZE & TYPE / ANALYSIS REQUIRED / Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Color, Alk, TSS, TDS	TOC, Turbidity, Ammonia	TKN, NO2+NO3, TP	Ortho P, Sulfate, Cl⁻	Ca, Na, K	*Metals		LAB NUMBER
Titusville	Wetland Surface Water	Grab	3/28/06	1200	SW		X	X	X	X	X	X		01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SB Eaken	3/28/06	1300	Casey Young	3-29-06	09:23
2						
3						
4						

Shipment Out: / / Ret: / /
Method Via: ____ Via: ____
Sample Kit RB______ D/T______ AB______ D/T______ Trip Bl. ☐ ☐
Cooler # ______

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J067946
Project Name:	Titusville	**Date Sampled:**	10/25/06
Project Number:	147556.03.TV	**Date Received:**	10/26/06 11:55
		Date Reported:	11/13/06

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Titusville

Approved By: Paul Gunsaulies

Signature valid

Digitally signed by Paul Gunsaulies
DN: cn=Paul Gunsaulies, o=AEL, c=US
Date: 2006.11.13 13:43:36 -05'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 5 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J067946
Date/Time Received: 10/26/06 11:55

Lab Code: J067946-01
Client Sample ID: 1
Site: Wetland Surface Water
Matrix: Water

Date/Time Sampled: 10/25/06 11:00
Shipping Method: fedex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		T
Color	10	50	50	**200**	Color Units		E110.2		J
Conductivity	1	1.0	1.0	**280**	umhos/cm		SW9050A		J
Ortho-phosphate (as P)	1	0.019	0.075	**0.16**	mg/L		E365.2		J
Sulfate (as SO4)	1	5.0	20	**5.0**	mg/L	U	E375.4		J
Total Alkalinity (as CaCO3)	1	5.0	5.0	**100**	mg/L		E310.1		J
Total Chlorides	1	0.50	2.0	**25**	mg/L		E325.2		J
Total Dissolved Solids	1	10	10	**220**	mg/L		E160.1		J
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.2**	mg/L		E351.2		T
Total Organic Carbon	1	0.47	1.9	**23**	mg/L		E415.1		T
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		T
Total Suspended Solids (TSS)	1	2.0	2.0	**6.8**	mg/L		E160.2		J
Turbidity	5	5.0	5.0	**29**	NTU		E180.1		J

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		J

Total Metals

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Cadmium	1	0.000051	0.00020	**0.00016**	mg/L	i	SW6010B		J
* Calcium	1	0.019	0.076	**43**	mg/L		SW6010B		J
Copper	1	0.00096	0.0038	**0.0053**	mg/L		SW6010B		J
* Iron	1	0.011	0.044	**3.7**	mg/L		SW6010B		J
Lead	1	0.0019	0.0076	**0.0019**	mg/L	U	SW6010B		J
* Magnesium	1	0.012	0.048	**1.8**	mg/L		SW6010B		J
Nickel	1	0.0016	0.0064	**0.0016**	mg/L	U	SW6010B		J
* Potassium	1	0.029	0.12	**2.5**	mg/L		SW6010B		J
* Sodium	1	0.019	0.076	**14**	mg/L		SW6010B		J
Zinc	1	0.0016	0.0064	**0.0061**	mg/L	i , V	SW6010B		J

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Calcium -- Analyzed 10/30/06 due to reanalysis.
* Comment for Iron -- Analyzed 10/30/06 due to reanalysis.
* Comment for Magnesium -- Analyzed 10/30/06 due to reanalysis.
* Comment for Potassium -- Analyzed 10/30/06 due to reanalysis.
* Comment for Sodium -- Analyzed 10/30/06 due to reanalysis.

5 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J067946
Date/Time Received: 10/26/06 11:55

Sample Cross Reference Information

Lab Code: J067946-01
Client Sample Number: 1

Site: Wetland Surface Water
Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT110106NH3	11/1/06	09:42	LSP		
Color	E110.2	NONE	WCJ-102706-COL	10/27/06	10:30	AA		
Conductivity	SW9050A	NONE	WCJ-111006-CON1	11/10/06	15:45	TF		
Nitrate + Nitrite	E353.2	NONE	WCJ-110706-N1	11/7/06	13:13	AA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-102706-O1	10/27/06	08:45	MSA		
Sulfate (as SO4)	E375.4	NONE	WCJ-110306-SO4	11/3/06	10:00	LMM		
Total Alkalinity (as CaCO3)	E310.1	NONE	WCJ-103006-ALK	10/30/06	17:30	PM		
Total Chlorides	E325.2	NONE	WCJ-103106-C2	10/31/06	15:47	MSA		
Total Dissolved Solids	E160.1	NONE	wcj-103106-tds	10/31/06	15:00	LM		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	WCT110306TKN	11/3/06	08:22	LSP	PB103106TPTKN	10/31/06
Total Metals	SW6010B	SW3010A	M102706-ICP-2	10/27/06	22:08	CDC	M102706-ICP-2	10/27/06 10:10:0
Total Organic Carbon	E415.1	NONE	WCT103106TOC	10/31/06	12:45	JCH		
Total Phosphorus (as P)	E365.4	METHOD	WCT110706TP	11/7/06	09:12	PG	PB103106TPTKN	10/31/06
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-103006-TSS	10/30/06	16:20	PM		
Turbidity	E180.1	NONE	WCJ-102606-TURB	10/26/06	17:50	PM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Titusville

Report No.: J067946
Date/Time Received: 10/26/06 11:55

Quality Assurance Report

Method Blanks

Total Metals

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
M102706-ICP-2	Cadmium	Method Blank	SW6010B	0.000051	0.000051	mg/L	U
M102706-ICP-2	Calcium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102706-ICP-2	Copper	Method Blank	SW6010B	0.00096	0.00096	mg/L	U
M102706-ICP-2	Iron	Method Blank	SW6010B	0.011	0.011	mg/L	U
M102706-ICP-2	Lead	Method Blank	SW6010B	0.0019	0.0027	mg/L	I
M102706-ICP-2	Magnesium	Method Blank	SW6010B	0.012	0.012	mg/L	U
M102706-ICP-2	Nickel	Method Blank	SW6010B	0.0016	0.0016	mg/L	U
M102706-ICP-2	Potassium	Method Blank	SW6010B	0.029	0.029	mg/L	U
M102706-ICP-2	Sodium	Method Blank	SW6010B	0.019	0.019	mg/L	U
M102706-ICP-2	Zinc	Method Blank	SW6010B	0.0016	0.0018	mg/L	I

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102606-TUR	Turbidity	Method Blank	E180.1	1.0	1.0	NTU	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102706-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-103006-ALK	Total Alkalinity (as CaCO3)	Method Blank	E310.1	5.0	5.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-103006-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-103106-C2	Total Chlorides	Method Blank	E325.2	0.50	0.50	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wcj-103106-tds	Total Dissolved Solids	Method Blank	E160.1	10	10	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110306-SO4	Sulfate (as SO4)	Method Blank	E375.4	5.0	5.0	mg/L	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-110706-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-111006-CO	Conductivity	Method Blank	SW9050A		1.0	umhos/cm	U

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Titusville

Report No.: J067946

Date/Time Received: 10/26/06 11:55

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT103106TOC	Total Organic Carbon	Method Blank	E415.1	0.47	0.47	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT110106NH3	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT110306TKN	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct110706tp	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill

Project name: Titusville

Date/Time Rcvd: 10-26-06 11:55

Log-In request number: J067946

Received by: CAT

Completed by: CAT

Cooler/Shipping Information:

Courier: ☐ AEL ☐ Client ☐ UPS ☐ Blue Streak ☑ FedEx ☐ Other (describe):

Type: ☑ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	0				
Temp taken from	☐ Temp blank ☑ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any "NO" responses or discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			–
2. Were custody papers properly included with samples?	–		
3. Were custody papers properly filled out (ink, signed, match labels)?	–		
4. Did all bottles arrive in good condition (unbroken)?	–		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	–		
6. Did the sample labels agree with the chain of custody?	–		
7. Were correct bottles used for the tests indicated?	–		
8. Were proper sample preservation techniques indicated on the label?	–		
9. Were samples received within holding times?	–		
10. Were all VOA vials checked for the presence of air bubbles?			–
11. Were there air bubbles present in the VOA vials?			–
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	–		
13. Was the cooler temperature less than 6°C?	–		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*		–	
15. Were the sample containers provided by AEL?	–		
16. Were samples accepted into the laboratory?	–		

Comments:

\\Jax-server\ael_qa\Forms\AEL Log-In Checklist Form.doc (10/9/06)

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J067946
CustomerName: CH2M Hill
Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date / Time		Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J067946-01	1	Total Phosphorus (T)	Water	10/25/2006	11:00	10/26/06 11:55	11/02/2006		250mL Poly
J067946-01	1	TKN (T)	Water	10/25/2006	11:00	10/26/06 11:55	11/02/2006		250mL Poly
J067946-01	1	Ammonia (T)	Water	10/25/2006	11:00	10/26/06 11:55	11/02/2006		250mL Poly
J067946-01	1	TOC (T)	Water	10/25/2006	11:00	10/26/06 11:55	11/02/2006		250mL Poly

Jacksonville Relinquisher: Casey Young
Shipping Receiver: B/S ~~Pony Express~~
Date/Time: 10/26/2006 ~~16:27:51~~ 1700

Shipping Relinquisher:
Tampa Receiver: K. Mad
Date/Time: 10/27/06 09:

Page 1 of 1

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 6821 SW Archer Road, Gainesville, FL 32608 • (352) 367-1500 Fax (352) 367-0050
❑ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

LAB I

J067946

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608

PHONE: 352-335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Titusville

P.O. NUMBER / PROJECT NUMBER: 147556.TV.03

PROJECT LOCATION: Volusia County, FL

SAMPLED BY: [signature]

TURN AROUND TIME: ☑ STANDARD ❑ RUSH ________

REMARKS / SPECIAL INSTRUCTIONS: *Ortho P not filtered in field.

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

ANALYSIS REQUIRED: OP, TOC, NO2+NO3 | Metals | NH3, TKN, TP | Chl, SO4, Color, Cond, | Turb, Alk, TDS, TSS

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	BOTTLE SIZE & TYPE / Preserv	OP, TOC, NO2+NO3	Metals	NH3, TKN, TP	Chl, SO4, Color, Cond,	Turb, Alk, TDS, TSS			LAB NUMBER
Titusville	Wetland Surface Water	Grab	10/25/06	1100	SW	7		X	X	X	X	X			01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #		Relinquished by:	Date	Time	Received by:	Date	Time
Out: / /	Via: ____	RB____	D/T____	1	[signature]	10/25/06	1200	Casey Young	10-26-06	11:55
		AB____	D/T____	2						
Ret: / /	Via: ____	Trip Bl. ❑	❑	3						
				4						

Received on ice: ☑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Appendix B
Detailed Vegetation Data

Baseline Period

TABLE B-1
Summary of Herbaceous 1-Meter Square Plots in the Parkland Wetland, Titusville - Sept. 28, 1999

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Ampelopsis arborea		30						4	7.26
Aster carolinianus	5		20		50	5	5	12	20.58
Baccharis halimifolia						10		1	2.42
Eupatorium capillifolium	10	5		10	10	5	10	7	12.11
Mikania scandens			5					1	1.21
Passiflora incarnata		10						1	2.42
Polygonum punctatum	40	5	10		3	3	5	9	15.98
Rubus sp.	5							1	1.21
Sacciolepis striata			5	40		7		7	12.59
Salix caroliniana							10	1	2.42
Typha domingensis						40	50	13	21.79
Total	60	50	40	50	63	70	80	59	100.00
Open Water	20	15	60	40	40	30	20	32	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Aster carolinianus		5	3		30			5	9.60
Eupatorium capillifolium	5	5	5	5			35	8	13.89
Ludwidgia peruviana							10	1	2.53
Pluchea rosea							5	1	1.26
Polygonum punctatum	3	60		5	10		50	18	32.32
Sambucus canadensis				5				1	1.26
Typha domingensis					50	105		22	39.14
Total	8	70	8	15	90	105	100	57	100.00
Open Water	80	25	90	80	10	0	0	41	

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Aster carolinianus	10			30	30			10	16.95
Eupatorium capillifolium			3					0	0.73
Polygonum punctatum	5		10	3		10		4	6.78
Polygonum densiflorum					5			1	1.21
Sacciolepis striata				5				1	1.21
Typha domingensis		20			80	95	107	43	73.12
Total	15	20	13	38	115	105	107	59	100.00
Open Water	80	75	85	55	0	0	0	42	

TABLE B-2
Summary of Herbaceous 1-Meter Square Plots in the Parkland Wetland, Titusville - Oct. 3, 2001

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Ampelopsis arborea	11			10				3	5.63
Aster carolinianus			85	60				21	38.87
Boehmeria cyclindrica		2	5					1	1.88
Eupatorium sp.		1						0	0.27
Lemna sp.							1	0	0.27
Ludwigia peruviana	15							2	4.02
Mikania scandens	5	1			40	7	20	10	19.57
Polygonum punctatum	70		1		5		1	11	20.64
Salix caroliniana		3		20		10		5	8.85
Total	101	7	91	90	45	17	22	53	100.00
Bare Ground/Dead Veg./Litter		3		1	5	10	10	4.14	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Ampelopsis arborea	5							1	3.65
Aster carolinianus					15			2	10.95
Boehmeria cyclindrica	1		5					1	4.38
Ludwigia peruviana	20							3	14.60
Mikania scandens	1	5	5	20				4	22.63
Polygonum punctatum		20		2		1	1	3	17.52
Salix caroliniana			15		5			3	14.60
Typha domingensis					1		15	2	11.68
Total	27	25	25	22	21	1	16	20	100.00
Bare Ground/Dead Veg./Litter				1	5	20	5	4.43	

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Ampelopsis arborea	30							4	9.49
Aster carolinianus			5	1	10			2	5.06
Boehmeria cyclindrica			5					1	1.58
Mikania scandens		40	40	1	60	60		29	63.61
Polygonum punctatum		20			1		30	7	16.14
Salix caroliniana		5	1		2			1	2.53
Typha domingensis						5		1	1.58
Total	30	65	51	2	73	60	30	45	100.00
Bare Ground/Dead Veg./Litter						30	20	7.14	

Table B-3

Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - September 28, 1999

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	2.00	0.51				2.51	5.02	2.70	0.40	9.52	6.11
Eupatorium capillifolium	FAC	5.10	7.00	6.60	8.20	4.00	30.90	61.80	33.28	1.00	23.81	28.54
Rubus sp.	FAC	2.81					2.81	5.62	3.03	0.20	4.76	3.89
Polygonum punctatum	OBL	7.80	8.70	3.61	5.80	6.00	31.91	63.82	34.37	1.00	23.81	29.09
Sacciolepis striata	OBL	0.01	3.00	7.60		3.90	14.51	29.02	15.63	0.80	19.05	17.34
Typha domingensis	OBL	0.01		1.90	1.50	6.80	10.21	20.42	11.00	0.80	19.05	15.02
Total		17.73	19.21	19.71	15.50	20.70	92.85	185.70	100.00	4.20	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	1.70					1.70	3.40	2.00	0.20	5.56	3.78
Eupatorium capillifolium	FAC	8.30	7.70	7.50		4.00	27.50	55.00	32.31	0.80	22.22	27.27
Rubus sp.	FAC			1.20			1.20	2.40	1.41	0.20	5.56	3.48
Polygonum punctatum	OBL	4.40	4.20	5.40	3.70	3.41	21.11	42.22	24.80	1.00	27.78	26.29
Sacciolepis striata	OBL	3.50	0.30				3.80	7.60	4.46	0.40	11.11	7.79
Typha domingensis	OBL	5.40	0.40	7.00	7.00	10.00	29.80	59.60	35.01	1.00	27.78	31.40
Total		23.30	12.60	21.10	10.70	17.41	85.11	170.22	100.00	3.60	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	0.21	5.90	2.00			8.11	17.63	15.37	0.60	21.43	18.40
Rubus sp.	FAC		0.30				0.30	0.65	0.57	0.20	7.14	3.86
Polygonum punctatum	OBL	2.51	5.40	6.60	3.62	2.70	20.83	45.28	39.48	1.00	35.71	37.60
Sacciolepis striata	OBL	0.01					0.01	0.02	0.02	0.20	7.14	3.58
Typha domingensis	OBL	2.00		6.60	9.20	5.71	23.51	51.11	44.56	0.80	28.57	36.57
Total		4.73	11.60	15.20	12.82	8.41	52.76	114.70	100.00	2.80	100.00	100.00

Transect length 46 meters.

Table B-4
Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - October 3, 2001

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Ampelopsis arborea	UPL		2.76	0.95			3.71	7.42	23.86	0.40	22.22	23.04
Eupatorium capillifolium	FAC	1.41					1.41	2.82	9.07	0.20	11.11	10.09
Polygonum punctatum	OBL	5.26	1.51	0.42	0.44		7.63	15.26	49.07	0.80	44.44	46.76
Typha domingensis	OBL				2.19	0.61	2.80	5.60	18.01	0.40	22.22	20.11
Total		6.67	4.27	1.37	2.63	0.61	15.55	31.10	100.00	1.80	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Ampelopsis arborea	UPL	3.96					3.96	7.92	13.99	0.20	10.00	12.00
Polygonum punctatum	OBL	2.85	4.22	1.00		5.61	13.68	27.36	48.34	0.80	40.00	44.17
Rubus sp.	FAC	0.65					0.65	1.30	2.30	0.20	10.00	6.15
Sacciolepis striata	OBL			0.40			0.40	0.80	1.41	0.20	10.00	5.71
Typha domingensis	OBL	1.32			4.90	3.39	9.61	19.22	33.96	0.60	30.00	31.98
Total		8.78	4.22	1.40	4.90	9.00	28.30	56.60	100.00	2.00	100.00	100.00

Transect length 50 meters.

TABLE B-5
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period			
		September 29, 1999		October 3, 2001	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
1	17	3.75	11.04	4.21	13.92
1	301			6.00	28.27
1	302			8.15	52.17
1	330	6.61	34.30	8.28	53.85
1	409	3.30	8.55		
1	410	2.30	4.15	2.30	4.15
1	411	3.15	7.79	3.23	8.19
1	412	6.50	33.17	8.18	52.55
1	413	6.08	29.02	7.12	39.82
1	414	6.68	35.03	8.85	61.51
1	415	4.20	13.85	5.80	26.42
1	416	6.90	37.37	8.25	53.46
1	417	4.50	15.90	4.85	18.47
1	418	5.22	21.39	8.19	52.68
1	419	2.88	6.51	3.45	9.35
1	420	3.31	8.60	3.99	12.50
1	421	4.12	13.32	5.49	23.67
1	422	3.95	12.25	5.55	24.19
1	423	6.05	28.73	8.30	54.11
1	424	4.62	16.76	8.10	51.53
1	440	7.30	41.83		
1	441	3.58	10.06	4.35	14.86
1	442	4.70	17.34	5.70	25.52
1	443	3.32	8.65	3.80	11.34
1	445	7.22	40.92	7.20	40.72
2	304			9.00	63.62
2	305			2.75	5.94
2	446	4.28	14.38	6.85	36.85
2	447	4.90	18.85	5.40	22.90
2	448	3.60	10.17		
2	449	5.35	22.47	6.42	32.37
2	450	6.00	28.26	7.78	47.54
2	451	2.81	6.20	3.30	8.55
2	452	6.50	33.17	8.00	50.27
2	453	3.45	9.34	3.41	9.13
3	306			7.87	48.65
3	307			6.80	36.32
3	308			2.46	4.75
3	454	4.38	15.06		
3	455	3.59	10.12		
3	456	5.42	23.06	6.89	37.28
3	457	3.58	10.06	3.89	11.88
3	458	4.70	17.34	5.62	24.81

TABLE B-5
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period			
		September 29, 1999		October 3, 2001	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
3	459	3.40	9.07	4.32	14.66
3	460	4.50	15.90	4.92	19.01
3	461	5.41	22.98	6.53	33.49
3	462	2.58	5.23		
3	463	4.10	13.20	4.12	13.33
3	464	3.10	7.54	3.00	7.07
3	465	2.60	5.31		
3	466	3.80	11.34	3.72	10.87
3	467	4.27	14.31	6.31	31.27
3	468	3.80	11.34	5.90	27.34
3	469	5.20	21.23		
3	470	3.45	9.34		
3	471	2.50	4.91		
3	472	2.80	6.15		
3	473	2.60	5.31	2.90	6.61
3	483	2.80	6.15	3.75	11.04
3	484	2.98	6.97	3.20	8.04
3	487	3.50	9.62	3.90	11.95
4	309			3.00	7.07
4	311			2.25	3.98
4	312			4.25	14.19
4	313			3.82	11.46
4	314			3.94	12.19
4	439			5.51	23.84
4	474	5.10	20.42	5.85	26.88
4	475	3.08	7.45	2.95	6.83
4	476	4.08	13.07	5.75	25.97
4	477	3.42	9.18	6.61	34.32
4	478	3.98	12.43	7.91	49.14
4	479	3.98	12.43	4.40	15.21
4	480	3.05	7.30	4.20	13.85
4	481	3.25	8.29	3.10	7.55
4	482	5.10	20.42	5.70	25.52
4	485	3.90	11.94	5.90	27.34
4	486	3.55	9.89	3.95	12.25
4	488	3.45	9.34	5.45	23.33
4	489	5.50	23.75	6.13	29.51
4	490	3.89	11.88	4.29	14.45
4	491	3.00	7.07		
4	492	3.25	8.29		
4	921	5.71	25.59	5.60	24.63
4	922	4.59	16.54	4.44	15.48

TABLE B-5
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period			
		September 29, 1999		October 3, 2001	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
4	923	3.30	8.55	3.18	7.94
4	924	3.10	7.54	3.20	8.04
4	925	5.21	21.31	5.25	21.65
4	926	7.20	40.69	8.14	52.04
4	927	3.42	9.18	5.60	24.63
4	928	5.30	22.05	6.42	32.37
4	929	3.60	10.17	3.75	11.04
4	930	4.20	13.85	4.50	15.90
4	931	2.95	6.83	2.90	6.61
4	932	4.18	13.72	4.35	14.86
4	933	9.11	65.15	11.44	102.79
4	934	9.55	71.59	10.34	83.97
4	935	3.68	10.63	4.48	15.76
4	936	3.75	11.04	3.62	10.29
4	937	2.71	5.77	3.62	10.29
4	938	5.40	22.89	5.40	22.90
4	939	4.29	14.45	5.49	23.67
4	940	4.65	16.97		
4	941	7.17	40.36	7.51	44.30
4	942	3.85	11.64		
4	943	5.10	20.42	5.40	22.90
5	310			4.54	16.19
5	315			5.56	24.28
5	316			3.39	9.03
5	317			5.42	23.07
5	318			4.48	15.76
5	319			4.62	16.76
5	320			3.31	8.60
5	321			3.20	8.04
5	719	2.40	4.52		
5	944	2.65	5.51	4.99	19.56
5	945	3.10	7.54		
5	946	2.51	4.95	2.35	4.34
5	947	3.20	8.04	5.70	25.52
5	948	3.50	9.62	3.19	7.99
5	949	3.15	7.79	3.20	8.04
5	950	2.69	5.68	5.80	26.42
5	951	2.98	6.97	5.42	23.07
5	952	2.70	5.72	5.70	25.52
Total		434.67	1607.31	558.81	2587.96

Subquad - approximately 10m each.

Operational Year 1

TABLE B-6
Summary of Herbaceous 1-Meter Square Plots in the Parkland Wetland, Titusville - Dec. 10, 2002

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Ampelopsis arborea				3				0.43	4.41
Aster carolinianus			15	8	2	2		3.86	39.71
Green algae		1						0.14	1.47
Lemna sp.	2	1	1	1				0.71	7.35
Ludwigia peruviana			1					0.14	1.47
Mikania scandens			18	4	4	2		4.00	41.18
Polygonum punctatum			1					0.14	1.47
Sacciolepis striata						2		0.29	2.94
Total	2	2	36	16	6	6	0	9.71	100.00
Bare Ground/Dead Veg./Litter			20	3	5			4.00	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Aster carolinianus			30	2		1		4.71	44.59
Lemna sp.		1	1	1	1			0.57	5.41
Ludwigia peruviana	5							0.71	6.76
Mikania scandens	2	7	6	2	5		1	3.29	31.08
Polygonum punctatum			1	1				0.29	2.70
Sacciolepis striata			1					0.14	1.35
Salix caroliniana	1							0.14	1.35
Typha domingensis							5	0.71	6.76
Total	8	8	39	6	6	1	6	10.57	100.00
Bare Ground/Dead Veg./Litter		10	10	10				5.00	

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Aster carolinianus	50		8					8.29	58.59
Lemna sp.	2	1		1	1	1	1	1.00	7.07
Mikania scandens		3	5	10	5		4	3.86	27.27
Polygonum punctatum			1					0.14	1.01
Typha domingensis						6		0.86	6.06
Total	52	4	14	11	6	7	5	14.14	100.00
Bare Ground/Dead Veg./Litter	20		12	3				5.00	

TABLE B-7
Summary of Herbaceous 1-Meter Square Plots in the Parkland Wetland, Titusville - March 20, 2003

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Algal mat					1	1	5	1.00	4.31
Wolfiella			50	2				7.43	32.00
Lemna sp.	5	1	2	5	5	1	1	2.86	12.31
Utricularia purpurea	0.5							0.07	0.31
Mikania scandens			35	1	5	1	2	6.29	27.08
Aster carolinianus		2						0.29	1.23
Polygonum punctatum	5	2	1	5	10	2	1	3.71	16.00
Ludwigia peruviana	1	0.5	0.5	1	5	1	2	1.57	6.77
Total	11.5	5.5	88.5	14	26	6	11	23.21	100.00
Bare Ground/Dead Veg./Litter	0.7	0.4	0.5	0.7	0.8	0.8	0.9	0.69	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Algal mat						1		0.14	0.71
Aster carolinianus			5	2	1			1.14	5.67
Lemna sp.			20	8	10	5	0.5	6.21	30.85
Mikania scandens			10	2	0.5	2		2.07	10.28
Sacciolepis striata			1					0.14	0.71
Typha domingensis						5	10	2.14	10.64
Utricularia purpurea			20	5	10	5	5	6.43	31.91
Wolfia					0.5	0.5	3	0.57	2.84
Wolfiella			1	1	5	2		1.29	6.38
Total	0	0	57	18	27	20.5	18.5	20.14	100.00
Bare Ground/Dead Veg./Litter			0.8	0.7	1	1.1	1	0.66	

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Algal mat							3	0.43	0.82
Mikania scandens	40		5					6.43	12.30
Aster carolinianus	10	20	10	15	10	5	2	10.29	19.67
Utricularia purpurea	5	7	4	5	3	1	1	3.71	7.10
Lemna sp.				1				0.14	0.27
Wolfiella						5	2	1.00	1.91
Wolfia	30	40	30	60	30	5	2	28.14	53.83
Polygonum punctatum			1	0.5	0.5	0.5	0.5	0.43	0.82
Typha domingensis	2	3	3	1	2	0.5	0.5	1.71	3.28
Total	87	70	53	82.5	45.5	17	11	52.29	100.00

TABLE B-8
Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - December 10, 2002

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	2.60					2.60	5.20	77.84	0.20	33.33	55.59
Polygonum punctatum	OBL			0.17			0.17	0.34	5.09	0.20	33.33	19.21
Sacciolepis striata	OBL				0.57		0.57	1.14	17.07	0.20	33.33	25.20
Total		2.60	0.00	0.17	0.57	0.00	3.34	6.68	100.00	0.60	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	3.17					3.17	6.34	24.82	0.20	16.67	20.75
Polygonum punctatum	OBL		0.53	0.72		0.14	1.39	2.78	10.88	0.60	50.00	30.44
Sacciolepis striata	OBL		0.52				0.52	1.04	4.07	0.20	16.67	10.37
Typha domingensis	OBL					7.69	7.69	15.38	60.22	0.20	16.67	38.44
Total		3.17	1.05	0.72	0.00	7.83	12.77	25.54	100.00	1.20	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m)					Total Linear	Cover		Frequency		Importance
		A	B	C		E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	0.90					0.90	1.96	23.32	0.20	25.00	24.16
Polygonum punctatum	OBL		0.20			0.10	0.30	0.65	7.77	0.40	50.00	28.89
Typha domingensis	OBL					2.66	2.66	5.78	68.91	0.20	25.00	46.96
Total		0.90	0.20	0.00	0.00	2.76	3.86	8.39	100.00	0.80	100.00	100.00

Transect length 46 meters.

TABLE B-9

Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - March 20, 2003

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	5.03		0.15			5.18	10.36	45.72	0.40	33.33	39.53
Polygonum punctatum	OBL	1.40	1.40	3.10	0.25		6.15	12.30	54.28	0.80	66.67	60.47
Sacciolepis striata	OBL					0.60	0.60	1.20	5.30	0.20	16.67	10.98
Total		6.43	1.40	3.25	0.25	0.00	11.33	22.66	100.00	1.20	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Polygonum punctatum	OBL			0.80		0.01	0.81	1.62	7.87	0.40	40.00	23.94
Sacciolepis striata	OBL		0.08				0.08	0.16	0.78	0.20	20.00	10.39
Typha domingensis	OBL				1.80	7.60	9.40	18.80	91.35	0.40	40.00	65.68
Total		0.00	0.08	0.80	1.80	7.61	10.29	20.58	100.00	1.00	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C		E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	1.75					1.75	3.80	100.00	0.20	100.00	100.00
Total		1.75	0.00	0.00	0.00	0.00	1.75	3.80	100.00	0.20	100.00	100.00

Transect length 46 meters.

TABLE B-10
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1	
		September 29, 1999		October 3, 2001		December 10, 2002	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
1	17	3.75	11.04	4.21	13.92	4.40	15.20
1	301			6.00	28.27	6.90	37.37
1	302			8.15	52.17		
1	330	6.61	34.30	8.28	53.85	9.20	66.44
1	409	3.30	8.55				
1	410	2.30	4.15	2.30	4.15		
1	411	3.15	7.79	3.23	8.19		
1	412	6.50	33.17	8.18	52.55	9.50	70.85
1	413	6.08	29.02	7.12	39.82	7.90	48.99
1	414	6.68	35.03	8.85	61.51	10.90	93.27
1	415	4.20	13.85	5.80	26.42	6.79	36.19
1	416	6.90	37.37	8.25	53.46	8.45	56.05
1	417	4.50	15.90	4.85	18.47	4.78	17.94
1	418	5.22	21.39	8.19	52.68	8.88	61.90
1	419	2.88	6.51	3.45	9.35	3.25	8.29
1	420	3.31	8.60	3.99	12.50		
1	421	4.12	13.32	5.49	23.67	5.90	27.33
1	422	3.95	12.25	5.55	24.19	6.30	31.16
1	423	6.05	28.73	8.30	54.11	9.85	76.16
1	424	4.62	16.76	8.10	51.53	11.23	99.00
1	440	7.30	41.83				
1	441	3.58	10.06	4.35	14.86		
1	442	4.70	17.34	5.70	25.52		
1	443	3.32	8.65	3.80	11.34		
1	445	7.22	40.92	7.20	40.72		
2	304			9.00	63.62	9.80	75.39
2	305			2.75	5.94	3.60	10.17
2	446	4.28	14.38	6.85	36.85	8.60	58.06
2	447	4.90	18.85	5.40	22.90	5.52	23.92
2	448	3.60	10.17				
2	449	5.35	22.47	6.42	32.37	7.40	42.99
2	450	6.00	28.26	7.78	47.54	8.75	60.10
2	451	2.81	6.20	3.30	8.55	5.20	21.23
2	452	6.50	33.17	8.00	50.27	10.20	81.67
2	453	3.45	9.34	3.41	9.13		
2	811					3.48	9.51
2	812					3.39	9.02
2	813					4.75	17.71
2	814					3.60	10.17
2	815					4.30	14.51
2	816					5.32	22.22

TABLE B-10
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1	
		September 29, 1999		October 3, 2001		December 10, 2002	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
2	817					5.20	21.23
2	818					4.60	16.61
2	819					4.90	18.85
2	820					3.25	8.29
3	306			7.87	48.65	9.87	76.47
3	307			6.80	36.32	10.10	80.08
3	308			2.46	4.75	2.90	6.60
3	454	4.38	15.06				
3	455	3.59	10.12				
3	456	5.42	23.06	6.89	37.28	8.10	51.50
3	457	3.58	10.06	3.89	11.88	4.00	12.56
3	458	4.70	17.34	5.62	24.81	6.20	30.18
3	459	3.40	9.07	4.32	14.66		
3	460	4.50	15.90	4.92	19.01	5.00	19.63
3	461	5.41	22.98	6.53	33.49	7.35	42.41
3	462	2.58	5.23				
3	463	4.10	13.20	4.12	13.33		
3	464	3.10	7.54	3.00	7.07		
3	465	2.60	5.31				
3	466	3.80	11.34	3.72	10.87		
3	467	4.27	14.31	6.31	31.27	7.80	47.76
3	468	3.80	11.34	5.90	27.34	7.30	41.83
3	469	5.20	21.23			12.20	116.84
3	470	3.45	9.34			4.69	17.27
3	471	2.50	4.91				
3	472	2.80	6.15			3.40	9.07
3	473	2.60	5.31	2.90	6.61	2.26	4.01
3	483	2.80	6.15	3.75	11.04	3.80	11.34
3	484	2.98	6.97	3.20	8.04	3.30	8.55
3	487	3.50	9.62	3.90	11.95		
3	821					8.10	51.50
3	822					3.30	8.55
4	309			3.00	7.07	3.45	9.34
4	311			2.25	3.98		
4	312			4.25	14.19	5.50	23.75
4	313			3.82	11.46	4.70	17.34
4	314			3.94	12.19	5.90	27.33
4	439			5.51	23.84		
4	474	5.10	20.42	5.85	26.88	5.90	27.33
4	475	3.08	7.45	2.95	6.83		
4	476	4.08	13.07	5.75	25.97	5.40	22.89

TABLE B-10
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1	
		September 29, 1999		October 3, 2001		December 10, 2002	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
4	477	3.42	9.18	6.61	34.32	9.87	76.47
4	478	3.98	12.43	7.91	49.14	10.05	79.29
4	479	3.98	12.43	4.40	15.21	4.50	15.90
4	480	3.05	7.30	4.20	13.85	4.20	13.85
4	481	3.25	8.29	3.10	7.55		
4	482	5.10	20.42	5.70	25.52	6.70	35.24
4	485	3.90	11.94	5.90	27.34	7.30	41.83
4	486	3.55	9.89	3.95	12.25		
4	488	3.45	9.34	5.45	23.33	7.25	41.26
4	489	5.50	23.75	6.13	29.51	8.00	50.24
4	490	3.89	11.88	4.29	14.45	5.00	19.63
4	491	3.00	7.07				
4	492	3.25	8.29				
4	921	5.71	25.59	5.60	24.63		
4	922	4.59	16.54	4.44	15.48		
4	923	3.30	8.55	3.18	7.94		
4	924	3.10	7.54	3.20	8.04		
4	925	5.21	21.31	5.25	21.65	5.80	26.41
4	926	7.20	40.69	8.14	52.04	8.70	59.42
4	927	3.42	9.18	5.60	24.63	7.80	47.76
4	928	5.30	22.05	6.42	32.37	7.50	44.16
4	929	3.60	10.17	3.75	11.04	4.00	12.56
4	930	4.20	13.85	4.50	15.90	4.50	15.90
4	931	2.95	6.83	2.90	6.61	3.40	9.07
4	932	4.18	13.72	4.35	14.86	4.60	16.61
4	933	9.11	65.15	11.44	102.79	12.60	124.63
4	934	9.55	71.59	10.34	83.97	13.50	143.07
4	935	3.68	10.63	4.48	15.76	4.60	16.61
4	936	3.75	11.04	3.62	10.29		
4	937	2.71	5.77	3.62	10.29		
4	938	5.40	22.89	5.40	22.90		
4	939	4.29	14.45	5.49	23.67	7.00	38.47
4	940	4.65	16.97				
4	941	7.17	40.36	7.51	44.30	7.70	46.54
4	942	3.85	11.64			8.40	55.39
4	943	5.10	20.42	5.40	22.90	5.50	23.75
5	310			4.54	16.19	6.90	37.37
5	315			5.56	24.28	6.60	34.19
5	316			3.39	9.03	4.30	14.51
5	317			5.42	23.07	6.35	31.65
5	318			4.48	15.76	5.60	24.62

TABLE B-10
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1	
		September 29, 1999		October 3, 2001		December 10, 2002	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
5	319			4.62	16.76	5.50	23.75
5	320			3.31	8.60	4.40	15.20
5	321			3.20	8.04	3.50	9.62
5	719	2.40	4.52				
5	823					2.90	6.60
5	824					3.25	8.29
5	825					3.50	9.62
5	944	2.65	5.51	4.99	19.56	6.00	28.26
5	945	3.10	7.54				
5	946	2.51	4.95	2.35	4.34		
5	947	3.20	8.04	5.70	25.52		
5	948	3.50	9.62	3.19	7.99		
5	949	3.15	7.79	3.20	8.04		
5	950	2.69	5.68	5.80	26.42		
5	951	2.98	6.97	5.42	23.07	6.70	35.24
5	952	2.70	5.72	5.70	25.52	5.10	20.42
Total		434.67	1607.31	558.81	2587.96	595.68	3385.27

Subquad - approximately 10m each.

Operational Year 2

TABLE B-11
Summary of Herbaceous 1-Meter Square Plots in the Parkland Wetland, Titusville - Dec. 02, 2003

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Lemna sp.	60	60	40	30	30	30	20	38.57	84.64
Polygonum sp.		1						0.14	0.31
Sacciolepis striata						1		0.14	0.31
Typha sp.	5				2			1.00	2.19
Utricularia purpurea				1				0.14	0.31
Wolfiella sp.	10	5	5	15	2	1	1	5.57	12.23
Total	75	66	45	46	34	32	21	45.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Lemna sp.	15	10	8	35	35			14.71	35.15
Ludwigia peruviana	5							0.71	1.71
Typha sp.						90	90	25.71	61.43
Wolfiella sp.	1	1	1	1	1			0.71	1.71
Total	21	11	9	36	36	90	90	41.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Lemna sp.	10	50	10	30	30	30	15	25.00	83.73
Ludwigia sp.				1				0.14	0.48
Polygonum sp.			2	1				0.43	1.44
Typha sp.						2	20	3.14	10.53
Wolfiella sp.	1	2	1	1	1	1	1	1.14	3.83
Total	11	52	13	33	31	33	36	29.86	100.00

TABLE B-12
Summary of Herbaceous 1-Meter Square Plots in the Parkland Wetland, Titusville - April 7, 2004

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover								Cover	
Species	N1	N2	N3	N4	N5	N6	N7		Percent	Relative
Aster carolinianus			2						0.29	0.74
Lemna sp.	35	50	3	12	5	5	4		16.29	41.91
Ludwigia peruviana		1							0.14	0.37
Mikania scandens			2	1	3	1	1		1.14	2.94
Polygonum sp.	1	1							0.29	0.74
Salix caroliniana	2	1			1				0.57	1.47
Wolfiella sp.			1	1	1	1	1		0.71	1.84
	38	53	8	14	10	7	6		19.43	50.00
Total	76	106	16	28	20	14	12	0	38.86	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Aster carolinianus				1	1			0.29	1.04
Lemna sp.	4	8	12	20	15	8	3	10.00	36.27
Mikania scandens	1	2	1	1	2	1		1.14	4.15
Salix caroliniana		1	1			1		0.43	1.55
Typha domingensis						10	90	14.29	51.81
Wolfiella sp.	1	2	2	2	1	1	1	1.43	5.18
Total	6	13	16	24	19	21	94	27.57	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Aster carolinianus	2		1		1			0.57	1.91
Cephalanthus occidentalis	1							0.14	0.48
Lemna sp.	20	60	55	10	10	8	2	23.57	78.95
Mikania scandens	2	1	2	2	1	1		1.29	4.31
Polygonum sp.			2	1				0.43	1.44
Typha domingensis						10	5	2.14	7.18
Wolfiella sp.	1	5	2	1	1	1	1	1.71	5.74
Total	26	66	62	14	13	20	8	29.86	100.00

TABLE B-13

Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - December 2, 2003

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Ampelopsis arborea	UPL	0.71					0.71	1.42	8.10	0.20	10.00	9.05
Polygonum punctatum	OBL	2.19	0.41	0.57	1.05	0.01	4.23	8.46	48.23	1.00	50.00	49.12
Sacciolepis striata	OBL				1.32	1.20	2.52	5.04	28.73	0.40	20.00	24.37
Typha domingensis	OBL	0.21			1.10		1.31	2.62	14.94	0.40	20.00	17.47
Total		3.11	0.41	0.57	3.47	1.21	8.77	17.54	100.00	2.00	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Ampelopsis arborea	UPL	0.13					0.13	0.26	2.30	0.20	14.29	8.29
Polygonum punctatum	OBL	0.86	0.31	0.07	0.31	0.13	1.68	3.36	29.68	1.00	71.43	50.56
Typha domingensis	OBL					3.85	3.85	7.70	68.02	0.20	14.29	41.15
Total		0.99	0.31	0.07	0.31	3.98	5.66	11.32	100.00	1.40	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Polygonum punctatum	OBL		1.03	0.22		0.29	1.54	3.35	23.77	0.60	75.00	49.38
Typha domingensis	OBL					4.94	4.94	10.74	76.23	0.20	25.00	50.62
Total		0.00	1.03	0.22	0.00	5.23	6.48	14.09	100.00	0.80	100.00	100.00

Transect length 46 meters.

TABLE B-14
Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - April 7, 2004

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL					2.00	2.00	4.00	26.25	0.20	16.67	21.46
Polygonum punctatum	OBL		0.61	0.51	0.75	1.15	3.02	6.04	39.63	0.80	66.67	53.15
Typha domingensis	OBL					2.60	2.60	5.20	34.12	0.20	16.67	25.39
Total		0.00	0.61	0.51	0.75	5.75	7.62	15.24	100.00	1.20	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	1.41					1.41	2.82	28.43	0.20	16.67	22.55
Eupatorium capillifolium	FAC	0.05					0.05	0.10	1.01	0.20	16.67	8.84
Polygonum punctatum	OBL	2.52	0.38	0.15			3.05	6.10	61.49	0.60	50.00	55.75
Typha domingensis	OBL				0.45		0.45	0.90	9.07	0.20	16.67	12.87
Total		3.98	0.38	0.15	0.45	0.00	4.96	9.92	100.00	1.20	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Polygonum punctatum	OBL		0.60	0.60			1.20	2.61	100.00	0.20	100.00	100.00
Total		0.00	0.60	0.60	0.00	0.00	1.20	2.61	100.00	0.20	100.00	100.00

Transect length 46 meters.

TABLE B-15
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
1	17	3.75	11.04	4.21	13.92	4.40	15.20	4.72	17.49
1	301			6.00	28.27	6.90	37.37		
1	302			8.15	52.17				
1	330	6.61	34.30	8.28	53.85	9.20	66.44	9.70	73.86
1	409	3.30	8.55						
1	410	2.30	4.15	2.30	4.15				
1	411	3.15	7.79	3.23	8.19				
1	412	6.50	33.17	8.18	52.55	9.50	70.85	10.40	84.91
1	413	6.08	29.02	7.12	39.82	7.90	48.99	8.05	50.87
1	414	6.68	35.03	8.85	61.51	10.90	93.27	11.50	103.82
1	415	4.20	13.85	5.80	26.42	6.79	36.19	7.16	40.24
1	416	6.90	37.37	8.25	53.46	8.45	56.05	8.30	54.08
1	417	4.50	15.90	4.85	18.47	4.78	17.94	4.20	13.85
1	418	5.22	21.39	8.19	52.68	8.88	61.90	9.50	70.85
1	419	2.88	6.51	3.45	9.35	3.25	8.29		
1	420	3.31	8.60	3.99	12.50				
1	421	4.12	13.32	5.49	23.67	5.90	27.33		
1	422	3.95	12.25	5.55	24.19	6.30	31.16		
1	423	6.05	28.73	8.30	54.11	9.85	76.16		
1	424	4.62	16.76	8.10	51.53	11.23	99.00	12.50	122.66
1	440	7.30	41.83						
1	441	3.58	10.06	4.35	14.86				
1	442	4.70	17.34	5.70	25.52				
1	443	3.32	8.65	3.80	11.34				
1	445	7.22	40.92	7.20	40.72				
1	716							5.75	25.95
1	720							6.10	29.21
1	721							11.20	98.47
1	722							7.40	42.99
1	723							5.10	20.42
2	304			9.00	63.62	9.80	75.39		
2	305			2.75	5.94	3.60	10.17	5.65	25.06
2	446	4.28	14.38	6.85	36.85	8.60	58.06		
2	447	4.90	18.85	5.40	22.90	5.52	23.92	5.40	22.89
2	448	3.60	10.17						
2	449	5.35	22.47	6.42	32.37	7.40	42.99	8.85	61.48
2	450	6.00	28.26	7.78	47.54	8.75	60.10	8.50	56.72
2	451	2.81	6.20	3.30	8.55	5.20	21.23	3.10	7.54
2	452	6.50	33.17	8.00	50.27	10.20	81.67	11.00	94.99
2	453	3.45	9.34	3.41	9.13				
2	811					3.48	9.51	5.10	20.42
2	812					3.39	9.02	4.30	14.51
2	813					4.75	17.71	4.30	14.51

TABLE B-15
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
2	814					3.60	10.17	4.85	18.47
2	815					4.30	14.51	3.99	12.50
2	816					5.32	22.22	3.90	11.94
2	817					5.20	21.23	5.40	22.89
2	818					4.60	16.61	5.85	26.86
2	819					4.90	18.85	5.75	25.95
2	820					3.25	8.29	3.52	9.73
3	306			7.87	48.65	9.87	76.47		
3	307			6.80	36.32	10.10	80.08		
3	308			2.46	4.75	2.90	6.60	2.80	6.15
3	454	4.38	15.06						
3	455	3.59	10.12						
3	456	5.42	23.06	6.89	37.28	8.10	51.50	8.60	58.06
3	457	3.58	10.06	3.89	11.88	4.00	12.56	4.12	13.32
3	458	4.70	17.34	5.62	24.81	6.20	30.18	6.50	33.17
3	459	3.40	9.07	4.32	14.66				
3	460	4.50	15.90	4.92	19.01	5.00	19.63	5.00	19.63
3	461	5.41	22.98	6.53	33.49	7.35	42.41	7.80	47.76
3	462	2.58	5.23						
3	463	4.10	13.20	4.12	13.33				
3	464	3.10	7.54	3.00	7.07				
3	465	2.60	5.31						
3	466	3.80	11.34	3.72	10.87				
3	467	4.27	14.31	6.31	31.27	7.80	47.76	8.50	56.72
3	468	3.80	11.34	5.90	27.34	7.30	41.83		
3	469	5.20	21.23			12.20	116.84	12.95	131.65
3	470	3.45	9.34			4.69	17.27	6.98	38.25
3	471	2.50	4.91						
3	472	2.80	6.15			3.40	9.07	3.75	11.04
3	473	2.60	5.31	2.90	6.61	2.26	4.01		
3	483	2.80	6.15	3.75	11.04	3.80	11.34	3.45	9.34
3	484	2.98	6.97	3.20	8.04	3.30	8.55		
3	487	3.50	9.62	3.90	11.95			4.15	13.52
3	717							6.40	32.15
3	718							7.20	40.69
3	821					8.10	51.50	8.60	58.06
3	822					3.30	8.55	3.30	8.55
4	309			3.00	7.07	3.45	9.34		
4	311			2.25	3.98				
4	312			4.25	14.19	5.50	23.75		
4	313			3.82	11.46	4.70	17.34		
4	314			3.94	12.19	5.90	27.33		
4	439			5.51	23.84				

TABLE B-15
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
4	474	5.10	20.42	5.85	26.88	5.90	27.33		
4	475	3.08	7.45	2.95	6.83				
4	476	4.08	13.07	5.75	25.97	5.40	22.89	5.60	24.62
4	477	3.42	9.18	6.61	34.32	9.87	76.47	11.20	98.47
4	478	3.98	12.43	7.91	49.14	10.05	79.29	10.60	88.20
4	479	3.98	12.43	4.40	15.21	4.50	15.90	4.58	16.47
4	480	3.05	7.30	4.20	13.85	4.20	13.85		
4	481	3.25	8.29	3.10	7.55				
4	482	5.10	20.42	5.70	25.52	6.70	35.24	5.60	24.62
4	485	3.90	11.94	5.90	27.34	7.30	41.83	7.75	47.15
4	486	3.55	9.89	3.95	12.25				
4	488	3.45	9.34	5.45	23.33	7.25	41.26		
4	489	5.50	23.75	6.13	29.51	8.00	50.24	7.90	48.99
4	490	3.89	11.88	4.29	14.45	5.00	19.63	4.75	17.71
4	491	3.00	7.07						
4	492	3.25	8.29						
4	921	5.71	25.59	5.60	24.63				
4	922	4.59	16.54	4.44	15.48				
4	923	3.30	8.55	3.18	7.94				
4	924	3.10	7.54	3.20	8.04				
4	925	5.21	21.31	5.25	21.65	5.80	26.41		
4	926	7.20	40.69	8.14	52.04	8.70	59.42	9.15	65.72
4	927	3.42	9.18	5.60	24.63	7.80	47.76	8.30	54.08
4	928	5.30	22.05	6.42	32.37	7.50	44.16	8.00	50.24
4	929	3.60	10.17	3.75	11.04	4.00	12.56		
4	930	4.20	13.85	4.50	15.90	4.50	15.90		
4	931	2.95	6.83	2.90	6.61	3.40	9.07		
4	932	4.18	13.72	4.35	14.86	4.60	16.61	4.50	15.90
4	933	9.11	65.15	11.44	102.79	12.60	124.63	14.40	162.78
4	934	9.55	71.59	10.34	83.97	13.50	143.07	14.70	169.63
4	935	3.68	10.63	4.48	15.76	4.60	16.61	4.90	18.85
4	936	3.75	11.04	3.62	10.29				
4	937	2.71	5.77	3.62	10.29				
4	938	5.40	22.89	5.40	22.90				
4	939	4.29	14.45	5.49	23.67	7.00	38.47	6.50	33.17
4	940	4.65	16.97						
4	941	7.17	40.36	7.51	44.30	7.70	46.54		
4	942	3.85	11.64			8.40	55.39		
4	943	5.10	20.42	5.40	22.90	5.50	23.75	5.53	24.01
5	310			4.54	16.19	6.90	37.37	7.50	44.16
5	315			5.56	24.28	6.60	34.19	6.70	35.24
5	316			3.39	9.03	4.30	14.51	4.31	14.58
5	317			5.42	23.07	6.35	31.65	6.40	32.15

TABLE B-15
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003	
SubQuad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**
5	318			4.48	15.76	5.60	24.62	6.20	30.18
5	319			4.62	16.76	5.50	23.75		
5	320			3.31	8.60	4.40	15.20		
5	321			3.20	8.04	3.50	9.62		
5	719	2.40	4.52						
5	823					2.90	6.60	3.40	9.07
5	824					3.25	8.29	3.30	8.55
5	825					3.50	9.62	3.70	10.75
5	944	2.65	5.51	4.99	19.56	6.00	28.26	6.10	29.21
5	945	3.10	7.54						
5	946	2.51	4.95	2.35	4.34				
5	947	3.20	8.04	5.70	25.52				
5	948	3.50	9.62	3.19	7.99				
5	949	3.15	7.79	3.20	8.04				
5	950	2.69	5.68	5.80	26.42				
5	951	2.98	6.97	5.42	23.07	6.70	35.24	6.35	31.65
5	952	2.70	5.72	5.70	25.52	5.10	20.42	7.52	44.39
Total		434.67	1607.31	558.81	2587.96	595.68	3385.27	506.58	3124.69

Subquad - approximately 10m each.

Operational Year 3

TABLE B-16
Summary of Herbaceous 1-Meter Square Plots from the Parkland Wetland, Titusville - April 28, 2005

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Ampelopsis arborea				8				2.00	4.49
Aster caroliniana			1	1				0.50	1.12
Azolla caroliniana	1	1						0.50	1.12
Lemna sp.	25	40	25	60				37.50	84.27
Limnobium spongia	1							0.25	0.56
Ludwigia peruviana	3							0.75	1.69
Polygonum sp.		1						0.25	0.56
Salvina minima	1		1					0.50	1.12
Typha domingenesis	5							1.25	2.81
Wolfiella sp.	1	1	1	1				1.00	2.25
Total	37	43	28	70				44.50	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Lemna sp.	80	80	90	90				85.00	93.41
Wolfiella sp.	6	8	5	5				6.00	6.59
Total	86	88	95	95				91.00	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Aster carolinianus	1							0.25	0.26
Lemna sp.	90	80	90	98				89.50	93.47
Ludwigia peruviana	1							0.25	0.26
Wolfiella sp.	5	8	5	5				5.75	6.01
Total	97	88	95	103				95.75	100.00

No data collected - plot inaccessible due to high water

TABLE B-17
Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - April 28, 2005

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	2.00		1.50			3.50	11.67	41.67	0.67	33.33	37.50
Polygonum punctatum	OBL	0.50	2.10				2.60	8.67	30.95	0.67	33.33	32.14
Typha domingensis	OBL	2.00	0.30				2.30	7.67	27.38	0.67	33.33	30.36
Total		4.50	2.40	1.50	0.00	0.00	8.40	28.00	100.00	2.00	100.00	100.00

Transect length 30 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Ampelopsis arborea	UPL	0.12					0.12	0.40	19.35	0.33	50.00	34.68
Polygonum punctatum	OBL			0.50			0.50	1.67	80.65	0.33	50.00	65.32
Total		0.12	0.00	0.50	0.00	0.00	0.62	2.07	100.00	0.67	100.00	100.00

Transect length 30 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL		0.15	0.15			0.30	1.00	100.00	0.67	100.00	100.00
Total		0.00	0.15	0.15	0.00	0.00	0.30	1.00	100.00	0.67	100.00	100.00

Transect length 30 meters.

No data collected - plot inaccessible due to high water

Operational Year 4

TABLE B-18
Summary of Herbaceous 1-Meter Square Plots from the Parkland Wetland, Titusville - Jan. 12, 2006

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Lemna sp.	90	10	10	90	90	90	90	67.14	68.81
Salvina minima	1	1	1	1	1	1	1	1.00	1.02
Typha domingenesis		75	75					21.43	21.96
Wolfia sp.	4	4	4	4	4	4	4	4.00	4.10
Wolfiella sp.	4	4	4	4	4	4	4	4.00	4.10
Total	99	94	94	99	99	99	99	97.57	100

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Lemna sp.	90	90	90	90	10	10	10	55.71	57.52
Salvina minima	1	1	1	1	1	1	1	1.00	1.03
Typha domingenesis					75	75	75	32.14	33.19
Wolfia sp.	4	4	4	4	4	4	4	4.00	4.13
Wolfiella sp.	4	4	4	4	4	4	4	4.00	4.13
Total	99	99	99	99	94	94	94	96.86	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Lemna sp.	90	90	90	90	90	10	10	67.14	68.81
Salvina minima	1	1	1	1	1	1	1	1.00	1.02
Typha domingenesis						75	75	21.43	21.96
Wolfia sp.	4	4	4	4	4	4	4	4.00	4.10
Wolfiella sp.	4	4	4	4	4	4	4	4.00	4.10
Total	99	99	99	99	99	94	94	97.57	100

TABLE B-19
Summary of Herbaceous 1-Meter Square Plots from the Parkland Wetland, Titusville - March 27, 2006

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Lemna sp.	60	0	90	70	95	95	1	58.71	87.26
Ludwigia peruviana								0.00	0.00
Mikania scandens				2		2		0.57	0.85
Salvinia minima								0.00	0.00
Typha domingenesis	10	25						5.00	7.43
Wolfia sp.	1	1	1	1	1	1	1	1.00	1.49
Wolfiella sp.	2	2	2	2	2	2	2	2.00	2.97
Total	73	28	93	75	98	100	4	67.29	100

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Lemna sp.	90	0	0	85	99	50	50	53.43	56.58
Ludwigia peruviana								0.00	0.00
Mikania scandens								0.00	0.00
Salvinia minima	5	1						0.86	0.91
Typha domingenesis					60	100	100	37.14	39.33
Wolfia sp.	1	1	1	1	1	1	1	1.00	1.06
Wolfiella sp.	2	2	2	2	2	2	2	2.00	2.12
Total	98	4	3	88	162	153	153	94.43	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

Species	Percent Cover							Cover	
	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Lemna sp.	60	95	80	90	90	10	10	62.14	62.50
Ludwigia peruviana	33							4.71	4.74
Mikania scandens								0.00	0.00
Salvinia minima	1	1						0.29	0.29
Typha domingenesis				5		100	100	29.29	29.45
Wolfia sp.	1	1	1	1	1	1	1	1.00	1.01
Wolfiella sp.	2	2	2	2	2	2	2	2.00	2.01
Total	97	99	83	98	93	113	113	99.43	100

TABLE B-20

Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - January 12, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL	10.00	10.00				20.00	40.00	100.00	0.40	100.00	100.00
Total		10.00	10.00	0.00	0.00	0.00	20.00	40.00	100.00	0.40	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL				10.00	10.00	20.00	40.00	100.00	0.40	100.00	100.00
Total		0.00	0.00	0.00	10.00	10.00	20.00	40.00	100.00	0.40	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL		1.00		10.00	10.00	21.00	45.65	100.00	0.60	100.00	100.00
Total		0.00	1.00	0.00	10.00	10.00	21.00	45.65	100.00	0.60	100.00	100.00

Transect length 46 meters.

TABLE B-21

Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland, Titusville - March 27, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL	5.00	5.00			5.00	15.00	30.00	100.00	0.60	100.00	100.00
Total		5.00	5.00	0.00	0.00	5.00	15.00	30.00	100.00	0.60	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL				10.00	10.00	20.00	40.00	100.00	0.40	100.00	100.00
Total		0.00	0.00	0.00	10.00	10.00	20.00	40.00	100.00	0.40	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Typha domingensis	OBL			0.30	7.00	10.00	17.30	37.61	100.00	0.60	100.00	100.00
Total		0.00	0.00	0.30	7.00	10.00	17.30	37.61	100.00	0.60	100.00	100.00

Transect length 46 meters.

Operational Year 5

TABLE B-22
Summary of Herbaceous 1-Meter Square Plots from the Parkland Wetland, Titusville - Oct. 25, 2006

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Lemna sp.	1	40	20	35	35	50	60	34.43	37.25
Mikania scandens	1	2	3	1				1.00	1.08
Polygonum punctatum		2	10					1.71	1.85
Salvina minima	80	10	25	61	35	50	20	40.14	43.43
Typha domingenesis							100	14.29	15.46
Utricularia sp.					1			0.14	0.15
Wolfiella sp.			1	1	1	1	1	0.71	0.77
Total	82	54	59	98	72	101	181	92.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Eupatorium capillifolium	4							0.57	0.58
Lemna sp.	1	30	50	60	50	50	50	41.57	41.99
Ludwigia peruviana	3	1						0.57	0.58
Mikania scandens	1			2				0.43	0.43
Salvina minima	15	15	35	40	40	30	25	28.57	28.86
Typha domingenesis		5				90	90	26.43	26.70
Wolfiella sp.		1	1	1	1	1	1	0.86	0.87
Total	24	52	86	103	91	171	166	99.00	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Ampelopsis arborea	1							0.14	0.19
Lemna sp.	3	10	30	40	30	25	30	24.00	31.58
Ludwigia peruviana	6							0.86	1.13
Mikania scandens		1			1			0.29	0.38
Salvina minima	10	40	40	35	20	30	15	27.14	35.71
Typha domingenesis					5	75	80	22.86	30.08
Wolfiella sp.			1	1	1	1	1	0.71	0.94
Total	20	51	71	76	57	131	126	76.00	100.00

TABLE B-23
Summary of Herbaceous 1-Meter Square Plots from the Parkland Wetland, Titusville - March 28, 2007

1-METER SQUARE PLOTS - NORTH (N) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	N1	N2	N3	N4	N5	N6	N7	Percent	Relative
Acer rubrum	1			1				0.29	1.74
Baccharis halimilfolia		1						0.14	0.87
Eupatorium capillifolium	1	2						0.43	2.61
Ludwigia peruviana	1							0.14	0.87
Mikania scandens	2	5	5	3		1		2.29	13.91
Parietaria floridana	1	10						1.57	9.57
Polygonum punctatum	1	30	30					8.71	53.04
Salvinia minima	1							0.14	0.87
Toxicodendron radicans	1							0.14	0.87
Typha domingenesis				3		5	10	2.57	15.65
Total	9	48	35	7	0	6	10	16.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	C1	C2	C3	C4	C5	C6	C7	Percent	Relative
Amperlopsis arborea	1							0.14	0.52
Aster carolinianus	2			1				0.43	1.57
Eupatorium capillifolium	1							0.14	0.52
Ipomoea sp.	1							0.14	0.52
Ludwigia peruviana	3							0.43	1.57
Mikania scandens	1		5	1				1.00	3.66
Salvinia minima		6						0.86	3.14
Typha domingenesis		4			5	80	80	24.14	88.48
Total	9	10	5	2	5	80	80	27.29	100.00

1-METER SQUARE PLOTS - SOUTH (S) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	S1	S2	S3	S4	S5	S6	S7	Percent	Relative
Aster carolinianus	1		2	1				0.57	2.11
Eupatorium capillifolium	1							0.14	0.53
Lemna sp.		8						1.14	4.21
Mikania scandens		1		1	2			0.57	2.11
Polygonum punctatum					6			0.86	3.16
Salvinia minima	2	2						0.57	2.11
Typha domingenesis					8	80	75	23.29	85.79
Total	4	11	2	2	16	80	75	27.14	100.00

TABLE B-24
Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland - October 26, 2006

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Polygonum punctatum	OBL		0.60	1.45	0.45		2.50	5.00	17.58	0.60	60.00	38.79
Typha domingensis	OBL	1.72				10.00	11.72	23.44	82.42	0.40	40.00	61.21
Total		1.72	0.60	1.45	0.45	10.00	14.22	28.44	100.00	1.00	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Eupatorium capillifolium	FAC	0.20					0.20	0.40	0.86	0.20	20.00	10.43
Typha domingensis	OBL		0.15	2.80	10.00	10.00	22.95	45.90	99.14	0.80	80.00	89.57
Total		0.20	0.15	2.80	10.00	10.00	23.15	46.30	100.00	1.00	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	**Indicator**	**A**	**B**	**C**	**D**	**E**	**Distance (m)**	**Percent**	**Relative**	**Absolute**	**Relative**	**Value**
Ampelopsis arborea	UPL	0.12					0.12	0.26	0.49	0.20	25.00	12.75
Typha domingensis	OBL			4.30	10.00	10.00	24.30	52.83	99.51	0.60	75.00	87.25
Total		0.12	0.00	4.30	10.00	10.00	24.42	53.09	100.00	0.80	100.00	100.00

Transect length 46 meters.

TABLE B-25

Summary of Herbaceous Ground Cover Belt Transects in the Parkland Wetland - March 28, 2007

BELT TRANSECT NORTH (N) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Polygonum punctatum	OBL	4.90	5.65	0.79			11.34	22.68	58.94	0.60	60.00	59.47
Typha domingensis	OBL				0.40	7.50	7.90	15.80	41.06	0.40	40.00	40.53
Total		4.90	5.65	0.79	0.40	7.50	19.24	38.48	100.00	1.00	100.00	100.00

Transect length 50 meters.

BELT TRANSECT CENTRAL (C) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Ampelopsis arborea	UPL	0.34					0.34	0.68	1.36	0.20	16.67	9.01
Eupatorium capillifolium	FAC	0.83					0.83	1.66	3.32	0.20	16.67	9.99
Typha domingensis	OBL		0.44	3.39	10.00	10.00	23.83	47.66	95.32	0.80	66.67	80.99
Total		1.17	0.44	3.39	10.00	10.00	25.00	50.00	100.00	1.20	100.00	100.00

Transect length 50 meters.

BELT TRANSECT SOUTH (S) FOR TARGET HERBACEOUS SPECIES

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Eupatorium capillifolium	FAC	2.33					2.33	5.07	9.05	0.20	14.29	11.67
Polygonum punctatum	OBL	0.25			0.82		1.07	2.33	4.16	0.40	28.57	16.36
Typha domingensis	OBL		0.35	2.95	9.04	10.00	22.34	48.57	86.79	0.80	57.14	71.97
Total		2.58	0.35	2.95	9.86	10.00	25.74	55.96	100.00	1.40	100.00	100.00

Transect length 46 meters.

TABLE B-26
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2			Operational Period Year 5	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003			October 25, 2006	
Sub Quad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**[1]Sub Quad**	**DBH (cm)**	**Basal Area (cm2)**
1	17	3.75	11.04	4.21	13.92	4.40	15.20	4.72	17.49	1	12.00	113.04
1	301			6.00	28.27	6.90	37.37			1	3.20	8.04
1	302			8.15	52.17					1	13.60	145.19
1	330	6.61	34.30	8.28	53.85	9.20	66.44	9.70	73.86	1	17.60	243.16
1	409	3.30	8.55							1	9.20	66.44
1	410	2.30	4.15	2.30	4.15					1	9.20	66.44
1	411	3.15	7.79	3.23	8.19					1	2.60	5.31
1	412	6.50	33.17	8.18	52.55	9.50	70.85	10.40	84.91	1	3.30	8.55
1	413	6.08	29.02	7.12	39.82	7.90	48.99	8.05	50.87	1	9.00	63.59
1	414	6.68	35.03	8.85	61.51	10.90	93.27	11.50	103.82	1	15.80	195.97
1	415	4.20	13.85	5.80	26.42	6.79	36.19	7.16	40.24	1	3.50	9.62
1	416	6.90	37.37	8.25	53.46	8.45	56.05	8.30	54.08	1	7.10	39.57
1	417	4.50	15.90	4.85	18.47	4.78	17.94	4.20	13.85	1	2.00	3.14
1	418	5.22	21.39	8.19	52.68	8.88	61.90	9.50	70.85	1	8.00	50.24
1	419	2.88	6.51	3.45	9.35	3.25	8.29			1	8.90	62.18
1	420	3.31	8.60	3.99	12.50					1	3.20	8.04
1	421	4.12	13.32	5.49	23.67	5.90	27.33			1	4.40	15.20
1	422	3.95	12.25	5.55	24.19	6.30	31.16			1	2.90	6.60
1	423	6.05	28.73	8.30	54.11	9.85	76.16			1	5.10	20.42
1	424	4.62	16.76	8.10	51.53	11.23	99.00	12.50	122.66	1	4.20	13.85
1	440	7.30	41.83							1	5.80	26.41
1	441	3.58	10.06	4.35	14.86					1	6.10	29.21
1	442	4.70	17.34	5.70	25.52					1	6.60	34.19
1	443	3.32	8.65	3.80	11.34					1	9.50	70.85
1	445	7.22	40.92	7.20	40.72					1	10.90	93.27

TABLE B-26
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

						Operational Period		Operational Period			Operational Period	
		Baseline Period				Year 1		Year 2			Year 5	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003		October 25, 2006		
Sub Quad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**[1]Sub Quad**	**DBH (cm)**	**Basal Area (cm2)**
1	716							5.75	25.95	1	6.30	31.16
1	720							6.10	29.21	1	6.90	37.37
1	721							11.20	98.47	1	7.70	46.54
1	722							7.40	42.99			
1	723							5.10	20.42			
2	304			9.00	63.62	9.80	75.39			2	9.40	69.36
2	305			2.75	5.94	3.60	10.17	5.65	25.06	2	5.90	27.33
2	446	4.28	14.38	6.85	36.85	8.60	58.06			2	4.20	13.85
2	447	4.90	18.85	5.40	22.90	5.52	23.92	5.40	22.89	2	7.30	41.83
2	448	3.60	10.17							2	6.20	30.18
2	449	5.35	22.47	6.42	32.37	7.40	42.99	8.85	61.48	2	9.00	63.59
2	450	6.00	28.26	7.78	47.54	8.75	60.10	8.50	56.72	2	3.90	11.94
2	451	2.81	6.20	3.30	8.55	5.20	21.23	3.10	7.54	2	6.00	28.26
2	452	6.50	33.17	8.00	50.27	10.20	81.67	11.00	94.99	2	12.40	120.70
2	453	3.45	9.34	3.41	9.13					2	8.70	59.42
2	811					3.48	9.51	5.10	20.42	2	4.50	15.90
2	812					3.39	9.02	4.30	14.51	2	8.90	62.18
2	813					4.75	17.71	4.30	14.51	2	5.20	21.23
2	814					3.60	10.17	4.85	18.47	2	8.80	60.79
2	815					4.30	14.51	3.99	12.50			
2	816					5.32	22.22	3.90	11.94			
2	817					5.20	21.23	5.40	22.89			
2	818					4.60	16.61	5.85	26.86			
2	819					4.90	18.85	5.75	25.95			
2	820					3.25	8.29	3.52	9.73			

TABLE B-26
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2			Operational Period Year 5	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003		October 25, 2006		
Sub Quad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**[1]Sub Quad**	**DBH (cm)**	**Basal Area (cm2)**
3	306			7.87	48.65	9.87	76.47			3	10.80	91.56
3	307			6.80	36.32	10.10	80.08			3	3.90	11.94
3	308			2.46	4.75	2.90	6.60	2.80	6.15	3	7.20	40.69
3	454	4.38	15.06							3	6.50	33.17
3	455	3.59	10.12							3	3.20	8.04
3	456	5.42	23.06	6.89	37.28	8.10	51.50	8.60	58.06	3	3.80	11.34
3	457	3.58	10.06	3.89	11.88	4.00	12.56	4.12	13.32	3	4.30	14.51
3	458	4.70	17.34	5.62	24.81	6.20	30.18	6.50	33.17	3	3.40	9.07
3	459	3.40	9.07	4.32	14.66					3	5.20	21.23
3	460	4.50	15.90	4.92	19.01	5.00	19.63	5.00	19.63	3	8.90	62.18
3	461	5.41	22.98	6.53	33.49	7.35	42.41	7.80	47.76	3	3.80	11.34
3	462	2.58	5.23							3	4.70	17.34
3	463	4.10	13.20	4.12	13.33					3	7.40	42.99
3	464	3.10	7.54	3.00	7.07							
3	465	2.60	5.31									
3	466	3.80	11.34	3.72	10.87							
3	467	4.27	14.31	6.31	31.27	7.80	47.76	8.50	56.72			
3	468	3.80	11.34	5.90	27.34	7.30	41.83					
3	469	5.20	21.23			12.20	116.84	12.95	131.65			
3	470	3.45	9.34			4.69	17.27	6.98	38.25			
3	471	2.50	4.91									
3	472	2.80	6.15			3.40	9.07	3.75	11.04			
3	473	2.60	5.31	2.90	6.61	2.26	4.01					
3	483	2.80	6.15	3.75	11.04	3.80	11.34	3.45	9.34			
3	484	2.98	6.97	3.20	8.04	3.30	8.55					

TABLE B-26
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2			Operational Period Year 5	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003		October 25, 2006		
Sub Quad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**[1]Sub Quad**	**DBH (cm)**	**Basal Area (cm2)**
3	487	3.50	9.62	3.90	11.95			4.15	13.52			
3	717							6.40	32.15			
3	718							7.20	40.69			
3	821					8.10	51.50	8.60	58.06			
3	822					3.30	8.55	3.30	8.55			
4	309			3.00	7.07	3.45	9.34			4	7.70	46.54
4	311			2.25	3.98					4	12.80	128.61
4	312			4.25	14.19	5.50	23.75			4	5.30	22.05
4	313			3.82	11.46	4.70	17.34			4	7.70	46.54
4	314			3.94	12.19	5.90	27.33			4	3.30	8.55
4	439			5.51	23.84					4	4.60	16.61
4	474	5.10	20.42	5.85	26.88	5.90	27.33			4	8.80	60.79
4	475	3.08	7.45	2.95	6.83					4	5.40	22.89
4	476	4.08	13.07	5.75	25.97	5.40	22.89	5.60	24.62	4	7.40	42.99
4	477	3.42	9.18	6.61	34.32	9.87	76.47	11.20	98.47	4	8.50	56.72
4	478	3.98	12.43	7.91	49.14	10.05	79.29	10.60	88.20	4	16.40	211.13
4	479	3.98	12.43	4.40	15.21	4.50	15.90	4.58	16.47	4	3.00	7.07
4	480	3.05	7.30	4.20	13.85	4.20	13.85			4	3.00	7.07
4	481	3.25	8.29	3.10	7.55					4	3.00	7.07
4	482	5.10	20.42	5.70	25.52	6.70	35.24	5.60	24.62	4	3.00	7.07
4	485	3.90	11.94	5.90	27.34	7.30	41.83	7.75	47.15	4	3.00	7.07
4	486	3.55	9.89	3.95	12.25							
4	488	3.45	9.34	5.45	23.33	7.25	41.26					
4	489	5.50	23.75	6.13	29.51	8.00	50.24	7.90	48.99			
4	490	3.89	11.88	4.29	14.45	5.00	19.63	4.75	17.71			

TABLE B-26
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2			Operational Period Year 5	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003		October 25, 2006		
Sub Quad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**[1]Sub Quad**	**DBH (cm)**	**Basal Area (cm2)**
4	491	3.00	7.07									
4	492	3.25	8.29									
4	921	5.71	25.59	5.60	24.63							
4	922	4.59	16.54	4.44	15.48							
4	923	3.30	8.55	3.18	7.94							
4	924	3.10	7.54	3.20	8.04							
4	925	5.21	21.31	5.25	21.65	5.80	26.41					
4	926	7.20	40.69	8.14	52.04	8.70	59.42	9.15	65.72			
4	927	3.42	9.18	5.60	24.63	7.80	47.76	8.30	54.08			
4	928	5.30	22.05	6.42	32.37	7.50	44.16	8.00	50.24			
4	929	3.60	10.17	3.75	11.04	4.00	12.56					
4	930	4.20	13.85	4.50	15.90	4.50	15.90					
4	931	2.95	6.83	2.90	6.61	3.40	9.07					
4	932	4.18	13.72	4.35	14.86	4.60	16.61	4.50	15.90			
4	933	9.11	65.15	11.44	102.79	12.60	124.63	14.40	162.78			
4	934	9.55	71.59	10.34	83.97	13.50	143.07	14.70	169.63			
4	935	3.68	10.63	4.48	15.76	4.60	16.61	4.90	18.85			
4	936	3.75	11.04	3.62	10.29							
4	937	2.71	5.77	3.62	10.29							
4	938	5.40	22.89	5.40	22.90							
4	939	4.29	14.45	5.49	23.67	7.00	38.47	6.50	33.17			
4	940	4.65	16.97									
4	941	7.17	40.36	7.51	44.30	7.70	46.54					
4	942	3.85	11.64			8.40	55.39					
4	943	5.10	20.42	5.40	22.90	5.50	23.75	5.53	24.01			

TABLE B-26
Summary of Canopy and Subcanopy Tree Plot 50m x 5m in the Parkland Wetland, Titusville

All Specimens are the same species ***Salix caroliniana***

		Baseline Period				Operational Period Year 1		Operational Period Year 2			Operational Period Year 5	
		September 29, 1999		October 3, 2001		December 10, 2002		December 2, 2003		October 25, 2006		
Sub Quad	**Tree #**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**DBH (cm)**	**Basal Area (cm2)**	**[1]Sub Quad**	**DBH (cm)**	**Basal Area (cm2)**
5	310			4.54	16.19	6.90	37.37	7.50	44.16	5	3.20	8.04
5	315			5.56	24.28	6.60	34.19	6.70	35.24	5	3.30	8.55
5	316			3.39	9.03	4.30	14.51	4.31	14.58	5	3.40	9.07
5	317			5.42	23.07	6.35	31.65	6.40	32.15	5	3.20	8.04
5	318			4.48	15.76	5.60	24.62	6.20	30.18	5	3.40	9.07
5	319			4.62	16.76	5.50	23.75			5	8.30	54.08
5	320			3.31	8.60	4.40	15.20			5	3.20	8.04
5	321			3.20	8.04	3.50	9.62			5	5.70	25.50
5	719	2.40	4.52							5	3.10	7.54
5	823					2.90	6.60	3.40	9.07	5	3.20	8.04
5	824					3.25	8.29	3.30	8.55	5	3.30	8.55
5	825					3.50	9.62	3.70	10.75	5	3.00	7.07
5	944	2.65	5.51	4.99	19.56	6.00	28.26	6.10	29.21	5	3.20	8.04
5	945	3.10	7.54							5	3.20	8.04
5	946	2.51	4.95	2.35	4.34					5	3.20	8.04
5	947	3.20	8.04	5.70	25.52					5	3.20	8.04
5	948	3.50	9.62	3.19	7.99					5	3.20	8.04
5	949	3.15	7.79	3.20	8.04							
5	950	2.69	5.68	5.80	26.42							
5	951	2.98	6.97	5.42	23.07	6.70	35.24	6.35	31.65			
5	952	2.70	5.72	5.70	25.52	5.10	20.42	7.52	44.39			
Total		434.67	1607.31	558.81	2587.96	595.68	3385.27	506.58	3124.69		543.30	3416.05

Subquad - approximately 10m each.
Years 4 and 5 - no tree data collected due to high water preventing safe access.
[1] Tree Numbers were not recorded because many tags were lost after prolong high water. All trees are the same species.

Appendix C
Benthic Data

TABLE 1. BENTHIC MACROINVERTEBRATES, TITUSVILLE, 11/18/99.

SPECIES	T.V.**	F.F.G.***	TITUSVILLE
MOLLUSCA			
Gastropoda			
Basommatophora			
Physidae			
Physella sp.	**8.84**	**CG**	20
Planorbidae			
Menetus dilatatus	**8.23**	**SC**	20
ANNELIDA			
Oligochaeta			
Haplotaxida			
Naididae	***8**	**CG**	40
Dero sp.	**9**	**CG**	40
Lumbriculida			
Lumbriculidae	**7.03**	**CG**	30
ARTHROPODA			
Crustacea			
Ostracoda			770
Insecta			
Odonata			
Aeshnidae			20
Coenagrionidae			20
Anax junius	***8**	**P**	15
Heteroptera			
Belostomatidae			
Belostoma sp.	**9.8**	**P**	41
Coleoptera			
Haliplidae			
Peltodytes sp.	**8.73**	**SH**	10
Hydrophilidae			
Derallus sp.			60
Diptera			
Chironomidae			30
Chironomus sp.	**9.63**	**CG**	367
Polypedilum illinoense	**9**	**SH**	11
******CHORDATA**			
Osteichthyes			
Poeciidae			
Gambusia sp.			1
TOTAL NO. OF ORGANISMS			**1494**
TOTAL NO. OF TAXA			**15**

*Hilsenhoff Tolerance Values used when North Carolina Tolerance Values not available.

**North Carolina Tolerance Values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes.

***F.F.G.- Functional Feeding Group: SH=Shredder, CG=Collector/Gatherer, FC=Filtering Collector, SC=Scraper, P=Predator and PI=Piercer

****Not included in analysis

TABLE 1. BENTHIC MACROINVERTEBRATES, THAYOR CREEK AND TITUSVILLE, MARCH 14, 2000.

SPECIES	THAYOR CREEK	TITUSVILLE
MOLLUSCA		
Gastropoda		
Basommatophora		
Physidae		
Physella sp.		201
Planorbidae		
Menetus dilatatus		155
ANNELIDA		
Oligochaeta		
Haplotaxida		
Naididae	8	5
Dero sp.	15	
Tubificidae w.o.h.c.	1	
ARTHROPODA		
Crustacea		
Ostracoda	1	10
Amphipoda		
Crangonyctidae		
Crangonyx sp.	8	5
Isopoda		
Asellidae		
Caecidotea sp.	123	
Decapoda		
Cambaridae		
Procambarus sp.	8	
Insecta		
Odonata		
Coenagrionidae		16
Libellulidae		10
Pachydiplax sp.		5
Heteroptera		
Belostomatidae		
Belostoma sp.		6
Corixidae		5
Nepidae		
Ranatra sp.	1	
Trichoptera		
Polycentropodidae		
Cyrnellus fraternus	3	
Lepidoptera		15
Coleoptera		
Dryopidae		25
Dytiscidae		
Coptotomus sp.	3	
Laccodytes sp.	128	
Elmidae		
Optioservus sp.	3	
Haliplidae		
Haliplus sp.		36

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TABLE 1. BENTHIC MACROINVERTEBRATES, THAYOR CREEK AND TITUSVILLE, MARCH 14, 2000.

SPECIES	THAYOR CREEK	TITUSVILLE
Peltodytes sp.	3	5
Hydrophilidae		16
Scirtidae		5
Diptera		
Ceratopogonidae		10
Bezzia/Palpomyia gp.		5
Chironomidae	3	5
Ablabesmyia gp.		10
Chironomus sp.	164	185
Einfeldia sp.		10
Glyptotendipes sp.		35
Parachironomus sp.		15
Polypedilum convictum		5
Polypedilum illinoense	67	40
Procladius bellus	113	
Pseudochironomus sp.		100
Tanytarsus sp.	23	65
Thienemannimyia gp.	7	
Zavrelimyia sp.		10
Stratiomyidae		
Stratiomys sp.		36
Tipulidae		
Limonia sp.		40
CHORDATA		
Osteichthyes		10
Poeciliidae		
Gambusia sp.	10	
TOTAL NO. OF ORGANISMS	**682**	**1091**
TOTAL NO. OF SPECIES	**19**	**31**

BENTHIC MACROINVERTEBRATES COLLECTED FROM TITUSVILLE, FL, DECEMBER 10, 2002.

SPECIES	T.V.**	F.F.G.***	CLASS FI	147556.Ia.TV
MOLLUSCA				
Gastropoda				
Basommatophora				
Physidae				
Physella sp.	8.84	CG		10
ANNELIDA				
Oligochaeta	*10	CG		
Haplotaxida				
Naididae	*8	CG		140
Dero sp.	9	CG		290
ARTHROPODA				
Crustacea				
Ostracoda	-			11
Insecta				
Odonata				
Aeshnidae	*3	P		
Anax sp.	*3	P		1
Coenagrionidae	*9	P		
Enallagma sp.	8.91	P		20
Libellulidae	*9	P		
Pachydiplax longipennis	*8	P		47
Coleoptera				
Haliplidae				
Haliplus sp.	*5	SH		20
Diptera				
Ceratopogonidae	*5	P		20
Atrichopogon sp.	6.49	P		10
Chaboridae				
Chaoborus punctipennis	8.5	P		30
Chironomidae				20
Chironomus sp.	9.63	CG		36
Glyptotendipes sp.	9.47	FC		91
Labrundinia sp.	5.9	P		2
Nimbocera sp.				2
Parachironomus sp.	9.42	CG		24
Polypedilum illinoense	9	SH	2	2
Pseudochironomus sp.	5.36	CG		3
Tanytarsus sp.	6.76	FC		23
CHORDATA****				
Osteichthyes				1
TOTAL NO. OF ORGANISMS				**802**
TOTAL NO. OF TAXA				**20**
FLORIDA INDEX				**1**
BIOTIC INDEX				**8.49**
MARGALEF				**2.841**
MENHINICK				**0.706**
SIMPSON				**0.815**
SHANNON				**2.165**

Pennington and Associate, Ina.

5 + 3 COC

Cell: A60

Comment: *Hilsenhoff Tolerance Values used when North Carolina Tolerance Values are not available
**North Carolina Tolerance Values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes
***F.F.G.-Functional Feeding Group: CG=Collector/Gatherer, FC=Filtering/Collectors, SC=Scrapers, SH=Shredders, P=Predators and PI=Piercer
****Not included in analysis

BENTHIC MACROINVERTEBRATES, TITUSVILLE, FL., CH2MHILL, MAY 2003.

SPECIES	T.V.**	F.F.G.***	FL	Titusville
MOLLUSCA				
Gastropoda				
Physidae				
Physella sp.	8.84	CG		20
Planorbidae	*6	SC		
Menetus dilatatus	8.23	SC		30
ANNELIDA				
Oligochaeta	*1	CG		
Haplotaxida				
Naididae	*8	CG		50
Dero sp.	10	CG		200
ARTHROPODA				
Crustacea				
Cladocera				
Daphnidae				
Ceriodaphnia sp.				10
Insecta				
Odonata				
Coenagrionidae	*9	P		
Enallagma sp.	8.91	P		20
Libellulidae	*9	P		
Pachydiplax longipennis	9.86			2
Coleoptera				
Hydrophilidae		P		10
Diptera				
Chaboridae				
Chaoborus punctipennis	8.5	P		60
Chironomidae				
Ablabesmyia rhamphe gp.	*6	P	2	20
Chironomus sp.	9.63	CG		490
Parachironomus sp.	9.42	CG		40
Polypedilum illinoense	9	SH	2	60
Procladius sp.	9.1	P	2	10
Pseudochironomus sp.	5.36	CG		120
Tanytarsus sp.	9.19	FC		140
CHORDATA****				
Osteichthyes				10
TOTAL NO. OF ORGANISMS				**1282**
TOTAL NO. OF TAXA				**16**
FLORIDA INDEX				**3**
BIOTIC INDEX				**8.96**
MARGALEF				**1.453**
MENHINICK				**0.447**
SIMPSON				**0.801**
SHANNON				**2.955**
HILL (N1)				**7.757**
HILL (N2)				**5.03**
PIELOU				**0.739**
SHELDON				**0.485**
HEIP				**0.459**
HILL				**0.548**
HILL MOD.				**0.596**

Pennington and Associates, Inc. 5 + 3 COC

Cell: A40

Comment: *Hilsenhoff Tolerance Values used when North Carolina Tolerance Values are not available
**North Carolina Tolerance Values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes
***F.F.G.-Functional Feeding Group: CG=Collector/Gatherer, FC=Filtering/Collectors, SC=Scrapers, SH=Shredders, P=Predators and PI=Piercer
****Not included in analysis

BENTHIC MACROINVERTEBRATES, TITUSVILLE, CH2MHILL, OCTOBER 2003.

SPECIES	T.V.	F.F.G.	Sta. TV-1
MOLLUSCA			
Gastropoda			
Basommatophora			
Physidae			
Physella sp.	**8.8**	**CG**	1
ANNELIDA			
Hirudinea		**P**	
Rhynchobdellida			
Glossiphoniidae		**P**	
Helobdella triserialis	**9.2**	**P**	2
ARTHROPODA			
Crustacea			
Decapoda			
Palaemonidae			
Palaemonetes kadiakensis	**7.1**		1
Insecta		**P**	
Odonata		**P**	
Coenagrionidae			
Enallagma sp.	**8.9**		8
Libellulidae			
Erythemis sp.			11
Pachydiplax longipennis	**9.9**		6
Hemiptera		**PI**	
Belostomatidae			
Belostoma sp.	**9.8**	**-**	1
Naucoridae			
Pelocoris sp.	**7**	**P**	8
Diptera		**P**	
Chaboridae			
Chaoborus punctipennis	**8.5**	**P**	24
Chironomidae			
Ablabesmyia rhamphe gp.			14
Chironomus sp.	**9.6**	**P**	42
Cladopelma sp.	**3.5**	**P**	2
Larsia sp.	**9.3**		1
Polypedilum illinoense	**9**	**P**	19
Pseudochironomus sp.	**5.4**	**CG**	20
Rheotanytarsus sp.	**5.9**	**CG**	5
Tanytarsus sp.	**6.8**	**CG**	31
Zavrelimyia sp.	**9.1**	**CG**	1
CHORDATA****			
Osteichthyes			7
TOTAL NO. OF ORGANISMS			**197**
TOTAL NO. OF TAXA			**18**
FLORIDA INDEX			**2**
BIOTIC INDEX			**8.04**
MARGALEF			**2.23**
MENHINICK			**1.282**
SIMPSON			**0.886**
SHANNON			**3.42**
HILL (N1)			**10.707**
HILL (N2)			**8.807**
PIELOU			**0.82**
SHELDON			**0.595**
HEIP			**0.571**
HILL			**0.823**
HILL MOD.			**0.804**

5 + 3 COC

BENTHIC MACROINVERTEBRATES, TITUSVILLE, FL., CH2MHILL, April 2004.

SPECIES	**T.V.****	**Titusville**	
Physella sp.	**8.84**	20	176.8
Naididae	**8**	341	2728
Dero sp.	**10**	279	2790
Palaemonetes kadiakens	**7.1**	1	7.1
Centroptilum sp.	**6.6**	10	66
Coenagrionidae	**9**	60	540
Argia sp.	**8.2**	10	82
Libellulidae	**9**	21	189
Pachydiplax longipennis	**9.86**	20	197.2
Pelocoris sp.	**7**	10	70
Celina sp.	**8**	10	80
Tropisternus sp.	**9.7**	10	97
Hydrocanthus sp.	**7.1**	20	142
Bezzia/Palpomyia gp.	**6.9**	10	69
Chaoborus punctipennis	**8.5**	110	935
Ablabesmyia rhamphe gp	**6**	200	1200
Chironomus sp.	**9.63**	2900	27927
Larsia sp.	**9.3**	100	930
Polypedilum illinoense	**9**	30	270
Pseudochironomus sp.	**5.36**	200	1072
Tanytarsus sp.	**9.19**	430	3951.7
Ormosia sp.	**6.3**	10	63
TOTAL NO. OF ORGANISMS		**4802**	**43582.8**
			9.075968

Pennington and Associates, Inc. 5 + 3 COC

BENTHIC MACROINVERTEBRATES, TITUSVILLE, FL., CH2MHILL, MAY 2004.

SPECIES	T.V.**	F.F.G.***	FL	Titusville
MOLLUSCA				
Gastropoda				
Physidae				
Physella sp.	**8.84**	**CG**		20
ANNELIDA				
Oligochaeta	***1**	**CG**		
Haplotaxida				
Naididae	***8**	**CG**		341
Dero sp.	**10**	**CG**		279
ARTHROPODA				
Crustacea				
Ostracoda				30
Decapoda				
Palaemonidae				
Palaemonetes kadiakensis	**7.1**			1
Insecta				
Ephemeroptera				
Baetidae		**CG**		
Centroptilum sp.	**6.6**	**CG**		10
Odonata				
Coenagrionidae	***9**	**P**		60
Argia sp.	**8.2**	**P**	**1**	10
Libellulidae	***9**	**P**		21
Erythemis sp.				50
Pachydiplax longipennis	**9.86**			20
Hemiptera				
Naucoridae		**-**		
Pelocoris sp.	**7**	**-**		10
Coleoptera				
Dytiscidae		**P**		
Celina sp.	**8**	**P**		10
Hydrophilidae		**P**		
Tropisternus sp.	**9.7**	**P**		10
Noteridae				
Hydrocanthus sp.	**7.1**			20
Diptera				
Ceratopogonidae		**P**		
Bezzia/Palpomyia gp.	**6.9**	**P**		10
Chaboridae				
Chaoborus punctipennis	**8.5**	**P**		110
Chironomidae				40
Ablabesmyia rhamphe gp.	***6**	**P**	**2**	200
Chironomus sp.	**9.63**	**CG**		2900
Larsia sp.	**9.3**	**P**		100
Polypedilum illinoense	**9**	**SH**	**2**	30
Pseudochironomus sp.	**5.36**	**CG**		200
Tanytarsus sp.	**9.19**	**FC**		430
Culicidae		**FC**		10
Tipulidae		**SH**		
Ormosia sp.	**6.3**	**CG**		10
CHORDATA**				
Osteichthyes				3

Pennington and Associates, Inc.

5 + 3 COC

SPECIES	T.V.**	F.F.G.***	FL	Titusville
TOTAL NO. OF ORGANISMS				**4932**
TOTAL NO. OF TAXA				**26**
FLORIDA INDEX				**6**
BIOTIC INDEX				**9.08**
MARGALEF				**2.038**
MENHINICK				**0.37**
SIMPSON				**0.634**
SHANNON				**2.438**
HILL (N1)				**5.419**
HILL (N2)				**2.733**
PIELOU				**0.519**
SHELDON				**0.208**
HEIP				**0.177**
HILL				**0.504**
HILL MOD.				**0.392**

Cell: A55

Comment: *Hilsenhoff Tolerance Values used when North Carolina Tolerance Values are not available
**North Carolina Tolerance Values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes
***F.F.G.-Functional Feeding Group: CG=Collector/Gatherer, FC=Filtering/Collectors, SC=Scrapers, SH=Shredders, P=Predators and PI=Piercer
****Not included in analysis

BENTHIC MACROINVERTEBRATES, TITUSVILLE, October 20, 2004.

SPECIES	T.V.	F.F.G.	Titusville
ANNELIDA			
Oligochaeta	***10**	**CG**	
Tubificida			
Naididae	***8**	**CG**	
Dero vega	**10**	**CG**	10
Lumbriculida			
Lumbriculidae	**7**	**CG**	10
ARTHROPODA			
Insecta			
Odonata			
Coenagrionidae		**P**	
Argia sp.	**8.2**	**P**	20
Libellulidae		**P**	31
Erythemis sp.			60
Hemiptera			10
Naucoridae			
Pelocoris sp.	**7**		41
Coleoptera			
Hydrophilidae			
Tropisternus sp.	**9.7**	**P**	10
Diptera			
Chironomidae			100
Ablabesmyia rhamphe gp.	**7.2**	**P**	40
Chironomus sp.	**9.6**	**CG**	250
Polypedilum illinoense	**9**	**SH**	1320
Tanytarsus sp.	**6.8**	**FC**	290
Zavrelimyia sp.	**9.1**	**P**	310
Culicidae		**FC**	10
Stratiomyidae		**CG**	
Odontomyia/Hedriodiscus sp.			10
TOTAL NO. OF ORGANISMS			2522
TOTAL NO. OF TAXA			16
FLORIDA INDEX			3
BIOTIC INDEX			8.73
MARGALEF			1.327
MENHINICK			0.319
SIMPSON			0.685
SHANNON			2.378
HILL (N1)			5.196
HILL (N2)			3.177
PIELOU			0.594
SHELDON			0.325
HEIP			0.28
HILL			0.611
HILL MOD.			0.519

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BENTHIC MACROINVERTEBRATES, TITUSVILLE, CH2MHILL, APRIL 28, 2005.

SPECIES	T.V.	F.F.G.	TV-1
ARTHROPODA			
Insecta			
Odonata			
Libellulidae		**P**	
Erythemis sp.			1
Pachydiplax longipennis	**9.9**		1
Hemiptera			
Naucoridae		**-**	
Pelocoris sp.	**7**	**-**	4
Coleoptera			
Hydrophilidae		**P**	
Tropisternus sp.	**9.7**	**P**	1
Diptera			
Chironomidae			
Ablabesmyia rhamphe gp.	**7.2**	**P**	10
Chironomus sp.	**9.6**	**CG**	5
Polypedilum illinoense	**9**	**SH**	4
Pseudochironomus sp.	**5.4**	**CG**	31
Tanytarsus sp.	**6.8**	**FC**	1
Tribelos sp.	**6.3**	**CG**	1
CHORDATA****			
Osteichthyes			4
TOTAL NO. OR ORGANISMS			**59**
TOTAL NO. OF TAXA			**10**
FLORIDA INDEX			4
BIOTIC INDEX			**6.62**
MARGALEF			**1.53**
MENHINICK			**1.302**
SIMPSON			**0.689**
SHANNON			**2.249**
HILL (N1)			**4.752**
HILL (N2)			**3.216**
PIELOU			**0.677**
SHELDON			**0.475**
HEIP			**0.417**
HILL			**0.677**
HILL MOD.			**0.591**

BENTHIC MACROINVERTEBRATES, TITUSVILLE, CH2MHILL, BREVARD COUNTY, FL, APRIL 28, 2005.

SPECIES	T.V.	TV-1	
Pachydiplax longipennis	**9.9**	1	9.9
Pelocoris sp.	**7**	4	28
Tropisternus sp.	**9.7**	1	9.7
Ablabesmyia rhamphe gp.	**7.2**	10	72
Chironomus sp.	**9.6**	5	48
Polypedilum illinoense	**9**	4	36
Pseudochironomus sp.	**5.4**	31	167.4
Tanytarsus sp.	**6.8**	1	6.8
Tribelos sp.	**6.3**	1	6.3
TOTAL NO. OR ORGANISMS		**58**	**384.1**
			6.622414

BENTHIC MACROINVERTEBRATES, TITUSVILLE, October 2005

SPECIES	T.V.	F.F.G.	Titusville
ANNELIDA			
Oligochaeta			
Hirudinea			
Rhynchobdellida			
Glossiphoniidae			1
ARTHROPODA			
Crustacea			
Amphipoda			
Hyalellidae			
Hyalella azteca	**7.8**	**CG**	7
Insecta			
Odonata			
Libellulidae			1
Erythemis sp.			2
Hemiptera			
Naucoridae			
Pelocoris sp.	**7**		1
Coleoptera			
Noteridae			
Hydrocanthus sp.	**7.1**		1
Diptera			
Chironomidae			
Ablabesmyia rhamphe gp.	**7.2**	**P**	1
Corynoneura sp.	**6**	**CG**	14
Larsia sp.	**9.3**	**P**	15
Polypedilum illinoense	**9**	**SH**	64
Tanytarsus sp.	**6.8**	**FC**	67
TOTAL NO. OF ORGANISMS			**174**
TOTAL NO. OF TAXA			**11**
FLORIDA INDEX			**6**
BIOTIC INDEX			**7.83**
MARGALEF			**1.344**
MENHINICK			**0.834**
SIMPSON			**0.705**
SHANNON			**2.133**
HILL (N1)			**4.385**
HILL (N2)			**3.386**
PIELOU			**0.616**
SHELDON			**0.399**
HEIP			**0.399**
HILL			**0.772**
HILL MOD.			**0.705**

BENTHIC MACROINVERTEBRATES, TITUSVILLE, BREVARD CO., FL, 1/12/06.

SPECIES	T.V.	Titusville	
Hyalella azteca	**7.8**	7	54.6
Pelocoris sp.	**7**	1	7
Hydrocanthus sp.	**7.1**	1	7.1
Ablabesmyia rhamphe gp.	**7.2**	1	7.2
Corynoneura sp.	**6**	14	84
Larsia sp.	**9.3**	15	139.5
Polypedilum illinoense	**9**	64	576
Tanytarsus sp.	**6.8**	67	455.6
TOTAL NO. OF ORGANISMS		**170**	**1331**
TOTAL NO. OF TAXA		**8**	7.829412
FLORIDA INDEX			
BIOTIC INDEX			
MARGALEF			
MENHINICK			
SIMPSON			
SHANNON			
HILL (N1)			
HILL (N2)			
PIELOU			
SHELDON			
HEIP			
HILL			
HILL MOD.			

5 + 3 COC

BENTHIC MACROINVERTEBRATES, TITUSVILLE, March 2006.

SPECIES	T.V.	F.F.G.	Titusville
MOLLUSCA			
Gastropoda			
Basommatophora			
Ancylidae		**SC**	
ANNELIDA			
Oligochaeta			
Tubificida			
Naididae	***8**	**CG**	10
Dero sp.	**10**	**CG**	80
Pristina leidyi	**9.6**	**CG**	80
ARTHROPODA			
Crustacea			
Cladocera			
Chydoridae			
Daphnidae			
Ceriodaphnia sp.			
Copepoda			20
Isopoda			
Asellidae			
Caecidotea sp.	**9.1**	**CG**	
Amphipoda			
Crangonyctidae			
Crangonyx sp.	**7.9**	**CG**	
Gammaridae			
Gammarus sp.	**9.1**	**SH**	
Hyalellidae			
Hyalella azteca	**7.8**	**CG**	23
Decapoda			
Cambaridae			
Procambarus sp.	**7**	**SH**	
Insecta			
Collembola			
Odonata			
Coenagrionidae			11
Ischnura sp.	**9.5**		
Libellulidae			
Pachydiplax longipennis	**9.9**		
Hemiptera			
Belostomatidae			
Belostoma sp.	**9.8**	**P**	10
Corixidae	**9**	**PI**	
Naucoridae			
Pelocoris sp.	**7**		
Veliidae			
Microvelia sp.		**P**	
Trichoptera			
Hydroptilidae			
Oxyethira sp.	**2.2**	**PI**	

BENTHIC MACROINVERTEBRATES, TITUSVILLE, March 2006.

SPECIES	T.V.	F.F.G.	Titusville
Coleoptera			
Dytiscidae			
Hydroporus sp.	**8.6**	**PI**	
Thermonectus sp.		**P**	
Haliplidae			
Peltodytes sp.	**8.7**	**SH**	
Hydrophilidae			
Tropisternus sp.	**9.7**	**P**	
Noteridae			
Hydrocanthus sp.	**7.1**		10
Scirtidae		**SC**	1
Diptera			
Ceratopogonidae		**P**	11
Bezzia/Palpomyia gp.	**6.9**	**P**	
Chironomidae			
Ablabesmyia mallochi	**7.2**	**P**	
Ablabesmyia rhamphe gp.	**7.2**	**P**	100
Chironomus sp.	**9.6**	**CG**	20
Corynoneura sp.	**6**	**CG**	10
Dicrotendipes sp.	**8.1**	**CG**	
Guttipelopia guttipennis			110
Kiefferulus sp.	**8**		
Labrundinia sp.	**5.9**	**P**	
Parakiefferiella sp.	**5.4**	**CG**	
Polypedilum halterale gp.	**7.3**	**SH**	10
Polypedilum illinoense	**9**	**SH**	580
Procladius sp.	**9.1**	**P**	
Psectrocladius (Monopsectrocladius) sp.	**3.6**	**SH**	
Tanypus sp.	**9.2**	**P**	
Tanytarsus sp.	**6.8**	**FC**	580
TOTAL NO. OF ORGANISMS			**1666**
TOTAL NO. OF TAXA			**17**
FLORIDA INDEX			**5**
BIOTIC INDEX			**8.07**
MARGALEF			**1.495**
MENHINICK			**0.416**
SIMPSON			**0.745**
SHANNON			**2.545**
HILL (N1)			**5.836**
HILL (N2)			**3.917**
PIELOU			**0.623**
SHELDON			**0.343**
HEIP			**0.302**
HILL			**0.671**
HILL MOD.			**0.603**

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BENTHIC MACROINVERTEBRATES, TITUSVILLE, GAINESVILLE, FL, MARCH 2006.

SPECIES	T.V.	Titusville
Naididae	**8**	10
Dero sp.	**10**	80
Pristina leidyi	**9.6**	80
Caecidotea sp.	**9.1**	
Crangonyx sp.	**7.9**	
Gammarus sp.	**9.1**	
Hyalella azteca	**7.8**	23
Procambarus sp.	**7**	
Ischnura sp.	**9.5**	
Pachydiplax longipennis	**9.9**	
Belostoma sp.	**9.8**	10
Corixidae	**9**	
Pelocoris sp.	**7**	
Oxyethira sp.	**2.2**	
Hydroporus sp.	**8.6**	
Peltodytes sp.	**8.7**	
Tropisternus sp.	**9.7**	
Hydrocanthus sp.	**7.1**	10
Bezzia/Palpomyia gp.	**6.9**	
Ablabesmyia mallochi	**7.2**	
Ablabesmyia rhamphe gp.	**7.2**	100
Chironomus sp.	**9.6**	20
Corynoneura sp.	**6**	10
Dicrotendipes sp.	**8.1**	
Kiefferulus sp.	**8**	
Labrundinia sp.	**5.9**	
Parakiefferiella sp.	**5.4**	
Polypedilum halterale gp.	**7.3**	10
Polypedilum illinoense	**9**	580
Procladius sp.	**9.1**	
Psectrocladius (Monopsectrocladius) sp.	**3.6**	
Tanypus sp.	**9.2**	
Tanytarsus sp.	**6.8**	580
TOTAL NO. OF ORGANISMS		**1513**

5 + 3 COC

BENTHIC MACROINVERTEBRATES COLLECTED FROM TITUSVILLE, FL, CH2MHILL, 10/25/06.

SPECIES	T.V.	F.F.G.	TITUSVILLE
MOLLUSCA			
Gastropoda			
Basommatophora			
Lymnaeidae		**SC**	
Fossaria sp.	***7**	**SC**	3
Physidae			
Physella sp.	**8.8**	**CG**	2
ANNELIDA			
Oligochaeta	***10**	**CG**	
Tubificida			
Lumbricidae		**CG**	4
Naididae	***8**	**CG**	
Dero sp.	**10**	**CG**	7
Lumbriculida			
Lumbriculidae	**7**	**CG**	2
Hirudinea		**P**	
Rhynchobdellida			
Glossiphoniidae		**P**	
Helobdella triserialis	**9.2**	**P**	1
ARTHROPODA			
Crustacea			
Ostracoda			19
Amphipoda		**CG**	
Crangonyctidae			
Crangonyx sp.	**7.9**	**CG**	3
Hyalellidae			
Hyalella azteca	**7.8**	**CG**	89
Insecta			
Odonata			
Libellulidae		**P**	
Erythemis simplicicollis	**9.7**		1
Pachydiplax longipennis	**9.9**		7
Coleoptera			
Dryopidae			
Helichus sp.	**4.6**	**SC**	1
Diptera			
Chaboridae			
Chaoborus sp.	**8.5**	**P**	2
Chironomidae			
Chironomus sp.	**9.6**	**CG**	3
Corynoneura sp.	**6**	**CG**	1
Polypedilum illinoense	**9**	**SH**	80
Tanytarsus sp.	**6.8**	**FC**	42
Zavrelimyia sp.	**9.1**	**P**	9

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5 + 3 COC

BENTHIC MACROINVERTEBRATES COLLECTED FROM TITUSVILLE, FL, CH2MHILL, 10/25/06.

SPECIES	T.V.	F.F.G.	TITUSVILLE
TOTAL NO. OR ORGANISMS			**276**
TOTAL NO. OF TAXA			**18**
FLORIDA INDEX			**3**
BIOTIC INDEX			**8.19**
MARGALEF			**2.097**
MENHINICK			**1.083**
SIMPSON			**0.784**
SHANNON			**2.727**
HILL (N1)			**6.62**
HILL (N2)			**4.626**
PIELOU			**0.654**
SHELDON			**0.368**
HEIP			**0.331**
HILL			**0.699**
HILL MOD.			**0.645**

T.V. - North Carolina Tolerance Values - range from 0 to 10 for organisms very **intolerant** (0) of organic wastes; organisms very **tolerant** (10).

* Hilsenhoff Tolerance Values used when North Carolina Tolerance values not available.

F.F.G. - Functional Feeding Group: SH = Shredder, CG = Collector/Gatherer, FC = Filtering Collector, SC = Scraper, P = Predator, PI = Piercer

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5 + 3 COC

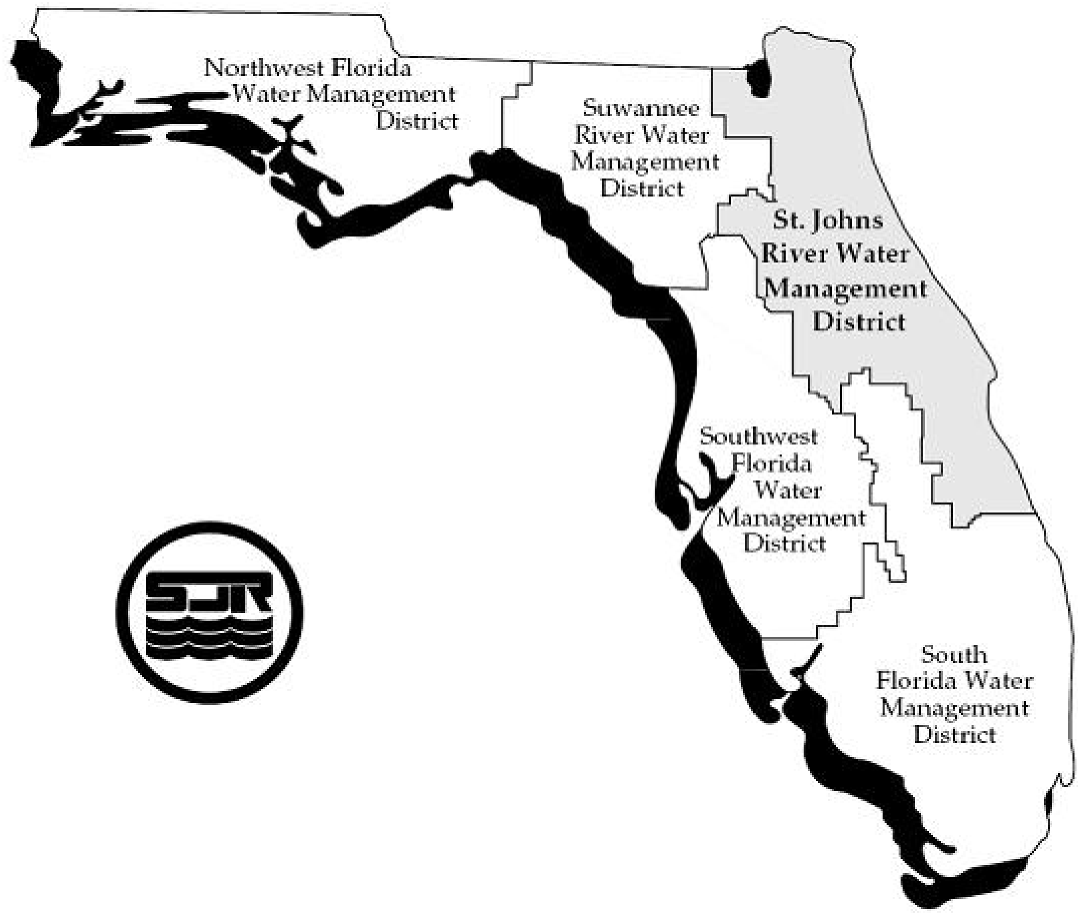
Appendix F - Tillman Ridge Wellfield: Fifth Annual Hydration Report

DEMONSTRATION PROJECT NO. 1, ST. JOHNS COUNTY, FLORIDA
TILLMAN RIDGE WELLFIELD
FIFTH ANNUAL HYDRATION REPORT

CH2MHILL

St. Johns River Water Management District
Palatka, Florida

August 2009
(Originally prepared December 2006)



The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 18 counties in northeast Florida. The mission of SJRWMD is to ensure the sustainable use and protection of water resources for the benefit of the people of the District and the state of Florida. SJRWMD accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

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EXECUTIVE SUMMARY

This report summarizes the Tillman Ridge Wellfield Demonstration Project from its inception in 2000 through June 2006. The baseline period (April 2000 to July 8, 2001) provided background information on the wetland hydrology and biological community. The hydration period began July 9, 2001, and is ongoing. This report provides results from that day to June 30, 2006.
The 5-acre wetland demonstration site is an isolated swamp in a Florida flatwoods landscape located in St. Johns County, Florida. There is little topographic relief in the area, and wetlands are only slightly (often less than 1 foot) lower than surrounding uplands. The wetland is located in the Tillman Ridge Wellfield, which supplies potable water to the St. Augustine area. The St. Johns River Water Management District (SJRWMD) has analyzed the groundwater conditions in this wellfield, and the potential for drawdown of the surficial aquifer in this wellfield has been recognized for some years. The selected wetland showed anecdotal evidence of surficial aquifer reduction including fallen trees, exposed roots, and invasion of the wetland (as defined by dominant vegetation) by upland and facultative-upland plants.

The purpose of the demonstration project is to evaluate the effects, costs, and benefits of applying water to the surface of the swamp. This report provides a summary and analysis of data collected from project inception in April 2000 through June 2006.

BASELINE PERIOD

The baseline period included design, installation, and monitoring efforts. Two shallow groundwater wells (piezometers) were installed at upland and wetland ends of a 90-meter long vegetation transect. Vegetation and amphibian communities were characterized. Vegetation sampling was conducted twice.

Water Level

Analysis of the baseline period showed that water levels were more than 6 feet below the surface most of the time, and did not appear above the wetland surface at any time during the 15-month period.

Water Quality

No surface water was present during the 15-month baseline period; therefore, no water quality data were available.

Soils

Soil analysis clearly indicated wetland status. However, the initial evaluation found only a shallow (8-inch) organic layer, suggesting a transitional soil condition or significant loss of organic matter through oxidation.

Vegetation

Dominant woody vegetation species were obligate and facultative wetland species, with some upland invaders. The site was characterized as a bald cypress / blackgum swamp (*Taxodium distichum* / *Nyssa sylvatica*) with slash pine (*Pinus* sp.) and an understory of wax myrtle (*Myrica cerifera*), loblolly bay (*Gordonia lasianthus*), and fetterbush (*Lyonia lucida*). There were numerous trees falling over from what appeared to be reduced water levels. Upland herbaceous vegetation was invading the wetland.

Amphibians

Amphibian populations were surveyed by University of Florida graduate students under the direction of Richard Franz. However, due to access and contract delays, only 4 months of pre-augmentation data are available on amphibians. In that short baseline period, frog species captured in the Tillman Ridge wetland totaled 21, compared to 57 individuals captured at a nearby control wetland.

HYDRATION PERIOD

Water Level

The total annual hydration supply (in addition to rainfall) to the 5-acre wetland was 65 inches (during Year 1), 53 inches (Year 2), 64 inches (Year 3), 61 inches (Year 4), and 57 inches (Year 5). Application of groundwater from a surficial aquifer well increased the average water level elevation about 5.7 feet by the end of hydration Year 5. Groundwater elevation exceeded the wetland surface 71% of the hydration period (60 months). The hydration period demonstrated that application could significantly increase surficial groundwater elevations. After hydration Year 5, the wetland hydrograph nearly mimics the target hydrograph, which was developed by analyzing biological indicators of long-term water level condition (soils and vegetation).

Midway through the second hydration year, three supplemental piezometers were installed around the wetland and the frequency of automatic elevation sampling was increased to every hour to provide a more complete database for analysis of the shallow groundwater and vertical seepage rates. (See the 2nd Annual Report dated February 2004). The most important result of the seepage analysis is that hydration not only increased the typical water elevation but in doing so slowed the rate of vertical seepage to the aquifer, thus causing water to remain at an elevation for longer periods of time. This effect is attributed to the difference in mineral (underlying) and organic (surficial) soil characteristics, implying that the organic soils are part of the self-perpetuating mechanisms of healthy wetlands. The relatively isolated nature of the wetland was verified through the lateral seepage evaluation, and an overall water budget was calculated.

Subsequently, in hydration years three and four, the three supplemental recorders have been relocated to Bennett Swamp to replace vandalized water level recorders. At the Tillman Ridge wetland, the wetland and upland recorders remain in their original locations on the main transect; the frequency of sampling was reduced to 12 readings per day; and both recorders are functioning properly.

The most notable event of the fourth year of operational monitoring was the 2004 hurricane season. The 2004 hurricane season produced 5 named storms that hit the State of Florida, one as a tropical storm (Bonnie in August 2004), and four as hurricanes (Charley in August 2004; and Frances, Ivan, and Jeanne in September 2004). All of the storms except for Ivan produced significant rainfall amounts that fell within the Tillman Ridge wetland watershed. September 2004 reported the greatest rainfall totals recorded within the watershed since the beginning of the project in June 2000.
The fifth (and first) year of operational monitoring reported the lowest annual rainfall totals of the study period. Rainfall during hydration Year 5 (July 2005 to June 2006) totaled 45.3 inches, which is below the long-term seasonal average for the area (48 to 50 inches). Basal area of canopy tree species increased compared to the baseline measurements. Canopy density in the fifth year, while less than baseline, has increased since the fourth year.

Water Quality

Surface water was sampled during the October 2005 and March 2006 monitoring events hydration Year 5. Water quality values were similar to those recorded during baseline and previous hydration sampling events. Water quality is typical for a cypress dome system surrounded by pine flatwoods in North Florida.

Soils

Soils were last investigated during the September 2002 monitoring event. Examination of the soil indicated that a deep (at least 1.5 feet deep) organic soil layer was found to be within 50 feet of the upland edge, indicating that wetland soils were present over most of the transect.

Vegetation

Vegetation was sampled in October 2005 and March 2006 during hydration Year 5. Standing water covered most of the meter square and belt transects during the October 2005 monitoring event, resulting in overall low diversity and density of plant species. Plant communities continue to be dominated by facultative species and percent cover continues to be highest at the upland end of the monitoring transects. The plant communities are responding slowly to changes in wetland hydrology. Tree fall in the wetland continues today because the soil has lost much of its organic characteristics after being dry for many years, consequently it cannot provide the support needed for some of the trees. This also leaves them more vulnerable to high winds. In time (several decades), the canopy will recover as the soil is reconditioned, trees germinate and grow.

Amphibians

Amphibian surveys are conducted by Coastal Plains Institute, Inc. (CPI), from January through September each year. A full presentation of these survey results is submitted by CPI directly to the District. A brief summary of the available CPI survey results (through 2006) are included in this annual report. In 2006, amphibian diversity (richness and abundance) was the lowest recorded for a single year since post-augmentation sampling began in 2003; these data can be attributed to the extremely dry conditions in 2006 (Means and Meegan 2006). Based on data throughout the project, preliminary conclusions by CPI were stated in their fourth annual report that amphibian species diversity (richness and particularly abundance) was still higher at the pilot demonstration wetland than at the control wetland (Means and Meegan 2006). CPI postulated that this was possibly due to wetland augmentation, but that the data is inconclusive.

RECOMMENDATIONS

This completes the fifth and final year of hydration and monitoring of the Tillman Ridge Wetland; and hydration continued through September 2006 in order to support the fourth and final year of the amphibian survey. A separate final report synthesizing the results and effects of hydration (or surface water diversion) on the study wetlands of the four pilot projects will be submitted when the program ends in September 2008.

CONTENTS

APPENDIXES

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
CompQAP	Comprehensive Quality Assurance Plan
CPI	Coastal Plains Institute, Inc.
dbh	diameter at breast height
ET	evapotranspiration
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
FDEP	Florida Department of Environmental Protection
ft	foot / feet
gpd	gallons per day
gpm	gallons per minute
H	herbaceous
in	inch(es)
MG	million gallons
N	Nitrate plus Nitrite NO_3+NO_2
NGVD	National Geodetic Vertical Datum
NH_3	Ammonia
NRCS	Natural Resource Conservation Service
OBL	obligate
Ortho P	orthophosphate
PVC	polyvinyl chloride
QA / QC	quality assurance / quality control
TKN	total Kjeldahl nitrogen
TP	total phosphorus
TSS	total suspended solids
SJRWMD	St. Johns River Water Management District

UF	University of Florida
UP	upland
WTP	water treatment plant

INTRODUCTION

PROJECT BACKGROUND AND RATIONALE

This pilot project is one of the Phase 2 TASK E *Avoidance of Impacts and Alternative Water Supply Strategies* projects being conducted for the St. Johns River Water Management District (SJRWMD). The goal of this pilot program is to assess the benefits of augmenting the surface water in wetlands to avoid the impacts of drawdown in the surficial aquifer, often associated with potable water wellfields. The Tillman Ridge Demonstration Project is one of four being conducted by SJRWMD to test this hydration concept in various ways.

Projecting water table impacts of aquifer withdrawals on a regional scale can be difficult and is associated with some uncertainty. However, experience in other parts of the state, especially in the northern Tampa Bay area, has shown that over-pumping groundwater resources can significantly lower the surficial aquifer system. In the Tampa Bay area, this resulted in adverse impacts to sensitive wetlands and aquatic systems. Thus, developing water supplies without regard for impacts to wetland and aquatic systems, and then mitigating later, is likely to be a very costly alternative. In comparison to the pump and mitigate strategy, impact avoidance strategies are likely to be more cost-effective.

One approach to balancing impacts (realized or potential) and resource development is avoiding impacts to wetlands. One strategy is to compensate for altered hydrology due to water table decline by directly supplying water to affected wetlands. The addition of water to a wetland can also be used as a means to avoid potential impacts where the possible effects of groundwater withdrawal are a concern.

The SJRWMD demonstration project program includes a combination of projects which, when implemented, will yield the operational cost and performance data needed by utilities to reliably identify the full cost of impact avoidance strategies.

The recommended duration of this demonstration project is 5 years. This period of time will provide an assessment of the feasibility of avoiding projected impacts to native vegetation resulting from the projected increases in groundwater withdrawals. The project conclusions and recommendations will provide the basis for better decision-making when assessing other wetlands for impact avoidance hydration.

On behalf of SJRWMD, CH2M HILL's role is to:

- Establish and conduct baseline monitoring and data collection to characterize the wetland's existing ecological and hydrological condition.

- Design water control facilities and structures.

- Prepare permit applications for facilities and structures, and once permitted, provide limited oversight during construction.

- Establish and conduct operational monitoring and data collection.

- Generate progress reports for the duration of the project.

The conclusions and recommendations developed for this type of hydration will include those concerning:

- Overall costs and benefits
- Water quantity
- Efficiency and timing of water delivery
- Ecological responses
- Operation and maintenance requirements

TILLMAN RIDGE WETLAND

The Tillman Ridge Wellfield and the associated wetlands are located in St. Johns County, Florida, between the St. Johns River and St. Augustine, west of Interstate 95 and north of County Road 214 (Figures 1 and 2). The area is located at the wet edge of the Eastern Valley physiographic region (White 1970). The area has little topographic relief, and drainage ways are generally indistinct. "The flatwoods are interspersed with many poorly defined drainage ways and depressions which are flooded or ponded for long periods of time" (Readle 1983). The soil types in the surrounding area are poorly or very poorly drained sands and loams. Natural vegetation includes slash pine, longleaf pine, and saw palmetto in the flatwoods. Hardwoods and cypress dominate the swamps (Readle 1983). The Tillman Ridge Wellfield itself sits on a slightly elevated area oriented north to south, with wetlands on the east and west.

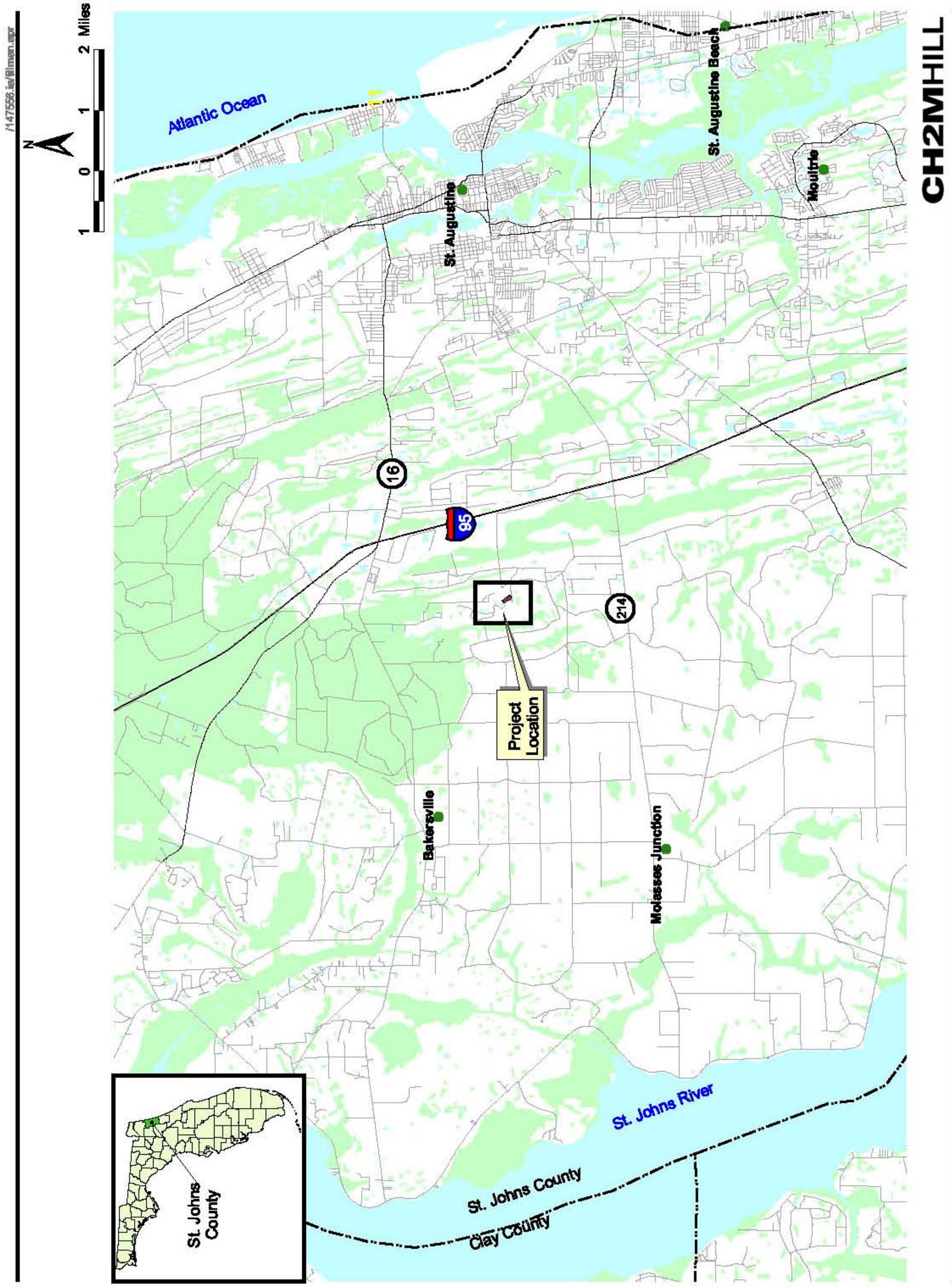

Figure 1. Project location map, St. Johns County

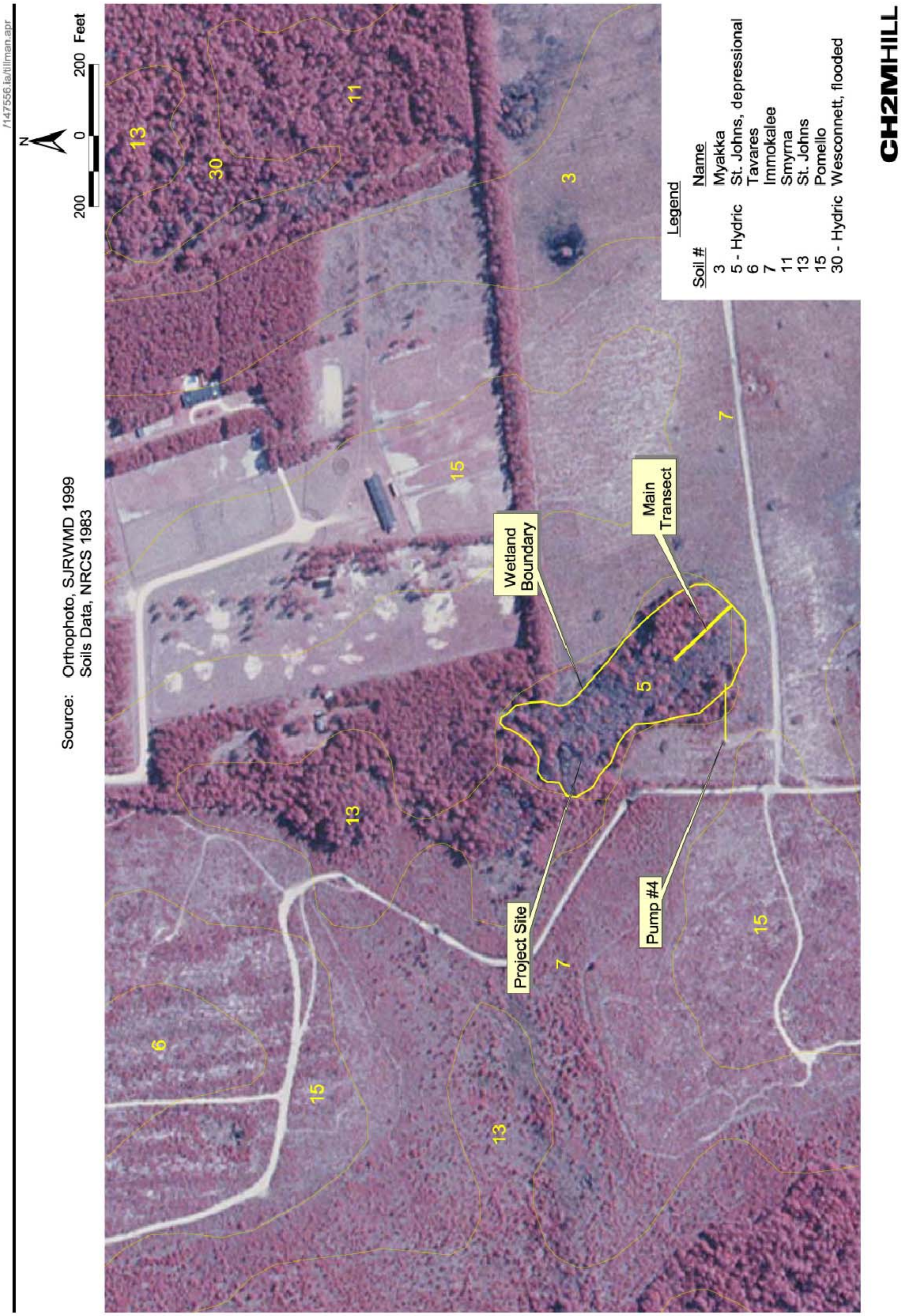

Figure 2. Wetland and transect location on Tillman Ridge Wellfield, St. Johns County

The wetland used for the hydration project is a 5-acre open stand of blackgum (*Nyssa sylvatica*), bald cypress (*Taxodium distichum*), slash pine (*Pinus elliotti*), and loblolly bay (*Gordonia lasianthus*) with a groundcover of dense leaf litter bordering the upland wellfield area. The project area of nominal wetland is underlain with a hydric soil, as classified by the Florida Association of Professional Soil Classifiers (Carlisle, 1990). As shown in Figure 2, the project site is within the Natural Resource Conservation Service (NRCS) soil type named *St. Johns fine sand, depressional (5)*. Surrounding upland soils are mainly *Immokalee fine sand (7)* and *Pomello fine sand, 0 to 5% slopes (15),* with a smaller area of *St. Johns fine sand (13)* adjacent to the northwest. Other soil types (shown in the figure) within one-half mile of the project wetland include uplands *Myakka fine sand (3), Tavares fine sand, 0 to 5 % slopes (6)*, and *Smyrna fine sand (11)*, and a hydric soil *Wesconnett fine sand, frequently flooded (30)* (Readle 1983).

The site was selected because of a combination of the following favorable factors:

- The St. Johns County Utility is a willing participant in the pilot hydration program.
- Although the County Utility only owns the well sites, it was possible to obtain easements to the wetland.
- Onsite investigations by CH2M HILL and the County's other consultant, CDM, showed that several of the wellfield wetlands might be useful in the study program.
- The wetland selected for the study is showing signs of altered hydrologic conditions, including leaning and fallen trees, exposed roots, encroachment of upland species, and water levels 4.5 feet below the surface during the wet season. For these reasons, the wetland appears likely to benefit from the hydration.
- The plant community is typical of other wetlands in the wellfield.
- There is a generally distinct vegetative edge between upland and wetland that allows for relatively simple distinction of the wetland area and any changes that might occur within the wetland.
- The nominal wetland is relatively small in size (5 acres).

- The wetland is immediately adjacent to an existing well no longer used by the utility and available for this pilot project. This feature makes the logistics of the hydration simple and cost-effective, and does not significantly affect the utility's overall site management and land use.

Restoration and impact avoidance by direct augmentation to a hydrologically altered wetland is being evaluated with the Tillman Ridge Wellfield pilot project. A nearby, abandoned wellfield well pumping from a semi-confined surficial aquifer (Toth 1994) was used to supply the wetland. The supply objective is to reproduce the natural wet and dry seasons of the wetland. The pumping schedule is based on three concepts:

1. **Provide hydration water on a schedule that mimics the monthly average rainfall of the region,** which is the simplest approach to increasing groundwater levels on a relatively natural cycle. The volume that is equal to the long-term monthly average inches of water for the 5-acre area was supplied according to the monthly average for the region west of St. Augustine, Florida (Fernald and Purdum 1998).

2. **Set a realistic and simple operational schedule,** so that managing this effort is achieved without significant additional cost to the wellfield operators. A 24-hour pumping increment is simple to implement and document, and not overly burdensome to the wellfield operators.

3. **Evaluate the data each year to assess hydration effectiveness** in meeting the project goal and to make changes, as needed, to improve the benefit of the hydration.

PURPOSE

This Annual Report summarizes and analyzes the results of the first 75 months of the project, including the 15-month baseline (prehydration) period (March 27, 2000 to July 8, 2001) and the 60 months of hydration (July 9, 2001 to June 30, 2006). The report presents the fifth evaluation of hydration effects, including effects on water level elevations and any floral and faunal changes. The report builds on the previous reports for the project, and includes all data collected in those reports and the data collected in sampling efforts since the last report. All data collected in previous years are provided in an appendix for easy reference. These data are used to annually evaluate the hydrologic and ecological responses of the wetland, if any, to hydration.

METHODS

WETLAND HYDRATION

Water is added to the wetland by pumping surficial aquifer groundwater. A detailed description of the supply system design (pipes, pump, distance, and location) is provided in Appendix C.

Tillman Ridge Water Treatment Plant (WTP) staff operates the pump, following as closely as possible the hydration schedule developed for the project. The water was supplied in 24-hour periods so that the labor needed to operate the pumps supplying the wetland could be provided within the normal WTP work schedule. Based on available pump curve information, the hydration schedule called for an average application rate of 70 gallons per minute (gpm) or 100,800 gallons per 24-hour day. Seventy-four (74) hydration periods (24 hours each) were scheduled to be delivered annually to the wetland; except for the first year, in which 70 hydration periods were delivered to the wetland.

The hydration periods are divided among the months of the year based on the historical average monthly rainfall amounts for the region west of St. Augustine, Florida. In this region of Florida, the wet season occurs from June through September; similarly, approximately 50% of the annual total is pumped to the wetland during these 4 months. The drier months are November, December, January, and April (Fernald and Purdum 1998); and approximately 20% of the annual total is delivered to the wetland during these months.

DATA COLLECTION

Data collection for the Tillman Ridge hydration demonstration project includes hydrologic, water quality, and floral and faunal sampling. CH2M HILL is responsible for all sampling except that of the amphibian community, which is being performed independently by Coastal Plains Institute, Inc. (CPI).

Primary field investigators during this fifth year of the project for all parameters except amphibians are CH2M HILL biologists Steve Eakin and Tony Davanzo. CPI researchers Ryan Means and Rebecca Meegan monitored amphibians.

Sampling Transects Design

The sampling transects (Figure 3) included an array of polyvinyl chloride (PVC) markers, two recording groundwater-monitoring wells (piezometers), and two staff gauges. Three adjacent, parallel transects were defined in an area that provided an adequate elevation range (from upland into wetland elevations) and representative vegetative communities.

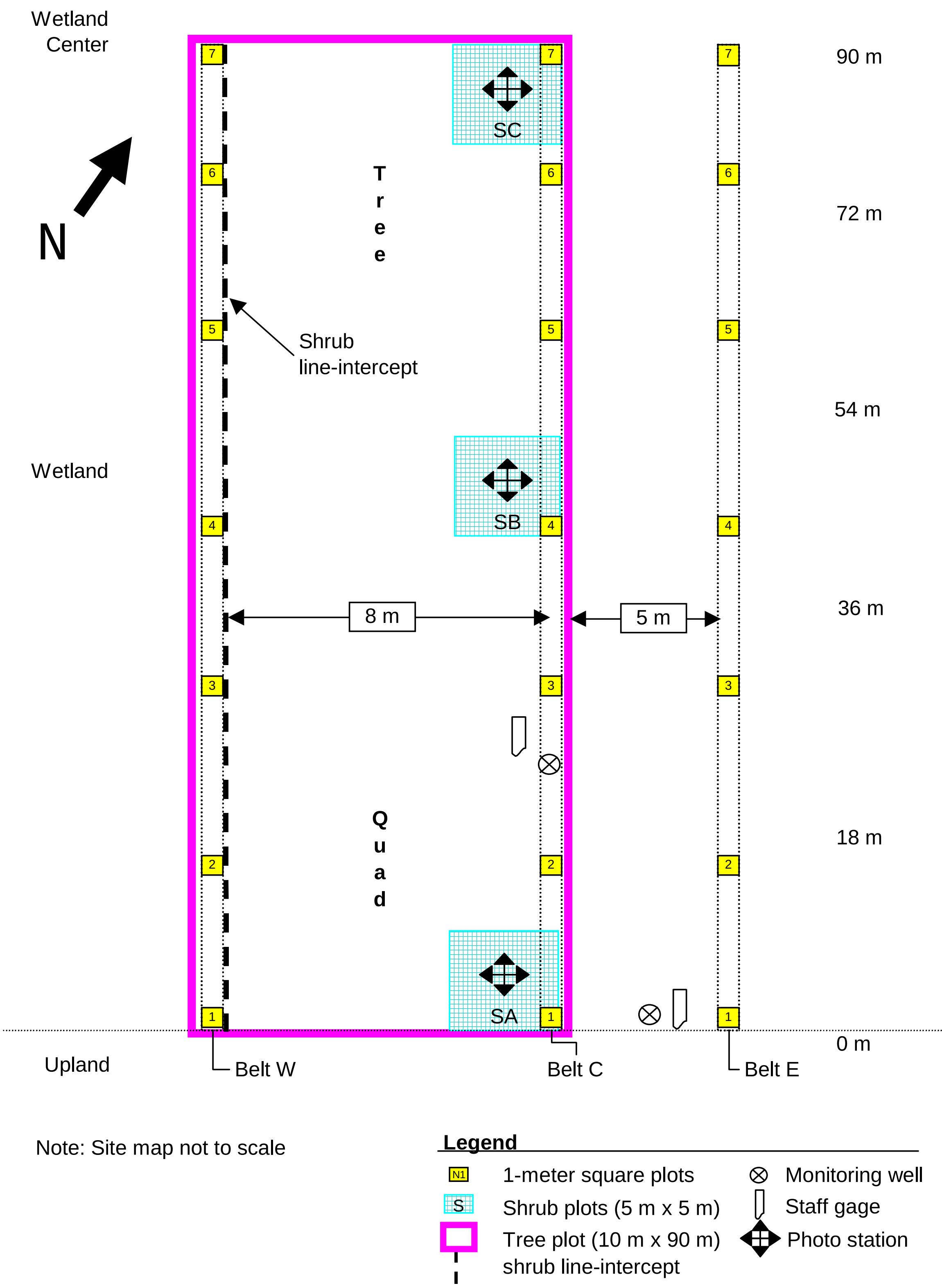

Figure 3. Wetland transect configuration

The transects were 90 meters long running from the upland edge to an interior deep zone. PVC markers, placed over iron rebar, were used to mark the transect end points and intermediate points and corners of each sampling plot (tree, shrubs, and herbaceous plants). Ground surface elevations were surveyed at 3-meter intervals along the length of the main transect, at natural ground at each piezometer, and at the top of casing. Topographic elevation maps and water stage correction factors were developed.

Photo Stations

Three photo stations were established along the main transect in the center of each of the shrub plots. The photographs taken at each station provided north, south, east, and west views from that station. Photographs were taken at each station during the spring and fall sampling events and will be supplied with this final report.

Sampling Schedule

One sampling of each parameter was performed for the baseline (pre-hydration) period. Semi-annual sampling is conducted in the 5-year hydration period. The sampling schedule for the project is presented in Table 1.

Table 1. Monitoring parameters/sampling plan

Parameter	Fall	Spring
BIOTA		
Trees (Annual In Fall)	X	
Herbs	X	X
Shrubs (Annual in Fall)	X	
Amphibians (Monthly Jan – Sep)	X	X
T & E Plant and Animal	X	X
SURFACE WATER SAMPLES		
Color	X	X
Total Suspended Solids (TSS)	X	X
Total Phosphorus, Low (TP)	X	X
Orthophosphate, Low (Ortho P)	X	X
Total Kjeldahl Nitrogen (TKN)	X	X
Ammonia (NH_3)	X	X
Nitrate plus Nitrite NO_3+NO_2 as N	X	X

Table 1 — *Continued*

Parameter	Fall	Spring
FIELD PARAMETERS		
Dissolved Oxygen	X	X
Temperature	X	X
pH	X	X
Conductivity	X	X
Stage	X	X
Ground water levels - Continuously	X	X
Photographs	X	X
SUBSTRATE SAMPLES		
Soil Description	Performed in March 2000 and Sep 2002	

Stage and Rainfall

Two recording piezometers and staff gauges were installed along the main monitoring transect. One set was installed near the upland boundary and the second in the wetland interior deep zone. The 3-inch piezometers were placed approximately 8 to 10 feet in the ground. Figure 3 presents the location of the recording piezometers.

Each piezometer contains a data logger that is programmed to collect and record the water level at set intervals. The data logger has a scrolling memory for 3,900 readings. Data are downloaded every 4 to 8 weeks. Each visit to the data loggers for download is also used to record staff measurements and verify that the data loggers and other equipment at the site are in good condition.

The rainfall monitoring gauge, a DAVIS Weather Wizard III, is maintained at the Tillman Ridge WTP approximately 1 mile from the hydration wetland site. Daily rainfall is recorded by plant staff, who, in turn, provide it to CH2M HILL. For missing data (periods when the WTP gauge was not operating), rainfall data were provided by SJRWMD from the Town Branch site, a few miles from the Tillman Ridge wetland (latitude 29549.31, longitude 812633.08).

Water Quality Sampling, Quality Assurance, and Quality Control

Surface Water Quality Sampling. One surface water quality sampling event was planned for the baseline (pre-hydration) period. Semi-annual sampling was scheduled for the hydration period when surface water is available. Sampling included collection of basic field parameters, minerals, and collection of grab sample for analysis of a short list of biologically important parameters, primarily nutrients (Table 1).

Temperature, dissolved oxygen, pH, total depth, and conductivity are measured and recorded during field sampling. Dissolved oxygen and temperature are measured at depths 5 to 8 centimeters (2 to 3 inches) below the water surface and within 8 to 10 centimeters (3 to 4 inches) of the ground surface.

All samples were kept on ice below 4 degrees Celsius (ºC) until arrival at the analytical laboratory. A field blank composed of analyte free water was also collected and analyzed for all parameters. Specific sample containers, holding times, and preservation techniques were based on the approved quality assurance / quality control (QA / QC) plan.

Quality Assurance and Quality Control. The Quality Assurance Section of Florida Department of Environmental Protection (FDEP) has approved the QA / QC techniques used during the monitoring at Tillman Ridge. The techniques used are accepted protocol for each type of sampling procedure. CH2M HILL field personnel followed the procedures outlined in the Comprehensive Quality Assurance Plan (CompQAP) (CH2M HILL 1999) for the execution of field activities, proper completion of chain-of-custody forms, sample preservation requirements, proper handling of samples, and certified laboratory analytical services. Strict adherence of holding times for all parameters was observed.

The laboratory analytical work was conducted by Columbia Analytical Services according to its CompQAP (Columbia 1998) and Applied Environmental Laboratory. Laboratory personnel followed procedures outlined in the laboratory’s CompQAP for sample kit preparation, tracking and analysis of samples, and data validation.

Approved instrument maintenance and calibration procedures were followed by the field team in accordance with the manufacturer’s recommendations, and consistent with standard procedures outlined in CH2M HILL’s CompQAP. Calibration results were recorded on the field data sheets. During each sampling event, one field blank was collected.

Soils

Soil profiles were characterized once along the main transect during the baseline period. All strata or horizons within this surficial zone were characterized. These surficial sediments comprise the principal zone of biological activity, where hydration efforts are likely to have measurable ecological effects.

Soils were excavated to a depth of 90 centimeters using a soil auger. Where possible, the soil horizons and their major subdivisions were identified and a thickness measurement taken for each horizon or subdivision. A subsample was collected from each identified horizon, preserved, and archived for future chemical or physical analyses, as may be necessary. Two cores were excavated along each monitoring transect, one at each end of the transect.

An additional evaluation of the histosol (organic soil) layer was conducted in September 2002. The depth of the layer was measured at approximately 20-meter intervals along the transect from the wetland to the upland end.

Vegetation Sampling

Sampling was conducted along the transects running from the upland edge to the interior deep-zone of the wetland (Figure 3). Vegetative community sampling included three main strata:

(1) Herbaceous Plant Community
(2) Shrubs and Saplings
(3) Canopy / Subcanopy

Herbaceous plant sampling was conducted semi-annually. Canopy / subcanopy and shrub / sapling data collection was conducted annually. In addition, field notes of vegetation conditions were collected each time the site was visited for other purposes, primarily for downloading the groundwater stage data.

Herbaceous Plant Community. The herbaceous plant community included all annual plants, soft-stemmed perennials, and woody seedlings less than 0.3 meter in height.

Two sampling methods were used to characterize the herbaceous plant stratum: 21 plots (1 meter by 1 meter) and three 1-meter-wide intercept transects (1 meter by 90 meters).

(1) One-Meter-Square Plots

Seven 1-meter-square permanent herbaceous sampling plots, spaced at appropriate intervals, were established along the main transect and seven more, spaced at the same intervals, were established along each of the adjacent belt transects, for a total of 21 permanent 1-meter-square herbaceous plots (Figure 3).

Within each of the 21 plots, species composition and percent cover of herbaceous species and woody seedlings (less than 0.3 meter tall) were determined.

(2) Belt-Intercept Transects

A modified line-intercept technique was used to evaluate herbaceous plant presence along the belt transects. The line intercept technique was used to monitor changes in aerial cover and zonation of target indicator species along an upland-to-wetland gradient.

The three 1-meter-wide belt-intercept transects record the occurrence and cover of nine target species: three obligate, three facultative, and three upland species in the herbaceous stratum. Each 1-meter-wide by 90-meter-long belt transect was divided into five intervals, each 18 meters in length. A measuring tape was stretched along the length of the belt, and the total linear distance within each interval covered by a target species was recorded.
To track changes in wetland community development, nine target species were selected *a priori* for monitoring. They included three obligate wetland, three facultative wetland, and three upland species. However, all the species were not present on site at the first sampling (March 27, 2000). Therefore, one obligate herbaceous wetland species, netted chain fern (*Woodwardia areolata*); and three facultative herbaceous wetland species, broomsedge (*Andropogon virginicus),* dogfennel (*Eupatorium capillifolium),* and redroot (*Lachnanthes caroliniana)* were monitored.

For each target species the belt-intercept linear distance of cover was used to generate estimates of percent cover and frequency (number of 18-meter intervals in which the species occurred) which are converted to relative vegetative cover and relative frequency. The values for each plant species are summed and averaged to yield an importance value. These values are presented below in Table 2.

Table 2. Plant cover and frequency statistics for herbaceous plant measurements

Linear Cover Distance for Species A		Sum of All Belt-Intercept Distances for Species A
Percent Cover	=	Linear distance of Species A **/** Total Transect distance x 100
Relative Percent Cover	=	Linear distance of Species A / Total Linear Distance of all species x 100
Frequency	=	Number of intervals in which Species A occurred **/** Total number of intervals
Relative Frequency	=	Frequency of Species A **/** Sum of the frequencies of all species x 100
Importance Value	=	Relative percent cover + relative frequency / 2

Shrubs/Saplings

The shrub / sapling stratum is defined as all woody vascular plant species exclusive of the canopy and subcanopy. This includes shrub species as well as sapling trees and sucker shoots of larger trees (if shoots are less than 1 meter in height and less than 2.5 centimeters diameter at breast height [dbh]).

Two sampling methods were used to characterize the shrubs / sampling stratum: three plots (5 meters by 5 meters) and line-intercept transect (90 meters).

(1) 25-Square-Meter Plots

Three permanent shrub / sapling plots, 5 meters by 5 meters in size, were established at regular intervals along the centerline of the main transect (Figure 3). All woody plants within the size class and rooted in or overhanging the plot were identified and recorded. For shrub and sapling species, the percent cover was determined. For sapling species, stem density was determined.

(2) Line Intercept

A line intercept transect was established along the western belt transect to monitor the occurrence and percent cover of shrub / sapling strata (Figure 3). A tape measure was placed along the length of the transect, and the linear intercept distance of each living species lying vertically over, under, or touching the tape was recorded. Dead plants were not recorded. The 90-meter transect was subdivided into 18-meter intervals for measuring frequency.

For the shrub stratum, the line-intercept linear distance data were used to generate estimates of percent cover and frequency that were converted to relative vegetative cover and relative frequency. The values for each plant species were summed and averaged to yield an importance value as described above for each species.

Canopy/Subcanopy

Canopy and subcanopy species were defined as those woody specimens greater than or equal to 1 meter in height and greater than or equal to 2.5 centimeters dbh. This includes dominant and subdominant hardwoods and softwood trees, sapling trees, and larger sucker shoots off main trunks / branches of trees.

A linear belt sub-transect (8 meters wide) following the centerline of the main transect (Figure 3) was used for sampling the subcanopy / canopy stratum.

The width of the transect was field-adjusted to obtain a minimum of 100 individuals. Each tree was marked with a permanent numbered aluminum tag in the second quarter of baseline monitoring.

All of the canopy trees greater than, or equal to 10.2 centimeters dbh and subcanopy trees greater than or equal to 2.5 and less than 10.2 centimeters dbh were identified to species, and measured for dbh at approximately 1.4 meters above the ground surface within each 18-meter interval along the 90-meter transect. Subsequent measurements were made at the bottom edge of the hanging tag to maintain consistency between annual measurements.

Species composition, density and dominance (basal area), importance value, and stand size structure was assessed from the data collected (Table 3). Long-term monitoring will allow for an assessment of the annual growth, recruitment, mortality, and observable changes in health or character of the canopy over a specific period. Importance values for the canopy / subcanopy species were calculated from dominance, density, and frequency data.

Table 3. Dominance, density, and frequency statistics for canopy/subcanopy species measurements

Statistic		Formula
Dominance	=	Total basal area of Species A
Relative Dominance	=	(Total basal area of Species A / Total basal area of all species) x 100
Density	=	Number of individuals of Species A
Relative Density	=	(Density of Species A / Total density of all species) x 100
Frequency	=	Number of intervals in which Species A occurred / Total number of intervals
Relative Frequency	=	(Frequency of Species A / Sum of the frequencies of all species) x 100
Importance Value	=	(Relative Dominance + Relative Density + Relative Frequency) / 3

Animals

Amphibians. During the 4-month baseline period, which was duration-limited by access and contract delays, researchers from the University of Florida (UF) in Gainesville conducted a sampling effort at the site to evaluate the amphibian community. During the ongoing hydration period, the same primary UF researcher (Ryan Means), now with CPI, along with Rebecca Meegan, conduct the amphibian surveys at the site.

Monitoring stations were established around the periphery of the wetland. Each station included a Y-shaped drift fence array with screen funnel traps, coverboards, and PVC pipes to sample the amphibians in the area. Dip-netting and frog call surveys were also used to detect the presence of amphibian species.

RESULTS

MONITORING SITE TOPOGRAPHIC SURVEY

The general topography of the monitoring site was surveyed. The upland edge of the wetland is at 40.1 feet. The ground contours across the monitoring wetland varies by a couple of feet in elevation (Figure 4), mainly between elevations 39 to 41. The average elevation of the wetland, 39.8 feet, was estimated by averaging all the measurement points shown in the figure, not including the upland staff gauge. The wetland monitoring well was sited at the lowest elevation in the transect (38.0 feet).

HYDRATION

The Tillman Ridge wetland was supplied with water on the actual schedule presented in Table 4. The instantaneous flow rate (gpm) of the pump varied from one hydration period to the next, and was higher than initially planned (50 gpm). The actual average flow rate (gpm, or gallons per day [gpd]) during the 5 years of hydration; and total annual amount supplied to the 5-acre wetland was:

- Year 1 -- 125,257 gpd; 70 days; 65 inches per year
- Year 2 – 94,907 gpd; 75 days; 53 inches per year
- Year 3 -- 109,823 gpd; 79 days; 64 inches per year
- Year 4 -- 110,915 gpd; 71 days; 58 inches per year
- Year 5 -- 103,851 gpd; 74 days; 57 inches per year

Total annual hydration amounts varied, as described, because of the fluctuating pump rate, and because of changes in the operational schedule by plant operators; also due to a lightning strike in May 2005 that damaged the pump.

An inch of water over the 5-acre area totals approximately 135,020 gallons. This resulted in an average annual water supply (additional to rainfall) of 59 inches (about 8 million gallons [MG]) each year between July 2001 and June 2006.

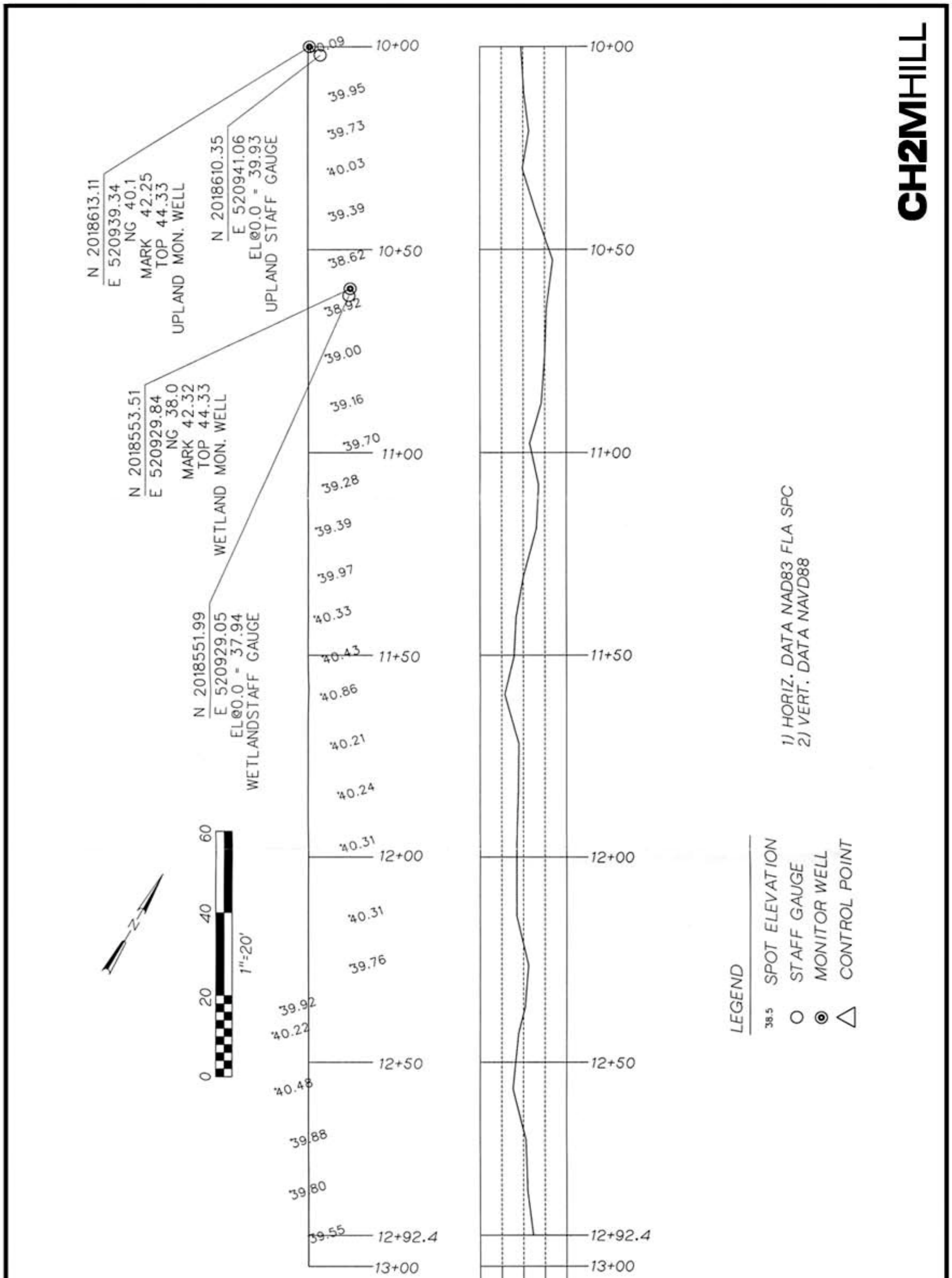

Figure 4. Transect profile

Table 4. Hydration amounts delivered from July 2005 through June 2006

The pumps are turned on and off at 10:00 am of the day noted on the schedule. All pumping periods occurred in 24 hour increments, and the volume of hydration water delivered is read by a plant operator from a meter in the pump house.

Month	Date ON	Date OFF	Number of 24-Hour Periods	Hydration[1] Volume (MG)	Inches
Jul 2005	July 8	July 12	4	0.415	3.0
	July 15	July 19	4	0.438	3.2
	July 22	July 23	1	0.113	0.8
Aug	Aug 8	Aug 11	3	0.328	2.4
	Aug 12	Aug 15	3	0.320	2.4
Sep	Sep 8	Sep 12	4	0.432	3.2
	Sep15	Sep 19	4	0.415	3.0
	Sep 22	Sep 24	2	0.207	1.5
Oct	Oct 3	Oct 6	3	0.311	2.3
	Oct 17	Oct 19	2	0.207	1.5
Nov	Nov 7	Nov 11	4	0.320	2.4
Dec	Dec 9	Dec 13	4	0.403	3.0
Jan 2006	Jan 10	Jan 14	4	0.392	2.9
Feb	Feb 7	Feb 10	3	0.294	2.2
	Feb 22	Feb 25	3	0.302	2.2
Mar	Mar 1	Mar 5	4	0.403	3.0
	Mar 14	Mar 19	5	0.504	3.7
Apr	Apr 11	Apr 16	4	0.518	3.8
May	May 3	May 6	3	0.320	2.4
	May 16	May 18	2	0.207	1.5
Jun	Jun 5	Jun 9	4	0.422	3.1
	Jun 19	Jun 23	4	0.415	3.0
		TOTAL	**74 periods**	**7.685 MG**	**56.5 in**

Note:
[1] Hydration amounts provided by St. Johns County Utility
Wet Season ~50% of the annual hydration is delivered to wetland during these 4 months.
MG = million gallons

RAINFALL

The rainfall data were provided by the Tillman Ridge WTP staff. Approximate annual baseline period rainfall was 38.4 inches (July 2000 to June 2001), which is well below the long-term average for this area (48 to 50 inches). Rainfall during hydration Year 5 (July 2005 to June 2006) totaled 45.3 inches, which is also below average. Both the first and the fifth years of hydration reported the lowest annual rainfall totals of the study period. September 2004 reported the greatest rainfall totals recorded within the watershed since the beginning of the project in June 2000.

The total measured volume of water entering the Tillman Ridge Wetland included rainfall and hydration volumes for the entire monitoring period is presented in Figure 5. During the 5-year study period, hydration provided an amount of water that was slightly more than, and in addition to, the long-term average rainfall.

SURFACE AND SHALLOW WATER ELEVATION ANALYSIS

Daily Water Level Elevation

Average daily water level elevations recorded in the upland and wetland piezometer locations were similar during the reporting period (Figure 6). All references to water level elevation in this report refer to wetland recorder location.

Basic water level elevation statistics are presented in Figure 6. Both mean and median values were compared for the baseline period and the hydration period. Changes in the frequency of data collection from the dataloggers influence the median values for the periods; therefore, mean values were deemed more accurate for the purpose of comparisons. These water level elevation statistics indicate that mean baseline (before July 9, 2001) water level elevations were approximately 5.7 feet lower than the post-hydration elevation. The difference between the pre- and post-hydration water level elevation minimums was approximately 8 inches. The recorded post-hydration minimum is not representative, as the minimum value was recorded on July 9, 2001, the first day of the hydration period.

The hydrograph for hydration Year 5 was similar to that of previous hydration years. The greatest change in water levels occurred between July and September 2005. At this time, water levels began recovering from low rainfall conditions during early summer to reach their max of 42.00 feet on September 7, 2005.

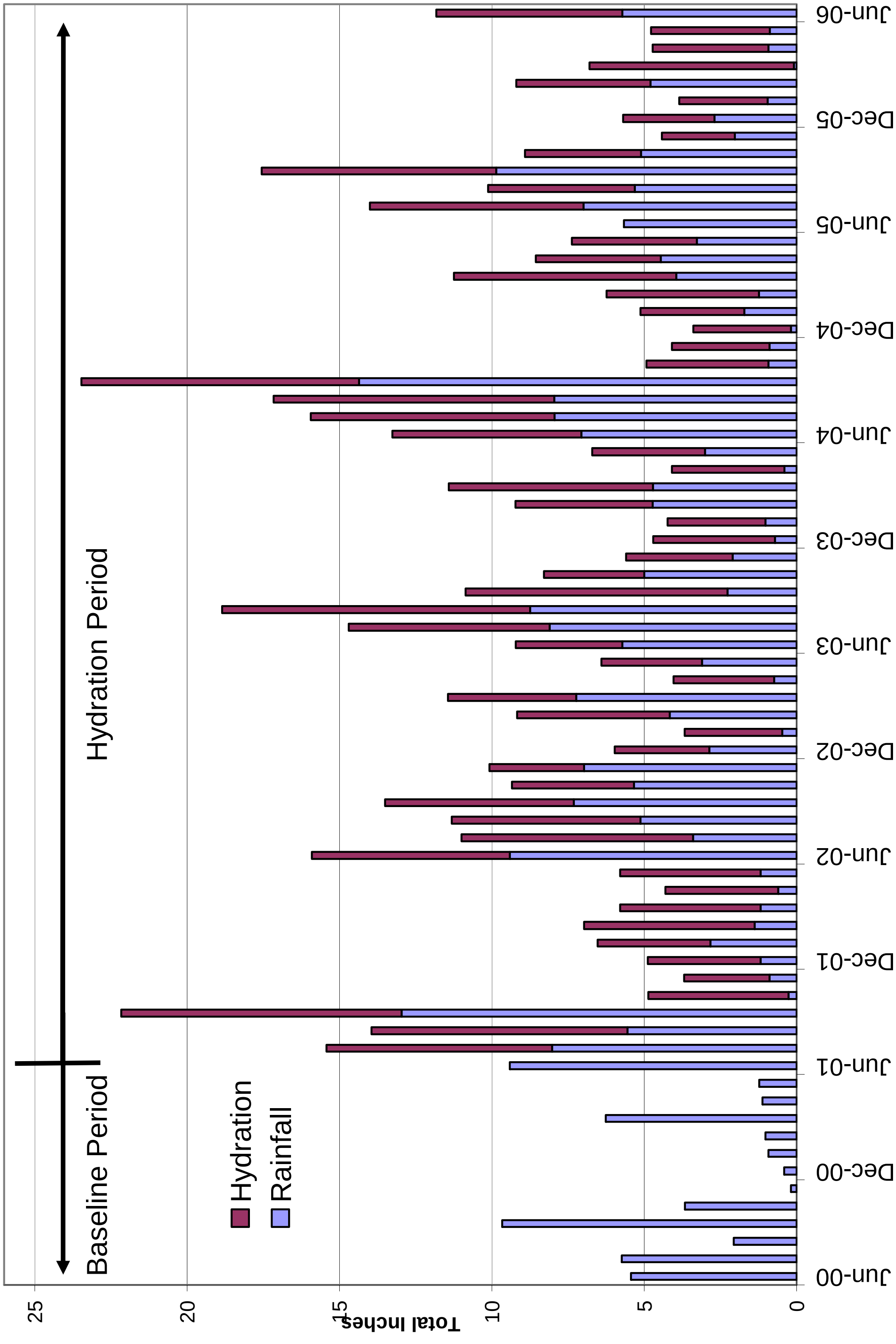

Figure 5. Rainfall and hydration water input, June 2000 to June 2006

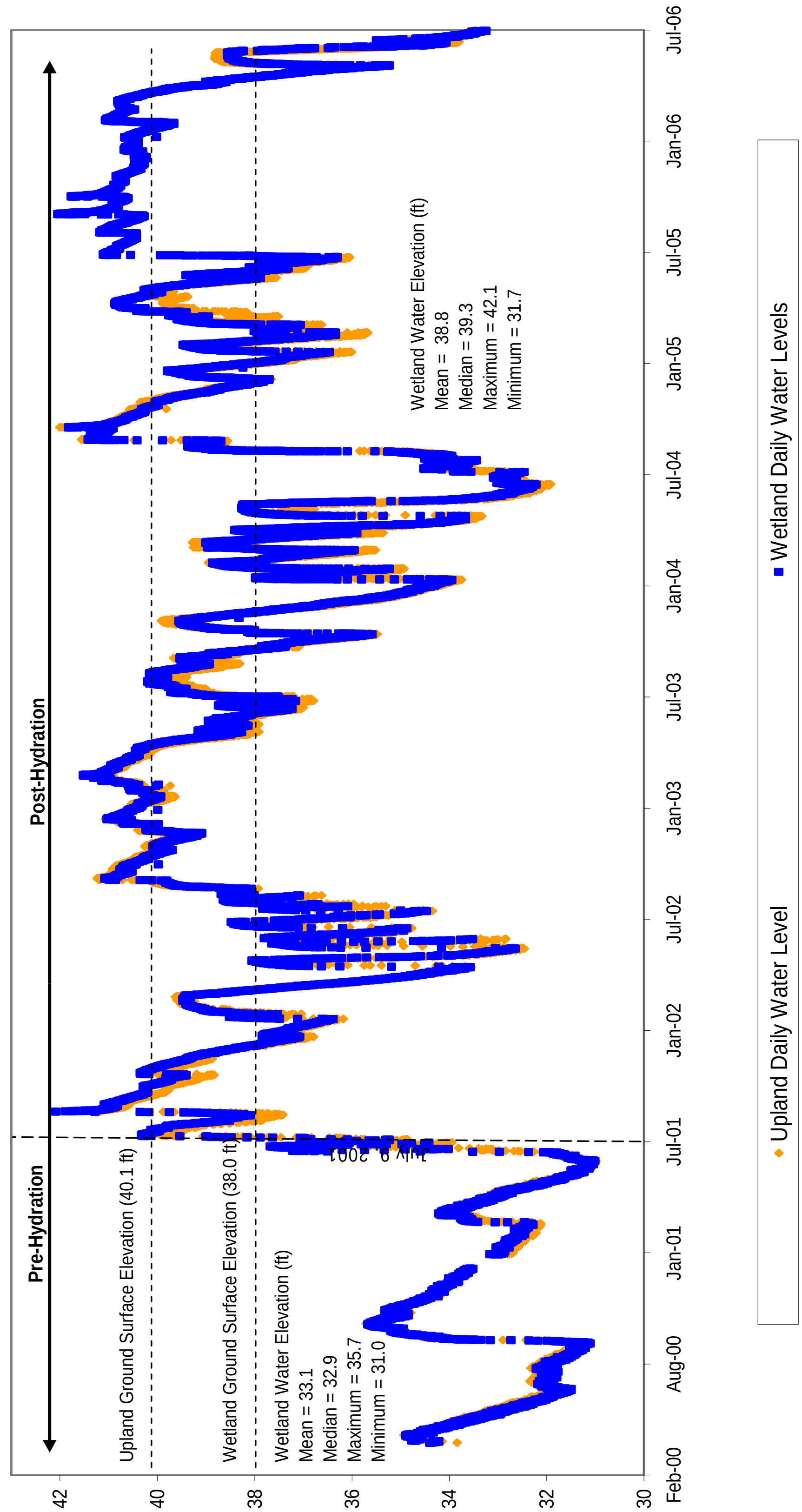

Figure 6. Upland and wetland water level elevations, March 2000 to June 2006

The stage exceedence curve for the 60-month hydration period was approximately equal to the target hydrograph (Figure 7) developed as part of the 2002 First Annual Report. Data from the organic soil profile and biological indicators of water elevation were used to estimate the target hydrograph. Pine (*Pinus* sp.), saw palmetto (*Serenoa repens*), fetterbush (*Lyonia lucida)*, and lichen indicators were used to develop the lower percent exceedence end of the target hydrograph. Measurement of the indicators can provide estimates of long-term or previous hydrologic regimes, and thus provide hydration targets. These data and relevant analysis are included as Appendix A.

Figure 7 provides the comparison of the target stage exceedence curve and study period stage exceedence curves for the baseline year and the cumulative hydration period curves. Pre- and post-hydration stage exceedence curves reflect the differences in water elevations (both above and below ground) in the wetland. Water levels were above the transect's lowest ground surface (38.0 feet) 71% of the time during the entire (60-month) hydration period.

The post-hydration exceedence curve for the entire 60-month study period nearly approximates the target hydrograph. Approximately the same hydration amounts were applied and same hydration schedule followed each year of the 60-month hydration period. It is most likely that the cumulative stage exceedence curve reflects the combination of the continuing hydration with a return to normal rainfall over the longer period. In a strictly hydrologic sense, the full benefit of hydration probably occurred during the first year and has been moderated over the following four years. The full expression of ecological effects will certainly require a considerably longer period of time.

Monthly Water Elevations

Monthly average water elevations differed between the baseline and hydration period by a mean value of 5.27 feet (Table 5). Mean water level elevations were greater during every month of hydration compared to baseline. The greatest differences between baseline and hydration months were observed during August.

Water level elevations were below the lowest wetland surface (38.0 feet National Geodetic Vertical Datum [NGVD], Figure 6) for the entire baseline period. There were 37 months during the 60-month hydration period when mean monthly water elevation was above the ground surface.

Monthly mean high water occurred in August, September, or October of each year. The monthly high water mean for the entire hydration period was in September.

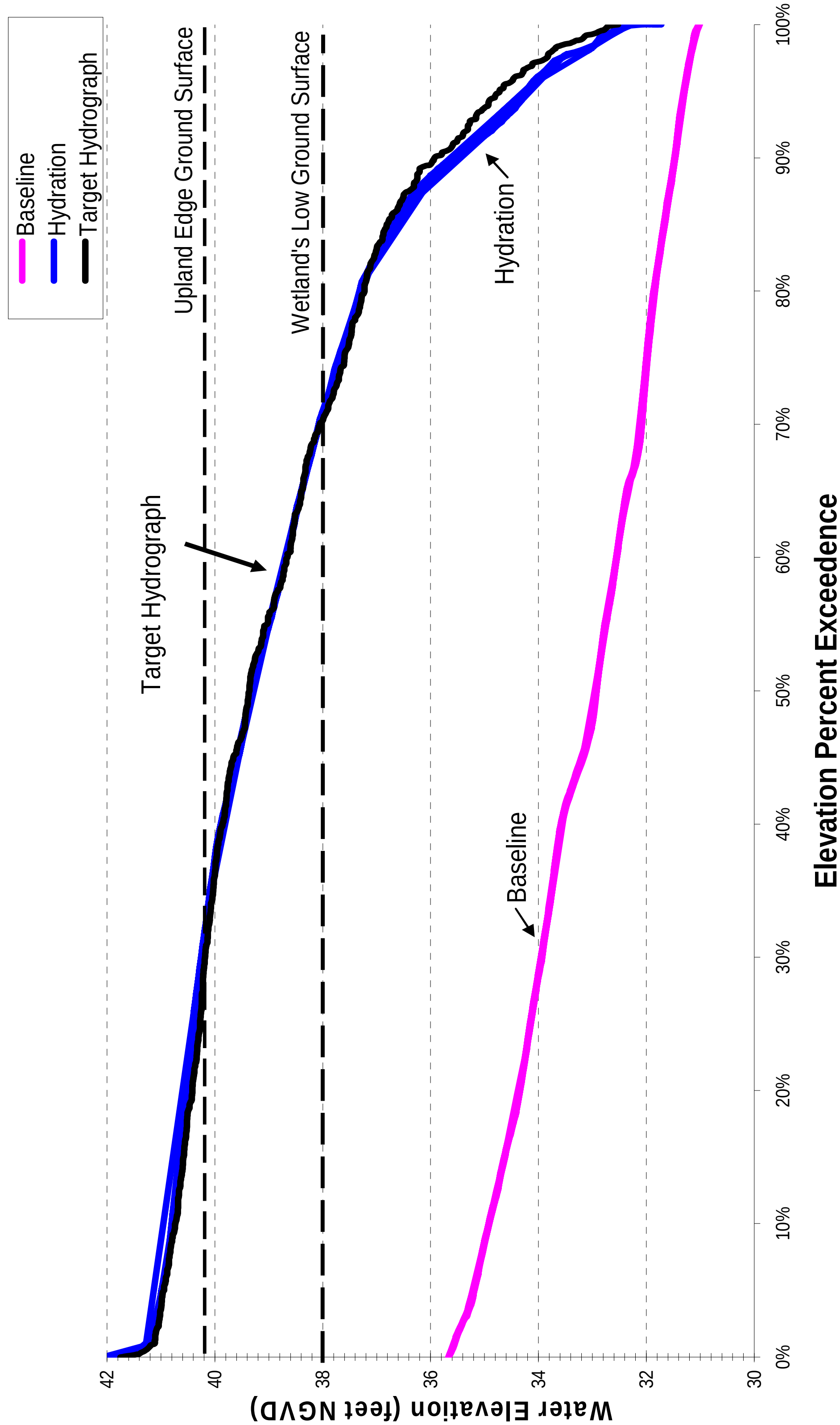

Figure 7. Pre-hydration and post-hydration stage exceedence curves
Elevations are in feet National Geodetic Vertical Datum (NGVD)

Table 5. Water elevations by month for baseline and hydration periods, March 2000 through June 2006

Month	Mean Groundwater Elevations (Feet NGVD)										
	Baseline Period			Hydration Period							Mean Difference
	2000	2001	Mean	2001	2002	2003	2004	2005	2006	Mean	
Jan		33.27	33.27		37.51	40.52	35.22	37.81	40.27	38.27	5.00
Feb		32.77	32.77		37.52	40.23	37.51	37.93	40.69	38.78	6.01
Mar	34.45	33.07	33.76		38.96	41.01	37.75	38.65	40.36	39.35	5.59
Apr	34.40	33.73	34.07		35.55	40.52	36.23	40.50	38.01	38.16	4.09
May	33.08	32.41	32.75		35.53	39.09	36.88	39.36	37.77	37.73	4.98
Jun	31.94	31.30	31.62		36.39	38.60	32.86	37.55	34.60	36.00	4.38
Jul	32.03		32.03	34.65	36.05	38.48	33.44	40.64		36.65	4.62
Aug	31.53		31.53	39.40	36.86	39.94	36.23	40.74		38.63	7.10
Sep	34.11		34.11	39.74	39.88	39.16	40.79	40.92		40.10	5.99
Oct	35.29		35.29	40.38	40.53	37.11	40.51	40.51		39.81	4.52
Nov	34.59		34.59	39.99	39.88	38.97	39.47	40.55		39.77	5.18
Dec	33.91		33.91	38.85	39.95	36.51	38.77	40.45		38.91	5.00
Mean	33.24			38.51							5.27
Median	33.18			38.97							5.79

*Where multiple baseline months were presented, those elevations were average for a comparison.

Precipitation, Hydration, and Water Level Elevations

Before the effect of hydration on water level elevations could be assessed, the effect of rainfall on water level elevations had to be evaluated. Figure 8 shows the relationship between the cumulative change in water levels relative to the June 2000 average monthly water level (31.94 feet NGVD) and the cumulative monthly total water inputs from rainfall. Linear regressions were performed on the pre-hydration and post-hydration data sets. The slope of the pre-hydration curve was relatively flat (5.78) while the post-hydration curve was steep (18.64). The increase in slope from pre-hydration to post-hydration indicates greater increases in water levels with respect to rainfall inputs. Absent from the cumulative rainfall inputs are augmentation inputs during the post-hydration period. Augmentation inputs account for the increased slope of the post-hydration regression line. Also, the steep increase in the post-hydration data points near the beginning of the period indicates a period of rapid adjustment to augmentation inputs. The Tillman Ridge wetland reached a new hydrological equilibrium approximately one year after augmentation began.

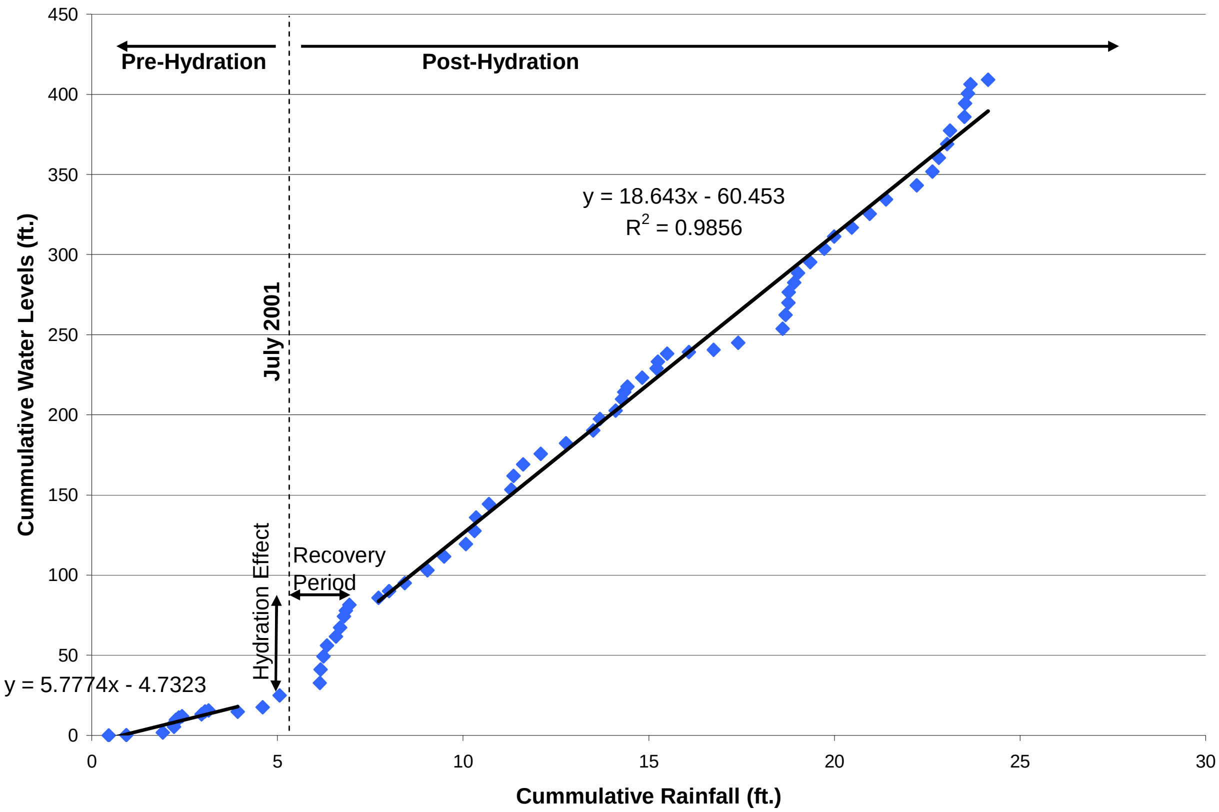

Figure 8. Cumulative water levels vs. cumulative rainfall

A Water Input – Output Evaluation

One way to consider the effects of the hydration is to compare the water estimated to be entering and leaving the wetland during baseline and hydration periods. The inflow components of a wetland's water budget can include precipitation, surface runoff, and lateral seepage, while outflows can include horizontal and vertical seepage, evapotranspiration (ET), and interception.

In an effort to account for changes in water levels between periods, two methods for calculating the wetland's water budget are presented below. Method A was used in all prior Tillman Ridge annual hydration reports, and Method B was introduced in the *Tillman Ridge Third Annual Hydration Repor*t. While these water budgets are a coarse and approximate analysis, they provide some insight into the relationship between hydration amounts and changes in water level elevation. Assumptions and results for both methods are described below.

Method A (Table 6)

1) Precipitation and groundwater augmentation are the dominant inflows to the Tillman Ridge wetland. Lateral seepage inflow appears to be insignificant based on field investigations. Inflow from surface water runoff is assumed to be minor due to the relatively flat topography of this flatwoods landscape.

2) ET is about 2 inches less than the long-term average rainfall for the area and is adjusted for the length of time in the baseline and hydration periods.

3) An estimate of horizontal and vertical seepage values was presented in the *Tillman Ridge Wellfield Second Annual Hydration Period Report* (February 2004). Lateral seepage rates were estimated to be small enough to be considered insignificant and estimates of vertical seepage problematic. For the purpose of Method A, these factors are not considered.

Table 6. Method A: Water input – output analysis for baseline and hydration periods by year

Hydrologic Variables						**Water Level**	
Period	**Rainfall (in.)**	**Hydration (in.)**	**ET (in.)**	**Net input (in.)**	**Input Difference (Baseline vs. Hydration) (in.)**	**Mean (ft.)***	**Difference (ft.)***
Baseline (381 days)	44.0	0	-50.1	-6.1		33.10	
Hydration Year 1 (365 days)	45.3	64.8	-46.0	64.1	**70.2 (5.9 ft.)**	38.03	**4.93**
Hydration Year 2 (365 days)	52.5	52.7	-46.0	59.2	**65.3 (5.4 ft.)**	39.90	**6.80**
Hydration Year 3 (365 days)	47.9	64.1	-46.0	66.0	**72.1 (6.0 ft.)**	37.49	**4.39**
Hydration Year 4 (365 days)	52.6	60.6	-46.0	67.2	**73.3 (6.1 ft.)**	38.42	**5.32**
Hydration Year 5 (365 days)	45.3	56.5	-46.0	55.8	**61.9 (5.2 ft.)**	39.66	**6.56**

*Note that these data are in feet (ft), while all other data are in inches (in).
ET = Evapotranspiration.

There was a net output of water during the baseline period. During all five hydration years, there was a net input of water to the wetland from rainfall and hydration. Differences in mean water level elevations from the hydration years compared to the baseline period were similar to the net input difference for each of those years (Table 6). During hydration Years 2 and 5, the increase in mean water level was greater than the net input difference. In this method, the unaccounted vertical seepage factor could be responsible for a portion of the difference in observed water levels in Years 1, 3, and 4 relative to total inputs and expected increases. Rainfall input during the 60-month period of hydration is similar to the typical long-term average rainfall for the area.

Method B (Table 7)

1) Precipitation and groundwater augmentation are the dominant inflows to the Tillman Ridge wetland. Lateral seepage inflow appears to be insignificant based on field investigations. Inflow from surface water runoff is assumed to be minor due to the relatively flat topography of this flatwoods landscape.

2) Lateral and vertical seepage rates vary throughout the season, as do ET rates. Seepage rates are dependent on such factors as wellfield pumping and the differences between water levels in the wetland and the surrounding uplands. ET is influenced by temperature, relative humidity, wind, characteristics of vegetation, and seasonal changes in solar energy inputs. An estimate of horizontal and vertical seepage values was presented in the Tillman Ridge Wellfield Second Annual Hydration Period Report (February 2004). Lateral seepage rates were estimated to be small enough to be considered insignificant and estimates of vertical seepage problematic. In that report, a field based estimate of ET was attempted but found to be problematic. For this report a simplified estimate of vertical loss, summing the effect of vertical seepage and ET, was estimated using daily water level data. From the data set, a daily change in the wetland's water level was determined. The daily change value integrates seepage losses during the previous 24 hours and ET losses during the day. Heimberg (1984) showed that pan evaporation rates and cypress dome ET rates follow similar seasonal patterns with peaks in May due to warm temperatures and low humidity, somewhat lower rates in the wet season, and lowest rates in December and January when days are shortest. Daily and monthly wetland ET is typically less than pan evaporation. Heimberg (1984) found that in a cypress dome in north Florida, ET was about 80% of pan evaporation in spring and fall dry periods, fell to 60% of pan evaporation in the summer wet season, and was minimal in winter being only 10 to 30% of pan evaporation.

Accordingly, separate vertical loss estimates were developed for the summer wet season, spring and fall dry seasons, and winter. The vertical loss estimates were calculated using daily water level data for periods without precipitation or groundwater augmentation. Vertical loss estimates were calculated using a rolling average of all hydration period data that met the criteria of no precipitation, or groundwater augmentation, and data that were above the wetland ground surface (38.0 feet). These averages were used for both baseline and hydration periods and differ from those used during Year 3 and Year 4 due to the addition of Year 5 data providing a more long-term average.

3) Heimberg also determined that in the cypress dome interception of rainfall by the forest canopy and understory layers was significant. Intercepted water is subsequently lost via evaporation, thus it does not contribute net inflow in the wetland. In Heimberg's study, 25% of rainfall was intercepted and evaporated on an annual basis, but that interception varied seasonally as a function of the leaf-out condition of deciduous species. For the Tillman Ridge wetland we assumed that interception was 20% of precipitation when canopy and subcanopy species were in leaf-out and 10% of rainfall after deciduous species had dropped their leaves. A simplified input – output analysis is presented in Table 7. Further investigation into the measurements of these variables is beyond the scope of work for the current project.

4) Median water level values are influenced by the frequency of data collected by the data loggers. Changes in frequency results in median values being skewed towards those when more frequent observations were made. Since the frequency of the data loggers has changed several times over the project period, the mean values for baseline and hydration water levels were used for this analysis.

There was a net outflow during Year 5 of the hydration period. Differences in mean water level elevations and net input values varied between methods A and B (Table 7). The input difference during Year 5 of the hydration period compared to the baseline period using method A was more similar to the mean water level difference. Net input values from both method A and B were lower than the difference in the mean water level values during Year 5. The combined ET and vertical seepage factor was greatest (most negative) during the spring and lowest (least negative) during both the fall and winter months.

Table 7. Method B: Water input – output analysis for Year 5, seasonal estimates of ET, vertical seepage, and interception

Evapotranspiration (ET) and vertical seepage were calculated by measuring the difference between water levels in the wetland recorder at the beginning of a day versus the end of that day on days when no rainfall or hydration took place and when water levels were above the wetland surface. Those days were then averaged to produce seasonal values. The same average daily seasonal values were used for baseline and hydration period calculations.

Hydrologic Variables							Water Level	
Period	**Rainfall (in.)**	**Hydration (in.)**	**Interception (in.)**	**E-T and Vertical Seepage (in.)**	**Net input (in.)**	**Input Difference (Baseline vs. Hydration) (in.)**	**Mean (ft.)***	**Difference (ft.)***
Baseline								
Summer (Jun – Aug) (92 d)	22.66	--	(20%) - 4.53	-77.28	-59.15			
Fall (Sep – Nov) (91 d)	13.52	--	(20%) - 2.70	-54.60	-43.78			
Winter (Dec – Feb) (91 d)	2.37	--	(10%) - 0.24	-54.60	-52.47			
Spring (Mar – May) (91 d)	8.61	--	(20%) - 1.72	-87.36	-80.47			
Total (365 d)	47.16	--	-9.19	-273.84	-235.87	**--**	33.10	**--**
Hydration Year 5								
Summer (Jun – Aug) (92 d)	18.04	17.9	(20%) - 3.61	-77.28	-44.95			
Fall (Sep – Nov) (91 d)	17.00	13.9	(20%) - 3.40	-54.60	-27.10			
Winter (Dec – Feb) (91 d)	8.35	10.3	(10%) - 0.84	-54.60	-36.79			
Spring (Mar – May) (91 d)	1.91	14.4	(20%) - 0.38	-87.36	-71.43			
Total Year 5 (365 d)	45.30	56.5	- 8.23	-273.84	-180.27	**55.60 (4.63 ft.)**	39.66	**6.56**

Summary of Hydration Observations

Observations of changes in water level elevations and associated water inputs between March 2000 and June 2006 include the following.

1. Mean water level elevation increased 5.7 feet from the 60-month hydration period to baseline period (Figure 6).

2. Water elevations exceeded the surface of the wetland 71% of the time during the hydration period. During the baseline period, water elevations never exceeded the surface of the wetland (Figure 7).

3. The double mass comparison of cumulative change in water levels to cumulative rainfall totals showed differences in the trends of the relationships between the pre-hydration and post-hydration periods (Figure 8). The slope of the regression line for post-hydration data was steeper than that of the pre-hydration period indicating greater increases in water levels relative to rainfall inputs. The difference is due to the augmentation inputs. The double mass plot also clearly shows that it took approximately one year for the wetland to reach a new hydrological equilibrium under the hydration regime.

4. The ratio between the net water input and mean stage differences was about 1.2, 0.8, 1.4, 1.2, and 0.8 for each of the five years of hydration, respectively. Approximately 1.2 feet, 0.8 foot, 1.4 feet, 1.2 feet, and 0.8 foot of water (both rainfall and hydration combined) were required to raise the mean water level elevation by 1 foot during each of the five years of hydration, respectively.

5. Two methods were used to calculate water budgets for the Tillman Ridge wetland. Method A was a continuation of water budgets presented in all previous Tillman Ridge annual reports. Method B, introduced in the *Tillman Ridge Third Annual Report*, used an estimated interception factor along with a combined ET and vertical seepage calculated using data from the wetland recorder in an attempt to more accurately represent environmental conditions affecting water levels in the wetland. Method A results were more similar to observed changes in water levels during Year 5. Method B demonstrates that interception and ET plus vertical seepage may be significant components to the wetland's water budget but their quantification is difficult to determine.

WATER QUALITY

Comparison of water quality data between any hydration year and baseline period was not possible, as no surface water was present during the 15-month baseline period. Water quality data were available on a single sampling date (September 2001) during hydration Year 1; in September 2002 and April 2003 of the second hydration year; during no sampling events of the third hydration year; both events for the fourth hydration year (October 2004 and April 2005); and in October 2005 and March 2006 of hydration Year 5. Laboratory results are provided in Appendix D, and summarized in Table 8.

Table 8. Water quality summary[1]

		Year 1	Year 2		Year 4		Year 5	
Parameter	Unit	September 2001	September 2002	April 2003	October 2004	April 2005	October 2005	March 2006
Dissolved Oxygen *	mg/L	0.93	0.26	0.39	3.65	3.67	2.49	1.93
Temperature *	°C	24.1	26.0	26.9	21.01	15.45	20.10	18.93
pH *		4.32	5.66	5.90	4.92	5.77	5.85	6.80
Conductivity	µmhos/cm	73.5	978	321	139	176	162	206
Color	Units	800	200	500	500	250	500	200
TSS	mg/L	5	6.5	4.0	5.6	<2.0	9.5	<2.0
Ammonia – N	mg/L	<0.1	0.01	0.020	0.16	<0.026	<0.026	0.27
Total Kjeldahl - N	mg/L	1.88	1.9	1.7	2.0	0.82	1.7	1.1
Nitrate + Nitrite - N	mg/L	<0.2	<0.2	0.050	<0.027	<0.027	<0.027	<0.027
Total Nitrogen	mg/L	1.9	2.0	1.8	2.0	0.8	1.7	1.1
Total Phosphorus-P	mg/L	0.47	0.47	0.29	0.21	<0.043	0.27	0.32
Ortho-Phosphate-P	mg/L	0.31	0.31	0.050	0.13	0.12	0.24	0.21

[1] No surface water present (therefore no water quality samples possible) during sampling events in baseline years or in Year 3 of the hydration period.

* Measurement taken in field

Water quality results from hydration Year 5 were similar to those of previous events. Water quality parameters were within expected values for a cypress dome system in a flatwoods landscape. Values for pH, conductivity, total suspended solids, and nutrients were low. Ammonia - N was the only elevated water quality parameter measured at the Tillman Ridge Wetland during hydration Year 5.

SOILS

Soil profiles were characterized from two locations along the main transect, the upland transitional zone and the wetland center located approximately 1 meter respectively from the beginning and the end of the main transect. The soils found at the site are generally consistent with the mapped profile described in Readle (1983). They are defined in that document within the St. Johns Fine Sand Series.

Upland Soil

Horizon (Depth)	Description
A (0-18 inches):	Black (10YR2/1) mucky sand with 80% organic matter coated sand grains; slightly hard
E (18-23 inches):	Brown (10YR4/3) sand with 20% organic matter coated sand grains; loose
Bh (23-30 inches):	Very dark brown (10YR2/2) sand with 80% organic matter coated sand grains; sticky
C (30>40 inches)	Dark brown (10YR3/3) sand; sticky

Wetland Soil

Horizon (Depth)	Description
Oa (0-8 inches):	Black (10YR2/1) mucky organic soil; loose
A (8-15 inches):	Very dark brown (10YR2/2) mucky sand with 80% organic matter coated sand grains; loose
A/E (15-21 inches):	Very dark grayish brown (10YR3/2) sandy loam; friable
Bt (21-33 inches):	Brown (10YR4/3) sandy clay loam; friable
C (33>41 inches):	Very dark brown (10YR2/2) loamy sand; slightly sticky

The upland soil site is descriptive of a flatwood soil. The Oa horizon of a seasonally flooded wetland represents the accumulation of organic matter. The development of an organic soil suggest that this site is presently at least a transitional wetland area (true histosols are considered those with 16 inches of organic sediment) and that organic sediments have been lost due to an extended period of drier conditions. However, the topography is very irregular and upturned trees have disturbed the soil within the transect. Overall, the soil profile is similar to those for cypress dome soils in flatwoods landscapes described in Coultas and Duever (1984).

No changes in soils were noted in May 2002, but more intensive sampling of the soil late in 2002 showed that the Oa horizon was much greater than 18 inches in most locations along the transect. Muck (organic soil) depths were measured along the transect from the wetland end of the transect to the upland edge in October 2002. There was a fully developed organic soil layer at all sampled points along the transect (see Appendix A, Table A-1). Development of organic soils is a slow process, usually proceeding at a rate of millimeters per year. Loss of the organic horizon in wetland soils is similarly slow. Thus, changes in the soil profile may not be detected over a 5-year period of monitoring.

VEGETATION

A total of 22 plant species were identified during the baseline March 2000 monitoring event (Table 9). Twenty-two species were also identified during the fifth hydration year monitoring events in October 2005 and March 2006.

Herbaceous Groundcover

1-Meter-Square Plots. Results of the herbaceous groundcover monitoring are presented in Table 10 as an average of the "paired" square-meter plots across the three transects (seven plots each on three transects). Overall percent cover and species composition observed over the study period were lower during hydration Year 5 compared to baseline monitoring. The herbaceous groundcover species diversity and percent cover were highest at the upland edge of the transects and have shown a seasonal fluctuation between obligate wetland and facultative species.

During the baseline, facultative species, dogfennel (*Eupatorium capillifolium*), covered 15% of the upland edge plots while obligate species where almost absent. During the October 2005 event, when water levels were high and had been above the wetland surface for several months, nearly all meter square plots were covered with standing water. Species diversity and cover were almost entirely absent. Only at the upland edge were a few species recorded. During the March 2006 event, water levels were again above the wetland surface and some meter square plots were covered by standing water. Again, the highest species diversity and density (Table 10) was recorded in the meter square plots at the upland edge; but this time the dominant (71%) species was Virginia chain fern (*Woodwardia virginica)* (facultative wet species).

High surface water levels during the growing season continue to retard growth of the herbaceous layer within the Tillman Ridge Wetland. Herbaceous vegetation has been observed in greater percent cover in areas where soil elevations are highest within the wetland and on stumps and hummocks where periods of prolonged inundation has been avoided. On a relative basis, the non-vegetated substrate (the leaf litter and standing water) has dominated most plots along all transects leading into the wetland. During the dry season, facultative species encroach further into the wetland from the upland edge until water levels rise during the wet season. Detailed information, which is summarized in Table 10, is provided in Appendix B.

Table 9. Herbaceous and woody species observed

Scientific Name	Common Name	Stratum	State Wetland Indicator	Baseline		Hydration Period									
				Mar '00	Sept '00*	Nov '01	May '02	Dec '02	Apr '03	Oct '03	Mar '04	Oct '04	Apr '05	Oct '05	Mar '06
Amphicarpum muhlenbergianum	Blue maidencane	Herb	FACW	X		X									
Andropogon glomeratus	Bushy bluestem	Herb	FACW	X											
Andropogon virginicus	Broomsedge	Herb	FAC	X		X	X	X	X	X		X	X	X	
Aster sp.	Aster	Herb	FAC-OBL				X								
Cephalanthus occidentalis	Buttonbush	Shrub	OBL				X	X	X	X	X	X	X	X	X
Erechtites hieraciifolius	Fireweed	Herb	FAC								X	X	X	X	X
Eupatorium capillifolium	Dogfennel	Herb	FAC	X		X	X	X		X	X	X	X		X
Gordonia lasianthus	Loblolly bay	Tree	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Ilex glabra	Gallberry	Shrub	FACW**	X											
Itea virginica	Virginia willow	Shrub	OBL	X											
Lachnanthes caroliniana	Redroot	Herb	FAC	X		X	X	X	X	X	X	X	X	X	X
Leucothoe racemosa	Doghobble	Shrub	FACW	X											
Lyonia lucida	Fetterbush	Shrub	FACW	X	X	X	X	X	X	X	X	X	X	X	X
Magnolia virginiana	Sweetbay	Tree	OBL				X								
Myrica cerifera	Wax myrtle	Shrub	FAC	X	X		X	X	X	X	X	X	X	X	X
Myrica heterophylla	Evergreen bayberry	Shrub	FACW	X											
Nyssa sylvatica	Blackgum	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Osmunda cinnamomea	Cinnamon fern	Herb	FACW	X						X					
Panicum sp.	Panic grass	Herb	FAC-OBL				X	X	X	X					
Persea palustris	Swamp bay	Tree	OBL	X		X	X	X	X	X	X	X	X	X	X
Phytolacca americana	Pokeweed	Herb	FACU+		X						X	X	X		
Pinus elliottii	Slash pine	Tree	FACW**	X	X	X	X	X	X	X	X	X	X	X	X

Table 9 — *Continued*

Scientific Name	Common Name	Stratum	State Wetland Indicator	Baseline		Hydration Period									
				Mar ‘00	Sept ‘00*	Nov ‘01	May ‘02	Dec ‘02	Apr ‘03	Oct ‘03	Mar ‘04	Oct ‘04	Apr ‘05	Oct ‘05	Mar ‘06
Polygonum punctatum	Smartweed	Herb	OBL			X	X	X	X	X	X	X	X	X	X
Pteridium aquilinum	Lacy bracken fern	Herb	FACU**				X					X	X	X	X
Rhynchospora sp.	Beakrushes	Herb	OBL	X										X	
Rubus sp.	Blackberry	Vine	FAC								X			X	
Solidago sp.	Goldenrod	Herb	FAC-OBL			X	X		X	X	X	X	X	X	X
Sporobolus sp.	Dropseed	Herb	FACW-OBL			X									
Taxodium distichum	Bald cypress	Tree	OBL	X	X	X	X	X	X	X	X	X	X	X	X
Toxicodendron radicans	Poison ivy	Herb	FAC**	X		X	X		X			X	X	X	X
Vaccinium elliottii	Highbush blueberry	Shrub	FACW											X	X
Verbesina sp.	Creeping oxeye	Herb	FAC-FACW				X								
Vitis rotundifolia	Muscadine grape	Vine	FAC**	X		X	X	X	X	X	X	X	X	X	X
Woodwardia areolata	Netted chain fern	Herb	OBL	X				X	X	X		X	X	X	X
Woodwardia virginica	Virginia chain fern	Herb	FACW	X		X	X	X	X	X	X	X	X	X	X

* Herbaceous strata were not monitored in fall of baseline period.

**National Wetlands Inventory Indicator Status. (State Wetlands Indicator status is given. When the state status is not available, the National Wetlands Indicator status is shown by **.)

+Higher end of the frequency range

FAC = Facultative: plants found in wetlands or uplands almost equally
FACU = Facultative upland: plants found mainly in uplands, occasionally in wetlands
FACW = Facultative wetland = plants found mainly in wetlands, occasionally in uplands
H = Herbaceous: non-woody plants
OBL = Obligate wetland species: plants found almost only in wetlands
UP = Upland: plants found almost only in uplands

Table 10. Summary of average herbaceous percent groundcover along square meter transects

Species	Average Percent Cover Per "Paired" Plot							Cover	
	1	2	3	4	5	6	7	Percent	Relative
Baseline Period - March 2000									
Amphicarpum muhlenbergianum	10.70							1.50	10.80
Andropogon virginicus	2.30						23.30	3.70	26.00
Eupatorium capillifolium	15.00						0.30	2.20	15.50
Gordonia lasianthus seedling					13.30	13.30		3.80	27.00
Lachnanthes caroliniana	0.70						0.30	0.10	1.00
Leucothoe racemosa seedling		3.30						0.50	3.40
Lyonia lucida seedling					0.30			0.00	0.30
Mosses			0.30	0.30	1.30		0.30	0.30	2.40
Myrica heterophylla seedling	0.70							0.10	0.70
Pinus sp.				0.30		0.30		0.10	0.70
Polygonum punctatum	1.30					0.70		0.30	2.00
Vitis sp.	5.00							0.70	5.10
Woodwardia virginica	1.70						3.30	0.70	5.10
Total	**37.30**	**3.30**	**0.30**	**0.70**	**15.00**	**14.30**	**27.70**	**14.10**	**100.00**
Hydration Period - October 2005									
Polygonum punctatum	1.67							0.24	3.88
Rhynchospora sp.	0.33							0.05	0.78
Rubus sp.	3.33							4.76	77.52
Vitis rotundifolia	2.67							0.38	6.20
Woodwardia virginica	5.00							0.71	11.63
Total	**43.00**							**6.14**	**100.00**
Hydration Period - March 2006									
moss	0.33				0.33	0.33		0.14	12.50
Polygonum punctatum	0.67	0.33				0.33		0.19	16.67
Woodwardia virginica	5.33						0.33	0.81	70.83
Total	**6.33**	**0.33**	**0.00**	**0.00**	**0.33**	**0.67**	**0.33**	**1.14**	**100.00**

During the baseline period, the diversity within the herbaceous groundcover plots varied between one and eight species. The relative percent cover of all the plots was dominated (27%) by seedlings of loblolly bay (*Gordonia lasianthus*). Other species that showed relatively high percent cover during the baseline included broomsedge (*Andropogon virginicus*) (26%) and dogfennel (15.5%).

During hydration Year 5, the diversity within the herbaceous groundcover plots varied between zero and five species. The relative percent cover from the two monitoring events was dominated (78%) by blackberry (*Rubus sp.*), a facultative species, during the October 2005 event; and by obligate Virginia chain fern (71%) during the March 2006 event.

Belt-Intercept Transects. The target herbaceous species occurrence along the three 1-meter wide belt transects was limited to one obligate and two facultative species. Presence / absence information for each sampling event is provided in Table 11. During the baseline period, percent cover of the target herbaceous species was highest at the upland end of the monitoring transects, and lowest or zero along the rest of the monitoring transects (Table 12).

Table 11. Presence of indicator (target) herbaceous species on belt transect

		Hydration									
	Baseline Mar 2000	**Nov 2001**	**May 2002**	**Dec 2002**	**Apr 2003**	**Sep 2003**	**Apr 2004**	**Oct 2004**	**Apr 2005**	**Oct 2005**	**Mar 2006**
Obligate (OBL)											
Woodwardia areolata	X	X	X	X	X	X	X		X	X	X
Facultative (FAC)											
Andropogon virginicus	X	X	X						X	X	
Eupatorium capillifolium	X	X	X	X	X	X	X	X	X		X
Lachnanthes caroliniana	X	X	X		X	X	X		X		

During the October 2005 monitoring event when water levels were high and standing water covered nearly all of the belt transects, only two target species were recorded. Dominated by an obligate species, netted chain fern *(Woodwardia areolata)*, the October 2005 event marks the lowest percent cover of target species during the entire study period. As in the baseline period, target species were observed, however, outside of the monitoring transect situated most often on hummocks formed from overturned trees and stumps. These hummocks provide microtopographic relief enabling some plants to escape flooding.

During the March 2006 monitoring event, percent cover and frequency within the belt transect zones was less than that observed during baseline conditions (Table 12). Percent cover, dominated by facultative species, was greatest at the upland end of the transect; dropped to zero in the transition zone to the wetland center where ground cover was mostly leaf litter; then occurred again near the end of the transect. Dogfennel occurred for the greatest total linear distance. Results for each transect on each sampling date are provided in Appendix B.

Table 12. Summary of percent cover of herbaceous groundcover on belt transects for target species

Species	Indicator	Percent Cover (%) Belt Transect Zone					Cover		Frequency		Importance Value
		A	B	C	D	E	Percent	Relative	Absolute	Relative	
Baseline Period – March 2000											
Andropogon virginicus	FAC	1.96	0.24				0.44	32.67	0.33	45.45	39.06
Eupatorium capillifolium	FAC	0.01					0.00	0.11	0.07	9.09	4.60
Lachnanthes caroliniana	FAC	4.31					0.86	63.92	0.20	27.27	45.60
Woodwardia areolata	OBL	0.00	0.15	0.07			0.04	3.29	0.13	18.18	10.74
Total		**6.28**	**0.39**	**0.07**	**0.00**	**0.00**	**1.35**	**100.00**	**0.73**	**100.00**	**100.00**
	FAC	6.28	0.24				1.30	96.71	0.60	81.82	89.26
	OBL		0.15	0.07			0.04	3.29	0.13	18.18	10.74
Total by Indicator Status		**6.28**	**0.39**	**0.07**	**0.00**	**0.00**	**1.35**	**100.00**	**0.73**	**100.00**	**100.00**
Hydration Period – October 2005											
Andorpogon virginicus	FAC	0.07					0.01	25.00	0.07	50.00	37.50
Woodwardia areolata	OBL					0.15	0.03	75.00	0.07	50.00	62.50
Total		**0.07**	0.00	0.00	0.00	**0.15**	**0.04**	**100.00**	**0.14**	**100.00**	**100.00**
	FAC	0.07					0.01	25.00	0.07	50.00	37.50
	OBL					0.15	0.03	75.00	0.07	50.00	62.50
Total by Indicator Status		**0.07**	0.00	0.00	0.00	**0.15**	**0.04**	**100.00**	**0.14**	**100.00**	**100.00**
Hydration Period – April 2006											
Eupatorium capillifolium	FAC	0.19				0.04	0.05	83.33	0.20	74.07	78.70
Woodwardia areolata	OBL					0.04	0.01	16.67	0.07	25.93	21.30
Total		**0.19**	0.00	0.00	0.00	**0.08**	**0.06**	**100.00**	**0.27**	**100.00**	**100.00**
	FAC	0.19				0.04	0.05	83.33	0.20	74.07	78.70
	OBL					0.04	0.01	16.67	0.07	25.93	21.30
Total by Indicator Status		**0.19**	0.00	0.00	0.00	**0.08**	**0.06**	**100.00**	**0.27**	**100.00**	**100.00**

Shrubs/Sapling Community

Shrub / sapling sampling is conducted annually in conjunction with canopy / subcanopy sampling. For the purposes of data analysis and discussion, the shrub / sapling species are the shortest / smallest of the three size classes:

- Shrub/sapling   <2.5 centimeters dbh and > 0.3 meter tall
- Subcanopy   ≥2.5 centimeters to < 10.0 centimeters dbh
- Canopy   ≥10.0 centimeters dbh

Data have been collected in October 2000, November 2001, December 2002, October 2003, October 2004, and October 2005. Shrubs commonly found in cypress-hardwood swamps include those occurring at this site — gallberry (*Ilex glabra*), Virginia willow (*Itea virginica*), fetterbush (*Lyonia lucida*), and wax myrtle (*Myrica cerifera*).

25-Square-Meter Shrub/Sapling Plots. Three shrub species were identified in the 5-meter shrub/sapling plots during the October 9, 2000 sampling effort (Table 13). Shrub plant species included fetterbush, wax myrtle, and swamp bay (*Persea palustris*). Total shrub cover was greatest in shrub plot C. The percent cover of shrub species during the fifth year operational monitoring event differed to that observed during baseline sampling within all the shrub plots. Fetterbush was absent from shrub plot A. Shrub plot A was dominated by muscadine grape (*Vitis rotundifolia*) (10%) which was encroaching from the upland pine plantation. Shrub plot B was sparse and contained only one species, loblolly bay. Within shrub plot C, only fetterbush was observed and at a greater percent cover (32%) compared to baseline.

Table 13. Shrub/sapling 5-meter by 5-meter plot

Stem counts for sapling species are given in parentheses.

Shrub Plot	Scientific Name	Wetland Indicator	Percent Cover						% Change 2005 to Baseline
				Hydration					
			Baseline Oct 2000	Nov 2001	Dec 2002	Oct 2003	Oct 2004	Oct 2005	
SA	*Lyonia lucida*	FACW	1%	3%	2%	5%			-100%
	Cephalanthus occidentalis	OBL	--				1%		--
	Pinus elliottii	FAC	--				2% (1)		--
	Vitis rotundifolia	FAC	--				20%	10%	100%
SB	*Persea palustris*	OBL	2% (7)	2%	1% (1)	2% (10)	1% (6)		-100%
	Gordonia lasianthus	FACW			1% (9)			1% (3)	100%
SC	*Lyonia lucida*	FACW	15%	20%	15%	20%	8%	32%	113%
	Myrica cerifera	FAC	25%	20%	20%				-100%

Plot size = 5 square meters

Line Intercept. Total cover by shrub species has been very low for the baseline and all of the hydration periods (Table 14). Three shrub / sapling species were recorded during the October 2000 baseline event. Loblolly bay (facultative wet) was the most common occurring shrub in the baseline period covering 3.35 meters or 11.17% of the total transect length. This same shrub species coverage dropped to 1.40 meters or 1.56% of the total transect length recorded at the October 2005 event.

The other shrub / sapling species found along the transect in the baseline were facultative wet fetterbush and obligate bald cypress sapling (*Taxodium distichum*) comprising 1.50% and 8.80% coverage, respectively. Neither of these two species were found in October 2005, but facultative wet species highbush blueberry (*Vaccinium elliottii*) and swamp bay (obligate) were found, and covered 1.00% and 0.89% of the transect, respectively.

Shifts in species composition are expected when relatively rapid changes in water level occurs. The wetland was atypically dry for many years, and most likely will require many years of saturated soil conditions to reestablish a stable wetland species composition.

Table 14. Summary of shrub/sapling line intercept transect

Species	Wetland Indicator Status	Linear Distance (m)					Total Linear Distance (m)	Cover		Frequency		Importance Value
		A	B	C	D	E		Percent	Relative	Absolute	Relative	
Baseline - October 2000												
Gordonia lasianthus	FACW				0.85	2.50	3.35	11.17	52.02	0.40	50.00	51.01
Lyonia lucida	FACW					0.45	0.45	1.50	6.99	0.20	25.00	15.99
Taxodium distichum	OBL	2.64					2.64	8.80	40.99	0.20	25.00	33.00
Total		**2.64**	**0.00**	**0.00**	**0.85**	**2.95**	**6.44**	**21.47**	**100.00**	**0.80**	**100.00**	**100.00**
Hydration Period – October 2005												
Gordonia lasianthus	FACW				1.40		1.40	1.56	45.16	0.20	33.33	39.25
Persea palustris	OBL	0.80					0.80	0.89	25.81	0.20	33.33	29.57
Vaccinium elliottii	FACW	0.90					0.90	1.00	29.03	0.20	33.33	31.18
Total		**1.70**	**0.00**	**0.00**	**1.40**	**0.00**	**3.10**	**3.44**	**100.00**	**0.60**	**100.00**	**100.00**

Canopy/Subcanopy

Canopy/subcanopy data were collected first in October 2000 during the baseline period, and subsequently in November 2001, December 2002, October 2003, October 2004, and October 2005. For the purposes of data analysis and discussion, the canopy and subcanopy species are the two taller/larger of the three size classes:

- Shrub/sapling <2.5 centimeters dbh and > 0.3 meter tall
- Subcanopy ≥2.5 centimeters to < 10.0 centimeters dbh
- Canopy ≥10.0 centimeters dbh

No significant changes in dominance, density, and frequency of the canopy/subcanopy layer plants measured in 2000 and 2005 were expected, as growth and recruitment to this layer are relatively slow compared to herbaceous and shrub/sapling communities. The canopy and subcanopy species at the Tillman Ridge demonstration wetland are characteristic of non-alluvial swamps in the southern Atlantic coastal plain, where blackgum (*Nyssa sylvatica*) and bald cypress are common species, and subcanopy species include bay and other hardwoods (Harms et al. 1998). The larger area within which the study wetland resides can be characterized as a managed pine flatwoods.

Canopy. The total basal area (or dominance) increased in the tree plot from the baseline monitoring event (46.34 square meters per hectare) to the October 2005 event, recording the highest value (50.55 square meters per hectare) of the entire monitoring period. The total basal area within the tree plot has experienced both gains and losses during the monitoring period since the baseline event as oxidized soils have exposed tree roots and trees have been toppled by windthrow.

Canopy density had been slowly decreased since baseline during the first four years of hydration monitoring, as trees were dying at a faster rate than the thin subcanopy is growing. Density (trees per hectare) in October 2000 (baseline) was 1033.33. During the October 2005 hydration monitoring event, density was 900.00 trees per hectare, less than the baseline value but an increase from the October 2004 event. The increase is the result of three trees moving from the subcanopy layer to the canopy layer.

Appendix B contains individual tree dbh information and basal area calculations. Individual tree dbh measurements increased slightly during the October 2005 event.

Five species and 87 trees were recorded during the Year 5 hydration period monitoring event (Table 15). Eighty-one were canopy-sized (greater than, or equal to 10 centimeters dbh), three more than the previous year monitoring event. The most common canopy species was blackgum with an importance value of 69.88. A slight increase from the baseline importance value (67.87) was the result of the death of trees from other species which elevated blackgum's relative importance value, even with a net loss of eight blackgum trees since baseline. Other species recorded included loblolly bay, slash pine (*Pinus elliottii*), and bald cypress with importance values of 15.08, 8.00, and 7.04, respectively.

Subcanopy. Six trees were subcanopy-sized (less than 10 centimeters dbh) (Table 15), seven less than the baseline and the lowest recorded since the beginning of the project. The only subcanopy species recorded was swamp bay. The October 2005 subcanopy density was 66.67 trees per hectare (144.44 in baseline). The basal area of the subcanopy trees (or dominance) was 0.13 square meter per hectare (0.37 in baseline). The subcanopy stratum at the Tillman Ridge Wetland continues to be very poorly developed and appears to be impacted from prolonged high water throughout the growing season.

Table 15. Tree importance values

Species	Baseline – October 2000		Hydration – October 2005		% Change in Importance Value
	No.	Importance Value	No.	Importance Value	
Canopy Species					
Gordonia lasianthus	11	18.36	7	15.08	-17.86%
Nyssa sylvatica	78	67.87	70	69.88	2.96%
Pinus elliottii	2	7.14	2	8.00	12.04%
Taxodium distichum	2	6.63	2	7.04	6.18%
Total	**93**	**100.00**	**81**	**100.00**	
Subcanopy Species					
Gordonia lasianthus	9	68.77			-100%
Persea palustris	4	31.23	6	100.00	220.20%
Total	**13**	**100.00**	**6**	**100.00**	

Note: Values for relative density and relative frequency used to calculate importance values are given in Appendix B.

ANIMALS

Amphibians

A brief summary of the available CPI survey results (through 2006) are included in this annual report. A full presentation of the amphibian survey results are presented in *Assessment of Amphibian Response to Wetlands Augmentation 4th Annual Report 2006*, submitted by Means and Meegan of CPI directly to the SJRWMD.

Baseline Period. Amphibian populations were surveyed monthly during the 4-month baseline period (June to September 2000) by UF biologists L. Richard Franz, Ryan C. Means, Steve A. Johnson. A summary of the species found during the baseline and hydration periods is presented in Table 16. All species encountered are typical of pine flatwoods in northeast Florida. A total of seven species of amphibians were found during the baseline period monitoring (Franz and Means 2001). No water was present during this monitoring period. Eastern narrowmouth toad (*Gastrophryne carolinensis*) and pine woods treefrog (*Hyla femoralis*) dominated the captures with eight and five specimens, respectively. Most captures were made in the PVC pipe array and in the funnel traps.

Hydration Period (2006). Amphibian populations at the Tillman Ridge wetland were surveyed monthly from January through September during each year of the hydration period by CPI biologists Ryan C. Means and Rebecca P. Meegan.

For the 2006 hydration year (Year 5), seven species were captured (species richness) in the augmented wetland; compared to eight species captured in the control wetland (Means and Meegan 2006). Abundance (total number of individuals) was 90 individuals captured in the pilot demonstration wetland; and 46 individuals at the control wetland (Table 16) (Means and Meegan 2006). For both wetlands, diversity (richness and abundance) was the lowest recorded for a single year since post-augmentation sampling began in 2003. These low capture numbers can be attributed to the extremely dry conditions in 2006 (Means and Meegan 2006). No state or federally listed threatened or endangered species were observed by CPI at the Tillman Ridge wetland during both the pre- and post-augmentation periods.

Table 16. Amphibian species captured in drift fence arrays at the pilot demonstration wetland

Common Name	Scientific Name	Baseline	Hydration			
		[1] 2000	[2] 2003	[2] 2004	[3] 2005	[4] 2006
Amphibians						
Florida cricket frog	*Acris gryllus*		6	1	12	3
Oak toad	*Bufo quercicus*	2				
Southern toad	*Bufo terrestris*	1	41	1	17	
Greenhouse frog*	*Eleutherodactylus planirostris*	3			3	
Eastern narrowmouth toad	*Gastrophryne carolinensis*	8	77	24	51	5
Green treefrog	*Hyla cinerea*					1
Pine woods treefrog	*Hyla femoralis*	5	45	22	78	39
Squirrel treefrog	*Hyla squirella*	1	22	17	89	35
Little grass frog	*Pseudacris ocularis*	1	5	2	9	
Spring peeper	*Pseudacris crucifer*				1	1
Pig frog	*Rana grylio*				1	
Southern leopard frog	*Rana sphenocephala*		42	3	81	6
Eastern spadefoot	*Scaphiopus holbrookii*		1	145	33	
Number of individuals (abundance)		21	239	215	375	90
Number of species (richness)		7	8	8	11	7

[1] Franz, R. and R.C. Means. 2001. Final Report. Florida Museum of Natural History, University of Florida, Gainesville, FL
[2] R.C. Means and Rebecca Meegan, CPI, Inc. Report prepared for SJRWMD, November 2004
[3] R.C. Means and Rebecca Meegan, CPI, Inc. Report prepared for SJRWMD, November 2005
[4] R.C. Means and Rebecca Meegan, CPI, Inc. Report prepared for SJRWMD, November 2006
* exotic species

Lack of sufficient rainfall resulted in dry pond basins for both the pilot demonstration and control wetland throughout most of the year. The pilot demonstration wetland had a small amount of water January through March, but the control pond remained dry for the entire sampling year (Means and Meegan 2006).

Based on data from 2006 and throughout the project, preliminary conclusions by CPI were stated in their fourth annual report that amphibian species diversity (richness and particularly abundance) was higher at the pilot demonstration wetland than at the control wetland (Means and Meegan 2006). CPI postulated that this was possibly due to wetland augmentation, but that the data is inconclusive for two reasons: (1) lack of sufficient baseline amphibian data, and (2) increased rainfall overall in the post-augmentation period may have caused elevated species diversity at both wetlands. One other conclusion reached by CPI, particular to Tillman Ridge study, was that augmentation appeared to have no detrimental effects to the amphibian fauna of the pilot demonstration wetland.

General Wildlife Observed

Wildlife within the wetland and using adjacent upland areas were recorded as observed during each sampling event. General wildlife observations include green treefrog (*Hyla cinerea*), pinewoods treefrog (*Hyla femoralis*), southern toad (*Bufo terrestris*), southern leopard frog (*Rana sphenocephala*), green anole (*Anoles carolinensis*), banded water snake (*Nerodia fasciata*), red shouldered hawk (*Buteo lineatus*), northern parula (*Parula americana*), tufted titmouse (*Parus bicolor*), Carolina wren (*Thryothorus ludovicianus*), pileated woodpecker (*Dryocopus pileatus*), and northern flicker (*Colaptes auratus*).

PHOTO STATIONS

Photographs from the three photo stations will be provided with this final report. The folder and file name of each photograph provides the date, location, and approximate compass direction of the view provided.

SUMMARY

Effects of hydration between July 2001 and June 2006 are included in the following:

1. Mean water level elevation increased by 5.7 feet over the 60-month hydration period compared to baseline.

2. Water elevations exceeded the surface of the wetland about 71% of the time for the total hydration period. During the baseline period there was no time when the water surface was above the wetland ground surface. The post-hydration exceedence curve approximately equaled the target exceedence curve.

3. Rainfall inputs to wetland for hydration Year 5 were slightly below the long-term seasonal average for the area. Total inputs (rainfall and hydration amounts) were slightly lower than previous hydration years at the Tillman Ridge Wetland.

4. The double mass comparison of cumulative change in water levels to cumulative rainfall totals showed differences in the trends of the relationships between the pre-hydration and post-hydration periods. The slope of the regression line for post-hydration data was steeper than that of the pre-hydration period indicating greater increases in water levels based relative to rainfall inputs. The difference is due to augmentation inputs. The double mass plot also clearly shows that it took approximately one year for the wetland to reach a new hydrological equilibrium under the hydration regime.

5. A more detailed investigation into components of the wetland's annual water budget (Method B) indicate that interception and combined ET and vertical seepage are significant factors affecting water levels in the wetland.

6. Wetland herbaceous vegetation overall is dominated by facultative species for most of the year. Obligate species demonstrate a seasonal relationship with facultative species and changes in water levels. As water levels rise, facultative species decline and obligate species increase. The wetland continues to exhibit a vegetation community that is low in diversity and percent cover. Percent cover of herbaceous vegetation is greatest at the upland end of the monitoring transects and exhibits minimal establishment towards the wetland end. Basal area of canopy tree species

increased compared to the baseline measurements. Canopy density, while less than baseline recorded an increase since the October 2004 event. The subcanopy continues to be very poorly developed and recorded decreases in both basal area and density.

7. For each year of the project's post-augmentation phase, amphibian species diversity (richness and abundance) was greater at the pilot demonstration wetland than at the control pond (Means and Meegan 2006). However, for the 2006 hydration year, diversity (richness and abundance) was the lowest recorded for a single year since post-augmentation sampling began in 2003 in both the pilot demonstration wetland and in the control wetland. Lack of sufficient rainfall resulted in dry pond basins for both wetlands throughout most of the year.

RECOMMENDATIONS

This completes the fifth and final year of hydration and monitoring of the Tillman Ridge Wetland; and hydration continued through September 2006 in order to support the fourth and final year of the amphibian survey.
A separate final report synthesizing the results and effects of hydration (or surface water diversion) on the study wetlands of the four pilot projects will be submitted when the program ends in September 2008.

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Appendix A
Target Hydrograph and Biological Indicators

Biological Indicators of Hydrology

Biological (botanical) indicators can be used to estimate certain characteristics of hydrographic conditions of a wetland since the biology integrates the overall hydrologic behavior. Different plants sprout, grow, and survive within relatively narrow and specific hydrologic ranges. Similarly, organic soils develop from fallen vegetation only under specific hydrologic conditions. Measurement of the indicators can provide estimates of long-term or previous hydrologic regimes, and thus provide hydration targets.

This evaluation considered the depth of muck soils, and elevation characteristics of pine, saw palmetto, and *Lyonia* root crowns.

The analysis approach employed here is a shortened version of the methods used by SJRWMD for development of Minimum Flows and Levels (e.g., Mace 2002). We used soil and vegetation information to estimate the Minimum Average water level and the Minimum Frequent Low water level. A mean water level no lower than 0.25 feet below the mean surface elevation of organic soils has been used to protect peat soils in south Florida (SJRWMD professional opinion based on unpublished data and Stephens 1974). This same depth below the muck surface has been found to correspond to the water level exceeded about 50 to 60 percent of the time (Brooks and Lowe 1984; Hall, 1987). The Minimum Frequent Low elevation was estimated in a similar fashion, as the mean organic soil elevation described above minus 1.67 feet. This is considered to be a minimum dry season depth necessary to maintain the organic soil profile and other wetland functions and structures (Mace 2002). The minimum Frequent Low has been found to occur at about the 85 to 90 percent stage exceedence range (G.B. (Sonny) Hall, personal communication 2001).

The SJRWMD Minimum Flows and Levels assessment protocols describe the mean elevation of the organic soil as the average of the elevation of the histic epipedon (an organic layer of 8 inches) and the beginning of a true histosol soil (an organic layer of 16 inches in depth). This elevation is equivalent to the 55 to 60 percent stage exceedence elevation. The same average minus 1.67 feet has been validated as the minimum infrequent low, or 85 to 90 percent of the stage exceedence.

The suite of soil and vegetation indicator elevations were placed on the stage exceedence curves and compared to the expected stage exceedences from the literature and SJRWMD's other MFL-related investigations. Differences were related to changes in the hydrologic regime in the wetland.

Hull et al (1989) provided elevation relationships for fetterbush, lichen and mosses (elevation relationships in Figures 3b, 4b, 5b, 6b, 7b, 8b of Hull et al. 1989). In that study, lichen lines were higher than upper moss line and Fetterbush root crown by about 0.3 to 0.6 feet. The moss line was close to but slightly lower than Fetterbush. The expected percent hydrologic exceedence for these lines was 10 percent to 15 percent. The Southwest Florida Water Management District studied elevation ranges of biological indicators of high water levels in isolated cypress swamps in the northern Tampa Bay area (SWFWMD 2001). The study supports the proximity of the mean elevation of moss and fetterbush lines reported by Hull et al. (1989).

Slash pine may be inundated 1 to 2 months per year in flatwoods environments (Abrahamson and Hartnett 1992) and so are likely to be found at approximately 10 percent inundation. Saw palmetto (Serenoa *repens*) is found in flatwoods as understory and just beyond the lower limit of slash pine inundation. “Palmetto often forms a conspicuous ring around margins of cypress ponds and similar wet areas, with its inner edge just above the presumed high water mark” (Brown et al 1992).

Muck Soil Profile

Muck (organic soil) depths were measured along the transect from the wetland end of the transect to the upland edge in October 2002. There was a fully developed organic soil layer at all sampled points along the transect (Table A-1).

Table A-1. Organic (OM) Soil Layer Depths at the Tillman Ridge Wellfield Wetland
2006 Annual Report Tillman Ridge Impact Avoidance Project

Transect Distance (feet)	Water Depth (feet)	OM Thickness (feet)	Surface Elevation (feet NGVD)
288 2		1.33	39.29
275 1.33		1.5	39.96
262 1.5		> 2.0	39.79
239 1.7		> 2.0	39.59
220 1.4		> 2.0	39.89
203 1.2		> 2.0	40.09
180 1.5		> 2.0	39.79
148 1.25		> 2.0	40.04
115 2.1		> 2.0	39.19
82 2.5		> 2.0	38.79
50 2.3		> 2.0	38.99
Average	**1.65**	**> 2.0**	**39.58**

Transect from interior (50 feet) to plant edge (288 feet).

Vegetation Indicators

Pine tree base, saw palmetto, and *Lyonia* root crown base elevations in and at the edge of the wetland were measured for use in establishing a target hydrograph for the hydration effort (Table A-2).

Table A-2. Elevation of Biological Indicator Plant Structures at Tillman Ridge Wellfield Wetland

Base Elevation of Pines			Saw Palmetto		*Lyonia* Root Crown	
Tree #	**dbh (ft)**	**Elev. (ft)**	**Plant #**	**Elev (ft)**	**Shrub #**	**Elev (ft)**
1 1.08		41.12	1	41.04	1	41.79
2 0.92		40.87	2	41.12	2	41.79
3 1.33		40.96	3	40.96	3	41.46
4 1.33		41.21	4	40.87	4	41.62
5 1.25		41.29	5	41.12	5	41.96
6 1.42		41.29	6	41.04	6	41.54
7 1.33		41.29	7	40.96	7	41.62
8 1.50		41.29	8	40.96	8	40.79
9 1.33		41.21			9	41.79
					10	41.71
					11	41.96
					12	41.62
					13	41.54
					14	41.62
					15	41.79
					16	41.87
					17	41.54
					18	41.46
					19	41.46
					20	41.54
					21	41.62
					22	41.04
					23	41.04
					24	41.46
					25	41.54
					26	41.79
					27 41.46	
	Pine		**Saw Palmetto**		***Lyonia* Root Crown**	
	Mean	**41.17 ft**	**Mean**	**41.02 ft**	**Mean**	**41.57 ft**

In addition to the information collected in Table A-2, the field biologist also noted that old lichen lines were present. These lichen lines were located 1 to 2 feet above the water level present during the fieldwork, at an elevation of 42.3 to 43.3 feet.

Target Hydrograph

The data from the organic soil profile and biological indicators of water elevation can be used to estimate a target hydrograph for the wetland (Table A-3, Figure A-1).

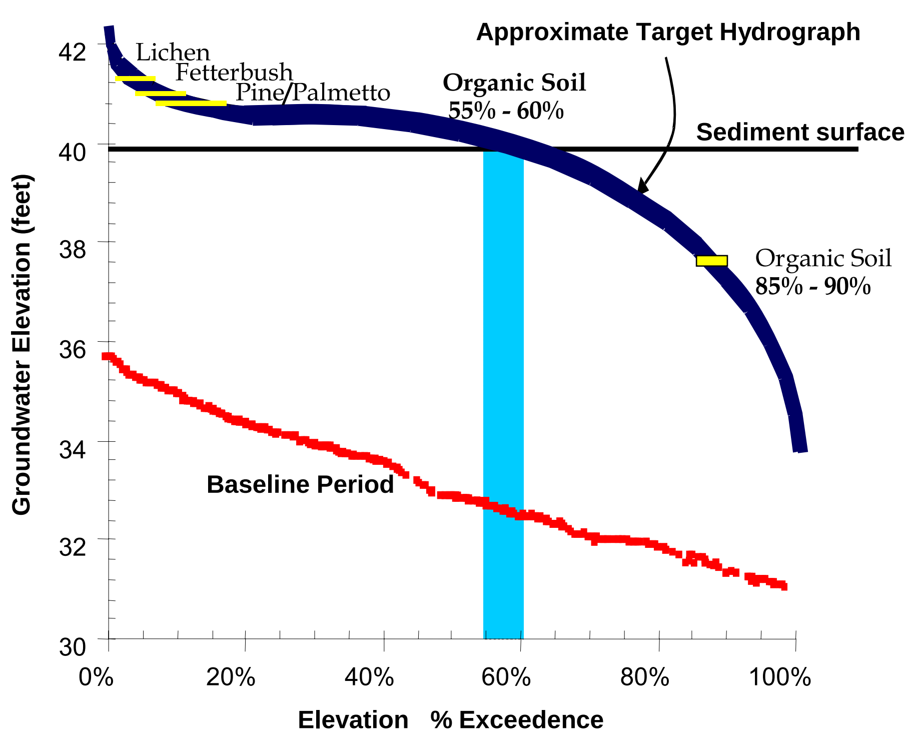
An organic soil layer existed up to the edge of the wetland (Table A-3). Therefore, the conservative assumption was made that the average elevation of the muck minus 0.25 feet was approximately equal to the minimum average stage (Table A-3). The 85 to 90 percent stage exceedence value was also estimated from the soil information.

Pine, palmetto, *Lyonia*, and lichen indicators were used to develop the lower percent exceedence end of the target hydrograph. The overlapping ranges of the plant indicators provided a less clear but still useful guide to development of the target hydrograph.

Table A-3. Biological Indicator Data Used to Develop Target Hydrograph

Indicator	Elevation (Feet NGVD)	Stage Exceedence Range
Muck soil	39.33	55 - 60% (minimum average)
Muck soil	37.91	85 - 90% (minimum infrequent low)
Pine - Palmetto	41.1	7 - 15%
Lyonia Root Crown	41.6	5 - 10%
Lichen (anecdotal)	42.3 – 43.3	< 5%

Figure A-1. Target Hydrograph with Baseline Period for the Tillman Ridge Wellfield Wetland



Appendix B
Detailed Vegetation Data

Baseline – Detailed Vegetation Data

Table B-1
Summary Of Herbaceous 1-Meter Squares from the Tillman Ridge wellfield wetland - March 27, 2000.

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum	2							0.29	1.50
Andropogon virginicus	5							0.71	3.76
Eupatorium capillifolium	25							3.57	18.80
Gordonia lasianthus					40	40		11.43	60.15
Mosses				1			1	0.29	1.50
Myrica herterophylla	1							0.14	0.75
Polygonum punctatum	3							0.43	2.26
Vitis sp.	15							2.14	11.28
Total	51	0	0	1	40	40	1	19.00	100.00
Bare Ground/Dead Veg./Litter	49	100	100	99	60	60	99	81.00	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andropogon virginicus							70	10.00	82.35
Eupatorium capillifolium							1	0.14	1.18
Gordonia lasianthus								0.00	0.00
Lachnanthes caroliniana							1	0.14	1.18
Leucothoe racemosa		10						1.43	11.76
Lyonia lucida					1			0.14	1.18
Mosses					1			0.14	1.18
Pinus sp.				1				0.14	1.18
Total	0	10	0	1	2	0	72	12.14	100.00
Bare Ground/Dead Veg./Litter	100	90	100	99	98	100	28	87.86	

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Amphicarpum muhlenbergianum	30							4.29	38.46
Andropogon virginicus	2							0.29	2.56
Eupatorium capillifolium	20							2.86	25.64
Lachnanthes caroliniana	2							0.29	2.56
Mosses			1		3			0.57	5.13
Myrica herterophylla	1							0.14	1.28
Pinus sp.						1		0.14	1.28
Polygonum punctatum	1					2		0.43	3.85
Woodwardia virginica	5						10	2.14	19.23
Total	61	0	1	0	3	3	10	11.14	100.00
Bare Ground/Dead Veg./Litter	39	100	99	100	97	97	90	88.86	

Table B-2
Summary of Herbaceous Ground Cover Belt Transects For The Tillman Ridge Wellfield Wetland - March 27, 2000.

TILLMAN RIDGE - WEST

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	FAC	1.00					1.00	1.11	30.67	0.20	25.00	27.84
Lachnanthes caroliniana	FAC	1.66					1.66	1.84	50.92	0.20	25.00	37.96
Woodwardia aereolata	OBL		0.40	0.20			0.60	0.67	18.40	0.40	50.00	34.20
Total		2.66	0.40	0.20	0.00	0.00	3.26	3.62	100.00	0.80	100.00	100.00

TILLMAN RIDGE - CENTRAL

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	FAC	3.90	0.25				4.15	4.61	46.58	0.40	66.67	56.62
Lachnanthes caroliniana	FAC	4.76					4.76	5.29	53.42	0.20	33.33	43.38
Total		8.66	0.25	0.00	0.00	0.00	8.91	9.90	100.00	0.60	100.00	100.00

TILLMAN RIDGE - EAST

Species	Indicator	Linear Distance (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Andropogon virginicus	FAC	0.40	0.40				0.80	0.89	13.25	0.40	50.00	31.62
Eupatorium capillifolium	FAC	0.02					0.02	0.02	0.33	0.20	25.00	12.67
Lachnanthes caroliniana	FAC	5.22					5.22	5.80	86.42	0.20	25.00	55.71
Total		5.64	0.40	0.00	0.00	0.00	6.04	6.71	100.00	0.80	100.00	100.00

Table B-3
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	Notes
Tillman	1	1	401	Nyssa sylvatica	16.27	
Tillman	1	1	402	Nyssa sylvatica	24.10	
Tillman	1	1	403	Gordonia lasianthus	10.90	Dead, tag pulled
Tillman	1	1	404	Nyssa sylvatica	21.95	
Tillman	1	1	405	Nyssa sylvatica	21.55	
Tillman	1	1	406	Nyssa sylvatica	19.65	
Tillman	1	1	407	Pinus elliottii	46.25	
Tillman	1	1	408	Gordonia lasianthus	19.67	
Tillman	1	1	409	Nyssa sylvatica	18.00	
Tillman	1	1	619	Nyssa sylvatica	21.35	
Tillman	1	2	300	Gordonia lasianthus		
Tillman	1	2	410	Pinus elliottii	22.70	
Tillman	1	2	411	Gordonia lasianthus	11.65	
Tillman	1	2	412	Nyssa sylvatica	35.32	
Tillman	1	2	413	Nyssa sylvatica	22.60	
Tillman	1	2	414	Nyssa sylvatica	25.20	
Tillman	1	2	415	Persea palustris	2.80	
Tillman	1	2	416	Nyssa sylvatica	14.97	
Tillman	1	2	417	Nyssa sylvatica	14.55	
Tillman	1	2	418	Persea palustris	3.00	
Tillman	1	2	419	Persea palustris	4.05	
Tillman	1	2	420	Nyssa sylvatica	40.80	
Tillman	1	2	421	Nyssa sylvatica	23.05	
Tillman	1	2	422	Taxodium distichum	36.17	
Tillman	1	2	423	Nyssa sylvatica	33.30	
Tillman	1	2	424	Nyssa sylvatica	18.05	
Tillman	1	2	425	Nyssa sylvatica	27.40	
Tillman	1	2	426	Nyssa sylvatica	28.70	
Tillman	1	2	427	Nyssa sylvatica	18.20	
Tillman	1	2	428	Nyssa sylvatica	13.15	
Tillman	1	2	617	Nyssa sylvatica	32.25	
Tillman	1	2	618	Nyssa sylvatica	20.20	
Tillman	1	3	429	Nyssa sylvatica	30.05	
Tillman	1	3	430	Nyssa sylvatica	16.00	
Tillman	1	3	431	Nyssa sylvatica	14.70	
Tillman	1	3	432	Nyssa sylvatica	30.45	
Tillman	1	3	433	Nyssa sylvatica	28.60	
Tillman	1	3	434	Nyssa sylvatica	20.90	
Tillman	1	3	435	Nyssa sylvatica	21.35	
Tillman	1	3	436	Nyssa sylvatica	19.00	
Tillman	1	3	437	Nyssa sylvatica	18.70	
Tillman	1	3	438	Nyssa sylvatica	17.35	
Tillman	1	3	439	Nyssa sylvatica	15.70	
Tillman	1	3	440	Nyssa sylvatica	20.00	
Tillman	1	3	441	Nyssa sylvatica	22.90	
Tillman	1	3	442	Nyssa sylvatica	18.00	
Tillman	1	3	443	Nyssa sylvatica	21.50	
Tillman	1	3	444	Nyssa sylvatica	11.10	
Tillman	1	3	445	Nyssa sylvatica	16.52	
Tillman	1	3	446	Nyssa sylvatica	15.80	dead
Tillman	1	3	447	Nyssa sylvatica	15.75	
Tillman	1	3	448	Nyssa sylvatica	19.35	
Tillman	1	3	449	Nyssa sylvatica		
Tillman	1	3	450	Gordonia lasianthus	19.80	
Tillman	1	3	611	Nyssa sylvatica	17.50	
Tillman	1	3	612	Nyssa sylvatica	10.90	
Tillman	1	3	613	Nyssa sylvatica	32.10	

Table B-3
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	Notes
Tillman	1	3	614	Nyssa sylvatica	29.80	
Tillman	1	3	615	Nyssa sylvatica	19.40	
Tillman	1	3	616	Nyssa sylvatica	12.55	
Tillman	1	4	449	Nyssa sylvatica	24.15	
Tillman	1	4	451	Gordonia lasianthus	11.80	
Tillman	1	4	452	Nyssa sylvatica	14.40	
Tillman	1	4	453	Nyssa sylvatica	16.45	
Tillman	1	4	454	Gordonia lasianthus	12.75	
Tillman	1	4	455	Nyssa sylvatica	15.30	
Tillman	1	4	456	Nyssa sylvatica	24.10	
Tillman	1	4	457	Nyssa sylvatica	30.20	
Tillman	1	4	458	Nyssa sylvatica	13.55	
Tillman	1	4	459	Gordonia lasianthus	15.00	Top broken
Tillman	1	4	460	Gordonia lasianthus	9.30	
Tillman	1	4	461	Nyssa sylvatica	41.07	
Tillman	1	4	462	Gordonia lasianthus	27.20	
Tillman	1	4	463	Nyssa sylvatica	46.45	
Tillman	1	4	464	Nyssa sylvatica	26.27	
Tillman	1	4	465	Nyssa sylvatica	25.25	
Tillman	1	4	466	Nyssa sylvatica	16.30	
Tillman	1	4	467	Nyssa sylvatica	33.00	
Tillman	1	4	468	Nyssa sylvatica	34.15	
Tillman	1	4	469	Gordonia lasianthus	6.30	Tree on side (486)
Tillman	1	4	486	Gordonia lasianthus	3.90	Tree on side (486)
Tillman	1	4	797	Persea palustris		
Tillman	1	4	608	Nyssa sylvatica	24.25	
Tillman	1	4	609	Gordonia lasianthus	11.55	same as 610, on side
Tillman	1	4	610	Gordonia lasianthus	3.35	same as 609
Tillman	1	5	298	Gordonia lasianthus		
Tillman	1	5	299	Persea palustris		
Tillman	1	5	470	Nyssa sylvatica	30.80	
Tillman	1	5	471	Nyssa sylvatica	24.50	
Tillman	1	5	472	Nyssa sylvatica	25.95	
Tillman	1	5	473	Gordonia lasianthus	5.05	Tree on side (486)
Tillman	1	5	474	Gordonia lasianthus	9.00	
Tillman	1	5	475	Gordonia lasianthus	35.45	
Tillman	1	5	476	Nyssa sylvatica	14.10	same as 477
Tillman	1	5	477	Nyssa sylvatica	32.35	same as 476
Tillman	1	5	478	Nyssa sylvatica	20.00	
Tillman	1	5	479	Nyssa sylvatica	17.90	
Tillman	1	5	480	Nyssa sylvatica	26.70	
Tillman	1	5	481	Nyssa sylvatica	24.20	
Tillman	1	5	482	Persea palustris	4.65	
Tillman	1	5	483	Nyssa sylvatica	25.55	
Tillman	1	5	484	Nyssa sylvatica	36.00	
Tillman	1	5	485	Taxodium distichum	22.85	
Tillman	1	5	487	Gordonia lasianthus	4.00	Tree on side (486)
Tillman	1	5	601	Nyssa sylvatica	15.25	
Tillman	1	5	602	Nyssa sylvatica	10.75	same as 603,dead
Tillman	1	5	603	Nyssa sylvatica	12.50	same as 602,dead
Tillman	1	5	604	Nyssa sylvatica	36.85	same as 416, 477
Tillman	1	5	605	Gordonia lasianthus	8.95	
Tillman	1	5	606	Gordonia lasianthus	3.80	same as 607
Tillman	1	5	607	Gordonia lasianthus	17.50	same as 606, on side
Tillman	1	5	715	Gordonia lasianthus		same as 606, 607
Tillman	1	5	797	Persea palustris		

Table B-4
Canopy and Subcanopy Importance Values for the Tillman Ridge Wellfield Wetland - October 9, 2000

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	11	3.49	7.53	122.22	11.83	1.00	35.71	18.36
Nyssa sylvatica	78	38.94	84.03	866.67	83.87	1.00	35.71	67.87
Pinus elliottii	2	2.32	5.00	22.22	2.15	0.40	14.29	7.14
Taxodium distichum	2	1.60	3.45	22.22	2.15	0.40	14.29	6.63
Total	93	46.34	100.00	1033.33	100.00	2.80	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	9	0.32	87.08	100.00	69.23	0.40	50.00	68.77
Persea palustris	4	0.05	12.92	44.44	30.77	0.40	50.00	31.23
Total	13	0.37	100.00	144.44	100.00	0.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Hydration Year 1 - Detailed Vegetation Data

Table B-5
Summary of Herbaceous Ground Cover Belt Transects for Tillman Ridge Wellfield Wetland - November 6, 2001.

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andropogon virginicus		11						1.57	25.00
Eupatorium capillifolium	1							0.14	2.27
Mosses			1				1	0.29	4.55
Solidago sp.	1							0.14	2.27
Sporobolus sp.	20							2.86	45.45
Unknown Seedling			1				1	0.29	4.55
Vitis rotundifolia	5							0.71	11.36
Woodwardia virginica				2				0.29	4.55
Total	27	11	2	2	0	0	2	6.29	100.00
Bare Ground/Dead Veg./Litter	73	89	98	98	100	100	98	93.71	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Lachnanthes caroliniana	1							0.14	4.17
Lyonia seedling			1					0.14	4.17
Mosses			1					0.14	4.17
Unknown Seedling			1					0.14	4.17
Woodwardia virginica	20							2.86	83.33
Total	21	0	3	0	0	0	0	3.43	100.00
Bare Ground/Dead Veg./Litter	79	100	97	100	100	100	100	96.57	

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Mosses						1		0.14	5.00
Polygonum punctatum	1							0.14	5.00
Unknown Seedling					1	1		0.29	10.00
Woodwardia virginica	15						1	2.29	80.00
Total	16	0	0	0	1	2	1	2.86	100.00
Bare Ground/Dead Veg./Litter	84	100	100	100	99	98	99	97.14	

TABLE B-6
Summary of Herbaceous Ground Cover Plots (1-Meter Squares) for Tillman Ridge Wellfield Wetland - May 1, 2002.

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andropogon virginicus	30							4.29	22.56
Eupatorium capillifolium	50		1					7.29	38.35
Lachnanthes caroliniana		1						0.14	0.75
Mosses				5				0.71	3.76
Nyssa seedling			1					0.14	0.75
Panicum sp.	15							2.14	11.28
Pinus seedling				1			1	0.29	1.50
Pteridium aquilinum	2							0.29	1.50
Solidago sp.	15							2.14	11.28
Unknown Seedling				1				0.14	0.75
Vitis rotundifolia	5							0.71	3.76
Woodwardia virginica				5				0.71	3.76
Total	117	1	2	12	0	0	1	19.00	100.00
Bare Ground/Dead Veg./Litter	0	99	98	88	100	100	99	83.43	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Aster sp.	1							0.14	0.84
Eupatorium capillifolium	30					1		4.43	26.05
Lachnanthes caroliniana	15							2.14	12.61
Mosses			5					0.71	4.20
Nyssa seedling			1	10				1.57	9.24
Pinus seedling						2	2	0.57	3.36
Solidago sp.	1							0.14	0.84
Verbesina sp.						1		0.14	0.84
Woodwardia virginica	50							7.14	42.02
Total	97	0	6	10	0	4	2	17.00	100.00
Bare Ground/Dead Veg./Litter	3	100	94	90	100	96	98	83.00	

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Cephalanthus occidentalis	1							0.14	0.80
Eupatorium capillifolium	40							5.71	32.00
Lachnanthes caroliniana	5							0.71	4.00
Magnolia virginica				1		1		0.29	1.60
Mosses						2		0.29	1.60
Panicum sp.	5							0.71	4.00
Pinus seedlings				1		1	1	0.43	2.40
Polygonum punctatum	15							2.14	12.00
Verbesina sp.	20					1	1	3.14	17.60
Woodwardia virginica	20						10	4.29	24.00
Total	106	0	0	2	0	5	12	17.86	100.00
Bare Ground/Dead Veg./Litter	0	100	100	98	100	95	88	83.00	

Table B-7
Summary of Herbaceous Ground Cover Belt Transects For The Tillman Ridge Wellfield Wetland - 11/06/2001.

TILLMAN RIDGE - WEST

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	FAC	2.17					2.17	2.41	10.44	0.33	16.67	13.55
Eupatorium capillifolium	FAC	15.45					15.45	17.17	74.35	0.33	16.67	45.51
Lachnanthes caroliniana	FAC	1.10					1.10	1.22	5.29	0.33	16.67	10.98
Woodwardia aereolata	OBL	0.85	0.65	0.56			2.06	2.29	9.91	1.00	50.00	29.96
Total		19.57	0.65	0.56	0.00	0.00	20.78	23.09	100.00	2.00	100.00	100.00

TILLMAN RIDGE - CENTRAL

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	FAC	3.15					3.15	3.50	29.01	1.00	33.33	31.17
Eupatorium capillifolium	FAC	2.30					2.30	2.56	21.18	1.00	33.33	27.26
Lachnanthes caroliniana	FAC	5.41					5.41	6.01	49.82	1.00	33.33	41.57
Total		10.86	0.00	0.00	0.00	0.00	10.86	12.07	100.00	3.00	100.00	100.00

TILLMAN RIDGE - EAST

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	2.61					2.61	2.90	59.18	1.00	50.00	54.59
Lachnanthes caroliniana	FAC	1.80					1.80	2.00	40.82	1.00	50.00	45.41
Total		4.41	0.00	0.00	0.00	0.00	4.41	4.90	100.00	2.00	100.00	100.00

Table B-8
Summary of Herbaceous Ground Cover Belt Transects for Tillman Ridge Wellfield Wetland - May 1, 2002.

TILLMAN RIDGE - WEST

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	6.21	1.04	0.85			8.10	9.00	53.18	1.00	50.00	51.59
Lachnanthes caroliniana	FAC	5.82					5.82	6.47	38.21	0.33	16.67	27.44
Woodwardia aereolata	OBL		0.96	0.35			1.31	1.46	8.60	0.67	33.33	20.97
Total		12.03	2.00	1.20	0.00	0.00	15.23	16.92	100.00	2.00	100.00	100.00

TILLMAN RIDGE - CENTRAL

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	4.33	0.08				4.41	4.90	34.13	1.00	66.67	50.40
Lachnanthes caroliniana	FAC	8.51					8.51	9.46	65.87	0.50	33.33	49.60
Total		12.84	0.08	0.00	0.00	0.00	12.92	14.36	100.00	1.50	100.00	100.00

TILLMAN RIDGE - EAST

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	1.95	0.22				2.17	2.41	17.70	1.00	66.67	42.18
Lachnanthes caroliniana	FAC	10.09					10.09	11.21	82.30	0.50	33.33	57.82
Total		12.04	0.22	0.00	0.00	0.00	12.26	13.62	100.00	1.50	100.00	100.00

Table B-9
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	DBH (cm^2) 11/6/2001	Notes
Tillman	1	1	401	Nyssa sylvatica	16.27	17.10	
Tillman	1	1	402	Nyssa sylvatica	24.10	25.10	
Tillman	1	1	403	Gordonia lasianthus	10.90	11.90	Dead, tag pulled
Tillman	1	1	404	Nyssa sylvatica	21.95	22.80	
Tillman	1	1	405	Nyssa sylvatica	21.55	21.70	
Tillman	1	1	406	Nyssa sylvatica	19.65	20.00	
Tillman	1	1	407	Pinus elliottii	46.25	47.90	
Tillman	1	1	408	Gordonia lasianthus	19.67	20.70	
Tillman	1	1	409	Nyssa sylvatica	18.00		
Tillman	1	1	619	Nyssa sylvatica	21.35	24.00	
Tillman	1	2	300	Gordonia lasianthus			
Tillman	1	2	410	Pinus elliottii	22.70	23.30	
Tillman	1	2	411	Gordonia lasianthus	11.65	12.80	
Tillman	1	2	412	Nyssa sylvatica	35.32	35.80	
Tillman	1	2	413	Nyssa sylvatica	22.60	22.70	
Tillman	1	2	414	Nyssa sylvatica	25.20	25.90	
Tillman	1	2	415	Persea palustris	2.80	3.40	
Tillman	1	2	416	Nyssa sylvatica	14.97	15.00	
Tillman	1	2	417	Nyssa sylvatica	14.55	14.80	
Tillman	1	2	418	Persea palustris	3.00	4.50	
Tillman	1	2	419	Persea palustris	4.05	4.80	
Tillman	1	2	420	Nyssa sylvatica	40.80	42.10	
Tillman	1	2	421	Nyssa sylvatica	23.05	23.40	
Tillman	1	2	422	Taxodium distichum	36.17	36.30	
Tillman	1	2	423	Nyssa sylvatica	33.30	33.70	
Tillman	1	2	424	Nyssa sylvatica	18.05	17.70	
Tillman	1	2	425	Nyssa sylvatica	27.40	27.40	
Tillman	1	2	426	Nyssa sylvatica	28.70	28.70	
Tillman	1	2	427	Nyssa sylvatica	18.20	18.50	
Tillman	1	2	428	Nyssa sylvatica	13.15	12.80	
Tillman	1	2	617	Nyssa sylvatica	32.25	34.70	
Tillman	1	2	618	Nyssa sylvatica	20.20	20.20	
Tillman	1	3	429	Nyssa sylvatica	30.05	30.10	
Tillman	1	3	430	Nyssa sylvatica	16.00	16.00	
Tillman	1	3	431	Nyssa sylvatica	14.70	14.60	
Tillman	1	3	432	Nyssa sylvatica	30.45	30.50	
Tillman	1	3	433	Nyssa sylvatica	28.60	28.70	
Tillman	1	3	434	Nyssa sylvatica	20.90	21.20	
Tillman	1	3	435	Nyssa sylvatica	21.35	21.60	
Tillman	1	3	436	Nyssa sylvatica	19.00	19.00	
Tillman	1	3	437	Nyssa sylvatica	18.70	18.50	
Tillman	1	3	438	Nyssa sylvatica	17.35	17.40	
Tillman	1	3	439	Nyssa sylvatica	15.70	15.60	
Tillman	1	3	440	Nyssa sylvatica	20.00	19.80	
Tillman	1	3	441	Nyssa sylvatica	22.90	22.90	
Tillman	1	3	442	Nyssa sylvatica	18.00	18.00	
Tillman	1	3	443	Nyssa sylvatica	21.50	21.40	
Tillman	1	3	444	Nyssa sylvatica	11.10	11.40	
Tillman	1	3	445	Nyssa sylvatica	16.52	16.30	
Tillman	1	3	446	Nyssa sylvatica	15.80		dead
Tillman	1	3	447	Nyssa sylvatica	15.75	15.60	
Tillman	1	3	448	Nyssa sylvatica	19.35	19.50	
Tillman	1	3	449	Nyssa sylvatica			
Tillman	1	3	450	Gordonia lasianthus	19.80	20.50	
Tillman	1	3	611	Nyssa sylvatica	17.50	17.40	
Tillman	1	3	612	Nyssa sylvatica	10.90	11.00	
Tillman	1	3	613	Nyssa sylvatica	32.10	34.00	

Table B-9
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	Notes
Tillman	1	3	614	Nyssa sylvatica	29.80	30.80	
Tillman	1	3	615	Nyssa sylvatica	19.40	19.50	
Tillman	1	3	616	Nyssa sylvatica	12.55	12.80	
Tillman	1	4	449	Nyssa sylvatica	24.15	24.10	
Tillman	1	4	451	Gordonia lasianthus	11.80	12.40	
Tillman	1	4	452	Nyssa sylvatica	14.40	14.30	
Tillman	1	4	453	Nyssa sylvatica	16.45	16.40	
Tillman	1	4	454	Gordonia lasianthus	12.75	13.30	
Tillman	1	4	455	Nyssa sylvatica	15.30	15.30	
Tillman	1	4	456	Nyssa sylvatica	24.10	24.20	
Tillman	1	4	457	Nyssa sylvatica	30.20	29.80	
Tillman	1	4	458	Nyssa sylvatica	13.55	13.40	
Tillman	1	4	459	Gordonia lasianthus	15.00	15.00	Top broken
Tillman	1	4	460	Gordonia lasianthus	9.30	9.80	
Tillman	1	4	461	Nyssa sylvatica	41.07	41.20	
Tillman	1	4	462	Gordonia lasianthus	27.20	27.10	
Tillman	1	4	463	Nyssa sylvatica	46.45	45.50	
Tillman	1	4	464	Nyssa sylvatica	26.27	26.00	
Tillman	1	4	465	Nyssa sylvatica	25.25	25.80	
Tillman	1	4	466	Nyssa sylvatica	16.30	16.20	
Tillman	1	4	467	Nyssa sylvatica	33.00	33.30	
Tillman	1	4	468	Nyssa sylvatica	34.15	34.30	
Tillman	1	4	469	Gordonia lasianthus	6.30	6.80	Tree on side (486)
Tillman	1	4	486	Gordonia lasianthus	3.90	4.10	Tree on side (486)
Tillman	1	4	797	Persea palustris			
Tillman	1	4	608	Nyssa sylvatica	24.25	24.80	
Tillman	1	4	609	Gordonia lasianthus	11.55	11.40	same as 610, on side
Tillman	1	4	610	Gordonia lasianthus	3.35	3.60	same as 609
Tillman	1	5	298	Gordonia lasianthus			
Tillman	1	5	299	Persea palustris			
Tillman	1	5	470	Nyssa sylvatica	30.80	30.90	
Tillman	1	5	471	Nyssa sylvatica	24.50	24.90	
Tillman	1	5	472	Nyssa sylvatica	25.95	26.10	
Tillman	1	5	473	Gordonia lasianthus	5.05	5.40	Tree on side (486)
Tillman	1	5	474	Gordonia lasianthus	9.00	9.00	
Tillman	1	5	475	Gordonia lasianthus	35.45	35.20	
Tillman	1	5	476	Nyssa sylvatica	14.10	14.30	same as 477
Tillman	1	5	477	Nyssa sylvatica	32.35	32.60	same as 476
Tillman	1	5	478	Nyssa sylvatica	20.00	19.80	
Tillman	1	5	479	Nyssa sylvatica	17.90	17.80	
Tillman	1	5	480	Nyssa sylvatica	26.70	27.00	
Tillman	1	5	481	Nyssa sylvatica	24.20	24.00	
Tillman	1	5	482	Persea palustris	4.65	4.70	
Tillman	1	5	483	Nyssa sylvatica	25.55	26.10	
Tillman	1	5	484	Nyssa sylvatica	36.00	36.20	
Tillman	1	5	485	Taxodium distichum	22.85	23.00	
Tillman	1	5	487	Gordonia lasianthus	4.00	4.10	Tree on side (486)
Tillman	1	5	601	Nyssa sylvatica	15.25	15.20	
Tillman	1	5	602	Nyssa sylvatica	10.75		same as 603,dead
Tillman	1	5	603	Nyssa sylvatica	12.50		same as 602,dead
Tillman	1	5	604	Nyssa sylvatica	36.85	36.20	same as 416, 477
Tillman	1	5	605	Gordonia lasianthus	8.95	9.40	
Tillman	1	5	606	Gordonia lasianthus	3.80	4.70	same as 607
Tillman	1	5	607	Gordonia lasianthus	17.50	17.50	same as 606, on side
Tillman	1	5	715	Gordonia lasianthus			same as 606, 607
Tillman	1	5	797	Persea palustris			

Table B-10
Canopy and Subcanopy Importance Values for the Tillman Ridge Wellfield Wetland - November 6, 2001

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	11	3.59	7.39	122.22	12.22	1.00	35.71	18.44
Nyssa sylvatica	75	40.95	84.20	833.33	83.33	1.00	35.71	67.75
Pinus elliottii	2	2.48	5.09	22.22	2.22	0.40	14.29	7.20
Taxodium distichum	2	1.61	3.31	22.22	2.22	0.40	14.29	6.61
Total	90	48.63	100.00	1000.00	100.00	2.80	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	9	0.36	84.18	100.00	69.23	0.40	50.00	67.80
Persea palustris	4	0.07	15.82	44.44	30.77	0.40	50.00	32.20
Total	13	0.43	100.00	144.44	100.00	0.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Hydration Year 2 - Detailed Vegetation Data

TABLE B-11
Summary of Herbaceous Ground Cover Belt Transects for Tillman Ridge Wellfield Wetland - December 13, 2002.

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andropogon virginicus	6							0.86	20.69
Eupatorium capillifolium	5							0.71	17.24
Polygonum punctatum					1			0.14	3.45
Lacnanthes caroliniana	10							1.43	34.48
Toxicodendron radicans	4							0.57	13.79
Woodwardia virginica				3				0.43	10.34
Total	25	0	0	3	1	0	0	4.14	100.00
Bare Ground/Dead Veg./Litter							75	10.71	
Open Water		100	100	100	100	100	25	75.00	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Eupatorium capillifolium	3							0.43	23.08
Mosses			2					0.29	15.38
Polygonum punctatum	2							0.29	15.38
Lacnanthes caroliniana	1							0.14	7.69
Toxicodendron radicans	1							0.14	7.69
Woodwardia virginica	4							0.57	30.77
Total	11	0	2	0	0	0	0	1.86	100.00
Bare Ground/Dead Veg./Litter			60		5			9.29	
Open Water		100	40	400	95	100	100	119.29	

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Eupatorium capillifolium	1							0.14	7.14
Polygonum punctatum	8							1.14	57.14
Woodwardia areolata 5								0.71	35.71
Total	14	0	0	0	0	0	0	2.00	100.00
Bare Ground/Dead Veg./Litter			40	70	80			27.14	
Open Water		100	99	60	5		100	52.00	

TABLE B-12
Summary of Herbaceous Ground Cover Belt Transects for Tillman Ridge Wellfield Wetland - April 10, 2003.

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andoropgon virginicus	2							0.29	4.00
Eupatorium capillifolium	15				1			2.29	32.00
Lachnanthes caroliniana	3	2	2					1.00	14.00
Panicum sp.	1							0.14	2.00
Polygonum punctatum	12							1.71	24.00
Vitis rotundifolia		2						0.29	4.00
Woodwardia areolata			10					1.43	20.00
Total	33	4	12	0	1	0	0	7.14	100.00
Bare Ground/Dead Veg./Litter	2	16	5						
Open Water		80	95	100	99	100	100		

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andoropgon virginicus	5							0.71	18.52
Cephalanthus occidentalis			6					0.86	22.22
Eupatorium capillifolium	7	1			1			1.29	33.33
Panicum sp.	3							0.43	11.11
Solidago sp.	4							0.57	14.81
Total	19	1	6	0	1	0	0	3.86	100.00
Bare Ground/Dead Veg./Litter	5		50						
Open Water		100	50	100	100	100	100		

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Eupatorium capillifolium	8	2						1.43	13.16
Lachnanthes caroliniana	12	3	6					3.00	27.63
Panicum sp.	2							0.29	2.63
Polygonum punctatum	20					3		3.29	30.26
Solidago sp.	10							1.43	13.16
Woodwardia virginica			10					1.43	13.16
Total	52	5	16	0	0	3	0	10.86	100.00
Bare Ground/Dead Veg./Litter	10			40					
Open Water		100	100	60	100	100	100		

Table B-13
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - December 13, 2002

TILLMAN RIDGE - WEST

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	2.38					2.38	2.64	61.98	0.20	33.33	47.66
Woodwardia virginica	OBL		1.00	0.46			1.46	1.62	38.02	0.40	66.67	52.34
Total		2.38	1.00	0.46	0.00	0.00	3.84	4.27	100.00	0.60	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	0.85					0.85	2.83	100.00	0.20	100.00	100.00
Total		0.85	0.00	0.00	0.00	0.00	0.85	2.83	100.00	0.20	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	0.10					0.10	0.33	100.00	0.20	100.00	100.00
Total		0.10	0.00	0.00	0.00	0.00	0.10	0.33	100.00	0.20	100.00	100.00

Table B-14
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - April 10, 2003

TILLMAN RIDGE - WEST

		Linear Distance (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginucus	FAC	0.08					0.08	0.09	0.62	0.20	14.29	7.45
Eupatorium capillifolium	FAC	3.35	3.76	0.11	0.17		7.39	8.21	57.15	0.80	57.14	57.15
Lachnanthes caroliniana	FAC	4.57					4.57	5.08	35.34	0.20	14.29	24.81
Woodwardia areolata	OBL		0.89				0.89	0.99	6.88	0.20	14.29	10.58
Total		8.00	4.65	0.11	0.17	0.00	12.93	14.37	100.00	1.40	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginucus	FAC	0.15					0.15	0.17	4.25	0.20	25.00	14.62
Eupatorium capillifolium	FAC	1.39	1.71				3.10	3.44	87.82	0.40	50.00	68.91
Lachnanthes caroliniana	FAC	0.28					0.28	0.31	7.93	0.20	25.00	16.47
Total		1.82	1.71	0.00	0.00	0.00	3.53	3.92	100.00	0.80	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	1.09	0.57				1.66	1.84	85.57	0.40	66.67	76.12
Lachnanthes caroliniana	FAC	0.28					0.28	0.31	14.43	0.20	33.33	23.88
Total		1.37	0.57	0.00	0.00	0.00	1.94	2.16	100.00	0.60	100.00	100.00

Table B-15
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	Notes
Tillman	1	1	401	Nyssa sylvatica	16.27	17.10	17.30	
Tillman	1	1	402	Nyssa sylvatica	24.10	25.10	25.80	
Tillman	1	1	403	Gordonia lasianthus	10.90	11.90	11.70	Dead, tag pulled
Tillman	1	1	404	Nyssa sylvatica	21.95	22.80	23.60	
Tillman	1	1	405	Nyssa sylvatica	21.55	21.70	22.20	
Tillman	1	1	406	Nyssa sylvatica	19.65	20.00	20.50	
Tillman	1	1	407	Pinus elliottii	46.25	47.90	50.00	
Tillman	1	1	408	Gordonia lasianthus	19.67	20.70	21.60	
Tillman	1	1	409	Nyssa sylvatica	18.00		18.30	
Tillman	1	1	619	Nyssa sylvatica	21.35	24.00		
Tillman	1	2	300	Gordonia lasianthus				
Tillman	1	2	410	Pinus elliottii	22.70	23.30	26.00	
Tillman	1	2	411	Gordonia lasianthus	11.65	12.80	24.10	
Tillman	1	2	412	Nyssa sylvatica	35.32	35.80	12.20	
Tillman	1	2	413	Nyssa sylvatica	22.60	22.70	36.80	
Tillman	1	2	414	Nyssa sylvatica	25.20	25.90	22.90	
Tillman	1	2	415	Persea palustris	2.80	3.40	4.20	
Tillman	1	2	416	Nyssa sylvatica	14.97	15.00		
Tillman	1	2	417	Nyssa sylvatica	14.55	14.80	14.30	
Tillman	1	2	418	Persea palustris	3.00	4.50	3.90	
Tillman	1	2	419	Persea palustris	4.05	4.80	5.10	
Tillman	1	2	420	Nyssa sylvatica	40.80	42.10	42.20	
Tillman	1	2	421	Nyssa sylvatica	23.05	23.40	23.60	
Tillman	1	2	422	Taxodium distichum	36.17	36.30	36.70	
Tillman	1	2	423	Nyssa sylvatica	33.30	33.70	34.70	
Tillman	1	2	424	Nyssa sylvatica	18.05	17.70	18.10	
Tillman	1	2	425	Nyssa sylvatica	27.40	27.40	28.60	
Tillman	1	2	426	Nyssa sylvatica	28.70	28.70	28.80	
Tillman	1	2	427	Nyssa sylvatica	18.20	18.50	18.20	
Tillman	1	2	428	Nyssa sylvatica	13.15	12.80	13.10	
Tillman	1	2	617	Nyssa sylvatica	32.25	34.70	34.80	
Tillman	1	2	618	Nyssa sylvatica	20.20	20.20	20.80	
Tillman	1	3	429	Nyssa sylvatica	30.05	30.10	31.00	
Tillman	1	3	430	Nyssa sylvatica	16.00	16.00	15.90	
Tillman	1	3	431	Nyssa sylvatica	14.70	14.60	14.60	
Tillman	1	3	432	Nyssa sylvatica	30.45	30.50	31.50	
Tillman	1	3	433	Nyssa sylvatica	28.60	28.70	29.50	
Tillman	1	3	434	Nyssa sylvatica	20.90	21.20	21.00	
Tillman	1	3	435	Nyssa sylvatica	21.35	21.60	21.50	
Tillman	1	3	436	Nyssa sylvatica	19.00	19.00	18.90	
Tillman	1	3	437	Nyssa sylvatica	18.70	18.50	19.10	
Tillman	1	3	438	Nyssa sylvatica	17.35	17.40	17.60	
Tillman	1	3	439	Nyssa sylvatica	15.70	15.60	15.90	
Tillman	1	3	440	Nyssa sylvatica	20.00	19.80	20.00	
Tillman	1	3	441	Nyssa sylvatica	22.90	22.90	23.40	
Tillman	1	3	442	Nyssa sylvatica	18.00	18.00	18.10	
Tillman	1	3	443	Nyssa sylvatica	21.50	21.40	21.40	
Tillman	1	3	444	Nyssa sylvatica	11.10	11.40	11.40	
Tillman	1	3	445	Nyssa sylvatica	16.52	16.30	16.60	
Tillman	1	3	446	Nyssa sylvatica	15.80			dead
Tillman	1	3	447	Nyssa sylvatica	15.75	15.60	15.80	
Tillman	1	3	448	Nyssa sylvatica	19.35	19.50	19.80	
Tillman	1	3	449	Nyssa sylvatica				
Tillman	1	3	450	Gordonia lasianthus	19.80	20.50	21.00	
Tillman	1	3	611	Nyssa sylvatica	17.50	17.40	17.50	
Tillman	1	3	612	Nyssa sylvatica	10.90	11.00		
Tillman	1	3	613	Nyssa sylvatica	32.10	34.00	34.20	

Table B-15
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	Notes
Tillman	1	3	614	Nyssa sylvatica	29.80	30.80	31.50	
Tillman	1	3	615	Nyssa sylvatica	19.40	19.50	19.80	
Tillman	1	3	616	Nyssa sylvatica	12.55	12.80	13.00	
Tillman	1	4	449	Nyssa sylvatica	24.15	24.10		
Tillman	1	4	451	Gordonia lasianthus	11.80	12.40	12.90	
Tillman	1	4	452	Nyssa sylvatica	14.40	14.30		
Tillman	1	4	453	Nyssa sylvatica	16.45	16.40	16.60	
Tillman	1	4	454	Gordonia lasianthus	12.75	13.30	14.00	
Tillman	1	4	455	Nyssa sylvatica	15.30	15.30	15.30	
Tillman	1	4	456	Nyssa sylvatica	24.10	24.20	24.50	
Tillman	1	4	457	Nyssa sylvatica	30.20	29.80	30.40	
Tillman	1	4	458	Nyssa sylvatica	13.55	13.40	13.90	
Tillman	1	4	459	Gordonia lasianthus	15.00	15.00	15.20	Top broken
Tillman	1	4	460	Gordonia lasianthus	9.30	9.80	10.60	
Tillman	1	4	461	Nyssa sylvatica	41.07	41.20	42.20	
Tillman	1	4	462	Gordonia lasianthus	27.20	27.10	27.80	
Tillman	1	4	463	Nyssa sylvatica	46.45	45.50	47.10	
Tillman	1	4	464	Nyssa sylvatica	26.27	26.00	26.40	
Tillman	1	4	465	Nyssa sylvatica	25.25	25.80	25.60	
Tillman	1	4	466	Nyssa sylvatica	16.30	16.20	16.30	
Tillman	1	4	467	Nyssa sylvatica	33.00	33.30	33.90	
Tillman	1	4	468	Nyssa sylvatica	34.15	34.30	35.10	
Tillman	1	4	469	Gordonia lasianthus	6.30	6.80	6.60	Tree on side (486)
Tillman	1	4	486	Gordonia lasianthus	3.90	4.10	4.20	Tree on side (486)
Tillman	1	4	797	Persea palustris				
Tillman	1	4	608	Nyssa sylvatica	24.25	24.80	24.50	
Tillman	1	4	609	Gordonia lasianthus	11.55	11.40		same as 610, on side
Tillman	1	4	610	Gordonia lasianthus	3.35	3.60	3.80	same as 609
Tillman	1	5	298	Gordonia lasianthus				
Tillman	1	5	299	Persea palustris				
Tillman	1	5	470	Nyssa sylvatica	30.80	30.90	31.50	
Tillman	1	5	471	Nyssa sylvatica	24.50	24.90	24.60	
Tillman	1	5	472	Nyssa sylvatica	25.95	26.10	27.20	
Tillman	1	5	473	Gordonia lasianthus	5.05	5.40	5.50	Tree on side (486)
Tillman	1	5	474	Gordonia lasianthus	9.00	9.00	9.60	
Tillman	1	5	475	Gordonia lasianthus	35.45	35.20	35.80	
Tillman	1	5	476	Nyssa sylvatica	14.10	14.30	14.40	same as 477
Tillman	1	5	477	Nyssa sylvatica	32.35	32.60	33.00	same as 476
Tillman	1	5	478	Nyssa sylvatica	20.00	19.80	20.20	
Tillman	1	5	479	Nyssa sylvatica	17.90	17.80	18.10	
Tillman	1	5	480	Nyssa sylvatica	26.70	27.00	26.90	
Tillman	1	5	481	Nyssa sylvatica	24.20	24.00	23.90	
Tillman	1	5	482	Persea palustris	4.65	4.70	5.30	
Tillman	1	5	483	Nyssa sylvatica	25.55	26.10	26.10	
Tillman	1	5	484	Nyssa sylvatica	36.00	36.20	36.60	
Tillman	1	5	485	Taxodium distichum	22.85	23.00	23.40	
Tillman	1	5	487	Gordonia lasianthus	4.00	4.10	4.40	Tree on side (486)
Tillman	1	5	601	Nyssa sylvatica	15.25	15.20	15.20	
Tillman	1	5	602	Nyssa sylvatica	10.75			same as 603,dead
Tillman	1	5	603	Nyssa sylvatica	12.50			same as 602,dead
Tillman	1	5	604	Nyssa sylvatica	36.85	36.20	37.60	same as 416, 477
Tillman	1	5	605	Gordonia lasianthus	8.95	9.40	10.50	
Tillman	1	5	606	Gordonia lasianthus	3.80	4.70	5.80	same as 607
Tillman	1	5	607	Gordonia lasianthus	17.50	17.50	18.30	same as 606, on side
Tillman	1	5	715	Gordonia lasianthus				same as 606, 607
Tillman	1	5	797	Persea palustris				

Table B-16
Canopy and Subcanopy Importance Values for the Tillman Ridge Wellfield Wetland - December 13, 2002

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	12	4.22	8.83	133.33	13.79	1.00	33.33	18.65
Nyssa sylvatica	70	38.49	80.60	777.78	80.46	1.00	33.33	64.80
Persea palustris	1	0.62	1.30	11.11	1.15	0.20	6.67	3.04
Pinus elliottii	2	2.77	5.80	22.22	2.30	0.40	13.33	7.15
Taxodium distichum	2	1.65	3.46	22.22	2.30	0.40	13.33	6.36
Total	87	47.75	100.00	966.67	100.00	3.00	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	7	0.22	74.28	77.78	63.64	0.40	40.00	59.30
Nyssa sylvatica	1	0.02	5.22	11.11	9.09	0.20	20.00	11.44
Persea palustris	3	0.06	20.51	33.33	27.27	0.40	40.00	29.26
Total	11	0.29	100.00	122.22	100.00	1.00	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Hydration Year 3 - Detailed Vegetation Data

TABLE B-17
Summary Of Herbaceous 1-Meter Squares from Tillman Ridge - October 6, 2003

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Andropogon virginicus	10							1.43	10.20
Eupatorium capillifolium	80							11.43	81.63
Lacnanthes caroliniana		1						0.14	1.02
Mosses					1	1	1	0.43	3.06
Osmunda cinnamomea				2				0.29	2.04
Solidago sp.	2							0.29	2.04
Tree Seedling		1						0.14	1.02
Vitis rotundifolia	90							12.86	91.84
Total	92	1	0	2	1	1	1	14.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Eupatorium capillifolium	10							1.43	6.62
Lacnanthes caroliniana	5							0.71	3.31
Mosses			2			2		0.57	2.65
Panicum sp.	5							0.71	3.31
Polygonum punctatum	5							0.71	3.31
Solidago sp.	2							0.29	1.32
Vitis rotundifolia	40							5.71	26.49
Woodwardia virginica	80							11.43	52.98
Total	147	0	2	0	0	2	0	21.57	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Eupatorium capillifolium	1							0.14	0.86
Lacnanthes caroliniana	5							0.71	4.31
Mosses					1			0.14	0.86
Panicum sp.	10							1.43	8.62
Polygonum punctatum	60							8.57	51.72
Woodwardia areolata	20						20	5.71	34.48
Total	95	0	0	0	1	0	20	16.57	100.00

TABLE B-18
Summary Of Herbaceous 1-Meter Squares from Tillman Ridge - March 26, 2004

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Erechtites hieracifolia		2		1	1		1	0.71	12.82
Eupatorium capillifolium	14			1				2.14	38.46
Lacnanthes caroliniana		1						0.14	2.56
Nyssa sylvatica seedling				1	1	1		0.43	7.69
Phytolacca americana	1						1	0.29	5.13
Pinus elliottii		1		1	1	1	1	0.71	12.82
Rubus sp.	3							0.43	7.69
Solidago sp.	2							0.29	5.13
Vitis rotundifolia	2							0.29	5.13
Woodwardia virginica				1				0.14	2.56
Total	22	4	0	5	3	2	3	5.57	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Erechtites hieracifolia						2	3	0.71	11.36
Eupatorium capillifolium					2	1	8	1.57	25.00
Lacnanthes caroliniana							1	0.14	2.27
Lyonia lucida					1			0.14	2.27
Nyssa sylvatica seedling		1	2	2	1			0.86	13.64
Panicum sp.							5	0.71	11.36
Phytolacca americana	1		1	1			1	0.57	9.09
Pinus elliottii		1			1			0.29	4.55
Polygonum punctatum							1	0.14	2.27
Solidago sp.							1	0.14	2.27
Vitis rotundifolia							2	0.29	4.55
Woodwardia virginica							5	0.71	11.36
Total	1	2	3	3	5	3	27	6.29	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Erechtites hieracifolia	2		1	1	1			0.71	10.20
Eupatorium capillifolium	18							2.57	36.73
Lacnanthes caroliniana	1							0.14	2.04
Nyssa sylvatica seedling	1		1	2				0.57	8.16
Panicum sp.	8							1.14	16.33
Phytolacca americana	1					1		0.29	4.08
Pinus elliottii			1		1			0.29	4.08
Polygonum punctatum				1				0.14	2.04
Solidago sp.	2							0.29	4.08
Woodwardia virginica	6						5	1.57	22.45
Total	37	0	2	3	1	1	5	7.00	100.00

Table B-19
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - October 6, 2003

TILLMAN RIDGE - WEST

Species	Indicator	Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	12.39					12.39	13.77	68.34	0.20	20.00	44.17
Lacnanthes caroliniana	FAC	3.78	0.13				3.91	4.34	21.57	0.40	40.00	30.78
Woodwardia areolata	OBL		0.95	0.88			1.83	2.03	10.09	0.40	40.00	25.05
Total		16.17	1.08	0.88	0.00	0.00	18.13	20.14	100.00	1.00	100.00	100.00

TILLMAN RIDGE - CENTER

Species	Indicator	Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	3.72					3.72	4.13	34.54	0.20	50.00	42.27
Lacnanthes caroliniana	FAC	7.05					7.05	7.83	65.46	0.20	50.00	57.73
Total		10.77	0.00	0.00	0.00	0.00	10.77	11.97	100.00	0.40	100.00	100.00

TILLMAN RIDGE - CENTER

Species	Indicator	Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	1.23					1.23	1.37	30.30	0.20	50.00	40.15
Lacnanthes caroliniana	FAC	2.83					2.83	3.14	69.70	0.20	50.00	59.85
Total		4.06	0.00	0.00	0.00	0.00	4.06	4.51	100.00	0.40	100.00	100.00

Table B-20
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - March 26, 2004

TILLMAN RIDGE - WEST

Species	Indicator	Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	13.63	0.30	0.77	0.12	0.02	14.84	16.49	84.09	1.00	71.43	77.76
Lacnanthes caroliniana	FAC	2.60					2.60	2.89	14.72	0.20	14.29	14.50
Woodwardia areolata	OBL		0.21				0.21	0.23	1.19	0.20	14.29	7.74
Total		16.23	0.51	0.77	0.12	0.02	17.65	19.61	100.00	1.40	100.00	100.00

TILLMAN RIDGE - CENTER

Species	Indicator	Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	5.86	1.14	0.15	0.13	0.01	7.29	8.10	57.73	1.00	83.33	70.53
Lacnanthes caroliniana	FAC	5.34					5.34	5.93	42.27	0.20	16.67	29.47
Total		11.20	1.14	0.15	0.13	0.01	12.63	14.03	100.00	1.20	100.00	100.00

TILLMAN RIDGE - CENTER

Species	Indicator	Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
		A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	6.10	0.61	0.20	0.15		7.06	7.84	100.00	0.80	100.00	100.00
Total		6.10	0.61	0.20	0.15	0.00	7.06	7.84	100.00	0.80	100.00	100.00

Table B-21
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	10/26/2003	Notes
Tillman	1	1	401	Nyssa sylvatica	16.27	17.10	17.30	17.85	
Tillman	1	1	402	Nyssa sylvatica	24.10	25.10	25.80	27.20	
Tillman	1	1	403	Gordonia lasianthus	10.90	11.90	11.70		Dead, tag pulled
Tillman	1	1	404	Nyssa sylvatica	21.95	22.80	23.60	24.60	
Tillman	1	1	405	Nyssa sylvatica	21.55	21.70	22.20	22.85	
Tillman	1	1	406	Nyssa sylvatica	19.65	20.00	20.50	20.30	
Tillman	1	1	407	Pinus elliottii	46.25	47.90	50.00	51.20	
Tillman	1	1	408	Gordonia lasianthus	19.67	20.70	21.60	21.90	
Tillman	1	1	409	Nyssa sylvatica	18.00		18.30	18.95	
Tillman	1	1	619	Nyssa sylvatica	21.35	24.00		27.90	
Tillman	1	2	300	Gordonia lasianthus					
Tillman	1	2	410	Pinus elliottii	22.70	23.30	26.00	24.70	
Tillman	1	2	411	Gordonia lasianthus	11.65	12.80	24.10	24.70	
Tillman	1	2	412	Nyssa sylvatica	35.32	35.80	12.20	12.30	
Tillman	1	2	413	Nyssa sylvatica	22.60	22.70	36.80	37.45	
Tillman	1	2	414	Nyssa sylvatica	25.20	25.90	22.90	22.80	
Tillman	1	2	415	Persea palustris	2.80	3.40	4.20	4.30	
Tillman	1	2	416	Nyssa sylvatica	14.97	15.00			
Tillman	1	2	417	Nyssa sylvatica	14.55	14.80	14.30	14.65	
Tillman	1	2	418	Persea palustris	3.00	4.50	3.90	4.10	
Tillman	1	2	419	Persea palustris	4.05	4.80	5.10	5.25	
Tillman	1	2	420	Nyssa sylvatica	40.80	42.10	42.20	42.90	
Tillman	1	2	421	Nyssa sylvatica	23.05	23.40	23.60	23.70	
Tillman	1	2	422	Taxodium distichum	36.17	36.30	36.70	36.00	
Tillman	1	2	423	Nyssa sylvatica	33.30	33.70	34.70		
Tillman	1	2	424	Nyssa sylvatica	18.05	17.70	18.10		
Tillman	1	2	425	Nyssa sylvatica	27.40	27.40	28.60	28.60	
Tillman	1	2	426	Nyssa sylvatica	28.70	28.70	28.80	28.85	
Tillman	1	2	427	Nyssa sylvatica	18.20	18.50	18.20	18.15	
Tillman	1	2	428	Nyssa sylvatica	13.15	12.80	13.10	13.10	
Tillman	1	2	617	Nyssa sylvatica	32.25	34.70	34.80		
Tillman	1	2	618	Nyssa sylvatica	20.20	20.20	20.80		
Tillman	1	3	429	Nyssa sylvatica	30.05	30.10	31.00	31.75	
Tillman	1	3	430	Nyssa sylvatica	16.00	16.00	15.90	15.85	
Tillman	1	3	431	Nyssa sylvatica	14.70	14.60	14.60	14.45	
Tillman	1	3	432	Nyssa sylvatica	30.45	30.50	31.50	31.60	
Tillman	1	3	433	Nyssa sylvatica	28.60	28.70	29.50	29.90	
Tillman	1	3	434	Nyssa sylvatica	20.90	21.20	21.00	20.95	
Tillman	1	3	435	Nyssa sylvatica	21.35	21.60	21.50	21.60	
Tillman	1	3	436	Nyssa sylvatica	19.00	19.00	18.90	19.00	
Tillman	1	3	437	Nyssa sylvatica	18.70	18.50	19.10	18.75	
Tillman	1	3	438	Nyssa sylvatica	17.35	17.40	17.60	17.50	
Tillman	1	3	439	Nyssa sylvatica	15.70	15.60	15.90	15.65	
Tillman	1	3	440	Nyssa sylvatica	20.00	19.80	20.00	19.80	
Tillman	1	3	441	Nyssa sylvatica	22.90	22.90	23.40	23.35	
Tillman	1	3	442	Nyssa sylvatica	18.00	18.00	18.10	18.10	
Tillman	1	3	443	Nyssa sylvatica	21.50	21.40	21.40	21.45	
Tillman	1	3	444	Nyssa sylvatica	11.10	11.40	11.40	11.10	
Tillman	1	3	445	Nyssa sylvatica	16.52	16.30	16.60	16.40	
Tillman	1	3	446	Nyssa sylvatica	15.80				dead
Tillman	1	3	447	Nyssa sylvatica	15.75	15.60	15.80	15.80	
Tillman	1	3	448	Nyssa sylvatica	19.35	19.50	19.80	19.55	
Tillman	1	3	449	Nyssa sylvatica					
Tillman	1	3	450	Gordonia lasianthus	19.80	20.50	21.00	21.15	
Tillman	1	3	611	Nyssa sylvatica	17.50	17.40	17.50	17.50	
Tillman	1	3	612	Nyssa sylvatica	10.90	11.00			
Tillman	1	3	613	Nyssa sylvatica	32.10	34.00	34.20	35.00	

Table B-21
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	10/26/2003	Notes
Tillman	1	3	614	Nyssa sylvatica	29.80	30.80	31.50	32.00	
Tillman	1	3	615	Nyssa sylvatica	19.40	19.50	19.80	19.90	
Tillman	1	3	616	Nyssa sylvatica	12.55	12.80	13.00	12.90	
Tillman	1	4	449	Nyssa sylvatica	24.15	24.10		24.55	
Tillman	1	4	451	Gordonia lasianthus	11.80	12.40	12.90	13.15	
Tillman	1	4	452	Nyssa sylvatica	14.40	14.30			
Tillman	1	4	453	Nyssa sylvatica	16.45	16.40	16.60	16.60	
Tillman	1	4	454	Gordonia lasianthus	12.75	13.30	14.00	14.10	
Tillman	1	4	455	Nyssa sylvatica	15.30	15.30	15.30	15.20	
Tillman	1	4	456	Nyssa sylvatica	24.10	24.20	24.50	24.65	
Tillman	1	4	457	Nyssa sylvatica	30.20	29.80	30.40	30.55	
Tillman	1	4	458	Nyssa sylvatica	13.55	13.40	13.90		
Tillman	1	4	459	Gordonia lasianthus	15.00	15.00	15.20		Top broken
Tillman	1	4	460	Gordonia lasianthus	9.30	9.80	10.60	10.85	
Tillman	1	4	461	Nyssa sylvatica	41.07	41.20	42.20	41.60	
Tillman	1	4	462	Gordonia lasianthus	27.20	27.10	27.80	27.55	
Tillman	1	4	463	Nyssa sylvatica	46.45	45.50	47.10	46.50	
Tillman	1	4	464	Nyssa sylvatica	26.27	26.00	26.40	26.60	
Tillman	1	4	465	Nyssa sylvatica	25.25	25.80	25.60	25.65	
Tillman	1	4	466	Nyssa sylvatica	16.30	16.20	16.30	16.30	
Tillman	1	4	467	Nyssa sylvatica	33.00	33.30	33.90	34.35	
Tillman	1	4	468	Nyssa sylvatica	34.15	34.30	35.10	35.00	
Tillman	1	4	469	Gordonia lasianthus	6.30	6.80	6.60		Tree on side (486)
Tillman	1	4	486	Gordonia lasianthus	3.90	4.10	4.20		Tree on side (486)
Tillman	1	4	797	Persea palustris				4.40	
Tillman	1	4	608	Nyssa sylvatica	24.25	24.80	24.50	24.60	
Tillman	1	4	609	Gordonia lasianthus	11.55	11.40			same as 610, on side
Tillman	1	4	610	Gordonia lasianthus	3.35	3.60	3.80	3.60	same as 609
Tillman	1	5	298	Gordonia lasianthus					
Tillman	1	5	299	Persea palustris					
Tillman	1	5	470	Nyssa sylvatica	30.80	30.90	31.50	31.70	
Tillman	1	5	471	Nyssa sylvatica	24.50	24.90	24.60	24.50	
Tillman	1	5	472	Nyssa sylvatica	25.95	26.10	27.20	27.15	
Tillman	1	5	473	Gordonia lasianthus	5.05	5.40	5.50		Tree on side (486)
Tillman	1	5	474	Gordonia lasianthus	9.00	9.00	9.60	9.45	
Tillman	1	5	475	Gordonia lasianthus	35.45	35.20	35.80	36.45	
Tillman	1	5	476	Nyssa sylvatica	14.10	14.30	14.40	14.10	same as 477
Tillman	1	5	477	Nyssa sylvatica	32.35	32.60	33.00	33.20	same as 476
Tillman	1	5	478	Nyssa sylvatica	20.00	19.80	20.20	20.10	
Tillman	1	5	479	Nyssa sylvatica	17.90	17.80	18.10	18.20	
Tillman	1	5	480	Nyssa sylvatica	26.70	27.00	26.90	26.80	
Tillman	1	5	481	Nyssa sylvatica	24.20	24.00	23.90	23.95	
Tillman	1	5	482	Persea palustris	4.65	4.70	5.30	5.30	
Tillman	1	5	483	Nyssa sylvatica	25.55	26.10	26.10	26.60	
Tillman	1	5	484	Nyssa sylvatica	36.00	36.20	36.60	36.60	
Tillman	1	5	485	Taxodium distichum	22.85	23.00	23.40	23.70	
Tillman	1	5	487	Gordonia lasianthus	4.00	4.10	4.40		Tree on side (486)
Tillman	1	5	601	Nyssa sylvatica	15.25	15.20	15.20	15.30	
Tillman	1	5	602	Nyssa sylvatica	10.75				same as 603,dead
Tillman	1	5	603	Nyssa sylvatica	12.50				same as 602,dead
Tillman	1	5	604	Nyssa sylvatica	36.85	36.20	37.60	37.00	same as 416, 477
Tillman	1	5	605	Gordonia lasianthus	8.95	9.40	10.50	10.50	
Tillman	1	5	606	Gordonia lasianthus	3.80	4.70	5.80	5.95	same as 607
Tillman	1	5	607	Gordonia lasianthus	17.50	17.50	18.30	18.70	same as 606, on side
Tillman	1	5	715	Gordonia lasianthus				3.05	same as 606, 607
Tillman	1	5	797	Persea palustris					

Table B-22
Canopy and Subcanopy Importance Values for the Tillman Ridge Wellfield Wetland - October 26, 2003

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	10	3.99	8.38	111.11	11.90	1.00	33.33	17.87
Nyssa sylvatica	69	38.55	80.95	766.67	82.14	1.00	33.33	65.47
Persea palustris	1	0.64	1.35	11.11	1.19	0.20	6.67	3.07
Pinus elliottii	2	2.82	5.92	22.22	2.38	0.40	13.33	7.21
Taxodium distichum	2	1.62	3.40	22.22	2.38	0.40	13.33	6.37
Total	84	47.62	100.00	933.33	100.00	3.00	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	4	0.13	57.12	44.44	44.44	0.40	40.00	47.19
Nyssa sylvatica	1	0.02	7.19	11.11	11.11	0.20	20.00	12.77
Persea palustris	4	0.08	35.69	44.44	44.44	0.40	40.00	40.04
Total	9	0.22	100.00	100.00	100.00	1.00	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Hydration Year 4 - Detailed Vegetation Data

Table B-23
Summary Of Herbaceous 1-Meter Squares from Tillman Ridge - October 19, 2004

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Panicum sp	2							0.29	66.67
Woodwardia virginica	1							0.14	33.33
Total	3	0	0	0	0	0	0	0.43	100.00
Bare Ground/Dead Veg./Litter	97	100	100	100	100	100	100	99.57	

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Eupatorium capillifolium	1							0.14	16.67
Lyonia lucida			1					0.14	16.67
Panicum sp.	1							0.14	16.67
Vitis rotundifolia	1							0.14	16.67
Woodwardia virginica	2							0.29	33.33
Total	5	0	1	0	0	0	0	0.86	100.00
Bare Ground/Dead Veg./Litter	95	100	99	100	100	100	100	99.14	

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Rubus sp.	3							0.43	37.50
Vitis rotundifolia	5							0.71	62.50
Total	8	0	0	0	0	0	0	1.14	100.00
Bare Ground/Dead Veg./Litter	92	100	100	100	100	100	100	98.86	

TABLE B-24
Summary Of Herbaceous 1-Meter Squares from Tillman Ridge - April 26, 2005

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Rubus sp.	20							2.86	26.32
Vitis rotundifolia	70							10.00	92.11
Erechtites hieracifolia	2							0.29	2.63
Lacnanthes caroliniana		1						0.14	1.32
Eupatorium capillifolium		1						0.14	1.32
Taxodium ascendens		1						0.14	1.32
Woodwardia virginica				1				0.14	1.32
Total	72	3	0	1	0	0	0	10.86	100.00

Bare Ground/Dead Veg./Litter

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Erechtites hieracifolia			2					0.29	6.67
Woodwardia virginica	20							2.86	66.67
Panicum sp.	2							0.29	6.67
Vitis rotundifolia	3							0.43	10.00
Eupatorium capillifolium	1							0.14	3.33
Lacnanthes caroliniana	1							0.14	3.33
Polygonum punctatum	1							0.14	3.33
Total	28	0	2	0	0	0	0	4.29	100.00

Bare Ground/Dead Veg./Litter

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Woodwardia virginica	7						2	1.29	56.25
Eupatorium capillifolium	1							0.14	6.25
Panicum sp.	1							0.14	6.25
Pinus elliottii			1	1		1		0.43	18.75
Nyssa sylvatica seedling				1	1			0.29	12.50
Total	9	0	1	2	1	1	2	2.29	100.00

Table B-25
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - October 19, 2004

TILLMAN RIDGE - WEST

No Target Species Observed

TILLMAN RIDGE - CENTER

Species	Indicator	Linear Distnace (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Eupatorium capillifolium	FAC	0.91					0.91	1.01	100.00	0.20	100.00	100.00
Total		0.91	0.00	0.00	0.00	0.00	0.91	1.01	100.00	0.20	100.00	100.00

TILLMAN RIDGE - EAST

Species	Indicator	Linear Distnace (m) A	B	C	D	E	Total Linear Distance (m)	Cover Percent	Cover Relative	Frequency Absolute	Frequency Relative	Importance Value
Eupatorium capillifolium	FAC	0.20					0.20	0.22	100.00	0.20	100.00	100.00
Total		0.20	0.00	0.00	0.00	0.00	0.20	0.22	100.00	0.20	100.00	100.00

Table B-26
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - April 26, 2005

TILLMAN RIDGE - WEST

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	FAC					0.23	0.23	0.26	6.53	0.20	20.00	13.27
Eupatorium capillifolium	FAC	1.80	0.43		0.86		3.09	3.43	87.78	0.60	60.00	73.89
Woodwardia areolata	OBL		0.20				0.20	0.22	5.68	0.20	20.00	12.84
Total		1.80	0.63	0.00	0.86	0.23	3.52	3.91	100.00	1.00	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	2.48	0.14	0.51	0.10	0.99	4.22	4.69	70.33	1.00	83.33	76.83
Lacnanthes caroliniana	FAC	1.78					1.78	1.98	29.67	0.20	16.67	23.17
Total		4.26	0.14	0.51	0.10	0.99	6.00	6.67	100.00	1.20	100.00	100.00

TILLMAN RIDGE - EAST

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	0.45	0.28	0.39		0.32	1.44	1.60	90.57	0.80	80.00	85.28
Lachnanthes caroliniana	FAC	0.15					0.15	0.17	9.43	0.20	20.00	14.72
Total		0.60	0.28	0.39	0.00	0.32	1.44	1.77	100.00	1.00	100.00	100.00

Table B-27
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	10/26/2003	10/19/2004	Notes
Tillman	1	1	401	Nyssa sylvatica	16.27	17.10	17.30	17.85	18.10	
Tillman	1	1	402	Nyssa sylvatica	24.10	25.10	25.80	27.20	27.80	
Tillman	1	1	403	Gordonia lasianthus	10.90	11.90	11.70			Dead, tag pulled
Tillman	1	1	404	Nyssa sylvatica	21.95	22.80	23.60	24.60	25.00	
Tillman	1	1	405	Nyssa sylvatica	21.55	21.70	22.20	22.85	23.10	
Tillman	1	1	406	Nyssa sylvatica	19.65	20.00	20.50	20.30	21.10	
Tillman	1	1	407	Pinus elliottii	46.25	47.90	50.00	51.20	52.40	
Tillman	1	1	408	Gordonia lasianthus	19.67	20.70	21.60	21.90	21.90	
Tillman	1	1	409	Nyssa sylvatica	18.00		18.30	18.95	19.10	
Tillman	1	1	619	Nyssa sylvatica	21.35	24.00		27.90	28.50	
Tillman	1	2	300	Gordonia lasianthus					3.00	
Tillman	1	2	410	Pinus elliottii	22.70	23.30	26.00	24.70	24.90	
Tillman	1	2	411	Gordonia lasianthus	11.65	12.80	24.10	24.70		
Tillman	1	2	412	Nyssa sylvatica	35.32	35.80	12.20	12.30	37.50	
Tillman	1	2	413	Nyssa sylvatica	22.60	22.70	36.80	37.45		
Tillman	1	2	414	Nyssa sylvatica	25.20	25.90	22.90	22.80	27.40	
Tillman	1	2	415	Persea palustris	2.80	3.40	4.20	4.30	4.80	
Tillman	1	2	416	Nyssa sylvatica	14.97	15.00			14.70	
Tillman	1	2	417	Nyssa sylvatica	14.55	14.80	14.30	14.65	14.90	
Tillman	1	2	418	Persea palustris	3.00	4.50	3.90	4.10	4.30	
Tillman	1	2	419	Persea palustris	4.05	4.80	5.10	5.25	5.60	
Tillman	1	2	420	Nyssa sylvatica	40.80	42.10	42.20	42.90	43.10	
Tillman	1	2	421	Nyssa sylvatica	23.05	23.40	23.60	23.70	23.80	
Tillman	1	2	422	Taxodium distichum	36.17	36.30	36.70	36.00	36.10	
Tillman	1	2	423	Nyssa sylvatica	33.30	33.70	34.70		35.90	
Tillman	1	2	424	Nyssa sylvatica	18.05	17.70	18.10			
Tillman	1	2	425	Nyssa sylvatica	27.40	27.40	28.60	28.60	28.60	
Tillman	1	2	426	Nyssa sylvatica	28.70	28.70	28.80	28.85	28.70	
Tillman	1	2	427	Nyssa sylvatica	18.20	18.50	18.20	18.15	18.10	
Tillman	1	2	428	Nyssa sylvatica	13.15	12.80	13.10	13.10	12.90	
Tillman	1	2	617	Nyssa sylvatica	32.25	34.70	34.80		36.20	
Tillman	1	2	618	Nyssa sylvatica	20.20	20.20	20.80		20.70	
Tillman	1	3	429	Nyssa sylvatica	30.05	30.10	31.00	31.75	32.50	
Tillman	1	3	430	Nyssa sylvatica	16.00	16.00	15.90	15.85	15.90	
Tillman	1	3	431	Nyssa sylvatica	14.70	14.60	14.60	14.45		
Tillman	1	3	432	Nyssa sylvatica	30.45	30.50	31.50	31.60	32.10	
Tillman	1	3	433	Nyssa sylvatica	28.60	28.70	29.50	29.90	30.50	
Tillman	1	3	434	Nyssa sylvatica	20.90	21.20	21.00	20.95	21.10	
Tillman	1	3	435	Nyssa sylvatica	21.35	21.60	21.50	21.60	21.60	
Tillman	1	3	436	Nyssa sylvatica	19.00	19.00	18.90	19.00	18.80	
Tillman	1	3	437	Nyssa sylvatica	18.70	18.50	19.10	18.75	19.10	
Tillman	1	3	438	Nyssa sylvatica	17.35	17.40	17.60	17.50	17.40	
Tillman	1	3	439	Nyssa sylvatica	15.70	15.60	15.90	15.65	15.70	
Tillman	1	3	440	Nyssa sylvatica	20.00	19.80	20.00	19.80	19.80	
Tillman	1	3	441	Nyssa sylvatica	22.90	22.90	23.40	23.35	23.30	
Tillman	1	3	442	Nyssa sylvatica	18.00	18.00	18.10	18.10	18.00	
Tillman	1	3	443	Nyssa sylvatica	21.50	21.40	21.40	21.45	21.90	
Tillman	1	3	444	Nyssa sylvatica	11.10	11.40	11.40	11.10	11.10	
Tillman	1	3	445	Nyssa sylvatica	16.52	16.30	16.60	16.40	17.00	
Tillman	1	3	446	Nyssa sylvatica	15.80					dead
Tillman	1	3	447	Nyssa sylvatica	15.75	15.60	15.80	15.80	15.90	
Tillman	1	3	448	Nyssa sylvatica	19.35	19.50	19.80	19.55	19.90	
Tillman	1	3	449	Nyssa sylvatica					24.70	
Tillman	1	3	450	Gordonia lasianthus	19.80	20.50	21.00	21.15	21.20	
Tillman	1	3	611	Nyssa sylvatica	17.50	17.40	17.50	17.50	17.90	
Tillman	1	3	612	Nyssa sylvatica	10.90	11.00				
Tillman	1	3	613	Nyssa sylvatica	32.10	34.00	34.20	35.00		

Table B-27
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	10/26/2003	10/19/2004	Notes
Tillman	1	3	614	Nyssa sylvatica	29.80	30.80	31.50	32.00	32.60	
Tillman	1	3	615	Nyssa sylvatica	19.40	19.50	19.80	19.90	19.80	
Tillman	1	3	616	Nyssa sylvatica	12.55	12.80	13.00	12.90	12.90	
Tillman	1	4	449	Nyssa sylvatica	24.15	24.10		24.55		
Tillman	1	4	451	Gordonia lasianthus	11.80	12.40	12.90	13.15	13.20	
Tillman	1	4	452	Nyssa sylvatica	14.40	14.30				
Tillman	1	4	453	Nyssa sylvatica	16.45	16.40	16.60	16.60	16.50	
Tillman	1	4	454	Gordonia lasianthus	12.75	13.30	14.00	14.10		
Tillman	1	4	455	Nyssa sylvatica	15.30	15.30	15.30	15.20	15.20	
Tillman	1	4	456	Nyssa sylvatica	24.10	24.20	24.50	24.65	25.00	
Tillman	1	4	457	Nyssa sylvatica	30.20	29.80	30.40	30.55	30.90	
Tillman	1	4	458	Nyssa sylvatica	13.55	13.40	13.90			
Tillman	1	4	459	Gordonia lasianthus	15.00	15.00	15.20			Top broken
Tillman	1	4	460	Gordonia lasianthus	9.30	9.80	10.60	10.85	10.90	
Tillman	1	4	461	Nyssa sylvatica	41.07	41.20	42.20	41.60	42.50	
Tillman	1	4	462	Gordonia lasianthus	27.20	27.10	27.80	27.55		
Tillman	1	4	463	Nyssa sylvatica	46.45	45.50	47.10	46.50	46.70	
Tillman	1	4	464	Nyssa sylvatica	26.27	26.00	26.40	26.60	26.50	
Tillman	1	4	465	Nyssa sylvatica	25.25	25.80	25.60	25.65	25.70	
Tillman	1	4	466	Nyssa sylvatica	16.30	16.20	16.30	16.30	16.20	
Tillman	1	4	467	Nyssa sylvatica	33.00	33.30	33.90	34.35	35.40	
Tillman	1	4	468	Nyssa sylvatica	34.15	34.30	35.10	35.00	35.10	
Tillman	1	4	469	Gordonia lasianthus	6.30	6.80	6.60			Tree on side (486)
Tillman	1	4	486	Gordonia lasianthus	3.90	4.10	4.20			Tree on side (486)
Tillman	1	4	797	Persea palustris				4.40	4.90	
Tillman	1	4	608	Nyssa sylvatica	24.25	24.80	24.50	24.60	24.90	
Tillman	1	4	609	Gordonia lasianthus	11.55	11.40				same as 610, on side
Tillman	1	4	610	Gordonia lasianthus	3.35	3.60	3.80	3.60		same as 609
Tillman	1	5	298	Gordonia lasianthus					2.80	
Tillman	1	5	299	Persea palustris					2.80	
Tillman	1	5	470	Nyssa sylvatica	30.80	30.90	31.50	31.70	31.90	
Tillman	1	5	471	Nyssa sylvatica	24.50	24.90	24.60	24.50	24.70	
Tillman	1	5	472	Nyssa sylvatica	25.95	26.10	27.20	27.15	27.90	
Tillman	1	5	473	Gordonia lasianthus	5.05	5.40	5.50			Tree on side (486)
Tillman	1	5	474	Gordonia lasianthus	9.00	9.00	9.60	9.45	9.20	
Tillman	1	5	475	Gordonia lasianthus	35.45	35.20	35.80	36.45	35.90	
Tillman	1	5	476	Nyssa sylvatica	14.10	14.30	14.40	14.10	14.10	same as 477
Tillman	1	5	477	Nyssa sylvatica	32.35	32.60	33.00	33.20	33.40	same as 476
Tillman	1	5	478	Nyssa sylvatica	20.00	19.80	20.20	20.10	20.50	
Tillman	1	5	479	Nyssa sylvatica	17.90	17.80	18.10	18.20	18.20	
Tillman	1	5	480	Nyssa sylvatica	26.70	27.00	26.90	26.80	27.40	
Tillman	1	5	481	Nyssa sylvatica	24.20	24.00	23.90	23.95	24.00	
Tillman	1	5	482	Persea palustris	4.65	4.70	5.30	5.30	5.50	
Tillman	1	5	483	Nyssa sylvatica	25.55	26.10	26.10	26.60	26.90	
Tillman	1	5	484	Nyssa sylvatica	36.00	36.20	36.60	36.60	36.60	
Tillman	1	5	485	Taxodium distichum	22.85	23.00	23.40	23.70	23.80	
Tillman	1	5	487	Gordonia lasianthus	4.00	4.10	4.40			Tree on side (486)
Tillman	1	5	601	Nyssa sylvatica	15.25	15.20	15.20	15.30	15.60	
Tillman	1	5	602	Nyssa sylvatica	10.75					same as 603,dead
Tillman	1	5	603	Nyssa sylvatica	12.50					same as 602,dead
Tillman	1	5	604	Nyssa sylvatica	36.85	36.20	37.60	37.00	36.80	same as 416, 477
Tillman	1	5	605	Gordonia lasianthus	8.95	9.40	10.50	10.50	10.50	
Tillman	1	5	606	Gordonia lasianthus	3.80	4.70	5.80	5.95	5.90	same as 607
Tillman	1	5	607	Gordonia lasianthus	17.50	17.50	18.30	18.70		same as 606, on side
Tillman	1	5	715	Gordonia lasianthus				3.05	3.00	same as 606, 607
Tillman	1	5	797	Persea palustris						

Table B-28
Canopy and Subcanopy Importance Values for the Tillman Ridge Wellfield Wetland - October 19, 2004

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	7	2.73	5.91	77.78	8.97	0.80	30.77	15.22
Nyssa sylvatica	67	40.91	88.49	744.44	85.90	1.00	38.46	70.95
Pinus elliottii	2	0.96	2.08	22.22	2.56	0.40	15.38	6.67
Taxodium distichum	2	1.63	3.53	22.22	2.56	0.40	15.38	7.16
Total	78	46.23	100.00	866.67	100.00	2.60	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	5	0.13	51.84	55.56	45.45	0.40	50.00	49.10
Persea palustris	6	0.12	48.16	66.67	54.55	0.40	50.00	50.90
Total	11	0.24	100.00	122.22	100.00	0.80	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Hydration Year 5 - Detailed Vegetation Data

TABLE B-29
Summary Of Herbaceous 1-Meter Squares from Tillman Ridge - October 18, 2005

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Rubus sp.	100							14.29	95.24
Vitis rotundifolia	5							0.71	4.76
Total	105	0	0	0	0	0	0	15.00	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Vitis rotundifolia	3							0.43	30.00
Woodwardia virginica	5							0.71	50.00
Polygonum punctatum	1							0.14	10.00
Rhychospora sp.	1							0.14	10.00
Total	10	0	0	0	0	0	0	1.43	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Woodwardia virginica	10							1.43	71.43
Polygonum punctatum	4							0.57	28.57
Total	14	0	0	0	0	0	0	2.00	100.00

Continued

1-METER SQUARE PLOTS - COMBINED E, C, & W FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
Polygonum punctatum	1.67							0.24	3.88
Rhychospora sp.	0.33							0.05	0.78
Rubus sp.	33.33							4.76	77.52
Vitis rotundifolia	2.67							0.38	6.20
Woodwardia virginica	5.00							0.71	11.63
Total	43.00							6.14	100.00

Table B-30
Summary Of Herbaceous 1-Meter Squares from Tillman Ridge - March 30,2006

1-METER SQUARE PLOTS - WEST (W) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Rubus sp.	100							14.29	99.01
Polygonum punctatum		1						0.14	0.99
Total	100	1	0	0	0	0	0	14.43	100.00

1-METER SQUARE PLOTS - CENTER (C) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Woodward.	8							1.14	88.89
Polygonum	1							0.14	11.11
Total	9	0	0	0	0	0	0	1.29	100.00

1-METER SQUARE PLOTS - EAST (E) FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Percent**	**Relative**
Woodward.	8						1	1.29	64.29
Polygonum	1					1		0.29	14.29
moss	1				1	1		0.43	21.43
Total	10	0	0	0	1	2	1	2.00	100.00

Continued

1-METER SQUARE PLOTS - COMBINED E, C, & W FOR ALL HERBACEOUS SPECIES

	Percent Cover							Cover	
Species	1	2	3	4	5	6	7	Percent	Relative
moss	0.33				0.33	0.33		0.14	12.50
Polygonum	0.67	0.33				0.33		0.19	16.67
Woodward.	5.33						0.33	0.81	70.83
Total	6.33	0.33	0.00	0.00	0.33	0.67	0.33	1.14	100.00

Table B-31
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - October 18, 2005

TILLMAN RIDGE - WEST

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Andropogon virginicus	FAC	0.20					0.20	0.22	100.00	0.20	100.00	100.00
Total		0.20	0.00	0.00	0.00	0.00	0.20	0.22	100.00	0.20	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Woodwardia areolata	FAC					0.40	0.40	0.44	100.00	0.20	100.00	100.00
Total		0.00	0.00	0.00	0.00	0.40	0.40	0.44	100.00	0.20	100.00	100.00

TILLMAN RIDGE - EAST

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
NONE							0.00	0.00	0.00	0.00	0.00	0.00
Total		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table B-32
Summary of Herbaceous Ground Cover Belt Transects for the Tillman Ridge Wellfield Wetland - March 30, 2006

TILLMAN RIDGE - WEST

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	0.30				0.12	0.42	0.47	100.00	0.40	100.00	100.00
Total		0.30	0.00	0.00	0.00	0.12	0.42	0.47	100.00	0.40	100.00	100.00

TILLMAN RIDGE - CENTER

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Woodwardia areolata	FAC					0.10	0.10	0.11	100.00	0.20	100.00	100.00
Total		0.00	0.00	0.00	0.00	0.10	0.10	0.11	100.00	0.20	100.00	100.00

TILLMAN RIDGE - EAST

		Linear Distnace (m)					Total Linear	Cover		Frequency		Importance
Species	Indicator	A	B	C	D	E	Distance (m)	Percent	Relative	Absolute	Relative	Value
Eupatorium capillifolium	FAC	0.20					0.20	0.22	100.00	0.20	100.00	100.00
Total		0.20	0.00	0.00	0.00	0.00	0.20	0.22	100.00	0.20	100.00	100.00

Table B-33
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

				Tree			DBH (cm^2)				
Transect	Quad	SubQuad	Tree #	Species	10/9/2000	11/6/2001	12/13/2002	10/26/2003	10/19/2004	10/18/2005	Notes
Tillman	1	1	401	Nyssa sylvatica	16.27	17.10	17.30	17.85	18.10	19.00	
Tillman	1	1	402	Nyssa sylvatica	24.10	25.10	25.80	27.20	27.80	28.70	
Tillman	1	1	403	Gordonia lasianthus	10.90	11.90	11.70				Dead, tag pulled
Tillman	1	1	404	Nyssa sylvatica	21.95	22.80	23.60	24.60	25.00	26.40	
Tillman	1	1	405	Nyssa sylvatica	21.55	21.70	22.20	22.85	23.10	24.10	
Tillman	1	1	406	Nyssa sylvatica	19.65	20.00	20.50	20.30	21.10	21.60	
Tillman	1	1	407	Pinus elliottii	46.25	47.90	50.00	51.20	52.40	54.30	
Tillman	1	1	408	Gordonia lasianthus	19.67	20.70	21.60	21.90	21.90	22.00	
Tillman	1	1	409	Nyssa sylvatica	18.00		18.30	18.95	19.10	19.90	
Tillman	1	1	619	Nyssa sylvatica	21.35	24.00		27.90	28.50	29.90	
Tillman	1	2	300	Gordonia lasianthus					3.00		
Tillman	1	2	410	Pinus elliottii	22.70	23.30	26.00	24.70	24.90	24.70	
Tillman	1	2	411	Gordonia lasianthus	11.65	12.80	24.10	24.70			
Tillman	1	2	412	Nyssa sylvatica	35.32	35.80	12.20	12.30	37.50	40.20	
Tillman	1	2	413	Nyssa sylvatica	22.60	22.70	36.80	37.45		22.90	
Tillman	1	2	414	Nyssa sylvatica	25.20	25.90	22.90	22.80	27.40	28.20	
Tillman	1	2	415	Persea palustris	2.80	3.40	4.20	4.30	4.80	5.10	
Tillman	1	2	416	Nyssa sylvatica	14.97	15.00			14.70	14.90	
Tillman	1	2	417	Nyssa sylvatica	14.55	14.80	14.30	14.65	14.90	15.10	
Tillman	1	2	418	Persea palustris	3.00	4.50	3.90	4.10	4.30	4.20	
Tillman	1	2	419	Persea palustris	4.05	4.80	5.10	5.25	5.60	5.80	
Tillman	1	2	420	Nyssa sylvatica	40.80	42.10	42.20	42.90	43.10	44.00	
Tillman	1	2	421	Nyssa sylvatica	23.05	23.40	23.60	23.70	23.80	24.10	
Tillman	1	2	422	Taxodium distichum	36.17	36.30	36.70	36.00	36.10	36.10	
Tillman	1	2	423	Nyssa sylvatica	33.30	33.70	34.70		35.90	37.20	
Tillman	1	2	424	Nyssa sylvatica	18.05	17.70	18.10				
Tillman	1	2	425	Nyssa sylvatica	27.40	27.40	28.60	28.60	28.60	29.70	
Tillman	1	2	426	Nyssa sylvatica	28.70	28.70	28.80	28.85	28.70	28.70	
Tillman	1	2	427	Nyssa sylvatica	18.20	18.50	18.20	18.15	18.10	18.20	
Tillman	1	2	428	Nyssa sylvatica	13.15	12.80	13.10	13.10	12.90	13.10	
Tillman	1	2	617	Nyssa sylvatica	32.25	34.70	34.80		36.20	37.60	
Tillman	1	2	618	Nyssa sylvatica	20.20	20.20	20.80		20.70	21.40	
Tillman	1	3	429	Nyssa sylvatica	30.05	30.10	31.00	31.75	32.50	33.60	
Tillman	1	3	430	Nyssa sylvatica	16.00	16.00	15.90	15.85	15.90	15.90	
Tillman	1	3	431	Nyssa sylvatica	14.70	14.60	14.60	14.45			
Tillman	1	3	432	Nyssa sylvatica	30.45	30.50	31.50	31.60	32.10	33.80	
Tillman	1	3	433	Nyssa sylvatica	28.60	28.70	29.50	29.90	30.50	31.50	
Tillman	1	3	434	Nyssa sylvatica	20.90	21.20	21.00	20.95	21.10	21.10	
Tillman	1	3	435	Nyssa sylvatica	21.35	21.60	21.50	21.60	21.60	21.90	
Tillman	1	3	436	Nyssa sylvatica	19.00	19.00	18.90	19.00	18.80	19.00	
Tillman	1	3	437	Nyssa sylvatica	18.70	18.50	19.10	18.75	19.10	19.20	
Tillman	1	3	438	Nyssa sylvatica	17.35	17.40	17.60	17.50	17.40	18.50	
Tillman	1	3	439	Nyssa sylvatica	15.70	15.60	15.90	15.65	15.70	15.80	
Tillman	1	3	440	Nyssa sylvatica	20.00	19.80	20.00	19.80	19.80	20.00	
Tillman	1	3	441	Nyssa sylvatica	22.90	22.90	23.40	23.35	23.30	23.30	
Tillman	1	3	442	Nyssa sylvatica	18.00	18.00	18.10	18.10	18.00	18.10	
Tillman	1	3	443	Nyssa sylvatica	21.50	21.40	21.40	21.45	21.90	21.60	
Tillman	1	3	444	Nyssa sylvatica	11.10	11.40	11.40	11.10	11.10	11.10	
Tillman	1	3	445	Nyssa sylvatica	16.52	16.30	16.60	16.40	17.00	16.70	
Tillman	1	3	446	Nyssa sylvatica	15.80						dead
Tillman	1	3	447	Nyssa sylvatica	15.75	15.60	15.80	15.80	15.90	15.90	
Tillman	1	3	448	Nyssa sylvatica	19.35	19.50	19.80	19.55	19.90	19.70	
Tillman	1	3	449	Nyssa sylvatica					24.70	25.60	
Tillman	1	3	450	Gordonia lasianthus	19.80	20.50	21.00	21.15	21.20	21.30	
Tillman	1	3	611	Nyssa sylvatica	17.50	17.40	17.50	17.50	17.90	17.50	
Tillman	1	3	612	Nyssa sylvatica	10.90	11.00					
Tillman	1	3	613	Nyssa sylvatica	32.10	34.00	34.20	35.00		36.30	

Table B-33
Raw Tree Data (Canopy and Subcanopy) for Tillman Ridge Wellfield Wetland

Transect	Quad	SubQuad	Tree #	Tree Species	DBH (cm^2) 10/9/2000	11/6/2001	12/13/2002	10/26/2003	10/19/2004	10/18/2005	Notes
Tillman	1	3	614	Nyssa sylvatica	29.80	30.80	31.50	32.00	32.60	33.80	
Tillman	1	3	615	Nyssa sylvatica	19.40	19.50	19.80	19.90	19.80	19.90	
Tillman	1	3	616	Nyssa sylvatica	12.55	12.80	13.00	12.90	12.90	13.20	
Tillman	1	4	449	Nyssa sylvatica	24.15	24.10		24.55			
Tillman	1	4	451	Gordonia lasianthus	11.80	12.40	12.90	13.15	13.20	13.30	
Tillman	1	4	452	Nyssa sylvatica	14.40	14.30					
Tillman	1	4	453	Nyssa sylvatica	16.45	16.40	16.60	16.60	16.50	16.60	
Tillman	1	4	454	Gordonia lasianthus	12.75	13.30	14.00	14.10			
Tillman	1	4	455	Nyssa sylvatica	15.30	15.30	15.30	15.20	15.20	15.30	
Tillman	1	4	456	Nyssa sylvatica	24.10	24.20	24.50	24.65	25.00	25.30	
Tillman	1	4	457	Nyssa sylvatica	30.20	29.80	30.40	30.55	30.90	31.20	
Tillman	1	4	458	Nyssa sylvatica	13.55	13.40	13.90				
Tillman	1	4	459	Gordonia lasianthus	15.00	15.00	15.20				Top broken
Tillman	1	4	460	Gordonia lasianthus	9.30	9.80	10.60	10.85	10.90	10.80	
Tillman	1	4	461	Nyssa sylvatica	41.07	41.20	42.20	41.60	42.50	43.60	
Tillman	1	4	462	Gordonia lasianthus	27.20	27.10	27.80	27.55		27.70	
Tillman	1	4	463	Nyssa sylvatica	46.45	45.50	47.10	46.50	46.70	48.00	
Tillman	1	4	464	Nyssa sylvatica	26.27	26.00	26.40	26.60	26.50	26.80	
Tillman	1	4	465	Nyssa sylvatica	25.25	25.80	25.60	25.65	25.70	26.20	
Tillman	1	4	466	Nyssa sylvatica	16.30	16.20	16.30	16.30	16.20	16.30	
Tillman	1	4	467	Nyssa sylvatica	33.00	33.30	33.90	34.35	35.40	35.70	
Tillman	1	4	468	Nyssa sylvatica	34.15	34.30	35.10	35.00	35.10	35.50	
Tillman	1	4	469	Gordonia lasianthus	6.30	6.80	6.60				Tree on side (486)
Tillman	1	4	486	Gordonia lasianthus	3.90	4.10	4.20				Tree on side (486)
Tillman	1	4	797	Persea palustris				4.40	4.90		
Tillman	1	4	608	Nyssa sylvatica	24.25	24.80	24.50	24.60	24.90	25.40	
Tillman	1	4	609	Gordonia lasianthus	11.55	11.40					same as 610, on side
Tillman	1	4	610	Gordonia lasianthus	3.35	3.60	3.80	3.60			same as 609
Tillman	1	5	298	Gordonia lasianthus					2.80		
Tillman	1	5	299	Persea palustris					2.80	3.60	
Tillman	1	5	470	Nyssa sylvatica	30.80	30.90	31.50	31.70	31.90	32.70	
Tillman	1	5	471	Nyssa sylvatica	24.50	24.90	24.60	24.50	24.70	24.60	
Tillman	1	5	472	Nyssa sylvatica	25.95	26.10	27.20	27.15	27.90	28.30	
Tillman	1	5	473	Gordonia lasianthus	5.05	5.40	5.50				Tree on side (486)
Tillman	1	5	474	Gordonia lasianthus	9.00	9.00	9.60	9.45	9.20		
Tillman	1	5	475	Gordonia lasianthus	35.45	35.20	35.80	36.45	35.90	35.60	
Tillman	1	5	476	Nyssa sylvatica	14.10	14.30	14.40	14.10	14.10	14.30	same as 477
Tillman	1	5	477	Nyssa sylvatica	32.35	32.60	33.00	33.20	33.40	34.40	same as 476
Tillman	1	5	478	Nyssa sylvatica	20.00	19.80	20.20	20.10	20.50	21.30	
Tillman	1	5	479	Nyssa sylvatica	17.90	17.80	18.10	18.20	18.20	18.50	
Tillman	1	5	480	Nyssa sylvatica	26.70	27.00	26.90	26.80	27.40	27.30	
Tillman	1	5	481	Nyssa sylvatica	24.20	24.00	23.90	23.95	24.00	23.80	
Tillman	1	5	482	Persea palustris	4.65	4.70	5.30	5.30	5.50	5.80	
Tillman	1	5	483	Nyssa sylvatica	25.55	26.10	26.10	26.60	26.90	27.70	
Tillman	1	5	484	Nyssa sylvatica	36.00	36.20	36.60	36.60	36.60	37.60	
Tillman	1	5	485	Taxodium distichum	22.85	23.00	23.40	23.70	23.80	24.30	
Tillman	1	5	487	Gordonia lasianthus	4.00	4.10	4.40				Tree on side (486)
Tillman	1	5	601	Nyssa sylvatica	15.25	15.20	15.20	15.30	15.60	15.20	
Tillman	1	5	602	Nyssa sylvatica	10.75						same as 603,dead
Tillman	1	5	603	Nyssa sylvatica	12.50						same as 602,dead
Tillman	1	5	604	Nyssa sylvatica	36.85	36.20	37.60	37.00	36.80	37.50	same as 416, 477
Tillman	1	5	605	Gordonia lasianthus	8.95	9.40	10.50	10.50	10.50	10.90	
Tillman	1	5	606	Gordonia lasianthus	3.80	4.70	5.80	5.95	5.90		same as 607
Tillman	1	5	607	Gordonia lasianthus	17.50	17.50	18.30	18.70			same as 606, on side
Tillman	1	5	715	Gordonia lasianthus				3.05	3.00		same as 606, 607
Tillman	1	5	797	Persea palustris						5.10	

Table B-34
Canopy and Subcanopy Importance Values for the Tillman Ridge Wellfiled Wetland - October 18, 2005

Canopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Gordonia lasianthus	7	2.95	5.84	77.78	8.64	0.80	30.77	15.08
Nyssa sylvatica	70	42.84	84.74	777.78	86.42	1.00	38.46	69.88
Pinus elliottii	2	3.11	6.14	22.22	2.47	0.40	15.38	8.00
Taxodium distichum	2	1.65	3.27	22.22	2.47	0.40	15.38	7.04
Total	81	50.55	100.00	900.00	100.00	2.60	100.00	100.00

Subcanopy Species

Species	No.	Dominance (m^2/ha)	Relative Dominance	Density (#/ha)	Relative Denstiy	Frequency (***)	Relative Frequency	Importance Value
Persea palustris	6	130.00	100.00	66.67	100.00	0.40	100.00	100.00
Total	6	130.00	100.00	66.67	100.00	0.40	100.00	100.00

Note: Frequency given as # of subquadrants in which the species occurs divided by the total number of subquadrants (5)

Appendix C
Water Delivery System

Tillman Ridge Well Field Wetland Hydration

TO: Rosanne Prager

COPIES: Ron Wycoff

FROM: Mandy Parks

DATE: February 27, 2001

This memo summarizes the supply system design for the wetland hydration of the St. John's River Water Management District Demonstration Project #1 at the Tillman Ridge well field.

Supply

The existing well (#4) previously produced 70 to 90 gallons per minute before its use was discontinued and the pump removed. This range will be the assumed available discharge from the well. A Goulds' (Model 70 LG 30412) stainless steel submersible pump meets site criteria, although a similar pump may be used. Pump specifications will be supplied by the vendor. The bottom of the submersible pump will be placed at the same elevation as the bottom of the well casing to ensure the motor is adequately cooled. Currently, this is ascertained to be 70 ft below ground surface.

An application period of 3 to 4 days per week will be needed to apply 3 inches of ground water over the 5-acre wetland. A flow meter will indicate and/or record flow depending on the model chosen. The existing pump house may be used to house the flow meter, air release valve, and pressure gauge. Three-phase (460 volts) electric power is assumed to be in place from the previous pump installation.

Piping

Piping from the submersed pump, to the surface, and out of the pump house will be 2 inch diameter Schedule 40 steel with a transition to 3 inch diameter pipe. The pipeline will be placed according to the schematic within the pump house and will exit the pump house through a boring in the wall. No information is available on the previous pipe system and care should be taken when installing this supply system.

The pipeline from the pump house to the wetland will be placed along natural grade and will be exposed to the elements. For this reason, Chlorinated Poly Vinyl Chloride (CPVC) is recommended. Heavy machinery and vehicles should be discouraged in the surrounding area. The pipe should be protected from freezing conditions with insulation or heat tracing, or water should be allowed to run during this period. The planned route from the pump house to the wetland was the shortest possible, but may require extensive clearing and grubbing.

A 3 inch diameter pipe is recommended to ensure non-scouring velocities between 3 and 4 feet per second depending on well production.

The pipeline will terminate before the wetland boundary to allow for the placement of energy dissipating rock riprap up to the wetland boundary. No alterations will take place within the wetland boundary. Land grading cannot be determined from available topographic information and, if necessary, will be performed during installation.

Materials

The following is an estimate of the materials needed for construction. Actual materials may vary according to the options chosen.

Material	Quantity	Unit
3" CPVC Pipe	70	l.f.
3" CPVC 45 degree elbow	2	each
2" PVC to 2” Sch 40 steel transition	1	each
3" Sch. 40 steel pipe	5	l.f.
2”-3" CPVC reducer	1	each
2" Sch. 40 steel 90 degree elbow	1	each
Flow Meter	1	each
2” Sch. 40 steel pipe	100	l.f.
Air Release Valve	1	each
Pressure Gauge	1	each
Goulds Model 70LG30412	1	each
Rock Riprap	20	s.f.


BAR
100 x kPa
psi

Appendix D
Water Quality Laboratory Data

Columbia Analytical Services INC.
An Employee-Owned Company

REVISED 12/24/02

December 23, 2002

Service Request No. J2102918

Bill Dunn
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Project No.: 147556.IA.TR
Project Name: Tillman Ridge

Dear Bill Dunn:

Enclosed is the amended report for our service request J2102918. The result for Total Phosphorus in sample Wet-1 has been corrected.

We appologize for any inconvenience this may have created. Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Joe Wiegel
Project Manager

CAS Jacksonville is NELAC-accredited by the State of Florida (E82502). Other state accreditations include: LA, AI 30759; MA, M-FL937; NH, 2942; NC, 527; SC, 96021; WA, C278.

8540 Baycenter Rd. ▪ Jacksonville, FL 32256 ▪ (904) 739-2277 ▪ Fax (904) 739-2011

REVISED 12/24/02

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2102918
Project:	Tillman Ridge/147556.IA.TR	**Date Collected:**	9/18/2001
Sample Matrix:	Water	**Date Received:**	9/19/2001
		Date Extracted:	NA

Inorganic Parameters

				Sample Name:	**Wet-1**	**Method Blank**
				Lab Code:	J2102918-001	J210919-MB
Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**		
Ammonia as N	mg/L (ppm)	350.3	0.1	10/1/01 1230	U	U
Color	Color Units	110.2	5	9/20/01 1115	800	U
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	9/19/01	U	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	9/20/01 1154	0.84	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	9/21/01 1515	1.3	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	9/21/01 0900	5	U
TKN	mg/L (ppm)	351.4	0.5	9/24/01 1100	1.8	U

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Tillman Ridge/147556.IA.TR
Sample Matrix: Water

Service Request: J2102918
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 9/29-10/1/01

Duplicate Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	Units	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Ammonia as N	mg/L (ppm)	350.3	0.1	U	U	U	<1
Color	Color Units	110.2	5	800	800	800	<1
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	U	U	U	<1
Orthophosphate as P	mg/L (ppm)	365.3	0.01	0.841	1.00	0.920	17.28
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	0.468	0.472	0.47	0.85
Solids, Total Suspended	mg/L (ppm)	160.2	5	U	U	U	<1
TKN	mg/L (ppm)	351.4	0.5	U	U	U	<1

U Not detected at or above the MRL.

Approved By: Paul Hunsaulis Date: 10/15/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2102918
Project:	Tillman Ridge/147556.IA.TR	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	9/29-10/1/01

Matrix Spike Summary
Inorganic Parameters

Sample Name: Batch QC
Lab Code: Batch QC

Analyte	Units	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Ammonia as N	mg/L (ppm)	350.3	0.1	20	U	18.2	91.0	75-125
TKN	mg/L (ppm)	351.4	0.5	10	U	11.1	111.0	75-125

U Not detected at or above the MRL.

Approved By: Paul Gunsaulis Date: 10/15/01

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Tillman Ridge/147556.IA.TR
Sample Matrix: Water

Service Request: J2102918
Date Collected: NA
Date Received: NA
Date Analyzed: 9/29-10/1/01

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	Units	EPA Method	TRUE Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Ammonia as N	mg/L (ppm)	350.3	10	10.2	102.0	75-125
Color	Color Units	110.2	25	25	100.0	75-125
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.466	93.2	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	0.5	0.506	101.2	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	90	112.5	75-125
TKN	mg/L (ppm)	351.4	10	11.7	117.0	75-125

Approved By: Paul Gursaulis Date: 10/15/01

Cooler Receipt and Preservation Form

Project/Client: Tillman Ridge/CH2M Hill **SR Number:** J2102918

Cooler received on 9/19/01 by: JH

Courier: CAS ☒ UPS ☐ FEDEX ☐
CLIENT ☐ CD&L ☐ OTHER ☐

	Yes	No	N/A
1. Were custody seals on the outside of the cooler?	☐	☒	☐
2. Were custody seals intact?	☐	☐	☒
3. Were custody papers properly filled out(ink, singed, ect.)?	☒	☐	☐
4. Did all bottles arrive in good condition(unbroken)?	☒	☐	☐
5. Did any VOA vials contain significant air bubbles?	☐	☐	☒
6. Were ice or ice packs present?	☒	☐	☐
7. Did all samples arrive within appropriate holding times?	☒	☐	☐

8. Where did the bottles originate? CAS/JAX ☒ CLIENT ☐

9. Temperature of cooler(s) upon receipt/within 0-6C?:

	Temp.	Yes	No	N/A		Temp.	Yes	No	N/A
Cooler 1:	2.5°C	☒	☐	☐	Cooler 3:		☐	☐	☐
Cooler 2:		☐	☐	☐	Cooler 4:		☐	☐	☐

Date/Time Temperature Taken: 9/19/01 12:02 **If No/NA, Explain**

Thermometer ID: 2618380101-0015 ☒ Temp Blank: ☐ Cooler Temp.: ☒
15-078-J-4 ☐ Sample Bottle: ☐ IR. Gun: ☒

If out of temperature, client approval to run samples

Cooler Breakdown: Date: 9/19/01 By: JH

	Yes	No	N/A
1. Were all the bottle labels complete(i.e. analysis, preservation, ect.)	☒	☐	☐
2. Did all bottle labels and tags agree with custody papers?	☒	☐	☐
3. Were correct containers used for the test indicated?	☒	☐	☐

4. Air samples: Cassettes/Tubes Intact: ☐ Tedlar Bags Inflated: ☐
Canisters Pressurized: ☐ NA: ☒

Explain any discrepancies

		Yes	No	Sample ID	Reagent	Volume Added
pH	Reagent					
>12	NaOH					
>9	NaOH+ZnAc					
<2	HNO3					
<2	H2SO4	X				
<2	HCl					
5-9*	P/PCB (608 Only)					

* If pH adjustment is required, use NaOH/or H2SO4 PM OK to adjust pH________

YES= All samples OK NO=Samples were preserved at lab as listed

VOC Vial pH Verification(Tested after Analysis) Following Samples Exhibited pH >2				

Other Comments:

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CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

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PAGE ______ OF ______

SR #

CAS Contact

Project Name: Tillman Ridge	Project Number: 147556.IA.TR
Project Manager: Bill Dunn	Report CC: Steven Eakin
Company/Address: CH2M HILL Inc. 2011 SW Williston Rd. Gainesville, FL 32608	
Phone #: (352) 335-5877	FAX#:
Sampler's Signature:	Sampler's Printed Name:

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

CLIENT SAMPLE ID	LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NUMBER OF CONTAINERS	Ammonia	Color	Nitrate/Nitrite	Orthophosphate Low	Total Kjedahl N	Total P Low	TSS								REMARKS/ ALTERNATE DESCRIPTION
PRESERVATIVE																				
wet-1		9-18-01	1500	WTR		X	X	X	X	X	X	X								
wet-1		9-18-01	1500	WTR		X	X	X	X	X	X									

Preservative Key
0. NONE
1. HCL
2. HNO_3
3. H_2SO_4
4. NaOH
5. Zn. Acetate
6. MeOH
7. $NaHSO_4$
8. Other ______

SPECIAL INSTRUCTIONS/COMMENTS

See QAPP ☐

TURNAROUND REQUIREMENTS
____ RUSH (SURCHARGES APPLY)
X STANDARD
REQUESTED FAX DATE ______
REQUESTED REPORT DATE ______

REPORT REQUIREMENTS
____ I. Results Only
X II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
____ III. Results + QC and Calibration Summaries
____ IV. Data Validation Report with Raw Data
____ V. Specialized Forms / Custom Report
Edata ____ Yes ____ No

INVOICE INFORMATION
PO#
BILL TO:

SAMPLE RECEIPT: CONDITION/COOLER TEMP: ______ CUSTODY SEALS: Y N

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature: [signature]	Signature: [signature]	Signature	Signature	Signature	Signature
Printed Name: Steve B. Eakin	Printed Name: E. JESS HEARN	Printed Name	Printed Name	Printed Name	Printed Name
Firm: CH2M HILL	Firm: CAS	Firm	Firm	Firm	Firm
Date/Time: 9/19/01 1200	Date/Time: 9/19/01 1202	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - Return to Originator; Yellow - Lab Copy; Pink - Retained by Client

SCOC-1000-07

October 24, 2002

Service Request No. J2203257

Bill Dunn
CH2M Hill
3011 SW Williston Road
Gainesville, FL 32608

RE: Test Report for
Project No.: 147556.IA.TR
Project Name: Tillman Ridge

Dear Bill Dunn:

Enclosed are the results of the samples(s) submitted to our laboratory on September 30, 2002. For your reference, these analyses have been assigned our service request number: J2203257.

All analyses were performed according to our laboratory's quality assurance program. NELAP requirements were met unless footnotes in each sample report indicate otherwise. Estimates regarding the degree of uncertainty in measurements can be inferred from the accuracy limits in the laboratory QA manual. However, these limits do not account for possible matrix effects. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Paul Gunsaulies
Project Manager

CAS Jacksonville is NELAC-accredited by the State of Florida (E82502). Other state accreditations include: LA, AI 30759; MA, M-FL937; NC, 527; SC, 96021; WA, C278.

8540 Baycenter Rd. ▪ Jacksonville, FL 32256 ▪ (904) 739-2277 ▪ Fax (904) 739-2011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	CH2M Hill	**Service Request:**	J2203257
Project:	Tillman Ridge/147556.IA.TR	**Date Collected:**	9/30/02
Sample Matrix:	Water	**Date Received:**	9/30/02
		Date Extracted:	NA

Inorganic Parameters

				Sample Name:	**Wet-1**	**FB-1**	**Method Blank**
				Lab Code:	J2203257-001	J2203257-002	J221001-MB
Analyte	**Units**	**EPA Method**	**MRL**	**Date/Time Analyzed**			
Ammonia as N	mg/L (ppm)	350.1	0.01	10/10/02 1100	0.01	U	U
Color	Color Units	110.2	5	10/2/02 0750	200	U	U
Nitrate+Nitrite as N	mg/L (ppm)	300.0	0.2	10/2/02 0752	U	0.43	U
Orthophosphate as P	mg/L (ppm)	365.3	0.01	10/1/02 1430	0.31	U	U
Phosphorus, Total as P	mg/L (ppm)	365.3	0.01	10/7/02 1410	0.47	U	U
Solids, Total Suspended	mg/L (ppm)	160.2	5	10/1/02 1930	6.5	U	U
TKN	mg/L (ppm)	351.4	0.5	10/8/02 0830	1.9	U	U

QA/QC Report

Client: CH2M Hill
Project: Tillman Ridge/147556.IA.TR
Sample Matrix: Water

Service Request: J2203257
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 10/1-10/02

Duplicate Summary
Inorganic Parameters

Sample Name: FB-1
Lab Code: J2203257-002

Analyte	Units	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Orthophosphate as P	mg/L (ppm)	365.3	0.01	0.009B	0.01	0.01	<1
TKN	mg/L (ppm)	351.4	0.5	U	U	U	<1

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	CH2M Hill	**Service Request:**	J2203257
Project:	Tillman Ridge/147556.IA.TR	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	10/1-10/02

Matrix Spike Summary
Inorganic Parameters

Sample Name: FB-1
Lab Code: J2203257-002

Analyte	**Units**	**EPA Method**	**MRL**	**Spike Level**	**Sample Result**	**Spiked Sample Result**	**Percent Recovery**	**CAS Percent Recovery Acceptance Limits**
Orthophosphate as P	mg/L (ppm)	365.3	0.01	0.5	0.01	0.51	100	75-125
TKN	mg/L (ppm)	351.4	0.5	10	U	8.95	90	75-125

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: CH2M Hill
Project: Tillman Ridge/147556.IA.TR
Sample Matrix: Water

Service Request: J2203257
Date Collected: NA
Date Received: NA
Date Analyzed: 10/1-10/02

Laboratory Control Sample Summary
Inorganic Parameters

Analyte	Units	EPA Method	TRUE Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Ammonia as N	mg/L (ppm)	350.1	0.5	0.51	102	75-125
Color	Color Units	110.2	25	25	100	75-125
Nitrate+Nitrite as N	mg/L (ppm)	300.0	20	20	100	90-110
Orthophosphate as P	mg/L (ppm)	365.3	0.5	0.49	98	75-125
Phosphorus, Total as P	mg/L (ppm)	365.3	1	0.94	94	75-125
Solids, Total Suspended	mg/L (ppm)	160.2	80	71	89	75-125
TKN	mg/L (ppm)	351.4	10	9.2	92	75-125

Analytical Services

CONDITION UPON RECEIPT FORM

Client: CH2M Hill - GNV | Project name: Tillman Ridge
Date received: 9/30/02 1255 | Service request number: J2203257
Received by: agf | CUR completed by: agf

Cooler/Shipping Information:

Courier: ☐ CAS ☑ Client ☐ UPS ☐ Airborne ☐ FedEx ☐ Other (describe):

Type: ☑ Cooler ☐ Box ☐ Other (describe)

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID	1				
Temp (°C)	3.4				
Temp taken from	☐ Temp blank ☑ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle	☐ Temp blank ☐ Sample bottle
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any "NO" responses or discrepancies should be explained in the "Comments" section below or an NCM if so required. If an NCM was initiated, write the NCM number in the appropriate space.

	CHECKLIST	YES	NO	NA	NCM #
1.	Were custody seals on shipping container(s) intact? **If "No", NCM required.**		✓		
2.	Were custody papers properly included with samples?	✓			
3.	Were custody papers properly filled out (ink, signed, match labels)?	✓			
4.	Did all bottles arrive in good condition (unbroken)?	✓			
5.	Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓			
6.	Did the sample labels agree with the chain of custody?	✓			
7.	Were correct bottles used for the tests indicated?	✓			
8.	Were proper sample preservation techniques indicated on the label?	✓			
9.	Were samples received within holding times? **If "No," NCM required.**	✓			
10.	Were all VOA vials checked for the presence of air bubbles? **If "No", NCM required.**			✓	
11.	Were there air bubbles present in the VOA vials? **If "Yes", NCM required.**			✓	
12.	Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓			
13.	Was the cooler temperature less than 6°C?	✓			
14.	Were sample pHs checked and recorded by Sample control? Checks are on reverse side of form. *NOTE: VOA samples are checked by laboratory analysts.*	✓			
15.	Were the sample containers provided by CAS?	✓			
16.	Were samples accepted into the laboratory?	✓			

Comments:

Columbia Analytical Services

Jacksonville Laboratory

Condition Upon Receipt - Sample pH

SR #: J 2203257 Date: 9/30/02 Initials: [illegible]

A check mark in any space under the appropriate column headings for the selected sample indicates that the pH was checked and met the required pH criterion listed in the column heading.

	Bottle Code																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	40-mL	40-mL	125-mL	250-mL	500-mL	1-L	250-mL	1-L	2-oz	4-oz	8-oz	16-oz	5 g	100-mL	250-mL	500-mL	1-L	1-L	250-mL	500-mL	1-L	250-mL	250-mL	1.75-L	500-mL	Misc.
Container	G	G	P	P	P	P	G	G	G	G	G	G	ENC	P	P	P	P	G	P	P	P	G	P	P	P	Misc.
Pres.	HCl		HCl											Sodium Thiosulfate	H2SO4	H2SO4	H2SO4	H2SO4	HNO3	HNO3	HNO3	HNO3	NaOH	NaOH	ZnAcetate NaOH	
Req. pH	<2	N/A	<2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<2	<2	<2	<2	<2	<2	<2	<2	>12	>12	>9	N/A
Sample #	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
-001						✓										✓										
-002						✓										✓										
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-037																										
-038																										
-039																										
-040																										

For aqueous samples with multiple containers, only 1 bottle is checked for pH

NOTE: VOA pH 's are performed by the analytical area, not sample control

Columbia Analytical Services INC.
An Employee-Owned Company
www.caslab.com

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

8540 Baycenter Rd. • Jacksonville, FL 32256 • (904) 739-2277 • 800-695-7222 x06 • FAX (904) 739-2011

PAGE 1 OF 1

SR #
CAS **J2203257**

Project Name: Tillman Ridge	Project Number: 147556.IA.TR
Project Manager: Bill Dunn	Report CC: Steve Eckm
Company/Address: CH2M HILL, 3011 SW Williston Rd., Gainesville, FL 32608	
Phone #: (352) 335-7991	FAX#: (352) 335-2959
Sampler's Signature:	Sampler's Printed Name:

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

CLIENT SAMPLE ID	LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NUMBER OF CONTAINERS	Ammonia, Color	NO_2/NO_3, ortho P	TKN, TP	TSS	REMARKS/ ALTERNATE DESCRIPTION
Wet-1		9/30/02	1100	WTR	2	X	X	X	X	
FB-1		9/30/02	1100	WTR	2	X	X	X	X	

PRESERVATIVE

Preservative Key
0. NONE
1. HCL
2. HNO_3
3. H_2SO_4
4. NaOH
5. Zn. Acetate
6. MeOH
7. $NaHSO_4$
8. Other ______

SPECIAL INSTRUCTIONS/COMMENTS

See QAPP ☐

TURNAROUND REQUIREMENTS
____ RUSH (SURCHARGES APPLY)
X STANDARD
REQUESTED FAX DATE
REQUESTED REPORT DATE

REPORT REQUIREMENTS
____ I. Results Only
X II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
____ III. Results + QC and Calibration Summaries
____ IV. Data Validation Report with Raw Data
____ V. Specialized Forms / Custom Report
Edata ____ Yes ____ No

INVOICE INFORMATION
PO#
BILL TO:

SAMPLE RECEIPT: CONDITION/COOLER TEMP: ________ CUSTODY SEALS: Y N

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
SBE					
Signature: Steve B. Eckm	Signature: April Ferguson	Signature	Signature	Signature	Signature
Printed Name	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name
Firm	Firm: CAS	Firm	Firm	Firm	Firm
Date/Time	Date/Time: 9/30/02 1255	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - Return to Originator; Yellow - Lab Copy; Pink - Retained by Client

SCOC-1000-07

COLUMBIA ANALYTICAL SERVICES, INC.

Client:	CH2M Hill	**Service Request No.:**	J2203257
Project:	Tillman Ridge	**Date Received:**	9/30/02
Sample Matrix:	Water		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Laboratory Control Sample (LCS).

Sample Receipt

Two samples were received for analysis at Columbia Analytical Services on 9/30/02. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4°C upon receipt at the laboratory.

Inorganic Parameters

Sample Notes and Discussion

According to service request, FB-1 (J2203257-002) is a field blank. However, there was a hit of nitrate at 0.43 mg/L. This result was confirmed by a later analysis (0.44 ppm).

Approved by Paul Gonsalves **Date** 10/25/02

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Florida DEP Data Qualifiers

B Results based upon colony counts outside the acceptable range.

D Measurement was made in the field.

H Value based on field kit determination; results may not be accurate.

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

J Estimated value (one of the following reasons is discussed in the project case narrative).

1. The result may be inaccurate because the surrogate recovery limits have been exceeded.
2. No known quality control criteria exists for the component.
3. The reported value failed to meet the established quality control criteria for either precision or accuracy.
4. The sample matrix interfered with the ability to make any accurate determination (e.g., primary and confirmation results show greater than 40% RPD).
5. The data is questionable because of improper laboratory or field protocols (e.g., GC/MS Tune did not meet method criteria).

K Off scale low. The value is less than the lowest calibration standard but greater than the method reporting limit (MRL).

L Off scale high. The analyte is above the upper limit of the linear calibration range.

M The MDL/MRL has been elevated because the analyte could not be accurately quantified due to matrix interference.

N Presumptive evidence of the analyte. Confirmation was not performed.

Q Sample held beyond the accepted holding time.

T Value reported is less than the laboratory method detection limit. The value is reported for informational purposes only.

U Indicates that the compound was analyzed for but not detected.

V Indicates that the analyte was detected in both the sample and the associated method blank.

Y The laboratory analysis was from an improperly preserved sample.

Z Too many colonies were present (TNTC). The numeric value represents the filtration volume.

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J031947
Project Name:	Tillman Ridge	**Date Sampled:**	4/10/2003
Project Number:	147556.03.TR	**Date Received:**	4/10/03 15:20
		Date Reported:	4/24/2003

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Tillman Ridge

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If you have any questions, the above named should be contacted.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 3 + COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Tillman Ridge

Report No.: J031947
Date/Time Received: 4/10/03 15:20

Lab Code: J031947-01
Client Sample ID: WET-1
Site: Wetland Surface Water
Matrix: Water

Date/Time Sampled: 4/10/2003 11:00
Sampled By: Steve Eakin
Shipping Method: Client drop off

Miscellaneous Analytes

Analytes:	Dilution	MDL	Adjusted Reporting Limit	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.020	0.020	**0.020**	mg/L	U	E350.1		*T*
Color	1	5.0	5.0	**500**	Color Units		SM2120B		*T*
Nitrate + Nitrite (as N)	1	0.050	0.050	**0.050**	mg/L	U	SM4500NO3-F		*T*
Ortho-phosphate (as P)	1	0.050	0.050	**0.050**	mg/L	U	E365.2		*G*
Total Kjeldahl Nitrogen (as N)	1	0.050	0.050	**1.7**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.050	0.050	**0.29**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	4.0	4.0	**4.0**	mg/L	U	E160.2		*G*

U The compound was analyzed for but not detected.
G DOH certification #E82620, Compqap #200005 (AEL-Gainesville)
T DOH certification #E84589, Compqap #980174 (AEL-Tampa)

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J031947

Project Name: Tillman Ridge **Date/Time Received:** 4/10/03 15:20

Sample Cross Reference Information

Lab Code: J031947-01 **Site: Wetland Surface Water**

Client Sample Number: WET-1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct041403nh3	4/14/2003 11:43	NBM		
Color	SM2120B	NONE	WCT041103COLOR	4/11/2003 11:00	RL		
Nitrate + Nitrite (as N)	SM4500NO3-F	NONE	WCT041103NO3	4/11/2003 14:01	JH		
Ortho-phosphate (as P)	E365.2	NONE	GWC041103-OP	4/11/2003 09:20	JDA		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	wct042103tkn	4/21/2003 08:44	SS		
Total Phosphorus (as P)	E365.4	NONE	wct042103tp	4/21/2003 05:35	SS		
Total Suspended Solids (TSS)	E160.2	NONE	gwc041703-tss	4/17/2003 08:00	VB		

Definitions:

Water matrix refers to all aqueous matrices, including but not limited to, drinking water, wastewater, ground water, surface water, aqueous wastes and leachates
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with an 'i' qualifier

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

CHAIN OF CUSTODY RECORD

Advanced Environmental Laboratories, Inc.
❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
❑ Tampa: 5810-D Breckenridge Parkway, Tampa, FL 33610 • (813) 630-9616 Fax (813) 630-4327
❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050

LAB NUMBER: G0J03947

154

CLIENT NAME: CH2M HILL	PROJECT NAME: TILLMAN RIDGE
ADDRESS: 3011 SW Williston Rd. Gainesville, FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.TR
PHONE: (352) 335-7991 FAX: (352) 335-2859	PROJECT LOCATION: St. Augustine
CONTACT: Steve Eakin	SAMPLED BY: Steve Eakin

TURN AROUND TIME: ☑ STANDARD ❑ RUSH ____

REMARKS / SPECIAL INSTRUCTIONS:

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: NH3, NO2+NO3 | TKN, TP, Ortho P | TSS, Color

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.		NH3, NO2+NO3	TKN, TP, Ortho P	TSS, Color					LAB NUMBER
WET-1	Wetland Surface Water	Grab	4/10/03	11:00	SW	2		X	X	X					01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via:	RB	D/T
		AB	D/T
Ret: / /	Via:	Trip Bl. ❑	❑

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	13:00	4/10/03	[signature]	4/10/03	1500
2						
3						
4						

Received on ice: ❑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

COC

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J046810
Project Name:	Tillman Ridge	**Date Sampled:**	10/19/04
Project Number:	147556.03.TR	**Date Received:**	10/20/04 09:30
		Date Reported:	10/29/04

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Tillman Ridge

Approved By: Paul Gunsaulies

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Tillman Ridge
Report No.: J046810
Date/Time Received: 10/20/04 09:30

Lab Code: J046810-01
Client Sample ID: Tillman Ridge
Site: Wetland Surface Water
Matrix: Water
Date/Time Sampled: 10/19/04 10:30
Shipping Method: Fed Ex
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.16**	mg/L		E350.1		*T*
* **Color**	50	250	250	**500**	Color Units		E110.2		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.13**	mg/L		E365.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**2.0**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.21**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**5.6**	mg/L		E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 5.39

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J046810

Date/Time Received: 10/20/04 09:30

Sample Cross Reference Information

Lab Code: J046810-01 **Site: Wetland Surface Water**

Client Sample Number: Tillman Ridge **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	WCT102204NH3-2	10/22/04 16:30	SS		
Color	E110.2	NONE	WCJ-102104-COL	10/21/04 08:45	AA		
Nitrate + Nitrite	E353.2	NONE	WCJ-102004-N	10/20/04 14:38	KDC		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-102104-OP	10/21/04 09:31	KDC		
Total Kjeldahl Nitrogen (as N)	E351.2	NONE	WCT102804TKN1	10/28/04 10:32	AJ	pb102404tptkn	10/24/04
Total Phosphorus (as P)	E365.4	NONE	WCT102704TP1	10/27/04 15:36	AJ	pb102404tptkn	10/24/04
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102104-TSS1	10/21/04 13:00	LM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Quality Assurance Report

Method Blanks

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102004-N	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-OP	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102104-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102204NH3-	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102704TP1	Total Phosphorus (as P)	Method Blank	E365.4		0.043	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT102804TKN1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2		0.048	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental Labs
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill
Project name: Tillman Ridge
Date/Time Rcvd: 10/20/04 0930
Log-in request number: J046810
Received by: WS
Completed by: WS

Cooler/Shipping Information:

Courier: ☐ AEL ☒ Client ☐ UPS ☐ Pony Express ☒ FedEx ☐ Other (describe): ____

Type: ☒ Cooler ☐ Box ☐ Other (describe) ____

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	0.0 °C				
Temp taken from	☐ Temp blank ☒ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler	☐ Temp blank ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?	—		
2. Were custody papers properly included with samples?	—		
3. Were custody papers properly filled out (ink, signed, match labels)?	—		
4. Did all bottles arrive in good condition (unbroken)?	—		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	—		
6. Did the sample labels agree with the chain of custody?	—		
7. Were correct bottles used for the tests indicated?	—		
8. Were proper sample preservation techniques indicated on the label?	—		
9. Were samples received within holding times?	—		
10. Were all VOA vials checked for the presence of air bubbles?			—
11. Were there air bubbles present in the VOA vials?		~~—~~ WS	—
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	—		
13. Was the cooler temperature less than 6°C?	—		
14. Were sample pHs checked and recorded by Sample control? *NOTE: VOA samples are checked by laboratory analysts.*	—		
15. Were the sample containers provided by AEL?	—		
16. Were samples accepted into the laboratory?	—		
17. Was it necessary to split samples into other bottles?		—	

Comments:

C:\Documents and Settings\Login_Jax\Desktop\Login Shortcuts\CUR form.doc (2/2/04)

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J046810

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J046810-01	Tillman Ridge	Total Phosphorus (T)	Water	10/19/2004	10:30	10/20/04 9:30	**11/3/2004**		250mL Poly
J046810-01	Tillman Ridge	TKN (T)	Water	10/19/2004	10:30	10/20/04 9:30	**11/3/2004**		250mL Poly
J046810-01	Tillman Ridge	Ammonia (T)	Water	10/19/2004	10:30	10/20/04 9:30	**11/3/2004**		250mL Poly

Jacksonville Relinquisher: [illegible] **Shipping Receiver:** Pony Express **Date/Time:** 10/20/2004 9:51:16 AM

Shipping Relinquisher: [illegible] **Tampa Receiver:** VIR **Date/Time:** 10-21-04 900

Advanced Environmental Laboratories, Inc.
☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

LAB N

J046810
Projectlabels10/15/2004

CLIENT NAME: CH2M HILL
ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608
PHONE: (352) 335-7991 FAX:
CONTACT: Steve Eakin

PROJECT NAME: Tillman Ridge
P.O. NUMBER / PROJECT NUMBER: 147556.03.TR
PROJECT LOCATION: St. Augustine, FL
SAMPLED BY: SBE

TURN AROUND TIME:
☑ STANDARD
☐ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:
0.0°C

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Ortho P | NO2+NO3, NH3, TKN | TP, TSS, Color

LAB NUMBER

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Ortho P	NO2+NO3, NH3, TKN	TP, TSS, Color						
Tillman Ridge	Wetland, Surface Water	Grab	10/19/04	10:30	SW	4	X	X	X						

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via: ___	RB___	D/T___
		AB___	D/T___
Ret: / /	Via: ___	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	SBE	10/12/04	10:30	Debra L. Salter	10/20/04	0930
2						
3						
4						

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J052862
Project Name:	Tillman Ridge	**Date Sampled:**	4/26/05
Project Number:	147556.03.TR	**Date Received:**	4/27/05 09:00
		Date Reported:	5/23/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Tillman Ridge

Approved By: 2005.05.23 10:51:36 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4+2 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Tillman Ridge
Report No.: J052862
Date/Time Received: 4/27/05 09:00

Lab Code: J052862-01
Client Sample ID: 1
Site: SW-1
Matrix: Water
Date/Time Sampled: 4/26/05 10:00
Shipping Method: Client drop off
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* **Color**	10	50	50	**250**	Color Units		E110.2		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.12**	mg/L	J4 , V	E365.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**0.82**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.043**	mg/L	U	E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

J4 The sample matrix interfered with the ability to make an accurate determination.
U The compound was analyzed for but not detected.
V Indicates that the analyte was detected in both the sample and the associated method blank.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH = 6.43

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J052862

Date/Time Received: 4/27/05 09:00

Sample Cross Reference Information

Lab Code: J052862-01

Client Sample Number: 1

Site: SW-1

Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct050305nh3-1	5/3/05	13:16	AJ		
Color	E110.2	NONE	WCJ-042805-COL1	4/28/05	09:35	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-042905-N3	4/29/05	14:41	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-042705-O3	4/27/05	16:17	MSA		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	WCT050205TKN	5/2/05	14:35	AJ	pb042905tptkn	4/29/05 10:30:00
Total Phosphorus (as P)	E365.4	METHOD	wct050205tp1	5/2/05	09:01	AJ	pb042905tptkn	4/29/05 10:30:00
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-050205-TSS1	5/2/05	15:00	MSA		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J052862

Date/Time Received: 4/27/05 09:00

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042705-O3	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.036	mg/L	i

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042805-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-042905-N3	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-050205-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCT050205TKN	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct050205tp1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct050305nh3-1	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Quality Assurance Qualifiers:

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill **Project name:** Tillman Ridge

Date/Time Rcvd: 4/27/05 0900 **Log-in request number:** J0528 62

Received by: PW **Completed by:** ADS

Cooler/Shipping Information:

Courier: ☐ AEL ☑ Client ☐ UPS ☐ Pony Express ☐ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ____________

Type: ☑ Cooler ☐ Box ☐ Other (describe) ____________

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	-2				
Temp taken from	☐ Sample Bottle ☑ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Advanced Environmental Laboratories, Inc.
- ❑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
- ❑ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
- ❑ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
- ❑ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

J052862

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Tillman Ridge

P.O. NUMBER / PROJECT NUMBER: 147556.03.TK

PROJECT LOCATION: St. Augustine

SAMPLED BY: Steve Eakin

TURN AROUND TIME:
✓ STANDARD
❑ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS:
2°C

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: TSS, Color | Ortho P | NO2+NO3 | NH3, TKN, TP

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	TSS, Color	Ortho P	NO2+NO3	NH3, TKN, TP				LAB NUMBER
SW-1		Grab	4/26/05	1000	SW	4	X	X	X	X				-01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via:	RB	D/T
Ret: / /	Via:	AB	D/T
		Trip Bl. ❑	❑

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	4/26/05	0200	[signature]	4/27/05	0900
2						
3						
4						

Received on ice: ☑ yes ❑ no QC ❑ sent ❑ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J057091
Project Name:	Tillman Ridge	**Date Sampled:**	10/18/05
Project Number:	147556.03.TR	**Date Received:**	10/19/05 10:30
		Date Reported:	11/7/05

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Tillman Ridge

Approved By: Paul Gunsaulies 2005.11.07 14:54:31 -05'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J057091

Date/Time Received: 10/19/05 10:30

Lab Code: J057091-01

Client Sample ID: 1

Site: TR-1

Matrix: Water

Date/Time Sampled: 10/18/05 11:00

Shipping Method: Blue Streak Courier Sv

Sampled By: CLIENT

Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.026**	mg/L	U	E350.1		*T*
* **Color**	25	130	130	**500**	Color Units		E110.2		*J*
Ortho-phosphate (as P)	1	0.019	0.075	**0.24**	mg/L		E365.2		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.7**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.27**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**9.5**	mg/L		E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Nitrate + Nitrite (as N)	1	0.027	0.11	**0.027**	mg/L	U	E353.2		*J*

U The compound was analyzed for but not detected.

J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)

T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)

* Comment for Color -- Color pH = 7.39

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J057091

Date/Time Received: 10/19/05 10:30

Sample Cross Reference Information

Lab Code: J057091-01

Client Sample Number: 1

Site: TR-1

Matrix: Water

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time	Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE	wct102705nh3-2	10/27/05 14:21	AJ		
Color	E110.2	NONE	WCJ-102005-COL	10/20/05 08:15	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-102005-N1	10/20/05 16:25	MSA		
Ortho-phosphate (as P)	E365.2	NONE	WCJ-102005-O1	10/20/05 10:00	MSA		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD	wct103105tkn-1	10/31/05 13:38	AJ	pb102905tptkn	10/29/05
Total Phosphorus (as P)	E365.4	METHOD	wct103105tp-1	10/31/05 10:51	AJ	pb102905tptkn	10/29/05
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-102105-TSS4	10/21/05 15:30	AB		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J057091

Date/Time Received: 10/19/05 10:30

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102005-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102005-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-102105-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct102705nh3-2	Ammonia (as N)	Method Blank	E350.1	0.026	0.026	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct103105tkn-1	Total Kjeldahl Nitrogen (as N)	Method Blank	E351.2	0.048	0.048	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
wct103105tp-1	Total Phosphorus (as P)	Method Blank	E365.4	0.043	0.043	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

Client: CH2M Hill - J'ville Project name: ____________

Date/Time Rcvd: 10/19/05 1030 Log-In request number: J057891

Received by: AS Completed by: AS

Cooler/Shipping Information:

Courier: ☐ AEL ☒ Client ☐ UPS ☐ Pony Express ☐ FedEx ☐ AES ☐ ASAP ☐ Other (describe): AS

AS 10/19/05

Type: ☒ Cooler ☐ Box ☐ Other (describe) ____________

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)					
Temp taken from	☐ Sample Bottle ☒ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☒ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?			✓
2. Were custody papers properly included with samples?	✓		
3. Were custody papers properly filled out (ink, signed, match labels)?	✓		
4. Did all bottles arrive in good condition (unbroken)?	✓		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	✓		
6. Did the sample labels agree with the chain of custody?	✓		
7. Were correct bottles used for the tests indicated?	✓		
8. Were proper sample preservation techniques indicated on the label?	✓		
9. Were samples received within holding times?	✓		
10. Were all VOA vials checked for the presence of air bubbles?			✓
11. Were there air bubbles present in the VOA vials?			✓
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	✓		
13. Was the cooler temperature less than 6°C?	✓		
14. Were the sample containers provided by AEL?	✓		
15. Were samples accepted into the laboratory?	✓		
16. Was it necessary to split samples into other bottles?		✓	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J057091

CustomerName: CH2M Hill

Collector: CLIENT

Department: **Wetchem (Tampa)**

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J057091-01	1	TKN (T)	Water	10/18/2005	11:00	10/19/05 10:30	**11/02/2005**		250mL Poly
J057091-01	1	Total Phosphorus (T)	Water	10/18/2005	11:00	10/19/05 10:30	**11/02/2005**		250mL Poly
J057091-01	1	Ammonia (T)	Water	10/18/2005	11:00	10/19/05 10:30	**11/02/2005**		250mL Poly

Jacksonville Relinquisher: 108 Ira Lott **Shipping Receiver:** FedEx ~~Pony Express~~ **Date/Time:** 10/19/2005 ~~14:30:22~~ 17:00

Shipping Relinquisher: ______ **Tampa Receiver:** K. Madelle **Date/Time:** 10-20-05 11:15

Advanced Environmental Laboratories, Inc.
☑ Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
☐ Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
☐ Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
☐ Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-1597

CHAIN OF CUSTODY RECORD

J057091

CLIENT NAME: CH2M HILL

ADDRESS: 3011 SW Williston Rd.
Gainesville, FL 32608

PHONE: (352) 335-7991 FAX:

CONTACT: Steve Eakin

PROJECT NAME: Tillman Ridge

P.O. NUMBER / PROJECT NUMBER: 147556.03.TR

PROJECT LOCATION: St John's County, FL

SAMPLED BY: [signature]

TURN AROUND TIME: ☑ STANDARD ☐ RUSH ______

REMARKS / SPECIAL INSTRUCTIONS: * Orthophosphate sample not filtered in field.

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge

BOTTLE SIZE & TYPE / ANALYSIS REQUIRED / Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Ortho. P *	NO2+NO3	NH3/TKN/TP	TSS/Color				LAB NUMBER
TR-1	Surface Water	Grab	10/18/05	1100	SW	4	X	X	X	X				01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via:	RB	D/T
		AB	D/T
Ret: / /	Via:	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[signature]	10/18/05	1615	[signature]	10/18/05	1620
2	BKS	10/19/05	1030	D. Salter	10/19/05	1030
3						
4						

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Advanced Environmental Laboratories, Inc.

6601 Southpoint Parkway
Jacksonville, Florida 32216
(904) 363-9350
FAX (904) 363-9354

Client:	CH2M Hill	**Report No.:**	J062234
Project Name:	Tillman Ridge	**Date Sampled:**	3/30/06
Project Number:	147556.03.TR	**Date Received:**	3/30/06 12:45
		Date Reported:	4/18/06

Attention: Steve Eakin

Phone Number: 3523357991

Address: 3011 SW Williston Road

Gainesville, FL 32608

Project Description

The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody.

Project Name: Tillman Ridge

Approved By: Paul Gunsaulies 2006.04.18 10:58:56 -04'00'

Paul Gunsaulies, Project Manager

If there are any questions involving this report, the above named should be contacted.

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

Advanced Environmental Laboratories certifies that the test results in this report meet all requirements of the NELAC standards, unless notated otherwise in the body of the report.

Total Number of Pages = 4 + 3 COC

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill
Project Name: Tillman Ridge

Report No.: J062234
Date/Time Received: 3/30/06 12:45

Lab Code: J062234-01
Client Sample ID: 1
Site: Tillman Wetland Surface Water
Matrix: Water

Date/Time Sampled: 3/30/06 11:00
Shipping Method: Client drop off
Sampled By: Steve Eakin
Sampling Method: G

Miscellaneous Analytes

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
Ammonia (as N)	1	0.026	0.10	**0.27**	mg/L		E350.1		*T*
* **Color**	10	50	50	**200**	Color Units		E110.2		*J*
Ortho-phosphate (as P)	1	0.013	0.052	**0.21**	mg/L		E365.1		*J*
Total Kjeldahl Nitrogen (as N)	1	0.048	0.19	**1.1**	mg/L		E351.2		*T*
Total Phosphorus (as P)	1	0.043	0.17	**0.32**	mg/L		E365.4		*T*
Total Suspended Solids (TSS)	1	2.0	2.0	**2.0**	mg/L	U	E160.2		*J*

Nitrate + Nitrite

Analytes:	Dilution	Adjusted MDL	Adjusted PQL	Results	Units	Qualifier(s)	Method	Parameter Comment	Lab
* **Nitrate + Nitrite (as N)**	1	0.027	0.11	**0.027**	mg/L	i	E353.2		*J*

i The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U The compound was analyzed for but not detected.
J DOH certification #E82574 (AEL-JAX) (FL NELAC certification)
T DOH certification #E84589 (AEL-Tampa) (FL NELAC Certification)
* Comment for Color -- Color pH is 6.43.
* Comment for Nitrate + Nitrite (as N) -- Sample is a hit.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill

Project Name: Tillman Ridge

Report No.: J062234

Date/Time Received: 3/30/06 12:45

Sample Cross Reference Information

Lab Code: J062234-01 **Site: Tillman Wetland Surface**

Client Sample Number: 1 **Matrix: Water**

Test Description	Analysis Method	Prep Method	Analytical Batch ID	Analysis Date/Time		Analyst	Prep Batch ID	Prep Date/Time
Ammonia (as N)	E350.1	NONE			15:56			
Color	E110.2	NONE	WCJ-033106-COL	3/31/06	08:40	MSA		
Nitrate + Nitrite	E353.2	NONE	WCJ-040606-N1	4/6/06	14:55	MSA		
Ortho-phosphate (as P)	E365.1	NONE	WCJ-033106-O1	3/31/06	09:28	MSA		
Total Kjeldahl Nitrogen (as N)	E351.2	METHOD			09:48			
Total Phosphorus (as P)	E365.4	METHOD			14:55			
Total Suspended Solids (TSS)	E160.2	NONE	WCJ-040606-TSS	4/6/06	15:45	LM		

If the Analytical Batch ID and Prep Batch IDis null, the analysis was not performed by AEL, and the original report from the subcontracted laboratory will be provided containing this information.

Advanced Environmental Laboratories, Inc.

Analytical Report

Client: CH2M Hill **Report No.:** J062234

Project Name: Tillman Ridge **Date/Time Received:** 3/30/06 12:45

Quality Assurance Report

Method Blanks

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033106-COL	Color	Method Blank	E110.2	5.0	5.0	Color Units	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-033106-O1	Ortho-phosphate (as P)	Method Blank	E365.1	0.013	0.013	mg/L	U

Nitrate + Nitrite

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040606-N1	Nitrate + Nitrite (as N)	Method Blank	E353.2	0.027	0.027	mg/L	U

Miscellaneous Analytes

QCBatchID	Analyte	QC Sample Type	Method	MDL	Result	Units	Qualifier
WCJ-040606-TSS	Total Suspended Solids (TSS)	Method Blank	E160.2	2.0	2.0	mg/L	U

Quality Assurance Qualifiers:

U The compound was analyzed for but not detected.

Definitions:

Water matrix refers to all aqueous matrices except drinking water, including but not limited to, wastewater, ground water, surface water, aqueous wastes and leach
Soil matrix refers to all non-aqueous matrices, including soils, solids, sludges, semi-solids, and non-aqueous waste samples
All results in mg/kg or % are reported in dry weight basis, unless notated otherwise. All results in mg/L are reported in wet weight basis.
MDL Method Detection Limit, without correction for dilution or moisture content
Adjusted Reporting Limit is the MDL accounting for all dilutions and moisture content cacluations.
PQL is defined to be 4 times the MDL, for all results qualified with a 'i' qualifier.
Sampling Method; G=Grab, P=Pump, C=Composite

The estimated measurements of uncertainty can be provided upon request

This is the last page of the analytical report.

La Advanced Environmental Labs Inc

Advanced Environmental
6601 Southpoint Parkway
Jacksonville, FL 32216

CH2M

Client: ~~City Green Cove Springs~~ Project name: Tillman Ridge

Date/Time Rcvd: 3-30-06 12:45 Log-In request number: J062234

Received by: CAY Completed by: CAY

Cooler/Shipping Information:

Courier: ☐ AEL ☑ Client ☐ UPS ☐ Pony Express ☐ FedEx ☐ AES ☐ ASAP ☐ Other (describe): ____________

Type: ☑ Cooler ☐ Box ☐ Other (describe) ____________

Cooler temperature: Identify the cooler and document the temperature blank or ice water measurement

Cooler ID					
Temp (°C)	0				
Temp taken from	☐ Sample Bottle ☑ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler	☐ Sample Bottle ☐ Cooler
Temp measured with	☑ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):	☐ IR gun ☐ Thermometer (enter ID):

Other Information:

Any discrepancies should be explained in the "Comments" section below.

CHECKLIST	YES	NO	NA
1. Were custody seals on shipping container(s) intact?	—		
2. Were custody papers properly included with samples?	—		
3. Were custody papers properly filled out (ink, signed, match labels)?	—		
4. Did all bottles arrive in good condition (unbroken)?	—		
5. Were all bottle labels complete (sample #, date, signed, analysis, preservatives)?	—		
6. Did the sample labels agree with the chain of custody?	—		
7. Were correct bottles used for the tests indicated?	—		
8. Were proper sample preservation techniques indicated on the label?	—		
9. Were samples received within holding times?	—		
10. Were all VOA vials checked for the presence of air bubbles?			—
11. Were there air bubbles present in the VOA vials?			—
12. Were samples in direct contact with wet ice? If "No," check one: ☐ NO ICE ☐ BLUE ICE	—		
13. Was the cooler temperature less than 6°C?	—		
14. Were the sample containers provided by AEL?	—		
15. Were samples accepted into the laboratory?	—		
16. Was it necessary to split samples into other bottles?		—	

Comments:

Chain-of-Custody for AEL Jax to AEL Tampa

AEL Jax
6601 Southpoint Parkway
Jacksonville, FL 32216
904-363-9350 Fax 904-363-9354
Contact Person: Sean Hyde

AEL Tampa
9610 Princess Palm Avenue
Tampa, FL 33619
813-630-9616 Fax 813-630-4327
Contact Person: Michael Cammarata

Project #: J062234

CustomerName: CH2M Hill

Collector: Steve Eakin

Department: Wetchem (Tampa)

☐ **Check if Rush**

Lab Code	Client Sample ID	Test	Matrix	Collect Date	/ Time	Receive Date	Due Date	# Bottles	Bottle Type (Pres.)
J062234-01	1	Total Phosphorus (T)	Water	03/30/2006	11:00	3/30/06 12:45	**04/13/2006**		250mL Poly
J062234-01	1	TKN (T)	Water	03/30/2006	11:00	3/30/06 12:45	**04/13/2006**		250mL Poly
J062234-01	1	Ammonia (T)	Water	03/30/2006	11:00	3/30/06 12:45	**04/13/2006**		250mL Poly

Jacksonville Relinquisher: [signature] **Shipping Receiver:** BIS ~~Pony Express~~ **Date/Time:** 03/30/2006 ~~16:23:54~~ 17:00

Shipping Relinquisher: **Tampa Receiver:** K. Madre **Date/Time:** 3/31/06 09:10

Advanced Environmental Laboratories, Inc.

- [x] Jacksonville: 6601 Southpoint Parkway, Jacksonville, FL 32216 • (904) 363-9350 Fax (904) 363-9354
- [ ] Tampa: 9610 Princess Palm Avenue, Tampa, FL 33619 • (813) 630-9616 Fax (813) 630-4327
- [ ] Gainesville: 2106 NW 67th Place, Suite 7, Gainesville, FL 32606 • (352) 367-1500 Fax (352) 367-0050
- [ ] Orlando: 528 S. North Lake Blvd., Suite 1016, Altamonte Springs, FL 32701 • (407) 937-1594 Fax (407) 937-15..

CHAIN OF CUSTODY RECORD

J062234

1 of 1

CLIENT NAME: CH2M HILL	PROJECT NAME: Tillman Ridge
ADDRESS: 3011 SW Williston Rd. Gainesville FL 32608	P.O. NUMBER / PROJECT NUMBER: 147556.03.TR
PHONE: (352)335-7991 FAX:	PROJECT LOCATION: St. Johns County
CONTACT: Steve Eckert	SAMPLED BY: [illegible]
TURN AROUND TIME: ☑ STANDARD ☐ RUSH ______	REMARKS / SPECIAL INSTRUCTIONS:

BOTTLE SIZE & TYPE

ANALYSIS REQUIRED: Color, TSS, NH_3, / TKN, NO_2+NO_3, / TP, ortho P

WW= waste water SW=surface water GW=ground water DW=drinking water OIL A=air SO=soil SL=sludge Preserv

SAMPLE ID	SAMPLE DESCRIPTION	Grab Composite	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. CONT.	Color, TSS, NH_3	TKN, NO_2+NO_3	TP, ortho P					LAB NUMBER
Tillman	Wetland Surface Water	Grab	3/30/06	1100	SW	4	X	X	X					01

I = Ice H = (HCl) S = (H_2SO_4) N = (HNO_3) T = (Sodium Thiosulfate)

Shipment	Method	Sample Kit	Cooler #
Out: / /	Via:	RB	D/T
		AB	D/T
Ret: / /	Via:	Trip Bl. ☐	☐

	Relinquished by:	Date	Time	Received by:	Date	Time
1	[illegible]	3/30	12:45	Casey Young	3-30-06	12:45
2						
3						
4						

Received on ice: ☑ yes ☐ no QC ☐ sent ☐ received

revised 8/01

Figure 1

Appendix G - Assessment of Amphibian Response to Wetlands Augmentation: Final Report

ASSESSMENT OF AMPHIBIAN RESPONSE TO WETLANDS AUGMENTATION

Final Report




Submitted to: St. Johns River Water Management District
By: Ryan C. Means and Rebecca P.M. Means
Coastal Plains Institute and Land Conservancy

2008

EXECUTIVE SUMMARY

This amphibian study is one component of a larger wetlands augmentation pilot study that took place within the St. Johns River Water Management District from 1998 through April 2008. The pilot study is part of a larger program entitled "Avoidance of Impacts and Alternative Water Supply Strategies in the St. Johns River Water Management District." The pilot study was designed to evaluate the effects, costs, and benefits of applying supplemental water to wetlands impacted by municipal groundwater withdrawal. The feasibility of using wetlands augmentation and water retention techniques as impact avoidance tools was investigated. The objective of this, the amphibian monitoring portion of the study, was to determine possible impacts on amphibians of either actively or passively applying supplemental water to wetlands.

There were a total of four study sites within this project: Tillman Ridge Wellfield, St Johns County (TR); Bennett Swamp, Volusia County (BS); Port Orange Wellfield, Volusia County (PO); Parkland Wetland, City of Titusville Wellfield, Brevard County (PW). TR and PO were active hydration sites, and BS and PW were passive hydration sites. Data collection took place at all sites both before and after augmentation of experimental wetlands. Two years (1999 and 2000) of baseline (pre-augmentation) amphibian data were collected and reported at Port Orange Wellfield (PO), Bennett Swamp (BS), and Parkland Wetland (PW); and four months of baseline data were reported for Tillman Ridge (TR) (Franz and Means 2001; Means and Franz 2005; Means 2001). Four years of post-augmentation data were collected from TR and PW. Four and a half years of post-augmentation data were collected from BS. Five years of post-augmentation data were collected from PO.

At the actively hydrated TR study site, amphibian activity in both the experimental and control wetlands was positively correlated with rainfall and water residency time. Species diversity increased during periods of increased rainfall and decreased during periods of drought and wetland dryness. Results from a Bray-Curtis similarity index indicated that the similarity of the amphibian communities between the experimental and control ponds did not change appreciably between baseline and hydration periods. Water levels of experimental and control wetlands were below the surface during the entire four month baseline period, but filled and dried several times during the four year hydration period. Area climate during the four and a half year study was marked by extreme rainy periods or intense drought. CH2M Hill (2008b) reported that active hydration measurably increased water levels at the experimental wetland and that measured water quality parameters remained unchanged after hydration. Amphibian reproduction was consistently greater at the experimental wetland than at the control wetland during the hydration period. Reproductive results may reflect a beneficial effect of hydration on amphibian reproduction but we cannot say this definitively. We observed a diverse, healthy, and successfully reproducing amphibian fauna for over four years at the experimental wetland; however, the contribution that active hydration made to these ecological metrics was inconclusive because of experimental and control wetland dryness during baseline and study design constraints (brief baseline period). We observed no detrimental effects from the application of groundwater on the amphibian community at the experimental wetland during the study.

At the passively hydrated BS study site, amphibian activity was positively correlated with rainfall and presence of water in the swamp. Species diversity and reproduction increased during periods of increased rainfall and available surface water and decreased during periods of drought and wetland dryness. Results from a Bray-Curtis similarity index showed that amphibian communities of the swamp were fairly similar between baseline and operational periods. Area climate during the six and a half year study was marked by extreme rainy periods or intense drought. By the last two and a half years of the project (concurrent with a severe drought), there were almost no amphibian captures. CPI scientists predict that amphibians will become active again (e.g. species diversity will increase) in the swamp basin when normal rainfall and swamp inundation return. CPI scientists observed a diverse, healthy, and successfully reproducing amphibian fauna during periods of available surface water in BS. CH2M Hill (2008b) reported that passive hydration measurably increased water levels of the swamp near the weir and that measured water quality parameters remained unchanged after the weir was installed. Results regarding the effect of passive hydration on amphibians were inconclusive because of study design constraints (lack of control wetland). Passive hydration appeared to have no detrimental effects on the amphibian community during this study.

At the actively hydrated PO study site, amphibian activity primarily was positively correlated with rainfall at all wetlands, though some response to water residency time was also noted, particularly as hydroperiod approached zero near study's end. Species diversity and reproduction increased during periods of increased rainfall and decreased during periods of drought and wetland dryness. Area climate during the seven year study was marked by extreme rainy periods or prolonged dry periods. Hydrological observations made by CPI of three additional control wetlands showed that the experimental and control wetlands all became inundated and dried synchronously during rainy and droughty periods, respectively. Results from a Bray-Curtis similarity index showed that the amphibian communities of the experimental and two control wetlands were similar during baseline and hydration period, which indicated that there was no measured effect of hydration on the amphibian community at the experimental wetland. The results suggest that the effects that hydration had on the experimental wetland were minor in comparison to rainfall and that hydration alone did not illicit a response by the amphibian community. CH2M Hill (2008b) reported that hydration coupled with increased rainfall resulted in higher water levels of the experimental wetland during the hydration period, and that rainfall was the dominant cause of the water level increase. CH2M Hill (2008b) also reported that measured water quality parameters remained unchanged after active hydration. Results regarding the effect of active hydration on amphibians were inconclusive because hydration itself did not have a significant enough effect on the experimental wetland to illicit a response in the amphibian community. CPI did not observe any detrimental effects on amphibian communities from the application of groundwater at the experimental wetland.

At the passively hydrated PW site, species richness of amphibian adults and larvae generally increased during rainy periods and decreased during dry periods in both the baseline and operational periods of the study. Observed amphibian communities were similar between baseline and operational periods. Results regarding the effect of passive hydration on amphibian communities at PW were inconclusive due to repeated occurrences of vandalism, lack of quantitative sampling, and study design constraints (lack of a control wetland). However, CPI scientists believe that amphibian fauna at the PW study site were not detrimentally affected by passive hydration. CH2M Hill (2008b) reported that passive hydration measurably increased water levels of the wetland during the hydration period, and that water quality parameters remained unchanged after weir installation.

CONTENTS

LIST OF FIGURES

INTRODUCTION

Project Background

Groundwater is the primary source of freshwater for all uses in Florida (U.S. Geological Survey 1990). Billions of gallons of groundwater have been removed for human consumption over the years. As a result of such water withdrawal, the potentiometric surface of the Floridan Aquifer System has lowered over time. The hydrology and ecology of surface wetlands may become impacted by underlying aquifer level depressions, especially over the long-term.

During the 1990's, the St Johns River Water Management District (SJRWMD) assessed areas anticipated to develop critical water resource problems as a result of future ground water pumping (Vergara 1994, Vergara 1998). As one component of this assessment, areas in which native plant communities and wetlands were at risk from future ground water development were identified with the use of a GIS model. Many of these areas were found to be located near existing water supply wellfields. To reduce impacts to natural systems in these wellfields, the SJRWMD began investigating the environmental and economic feasibility of alternative water supply strategies to prevent or minimize environmental harm (CH2M Hill 1996).

Augmentation Study

One strategy for balancing impact and resource development is to compensate for altered hydrology by directly augmenting or otherwise managing water levels in affected or threatened wetlands (CH2M Hill 1997). To investigate this strategy, four demonstration projects were initiated in 1999. Two wetland augmentation and two water retention projects were recommended by the District's primary contractor, CH2M Hill. At augmentation sites, an experimental wetland was chosen to be augmented with groundwater based on field observations of apparent impact. At water retention sites, a control weir was constructed to serve as a passive water retention system. The four sites from north to south are (Figure 1):

Tillman Ridge Wellfield, St Johns County (TR) (active hydration)
Bennett Swamp, Volusia County (BS) (passive hydration)
Port Orange Wellfield, Volusia County (PO) (active hydration)
Parkland Wetland, Titusville, Brevard County (PW) (passive hydration)

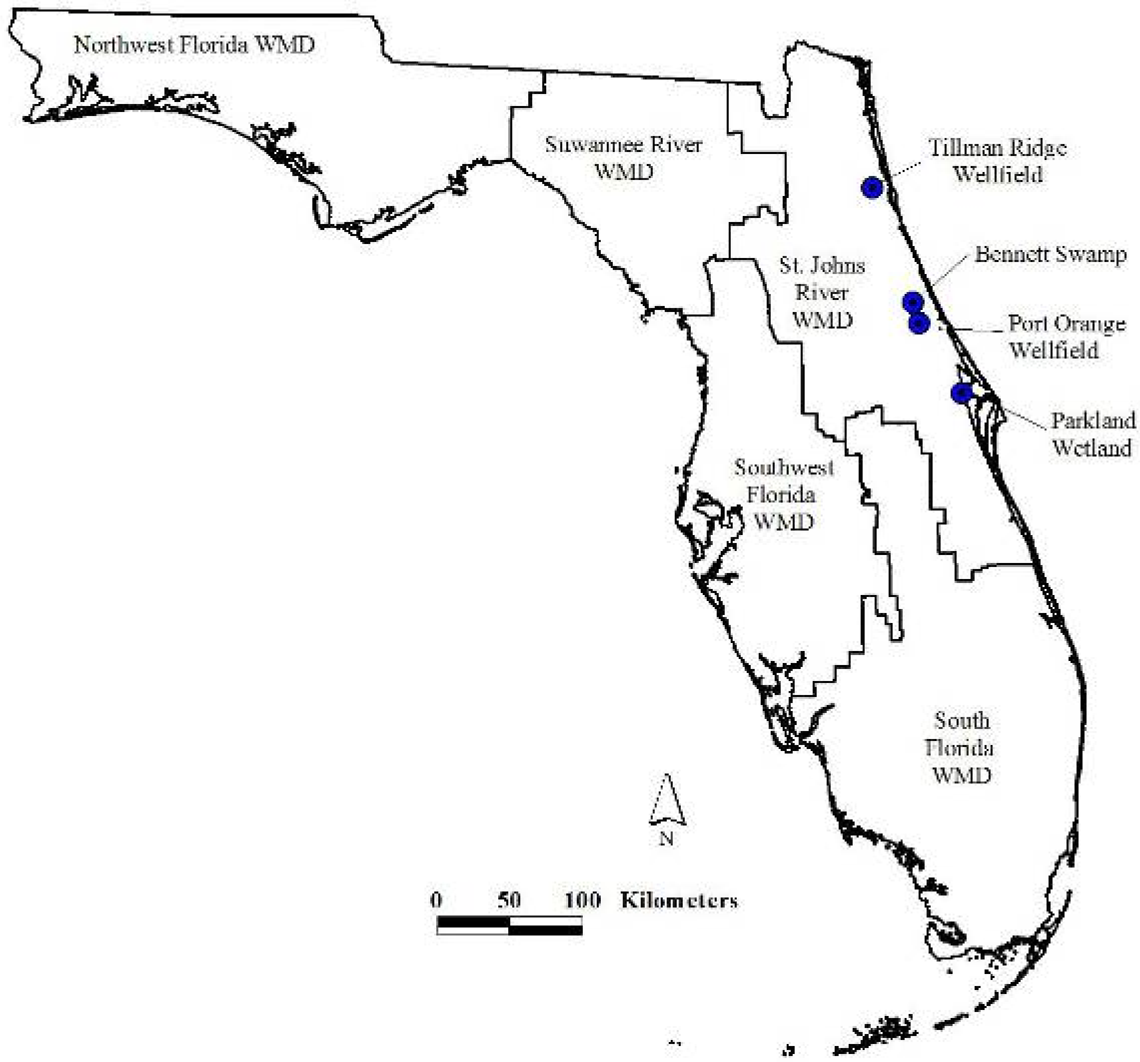


Figure 1. Map of the study sites within the St. Johns River Water Management District.

During 1999-2000, baseline hydrological and biological data were collected at the four demonstration project sites. CH2M Hill scientists conducted characterizations of existing ecological and hydrological conditions, design and permitting of facilities and structures, oversight during construction, and generation of progress reports. Their monitoring program focused on hydrology, water quality, vegetation, soil, and ecological indicators of hydrologic conditions. In 2001 and 2002, treatment of experimental wetlands was initiated and monitoring continued.

Groundwater augmentation of the experimental wetland at Tillman Ridge began in July 2001 and augmentation at Port Orange began in May 2002. The volume of water added each month to the experimental wetlands at TR and PO was based on the historical average monthly rainfall amounts for that region. Water was added for a 24-hour period between zero and ten times a month, according to a schedule designed by CH2M Hill.

During the hydration period, water delivery schedules were sometimes modified whenever necessary.

A control weir at Parkland Wetland was constructed in a ditch draining out of the north side of the wetland and was operational beginning May 2002. A control weir at Bennett Swamp was constructed across Thayer Canal, on the east side of the study area in January of 2004. Thayer Canal is one of four main outflows of Bennett Swamp. The control weirs located at Bennett Swamp and Parkland Wetland were designed to be passive water retention systems (CH2M Hill 2008b). The objective was to retain more surface water within the systems for a longer duration without increasing flooding during major storm events. Water retention continued at BS through April 2008. Project operations at TR and PW concluded in 2006 and at PO in 2007.

Hydrological results of this wetlands augmentation pilot study are fully discussed in the latest project annual reports by CH2M Hill (2006, 2007a, 2007b, 2008). A summary of final hydrological results from this project can be found in (CH2M Hill 2008b).

Amphibian Assessment

University of Florida biologists L. Richard Franz and Ryan C. Means were contracted to monitor amphibians and evaluate amphibian species diversity at all sites during baseline (1999 and 2000). The baseline period is fully discussed in Means (2001) and Means and Franz (2005). The Coastal Plains Institute (CPI) was contracted to continue amphibian monitoring during the five and a half year operational period (2003-2008). Results from the operational period are fully discussed in annual reports generated by CPI (Means and Meegan 2003, 2004, 2005; Means 2006, 2007, 2008).

The amphibian study was undertaken because the SJRWMD wanted to investigate and assess any possible effects wetlands treatments may have on amphibians. Amphibians were selected as a study focus in the augmentation/retention demonstration projects because of their sensitivity to water quality changes and their well-documented worldwide decline (Alford and Richards 1999, IUCN *et al*. 2004, Lannoo 2005). Many factors are responsible for amphibian declines. The loss and alteration of upland and wetland habitats is probably the most significant cause for declines in the Southeast (Dodd 1997, Means 2003). With habitat loss and worldwide species declines underway, the current study offered something beyond the obvious goal of assessing the amphibian response to wetlands augmentations. It offered the opportunity to obtain much needed long-term data on amphibians from a poorly sampled portion of the southeastern U.S., namely, northeast and east-central Florida.

Clarification of Terms

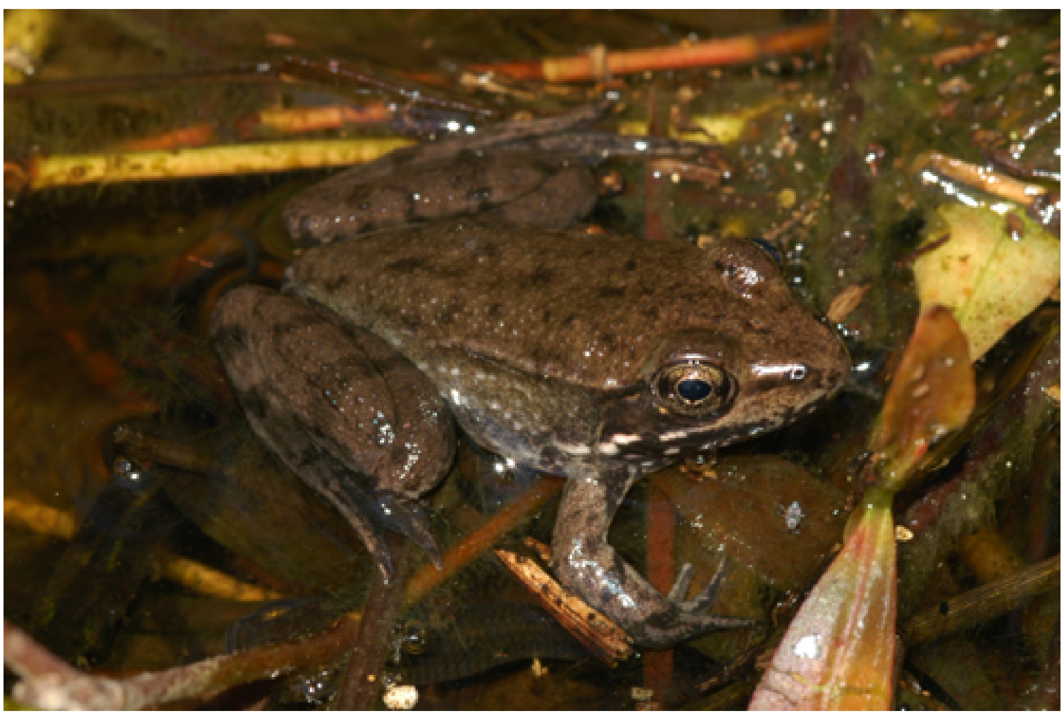
In this report, the term “active hydration” is a synonym for “augmentation.” The term “passive hydration” is a synonym for “water retention.” The terms “baseline” and “pre-augmentation” are considered synonyms. The terms “post-augmentation,” and “hydration period” are synonyms and are used for active hydration sites (Port Orange Wellfield and

Tillman Ridge Wellfield). “Operational period” refers to the post weir installation periods at Bennett Swamp and Parkland Wetland. The terms “wetland” and “pond” also are considered synonyms, and these two apply to both the TR and PO study sites only. “Water residency time” is considered synonymous to “hydroperiod” in this report. Synonymous terms are used throughout the report.

Objectives of the Final Report

The remainder of this report will summarize amphibian community activity at the four study sites over the past decade. Some pertinent results from the hydrological portion of this study conducted by CH2M Hill will be cited within this report to provide the reader with a coherent big picture of how amphibian results relate to hydrological results. Assessments of the effects of active and passive hydration on amphibians were inconclusive for various reasons in this study. Nevertheless, we present and analyze pertinent amphibian data from all sites and inform the reader why results were inconclusive. If the reader would like more detailed information within a given single project year, he/she is referred to an M.S. Thesis by Means (2001) and annual reports by Means and Meegan (2003, 2004, 2005) and Means (2006, 2007, 2008). The wetlands augmentation pilot study’s final project report by CH2M Hill (2008b) should be read in unison with this amphibian final report.

TILLMAN RIDGE WELLFIELD
ST. JOHNS COUNTY



TILLMAN RIDGE WELLFIELD

Site Description

Tillman Ridge was located at the north end of Water Plant Road, one mile north of SR 214, five miles east of Molasses Junction (jct. SR 13 A and SR 214), in St. Johns County, FL. The property was owned and managed by Rayonier, Inc. and was leased to St. Johns County Hunt Club. The public supply well and pumphouse locations were leased to St. Johns County by Rayonier, Inc.

The Tillman Ridge site was a planted pine flatwoods on the western side of Trestle Bay Swamp. The uplands were mechanically site prepared and bedded for pine silviculture. There were several isolated wetlands on the property. The southeastern portion of the property was situated on a low sand ridge called Tillman Ridge at an elevation of 40 ft above mean sea level. The property sloped down from the ridge to about 30 ft along its western edge. Evidence indicated that wetlands at TR had been impacted (e.g. drying) by long-term groundwater withdrawal and subsequent aquifer drawdown (CH2M Hill 2006). Evidence that wetlands may be drying include leaning and fallen trees, exposed roots, encroachment of upland species, and measured water levels several feet below the surface during the wet season (CH2M Hill 2006). Two wetlands were monitored for amphibian species diversity at this site. An experimental wetland received supplemental groundwater, and another wetland served as a control or reference site. Additional site description information can be found in Means (2001) and CH2M Hill (2006).

The experimental pond was located adjacent north and east of Well 4. The forested wetland was dominated by loblolly bay (*Gordonia lasianthus*), black gum (*Nyssa silvatica*), and slash pine (*Pinus elliotii*). The pond was a shallow, oval-shaped basin with a north-south trending long axis approximately five acres in size. Adjacent uplands on the western side of the pond were scrubby flatwoods. A private ranch was situated on the northeast side of the wetland. A sizeable tract of nine to ten year-old planted pines occurred on uplands to the east and south of the experimental pond. Wetland augmentation occurred on a predetermined schedule.

The control pond was located 0.7 miles southeast of the experimental pond. It was approximately 200 ft east of Well 9. The control pond was a shallow, circular depression approximately 2.5 acres in size, and it was forested with gum, loblolly bay, cypress, and pine. The surrounding uplands were flatwoods forested by nine to ten year old planted pines.

Active Hydration

A description of water delivery to the experimental wetland during the operation period is paraphrased from CH2M Hill (2008b). Groundwater from a semi-confined surficial aquifer (Toth 1994) was pumped from an existing, off-line well at an average rate of approximately 108,950 gallons per day. Approximately ¾ of an inch of water across the five-acre wetland was delivered in a 24-hour period. Approximately eight million gallons per year were delivered to the wetland. The number of irrigation periods per month varied depending on a predetermined schedule. Hydration water was applied on a schedule that mimics the monthly average rainfall of the region. Because of the significantly low water levels in the wetland during the baseline period, an initial hydration amount equal to average annual rainfall was scheduled.

Methods

Amphibian monitoring methodology during the post-augmentation period was identical to baseline. The experimental and control wetlands were monitored identically for amphibian species diversity (richness and abundance). The control pond was selected on the basis of being botanically and hydrologically similar to the experimental pond. The size of the experimental pond was approximately two times larger than the control pond.

At each pond, a total of four Y-shaped drift fence arrays modified from Bury and Corn (1987) were installed roughly equidistantly around the pond perimeter near the ordinary high water line. Drift fences consisted of three two-foot high strips of black siltation fencing. Each array strip or arm began seven meters from the midpoint and was approximately seven meters long. One arm pointed north and the others extended southeast and southwest such that the angle between all arms was 120 degrees.

One screen funnel trap of standard size was placed at the ends of each drift fence strip for a total of 24 traps per pond (six traps per array, four arrays per pond = 24 traps per pond). Traps were operational for a standard seven night period during each month (January-September) and checked daily to reduce amphibian mortality. The monitoring week usually took place during the last week of each month. Aberrations from the standard monitoring schedule occurred only on rare occasions due to extenuating circumstances such as inclement weather or illness.

Near each trap, one three-foot high 1.5” diameter PVC pipe was stood upright in the ground. Standing pipes acted as refugia (not traps) that attracted many treefrogs. Large numbers of tree frogs could be removed, captured and processed. Pipes were checked once during a sampling week. We felt that repeated pipe checks during a week may disturb frogs that take refuge in pipes and ultimately cause a reduction in numbers of treefrogs around wetlands. Individuals captured in drift fence arrays were non-uniquely marked by clipping the outer two toes from the right foot This was done to distinguish between new captures and recaptures to reduce sampling biases and keep sampling efforts equal between study ponds, only new captures from drift fence arrays were used for statistical analysis.

Aural surveys were conducted to record breeding events during one night per sample week, dependent upon the presence of water in the ponds and heavy rains. Dipnetting also was conducted once per sample week to record the presence of larval amphibians whenever pond water levels permitted.

CH2M Hill scientists closely monitored water level fluctuations of the experimental wetland using piezometers and associated monitoring technology. CPI scientists recorded presence or absence of standing water in experimental and control wetland basins on a monthly basis.

The experimental wetland was predetermined (CH2M Hill 1997), and the control pond was selected by University of Florida biologists at the outset of baseline amphibian monitoring (Means 2001). Monetary constraints at the outset of the project limited the number of control ponds to one, and initial lack of landowner access permission limited the length of baseline monitoring to four months (June-September 2000), instead of the desired two years.

Statistics

PRIMER 6 software for MS Windows was used in the analysis of quantitative species diversity data from drift fence arrays (new captures only). The data were converted into captures per unit effort (CPUE) both in the pre and post-hydration periods in order to diminish the effects of comparing periods of unequal sampling duration. Raw data also were smoothed using square root transformation. The Bray-Curtis Similarity Index, widely used for ecological applications, was computed for each study wetland and sampling period. This index was used to compare amphibian community similarity between the two sites before and after active hydration. The Bray-Curtis Similarity Index is actually a distance measure of dissimilarity where coefficients are weighted toward abundant species, with rare species adding little to the value (Dodd *in press*). The measure of similarity is the reciprocal of the calculated value. Bray-Curtis results were visually displayed in a cluster dendrogram and used to interpret diversity changes in the post-augmentation period relative to baseline. A multidimensional scaling (MDS) plot also was used to graphically display Bray-Curtis results. Bray-Curtis does not measure statistical significance; however, it has proven extremely useful in assessing the effects of environmental change on herpetofauna and other taxa during monitoring studies (Pawar *et al*. 2004; Pieterson *et al*. 2006; Dodd *et al*. 2007). Dodd (*in press*) provides a complete description of the Bray-Curtis Similarity Index.

Results and Discussion

<u>Weather</u>

Rainfall data were reported in CH2M Hill (2008b) and are utilized in this report. Average annual baseline period rainfall was 38.4 inches and increased to 48.7 inches during the hydration period (CH2M Hill 2008b). Although average annual rainfall increased significantly during the hydration period, the hydration period was near the historical annual average of approximately 50 inches. The entire study period saw extremes in weather conditions. It was dry and desert-like for the majority of the time punctuated by extreme rainfall events, most notably the intense tropical cyclone seasons of 2004 and 2005. Were it not for the tropical storm activity in those two years, the average annual rainfall measured during the hydration period would be appreciably less. Extreme rain events often occurred when CPI was not actively amphibian monitoring either during the fall or between sampling weeks. Some heavy rainfalls occurred during monitoring weeks and were always accompanied by amphibian capture increases. Droughty conditions always resulted in relatively few captures.

Appendix D, Figures 1 and 2 demonstrate the positive relationship between rainfall and amphibian species diversity at TR study wetlands during the hydration period. Amphibian richness and abundance at both study wetlands were positively correlated to rainfall. The correlation between amphibian activity and rainfall is a well-documented occurrence in amphibian ecology (Gibbons and Bennett 1974, Dodd 1995, R.P.M. Means 2008).

<u>Wetland Hydroperiods</u>

Both the experimental and control wetlands were dry during the four month baseline period (June-September 2000). During the hydration period, both ponds periodically filled and dried, but not always synchronously. The experimental pond typically held water for longer than the control pond during hydration. This difference may have resulted from active hydration. There were not enough baseline data for use as a reference frame to determine whether or not both ponds' hydroperiods were similar before hydration of the experimental wetland.

Appendix D, Figures 5 and 6 demonstrate the relationship of water residency days (number of days in a given year that a pond held water) to species richness, abundance, and to young (metamorphic) amphibian production. While not as strongly correlated as to rainfall, amphibian activity at both ponds was positively correlated to water residency days. These results indicate that amphibians primarily responded to rainfall and secondarily to water residency at TR.

<u>Effects of Augmentation on the Experimental Wetland</u>

Water levels increased in the wetland 5.7 feet during the hydration period compared to the baseline period (CH2M Hill 2008b). The hydration period had approximately ten inches more average annual rainfall than the baseline period. CH2M Hill (2008b) reports that active hydration played a role in the increase and its effects were very quickly realized at the Tillman Ridge site beginning in the first hydration year. Cumulative inputs from rainfall and active hydration had a greater effect on water levels during the hydration period than rainfall alone did during the baseline period (CH2M Hill 2008b). During active hydration periods when no rainfall occurred, water levels at the wetland piezometer increased an average of 0.03 feet per day. When no active hydration and no rainfall occurred, daily water levels fell during both the baseline period (-0.09 feet) and during all five hydration years (-0.13, -0.18, -0.06, -0.06, and -0.11 feet, respectively) (CH2M Hill (2008b).

The application of groundwater did not significantly alter wetland water-quality parameters (pH, conductivity, turbidity, and nutrients) during the hydration period (CH2M Hill 2008b). Measured water quality parameters were similar to expected values for Florida cypress dome wetlands, and did not show any evidence of being influenced by groundwater additions to the wetland during the study (CH2M Hill 2008b). Groundwater was delivered to the wetland edge and allowed to trickle through the leaf litter and soils before reaching the deeper parts of the wetland where water quality samples were collected. For a complete discussion on the hydrological results of this demonstration project, the reader is referred to CH2M Hill (2008b).

Effects of Augmentation on Amphibians

Making a conclusive assessment of amphibian response to augmentation at TR was not possible because of too short of a baseline monitoring period (four months) compared to the hydration period (four years). With such little baseline data, our ability to compare between pre and post-augmentation was very limited. During baseline, we did not sample long enough to accumulate all or most of the species that were hypothetically present at both sites. Furthermore, monitoring only occurred in summertime during baseline; consequently, winter species were not captured. We captured nearly twice the number of species after hydration at both ponds relative to baseline, and that included nearly all of the species expected to occur at the sites.

Results from a Bray-Curtis similarity index indicated that the similarity of the amphibian communities between the experimental and control ponds did not change appreciably between baseline and hydration periods (Figure 2). There was 74% similarity in the amphibian communities of both ponds during baseline, and 70% during hydration. Species diversities at both ponds increased during the hydration period, but they increased in a similar way. This may be an indication that hydration had no measurable effect on the species diversity of the experimental wetland, but without sufficient baseline data, this statement is not definitive.

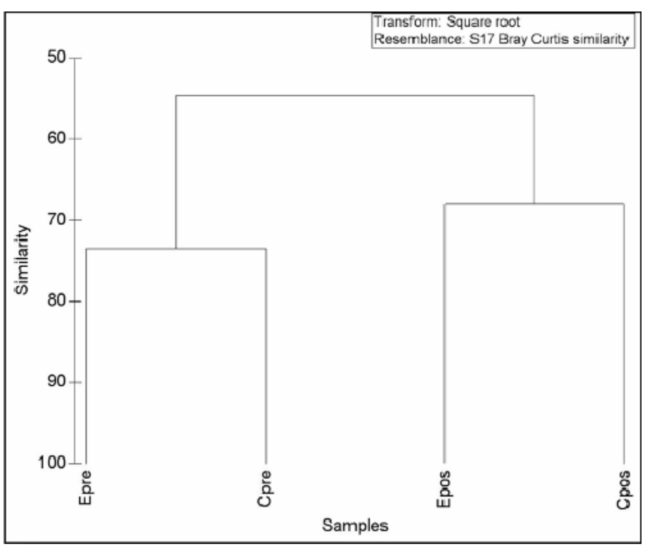


Figure 2. Cluster dendrogram representing Bray-Curtis similarity among experimental and control ponds at Tillman Ridge Wellfield during baseline and hydration periods.

Amphibian reproductive success was measured as the richness and abundance of young, newly recruited amphibians (also called “metamorphs”) that emerged from study wetlands and were captured in drift fence arrays soon after their metamorphosis. No metamorphs were captured during baseline at neither the experimental nor the control pond. This was expected since both ponds were dry during baseline and had been dry for a substantial period. Young individuals were captured during every hydration year for each pond. During hydration, species richness and abundance of metamorphs were almost always substantially higher at the experimental wetland than the control wetland (Appendix E, Figures 3 and 4). It is possible that the higher reproductive output of the experimental wetland relative to the control wetland was the result of hydration. The experimental pond was more reproductively active during hydration period, but we cannot conclude that hydration was the reason for the higher reproductive output of the experimental wetland without having an understanding of the original reproductive conditions of each wetland prior to active hydration.

In summary, the amphibian community of the experimental wetland responded to rainfall, or the lack thereof, throughout the study and secondarily to pond hydroperiod. CH2M Hill (2008b) reported that active hydration measurably increased water levels at the experimental pond. After observing a diverse, healthy, and successfully reproducing amphibian fauna for over four years, it is our opinion that augmentation had no detrimental effects on the amphibian community of the TR experimental wetland. Active hydration might have been beneficial to the amphibian community of the experimental wetland, especially to breeding success. However, we are unable to make definitive scientific conclusions relating to augmentation effects because there were not enough baseline data available for us to have an understanding of the original herpetological conditions of the experimental and control wetlands. Without that understanding, an assessment of the effect of augmentation on amphibians was inconclusive.

BENNETT SWAMP
VOLUSIA COUNTY

BENNETT SWAMP

Site Description

Bennett Swamp (BS) was located 5 miles west of the city of Daytona Beach and 1 mile north of US 92. The swamp was owned by the SJRWMD and managed by the Tiger Bay State Forest, Florida Division of Forestry. Access to the eastern side of the property was through the Tomoka Land Development property along Thayer Canal. Western access was off of Indian Lake Road, which intersects US 92 approximately 5 miles west of Daytona Beach.

BS was a single, large wetland basin approximately 7 miles long, trending NNW to SSW, with a total area of 2540 acres. The wetland basin was dominated by bays, cypress, and pines. Brush thickets were common in areas that burned during the 1998 summer wildfires. Many trees were killed and remained as charred snags throughout the project. BS drains eastward into the Tomoka River, via a man-made canal called Thayer canal. A sand ridge called Rima Ridge bordered the west side of the swamp basin and it attained a maximum elevation of about 45 feet. Upland vegetation on Rima Ridge included patches of sand pine scrub, longleaf pine, and planted slash pine. Four amphibian monitoring stations were placed around the perimeter of the swamp basin. Additional site description information can be found in Means (2001).

Station 1 was located east of Banks Lake entirely within the swamp in a mature loblolly bay forest that held standing water during wet periods. Access was off of Indian Lake Rd. down a small track that eventually dead ends at the upland/swamp ecotone, where the station lies.

Station 2 was located along the northwest edge of the swamp where Rima Ridge sloped into the swamp basin. Site access was off of Bennett Field Rd., a western swamp access road along Rima Ridge. The site was situated on the ecotone between sandhill and swamp basin. The entire area was salvage logged after the 1998 summer wildfires that burned through and killed the majority of trees. Most of the uplands were treeless with herbs and shrubs characteristic of dry sand soils. Longleaf pines were planted here late in 2004. In early January 2005, Station 2 was control burned by Tiger Bay State Forest. The adjacent swamp basin was a dense shrub and briar thicket with areas of standing water.

Station 3 was located along the northeast edge of the swamp in a mixed slash pine and loblolly bay stand. The area burned during the 1998 summer wildfires, but by 2004, dense shrubby and herbaceous undergrowth had returned to the site. The station was established in a low-lying area that flooded during wet periods. Access was off of Slim Pines Rd on the eastern side of the swamp within the Tomoka Land Development property.

Station 4 was located on Hayes Island along an old logging track. Access was limited by a cable gate off of where Slim Pines Rd intersected Thayer Canal within Tomoka Land

Development property. The array was established in a stand of slash pine, about 50 yards west of a large area of bay swamp. The station was set near an ephemeral borrow pit within a dense planted slash pine forest. Understory consisted of pine needles and occasional shrubs.

Passive Hydration

A water retention weir was constructed across Thayer canal in January 2004, which acted to retain surface water flowing out of the swamp. The weir was operational through April 2008. This weir was designed to increase the hydroperiod and aquifer recharge of BS. Extreme flooding was avoided by allowing rain water from flood events to overtop the weir (CH2M Hill 2008a). The control elevation of the weir was set at 27.5 feet (NGVD29), two feet above the invert elevation of Thayer Canal at that location, and was designed to increase the wetland average seasonal high in 6-inch increments to 2 feet above the canal's invert, and wetland outflow elevation (CH2M Hill 2008a).

Methods

Amphibian monitoring methodology for the post-augmentation sampling period was identical to the baseline sampling period. Four drift fence arrays identical to those in use at TR and PO were employed around the perimeter of BS, one drift fence array (three arms, six traps) per each monitoring station. Additional amphibian sampling techniques were utilized at each station including dipnetting and aural surveys. Traps were operational for a seven night period during each month (January-September) and checked daily to reduce amphibian mortality.

Presence or absence of standing water at the four monitoring stations was recorded monthly. All stations did not necessarily dry and fill with water in unison during the study, however, if any of the stations recorded standing water then it was assumed that BS as a whole had standing water somewhere in the basin.

Amphibian monitoring baseline period and hydrological monitoring baseline period were different because of logistical constraints. Amphibian baseline took place from January through September of 1999 and 2000. Hydrological baseline took place from February 2000 through September 2003.

The study design was predetermined before the outset of baseline monitoring. There were no control wetlands monitored at the BS study site due to logistical and monetary constraints and the unavailability of a nearby similar site. CPI inherited the study design during the operational period.

Statistics

PRIMER 6 software for Windows was used for statistical computations. Quantitative species diversity data from drift fence arrays (new captures only) were converted into captures per unit effort (CPUE) both in the pre and post-hydration periods in order to diminish the effects of comparing periods of unequal sampling duration. Raw data also were smoothed using square root transformation. The Bray-Curtis Similarity Index, widely used for ecological applications, was computed for each sampling period. This index was used to compare amphibian community similarity of BS before and after passive hydration. Bray-Curtis results were used to interpret diversity changes in the operational period relative to baseline. Bray-Curtis results were visually displayed in a cluster dendrogram and used to interpret diversity changes in the post-augmentation period relative to baseline. A multidimensional scaling (MDS) plot also was used to graphically display Bray-Curtis results. The reader is referred to the “Statistics” heading of the Tillman Ridge section of this report and to Dodd (*in press*) for a complete description of the Bray-Curtis Similarity Index.

Results and Discussion

Weather

Rainfall data were reported in CH2M Hill (2008b) and are utilized in this report. Weather conditions were droughty with a few heavy rains during amphibian baseline, but it was wetter on the average during hydrological baseline than during the operational period. Operational period monitoring was the same for both amphibian and hydrological aspects of the study (January 2004-April 2008). During the operational period, annual rainfall totals were well above historical annual average at the beginning and dropped to well below average by the end of the period. From early 2006 through the end of the study, conditions at BS were droughty. The entire study period saw extremes in weather conditions. It was dry and desert-like for the majority of the time punctuated by extreme rainfall events, most notably the intense tropical cyclone seasons of 2004 and 2005. If it were not for the tropical storm activity in those two years, the average annual rainfall measured during the hydration period would be appreciably less, and average annual rainfall would have been below historical average. Extreme rain events often occurred when CPI was not actively amphibian monitoring either during the fall or between sampling weeks. Some heavy rainfalls occurred during monitoring weeks and were always accompanied by amphibian capture rate increases. Droughty conditions always resulted in relatively few captures.

Wetland Hydroperiod

Standing water was observed at BS stations throughout the first year (1999) of amphibian monitoring baseline. By March 2000, the swamp basin in the vicinity of all monitoring stations had dried. A heavy rain in April 2000 rehydrated most stations and standing water remained for a short period through May. By June 2000, all stations were dry again and remained so throughout the rest of the baseline period (through September 2000).

Standing water levels during the operational period were generally high relative to baseline within the first two hydration years because of large rainfall inputs from the

2004 and 2005 tropical cyclone seasons. BS continuously had standing water at some or all of the monitoring stations during this time. Inflow and outflow creeks/canals to and from the swamp were flooded and many access roads were difficult to travel. However, a marked drying trend in the swamp basin began in late 2005 concurrent with decreasing monthly rainfall totals and what would become the beginning of persistent droughty conditions in the area for the remainder of the operational period. In May 2006, standing water at all amphibian monitoring stations dried and remained so for the rest of the study through April 2008.

Effects of Passive Hydration on Bennett Swamp

Measurable water levels increased in the wetland 0.61 feet at the Thayer Canal transect located near the control structure during the operational period compared to baseline. Surface water levels fell more slowly within the effective height of the weir during the operational period compared to baseline at the Thayer Canal transect. This indicated that the weir had the desired effect of retaining surface waters for longer periods with slower attenuation (CH2M Hill 2008b).

Surface water samples collected exhibited water quality typical of central Florida forested black water swamps (CH2M Hill 2008b). Water quality values were similar between baseline and operational periods. Water quality parameter values, from the three monitoring transects within Bennett Swamp, were similar to one another. Values measured were low pH, conductivity, nutrients, and total dissolved solids; and high color (CH2M Hill 2008b).

Effects of Passive Hydration on Amphibians

Results regarding the effect of passive hydration on amphibians at BS were inconclusive because there were no available control sites for use as reference frames for the Bennett Swamp demonstration project. We could not definitively say whether amphibians at BS responded to passive hydration without being able to compare BS to a similar untreated control wetland.

Results from the Bray-Cutis Similarity Index indicate that amphibian species diversity during baseline was fairly similar (65 percent) to that of the operational period (Figure 3). Species diversity peaked in the first two years of hydration. Average annual rainfall during baseline was reportedly greater than that of the operational period. Increased rainfall from the tropical cyclone seasons of the first two hydration years (2004 and 2005) were accompanied by marked increases in amphibian species diversity relative to baseline at BS (Means and Meegan 2005). Intense drought during the last half of the operation period smoothed out the effects of increased rainfall early on in operation by reducing measured species diversity. The opposing effects of rainfall and drought during the longer operational period smoothed out species diversity such that overall, it measured similar to that of baseline. This shows that short term fluctuations are not always congruent to long term trends.

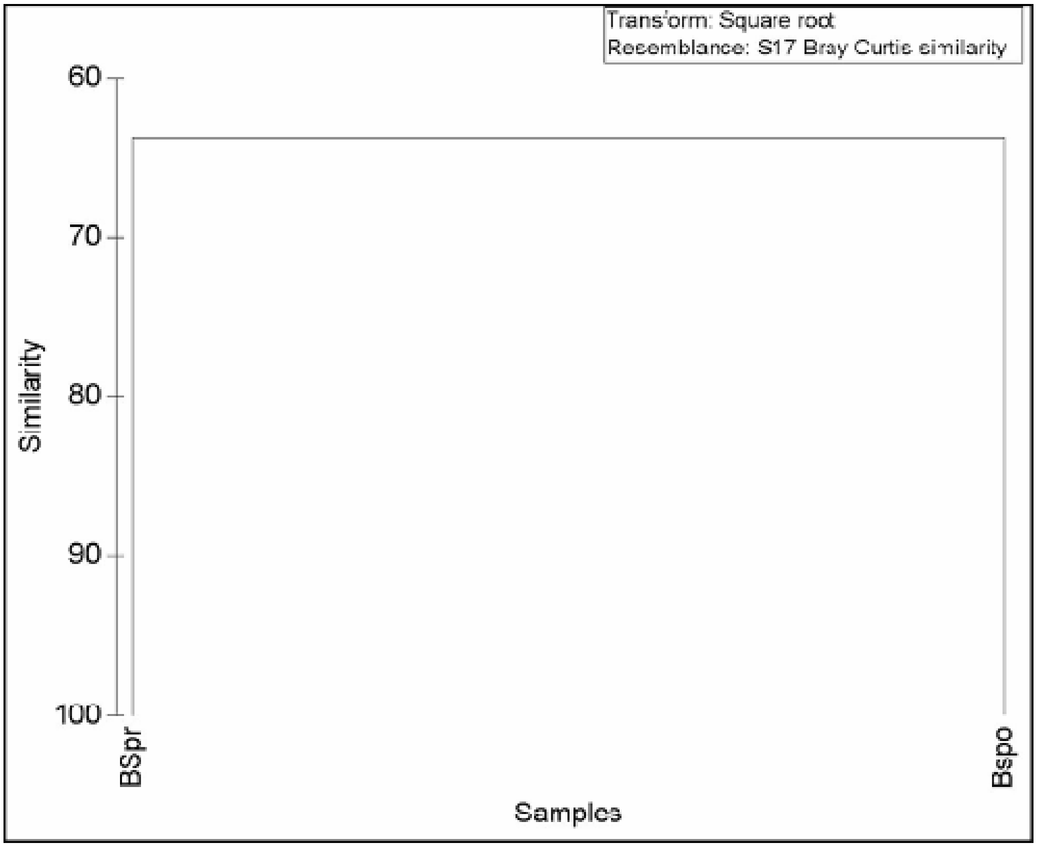


Figure 3. Cluster dendrogram representing Bray-Curtis similarity between baseline and operational periods at Bennett Swamp.

Amphibian reproductive success was measured as the richness and abundance of young, newly recruited amphibians that emerged from study wetlands and were captured in drift fence arrays soon after their metamorphosis (Appendix E, Figures 7 and 8). In each of the baseline and first two years of hydration, amphibian reproduction was measurably existent and apparently healthy. Beginning in 2006, young metamorph species richness and abundance steeply dropped to zero and remained so through the end of the study in 2008. This sharp decline in measured amphibian reproduction was concurrent with the onset of severe drought conditions and wetland basin dry-up.

In summary, CH2M Hill (2008b) reported that passive hydration slightly increased the amount of water held at BS, but no conclusive assessment on whether passive hydration affected amphibians could be made. However, after observing a diverse, healthy, and successfully reproducing amphibian fauna for over five years, we feel that passive hydration had no detrimental effects on the amphibian community of BS. Throughout both phases of the project, amphibian species diversity waxed and waned with increased and decreased rainfall, respectively. By the last two and a half years of the project, there were very few amphibian captures and no reproduction relative to the rest of the study. We hypothesize that amphibians will become active again (e.g. species diversity will increase) in the swamp basin when normal rainfall and swamp inundation return. The life histories of amphibians, in general, make them well-suited to withstand drought, and this surely is not the only drought to have happened in east-central Florida.

PORT ORANGE WELLFIELD
VOLUSIA COUNTY

PORT ORANGE WELLFIELD

Site Description

Port Orange Wellfield was located along the west side of Tomoka Farms Rd approximately two miles south of US 92 on the outskirts of Daytona Beach. The gated entrance to the property was on Shunz Rd adjacent south of the Volusia County landfill. PO was owned by the City of Port Orange.

The wellfield property was approximately 16,000 acres primarily utilized as a water recharge and supply area for municipal purposes. Several water supply wells located along the property's paved road system pumped groundwater to nearby cities on a rotational schedule. PO was almost entirely forested in mixed slash pine and longleaf pine (*Pinus palustris*) flatwoods. Hundreds of small to large ephemeral cypress-dome ponds were scattered across the flatwoods landscape. One sandhill ridge complex called Rima Ridge spanned north to south roughly through the center of the property. Elevations associated with the ridge averaged 40 feet, with higher points exceeding 45 feet. Some intact longleaf pine-wiregrass community occurred on the ridge. Of the four properties studied in this project, PO was the best ecologically managed. Extensive areas of relatively healthy native Florida ecosystems were present. The land was used for additional purposes including hunting, off-road vehicular riding, horseback riding, and limited timber harvesting. Additional site description information can be found in Means (2001).

The project study wetlands were located along the eastern side of Tiger Bay Swamp in extensive flatwoods. Three of the study ponds were located adjacent to well pumphouses. The fourth study pond was located on the south side of the property, approximately one mile south of the other three. All of the ponds were dominated by pond cypress (*Taxodium ascendens*) with occasional black gum and slash pines present.

The experimental wetland (Pond 1) received supplemental water on a predetermined schedule. It was located directly south of Well 19 on Puddle Lane. It was a shallow cypress pond with an area of approximately six and a half acres. Severe wildfires in summer 1998 burned entirely through the depression and surrounding flatwoods. Pines and bays were killed in the fire, but most of the cypress survived. By project's end in 2008, remains of the 1998 wildfires were barely detectable, save for a few charred dead snags. A blanket of nearly continuous herbaceous vegetation returned to the pond basin by about three or four years after the fires. On the north side of the pond, a ten meter wide fire line was constructed to fight the 1998 fires. This feature still existed at project's end. The fire lane may have altered the hydrology of the north side of the wetland. Furthermore, there were deep roadside ditches along Puddle Lane adjacent to the pond. When the pond dried during normal dry periods, the ditches sometimes contained deep puddles. The ditches may have served as refuges for aquatic species such as predatory fish that normally would have been eliminated during pond dry-up.

Pond 2 was a control pond located approximately 650 m southeast of Pond 1 and was adjacent north of Well 16. It was very similar to Pond 1, with pond cypress dominating the wetland. Pond area was approximately eight acres. Pond 2 historically was part of a larger strand complex, but was bisected by the paved narrow access road. Like at Pond 1, deep ditches existed at Pond 2 along the access road, and culverts allowed the intermixing of water from both sides of the road. Wildfires swept through the pond during summer 1998, also killing some of the pines and cypress in the depression. Other than a few snags, evidence of the 1998 wildfires was barely detectable by project’s end. Herbaceous vegetation gradually returned to most parts of the depression by four or five years after the fire. A continuous shallow fireline ditch surrounded the wetland.

Pond 3 was the largest of the study ponds with an area of nearly 15 acres. This control pond was dominated by cypress and had more young slash pines than the other study ponds. The abundance of young slash pines may indicate wetland disturbance due to aquifer drawdown, but this statement is only speculative. Pond 3 was located north of Pond 1 approximately 900 m and was adjacent west of Well 11 off Harley Rd. The pond depression was protected from the 1998 summer wildfires by a 30 m wide fire line that was put in on the south side of the wetland within wetland boundaries. This treeless swath began at the end of Shunz Road. During pond fillings, the denuded swath nearest the wetland formed a muddy puddle of open water. As a result of fire exclusion in 1998, the understory character of the wetland remained thickly herbaceous during baseline in contrast to the denuded, charred wetland floors of the other three study ponds that burned. By midway into the project, the groundcover of the other three wetlands that had burned in 1998 resembled that of pond 3. U.S. Interstate Highway 4 (I-4) borders the northern fringes of Pond 3.

Pond 4 was a control pond located outside of the cluster of Ponds 1, 2, and 3. It was approximately 1.5 miles southeast of pond 1, and 0.4 miles east of a major powerline. It had an area of four acres. Pond 4 was not located adjacent to a pump station like the other three study ponds. The depression burned in the summer of 1998, and herbaceous understory vegetation had gradually returned in the years since the fires, like at ponds 1 and 2. An old fireline ditch encircled the pond. The ditch would sometimes retain water puddles when the rest of the original pond basin dried.

Active Hydration

A description of water delivery to the experimental wetland (Pond 1) at PO was paraphrased from CH2M Hill (2008b). Groundwater, presumably from the Upper Floridan aquifer, was pumped from an existing, on-line well (#19) at an average rate of approximately 360,000 gallons per day. Approximately two inches of water across the 6.5-acre wetland was generally delivered in a 24-hour period. Approximately four million gallons per year were delivered to the wetland. Hydration water was applied on a schedule that mimicked the pattern of the average monthly rainfall, with no active hydration during the dry season.

Methods

The study design for PO was the most robust of the four study sites within this pilot study. Monitoring methodology for baseline and hydration periods was identical. The monitoring methods employed at PO were the same as those used at TR except for three differences. First, there were three control ponds at PO versus one control pond at TR. Second, baseline monitoring lasted for two years at PO versus only four months for TR. Last, the hydration period at PO lasted five years versus four at TR. The PO experimental pond (Pond 1) was predetermined (CH2M Hill 1997), and the control ponds (Ponds 2-4) were selected by University of Florida biologists at the outset of baseline amphibian monitoring (Means 2001). The control ponds were selected on the basis of being botanically and hydrologically similar to the experimental pond. Control ponds were located nearby to the experimental pond. Presence or absence of standing water in all four study ponds was recorded monthly. The reader is referred to the TR Methods section of this report for a complete description of amphibian monitoring methods.

Statistics

PRIMER 6 software for MS Windows was used in the analysis of quantitative species diversity data from drift fence arrays (new captures only). The data were converted into captures per unit effort (CPUE) both in the baseline and post-hydration periods in order to diminish the effects of comparing periods of unequal sampling duration. Raw data also were smoothed using square root transformation. The Bray-Curtis Similarity Index, widely used for ecological applications, was computed for each study wetland and sampling period. This index was used to compare amphibian community similarity between four sites before and after active hydration. Percent similarity between study wetlands before and after hydration was visually presented in a cluster dendrogram. A multidimensional scaling (MDS) plot of the Bray-Curtis values was utilized to visually interpret diversity changes in the post-augmentation period relative to baseline. The reader is referred to the “Statistics” heading of the Tillman Ridge section of this report and to Dodd (*in press*) for a complete description of the Bray-Curtis Similarity Index.

Results and Discussion

Weather

Rainfall data were reported in CH2M Hill (2008b) and are utilized in this report. Average annual baseline period rainfall was 48 inches and increased to 58 inches during the hydration period (CH2M Hill 2008b). Baseline average annual rainfall was similar to the historical average of approximately 50 inches, while the hydration period saw a 10 inch increase annually. These figures can be misleading, however. The entire study period saw extremes in weather conditions. It was dry and desert-like for the majority of the time punctuated by extreme rainfall events, most notably the intense tropical cyclone seasons of 2004 and 2005. Were it not for the tropical storm activity in those two years, the average annual rainfall measured during the hydration period would be substantially less.

Extreme rain events often occurred when CPI was not actively amphibian monitoring either during the fall or between sampling weeks. Some heavy rainfalls occurred during monitoring weeks and were always accompanied by amphibian capture rate increases. Droughty conditions always resulted in relatively few captures.

Appendix D, Figures 3 and 4 demonstrate the positive relationship between rainfall and amphibian species diversity at the study wetlands. While amphibian response at some ponds showed more direct correlation with rainfall, all four study ponds generally had a positive correlation between rainfall and number of individuals and species. The correlation between amphibian activity and rainfall is a well-documented occurrence in amphibian ecology (Gibbons and Bennett 1974, Dodd 1995, R.P.M. Means 2008).

Wetland Hydroperiods

Throughout the baseline and hydration periods, the experimental pond (Pond 1) and the additional three CPI control ponds (Ponds 2-4) all filled and dried synchronously in response to rainfall or droughty conditions. During heavy rain events, all ponds became hydrated. Lengthy dry periods would dry out the pond basins, and all would dry within the same month, and whenever dry-up occurred within our sampling week, all pond dry-ups occurred within the same week. Beginning in early 2006, all study ponds dried and remained dewatered through the end of amphibian monitoring in September 2007. The drying of the wetlands was concurrent with the onset of severe drought conditions.

Appendix D, Figures 7-10 demonstrate the relationship of water residency days (number of days in a given year that a pond held water) to species richness, abundance, and young (metamorphic) amphibian production at study wetlands during the hydration period. From year to year, amphibian activity was not consistently correlated with water residency days at any of the study wetlands. A general trend for all ponds was that as water residency approached zero at the end of the study, amphibian activity also became greatly reduced. Amphibian activity at the experimental pond did not exhibit any outstanding trends with respect to control ponds. Our results indicated that amphibians primarily responded to rainfall and secondarily to water residency at PO.

Effects of Augmentation on the Experimental Wetland

Daily water levels during the baseline period averaged 36.69 feet. During the hydration period, water levels averaged 37.48 feet, 0.79 feet greater than the baseline period (CH2M Hill 2008b). The hydration period had approximately ten inches more average annual rainfall than the baseline period. Increases in water levels at the wetland piezometer were not observed on days when only active hydration and no rainfall took place. On these days during the hydration period, water levels in the wetland piezometer decreased an average of 0.03 feet per day, indicating that the wetland may have been discharging to the Surficial Aquifer System (CH2M Hill 2008b). Water levels also decreased in the same piezometer an average of 0.03 feet when no hydration and no rainfall occurred (CH2M Hill 2008b). CH2M Hill's hydrological data also indicated that cumulative inputs from rainfall and active hydration had a slightly greater effect on water levels during the hydration period than rainfall alone did during the baseline period (CH2M Hill 2008b). Hydroperiod observations from the three CPI control ponds in conjunction with CH2M Hill hydrological data from the experimental wetland indicated that rainfall had a much greater effect on water level fluctuations than did augmentation.

Active hydration had no long term, measurable effect on water quality in the experimental wetland. Water quality parameters were similar during the baseline and hydration periods and were typical of a central Florida stillwater cypress swamp (CH2M Hill 2008b). Values for pH, conductivity, total suspended solids, metals, and nutrients were typically low. For a complete discussion on the hydrological results of this pilot project, the reader is referred to CH2M Hill (2008b).

Effects of Augmentation on Amphibians

There was sufficient study design rigor at PO in place to make a conclusive assessment of amphibian response to hydration, provided that hydration itself had a noticeable effect on the experimental wetland. Although CH2M Hill (2008b) reported that there was a modest effect of hydration on the water level of Pond 1, from an amphibian's perspective, the effects were not great enough. That the experimental and control ponds all filled and dried synchronously during baseline and hydration periods indicated that any hydroperiod boost at Pond 1 measured by CH2M Hill was not readily noticeable within monthly CPI sampling visits during hydration. Furthermore, wetland water quality remained unchanged after hydration.

Results from a Bray-Curtis Similarity Index are displayed in both a cluster dendrogram (Figure 4) and a MDS plot (Figure 5). Results indicate that the species diversities of Ponds 1, 2, and 4 were similar (70 percent) to one another in both pre and post augmentation. Ponds 1 and 2 were even more highly similar (80 percent) to one another in the pre and the post periods. Results indicated that there was no measurable effect of hydration on amphibian species diversity of Pond 1 relative to two control ponds. These results should be expected, since there was no substantial effect of hydration on abiotic conditions of Pond 1. If abiotic factors (e.g. water quality or hydroperiod) at Pond 1 had changed, then one might hypothesize that species diversity also would have changed there. But this was not the case. Without any noticeable effects of hydration on the experimental wetland, it was not possible to make a definitive assessment of the effects of hydration on the amphibian community at the PO experimental wetland. Therefore, results regarding the possible effects of active hydration on amphibians at PO were inconclusive.

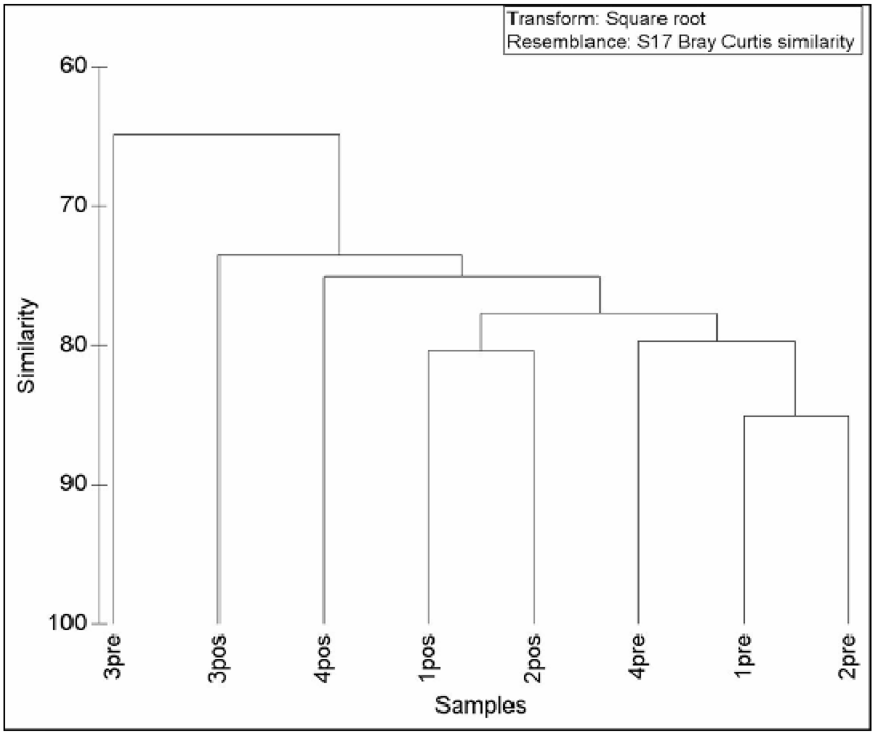


Figure 4. Cluster dendrogram representing Bray-Curtis similarity among experimental and control ponds at Port Orange Wellfield during baseline and hydration periods.

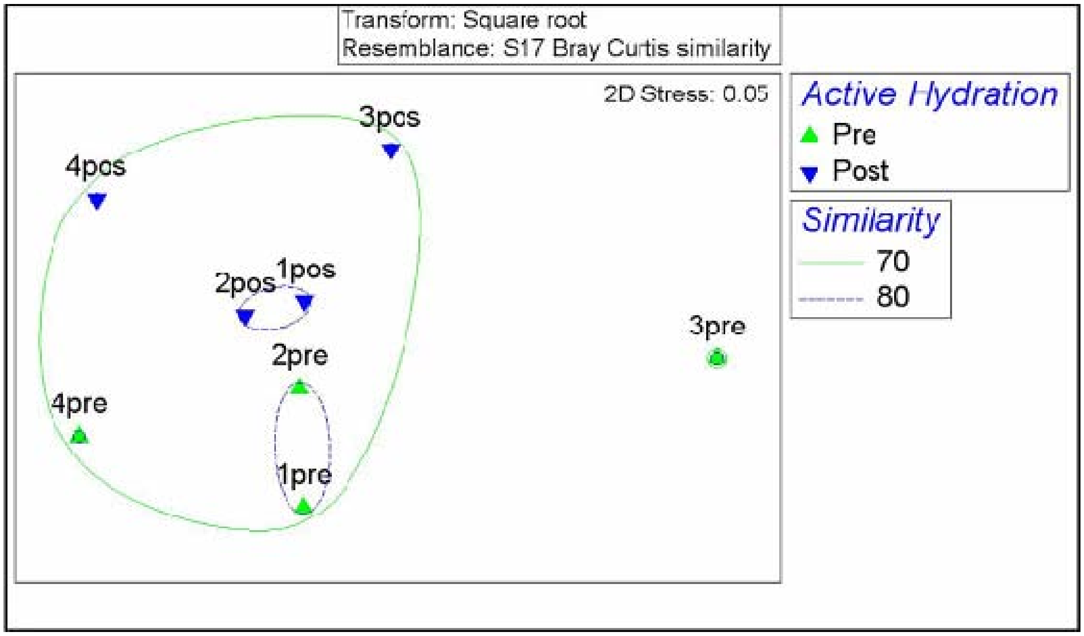


Figure 5. Multidimensional scaling plot representing Bray-Curtis similarity among experimental and control ponds at Port Orange Wellfield during baseline and hydration periods.

As an aside, results from Pond 3 (control pond) were very interesting and may indicate an effect of wildfire on species diversity of this pond. As mentioned in “Site Descriptions,” Pond 3 was the only PO study pond that did not burn during the severe wildfires of 1998. The other three ponds (Ponds 1,2 and 4) burned thoroughly, The MDS plot (Figure 5) clearly shows that Pond 3 was dissimilar to Ponds 1,2 and 4 during the pre-treatment phase, but by the end of the study, it became highly similar (at least 70 percent) to the other ponds. We suggest that, as ecological succession returned the physical attributes of Ponds 1, 2 and 4 back to a state similar to unburned Pond 3, amphibian species diversity of all ponds gradually became more similar.

Amphibian reproductive success was measured as the richness and abundance of young, newly recruited amphibians that emerged from study wetlands that were captured in drift fence arrays soon after their metamorphosis (Appendix E, Figures 11 and 12). In general, the reproductive output of all ponds was similar during baseline and the first three hydration years. But from 2006 until project’s end in 2007, no amphibian reproduction was recorded. This sharp decline in reproductive success was concurrent with the onset of severe drought conditions in 2006 and 2007. Results from amphibian reproductive data also suggest that the amphibian community of the experimental pond did not substantially differ from control ponds from pre to post-augmentation.

In summary, hydrological results from both CH2MHill and CPI showed that augmentation had no appreciable effect at the PO experimental wetland. Therefore, no conclusive assessment of the amphibian response to augmentation could be made. Analysis of amphibian species diversity and reproductive data indicated that the amphibian species communities of experimental and control wetlands were similar during baseline and hydration periods. This should be expected since there was no appreciable effect of hydration on the treated wetland. Amphibian activity and reproduction sharply declined starting in early 2006 with the onset of drought and remained low through project’s end in 2007. Throughout both study phases, amphibian activity and reproduction waxed and waned responding to wet and dry periods, respectively.

PARKLAND WETLAND
BREVARD COUNTY

PARKLAND WETLAND

Site Description

Parkland Wetland (PW) was located northwest of the Titusville water treatment plant, north of SR 406, between Dixie Hwy and I-95. The wetland was owned by the City of Titusville. The wetland served as a water supply source to the City of Titusville as well as recharge area to the surficial aquifer.

Parkland Wetland was a natural depressional wetland with a total area of 100 acres embedded within a suburban landscape associated with the western edge of the city of Titusville. The uplands on the west side of the depression exceeded 50 feet in elevation, and those on the east rose to about 30 feet. Dense thickets of willow (*Salix* sp.) and patches of red maple (*Acer rubrum*) dominated the vegetation of PW. Open areas contained dense patches of cattail (*Typha* sp.), maidencaine (*Panicum hemitomum*), wax myrtle (*Myrica cerifera*), and blackberry (*Rubus* sp.). Brazilian Pepper (*Shinus terebinthifolius*) and other exotics also were common in and around PW. The perimeter was almost entirely surrounded by high-density housing with little or no natural plant buffers. Astronaut High School was located on the southwest perimeter. Tiny patches (< one acre) of the original upland plant communities remained around the fringes of the wetland, including longleaf pine on the east side. By 2004, small remaining patches of sand pine scrub north of the high school were eliminated and replaced with additional high-density housing. Four stations were distributed around the perimeter of the wetland and were inventoried for amphibian species.

Station 1 was located in a dense willow-red maple thicket along the southwest wetland margin in back of Astronaut High School. It was bordered by open sand, school grounds, and high density housing. By 2004, new housing eliminated all patches of sand pine scrub that once stood here during baseline through early in the operational period.

Station 2 was located in a dense wax myrtle thicket along the east central shore of PW at the end of Bonnymeade Street. A small remnant patch of longleaf pine sandhill community lies adjacent to the wetland. The area had large longleaf pines and a small live oak hammock. Houses were nearby, and off-road-vehicle trails penetrated all areas. Active gopher tortoise burrows were present, and old adult tortoises were often observed on site.

Station 3 was located at a permanent open water body along Elder Street. The approximately two acre body of water was in the southeast corner of PW. We believe that this water body was a man-made structure serving as a water retention pond. It was bordered by houses, yards, and fences along its south and east perimeter.

Station 4 consisted of an outflow canal that drained the northern part of PW. It was a steep-sided ditch cut through an urban neighborhood next to a convenience store on Singleton Avenue.

Passive Hydration

A water retention weir was constructed across a canal draining north out of PW and was operational May 2002. The objective of the weir was to hold more naturally occurring surface water within the system for a longer duration by raising the outlet elevation without increasing flooding from major storm events CH2M Hill (2008b).

Methods

The PW study site was predetermined, and no control wetlands were selected for amphibian sampling because of logistical constraints and the unavailability of a nearby similar site. Sampling methodology during baseline and operation was identical. Four stations were inventoried for amphibian species richness around the perimeter of the wetland. Inventory techniques consisted of generalized searching, dipnetting for larvae, and frog call surveys at each of the four sampling stations. Presence or absence of standing water at the four monitoring stations was recorded per site visit. All stations did not necessarily dry and fill with water in unison during the study, however, if any of the stations recorded standing water then it was assumed that PW as a whole had standing water somewhere in the basin. PW was inventoried during one day each in the months of February (winter), April (spring), July (summer), and September (fall) in 1999 and 2000 (baseline) and 2003-2006 (operation period). To diminish the effects of comparing data from periods of unequal duration, we compared the species observed per unit effort for both the pre and post-operation periods. Because of site vandalism and logistical and monetary constraints early in the study (1999 and 2000), no standard on-site trapping devices were employed at PW. Because of aforementioned constraints, no quantitative data were obtained at PW. Lack of quantitative data diminished our ability to make a definitive assessment of amphibian response to passive hydration at this site.

Results and Discussion

Weather

Rainfall data were reported in CH2M Hill (2008b) and are utilized in this report. Rainfall during the baseline period averaged 51 inches annually. This figure is very close to the historical annual average of approximately 50 inches. Operational period annual rainfall averaged 58 inches, which was eight inches above average. Increased annual rainfall during operational period resulted largely from inputs from the heavy tropical cyclone seasons of 2004 and 2005. Even though PW received consistently more rainfall throughout baseline and operational periods than the other three study sites, there still were lengthy periods of dryness punctuated by heavy rains in both study phases. CH2M Hill (2008b) has further discussion on rainfall trends for PW.

Wetland Hydroperiod

Water was present above the wetland ground surface 68 percent of the time during baseline and 99 percent of the time during operation (CH2M Hill 2008b).

Effects of Passive Hydration on Parkland Wetland

During the operational period, the surface water was held at higher elevations and for longer periods than during the baseline period. Average baseline and operational periods daily water elevations differed by a mean value of 1.55 feet (CH2M Hill 2008b).

Water quality parameters were within expected values for surface water systems in Brevard County and adjacent areas in central Florida. The Parkland Wetland exhibits water quality typical of Class III Surface Waters and a wetland receiving runoff from an urban area. The operational period did not significantly affect water quality parameters compared to the baseline period (CH2M Hill 2008b).

Effects of Passive Hydration on Amphibians

Making a definitive assessment of the effects of passive hydration on amphibians was not possible because of the lack of quantitative sampling and unavailability of a control site. However, drawing from the experience of conducting inventories on this wetland before and after weir installation, the authors believe that the amphibian fauna of PW was neither positively nor negatively affected by the installation of a weir during the course of this project. Amphibian activity and reproduction were affected by rainfall and drought throughout the study. Numbers of species of adults and larvae increased during rainy periods and decreased during dry periods both before and after passive hydration.

Five species were observed during baseline. Ten species were observed during the operational period. Sampling duration was twice as long in post-operation period than in the pre-operation period. Except for one species (the two-toed amphiuma), species composition of baseline was a subset of that for post-operation. This similarity is probably because we did not have time enough to observe all potential species for the site during the shorter baseline sampling period. If given enough time in baseline, we probably would have accumulated equal or very similar species composition as that observed during post-operation. The drop out of the two-toed amphiuma in post-operation probably is explained by sampling bias, not a true species decline.

To diminish the biasing effects of comparing data from periods of unequal duration, we computed the species observed per unit effort and determined that the total number of amphibian species observed per unit sampling effort was identical for the pre and post-operation periods. This provided an indication that the amphibian species richness did not measurably change from baseline to operation. All species observed were expected occurrences for this location.

OVERALL PROJECT DISCUSSION

Although results from this study were inconclusive regarding the effects of active or passive hydration on amphibians, other studies from around the Southeast confirm that there can be both positive and negative effects on amphibians from active hydrations. A recent study from southern Louisiana demonstrated benefits of wetlands augmentation to pond breeding amphibians (Seigel *et al*. 2006). During a seven-week period, researchers added 366,000 L of water from nearby wells to an important breeding pond of the highly imperiled dusky gopher frog (*Rana sevosa*). Water level of the pond was increased and maintained during a dry period until a heavy natural rainfall filled the pond basin. This avoided what may have been a complete larval mortality. Instead, 130 metamorphic frogs were produced in the first successful reproduction in three years. In this case, the addition of supplemental water into a breeding pond allowed a rare species to successfully reproduce and avoid possible extirpation.

A study of a 30-year groundwater augmentation at Round Pond in Hillsborough County, Florida, provides an example of negative effects to fauna of altering water quality of treated wetlands (Brenner *et al*. 2000). This research documented the bioaccumulation of ^{226}RA in fishes (bone), unionid mussels (shell and mantle), plants, and lake-bottom sediments from groundwater originating in phosphate-rich sediments of the Floridan aquifer system in the Tampa Bay area. The data suggest that high levels of radium in soft tissues could represent an important pathway for transfer of radionuclides into higher trophic levels in both aquatic and terrestrial food webs.

This SJRWMD augmentation pilot study was the first to investigate the effects of augmentation on amphibians at impacted sites in east central Florida. A second similar study in the Southwest Florida Water Management District (SWFWMD) was initiated in October 1997 at an impacted wellfield site called Brooker Creek Preserve (Wildlands Conservation *in press*). During their study’s baseline period, experimental wetlands were characterized as severely desiccated communities with xeric-adapted species present such as the six-lined racerunner (*Cnemidophorus sexlineatus*). Virtually no aquatic amphibians had been observed in these impacted wetlands since the El Niño rainfall pattern of 1997-98. In the first augmentation year (2003), increased rainfall led to an increased occurrence of wetland adapted species such as the southern leopard frog (*Rana sphenocephala*) and pig frog (*R. grylio*) at both experimental and control sites. Because of vacillating climate extremes during their study, wetlands quickly went from having wildlife populations comprised predominantly of species found in xeric and mesic habitats to rapid influxes of species that prefer wetlands—and back again. In that study, amphibians and birds seemed to respond most readily to hydrological changes (Wildlands Conservation *in press*). Their study’s results mirrored our own in that species apparently responded well to increased rainfall and hydroperiod in both augmented and non-augmented wetlands.

Inconclusive results from our amphibian study resulted from several factors. Insufficient study design at three sites (TR, BS, PW) eliminated our ability to make definitive final assessments in this study. At PO, there was sufficiently rigorous experimental design in order to make a definitive assessment of amphibian response to augmentation; however, from an amphibian's perspective, water input was not significant enough to measurably affect the experimental wetland. In this study, weather conditions often were marked by severe drought. During drought, at PO, supplemental water from augmentation typically did not remain for long on the surface of the experimental wetland. Supplemental water, when applied to the parched wetland basin, rapidly percolated into the surficial aquifer system. There was not the requisite boost in hydroperiod that amphibians needed in order to breed more successfully or sustain high activity during drought.

Of particular concern in this study was whether augmentation using water of a different chemical constitution in experimental wetlands would have significant impacts on the species diversity or reproductive success of pond-breeding amphibians present in these wetlands. Hydrological results from this study indicated that measured water quality parameters did not differ between baseline and hydration/operational periods. This probably resulted from a combination of factors including well-conceived hydration techniques utilized by CH2M Hill, dilution by heavy rain, and some discharge of supplemental water into the surficial aquifer system. Introducing groundwater to the wetland's edge to allow groundwater to be conditioned by wetland soil and detritus as described in CH2M Hill's report likely will benefit amphibian populations because water quality changes will be diminished by this technique. Amphibians can be very sensitive to water quality changes. That water quality did not change at any of the study sites is encouraging and positive from a management standpoint. In future augmentations, water quality should be monitored.

CH2M Hill (2008b) showed that measured water levels at experimental wetlands were higher during hydration/operation periods for all sites. Cumulative inputs of water from increased rainfall and augmentation during hydration periods were the reason for higher water levels. CPI reported that both control and experimental wetlands filled and dried in unison at PO throughout the entire study. These observations indicated that rainfall dictated the hydrological regime of the experimental wetland at PO. To what extent hydration might have added to the hydroperiod of the experimental pond is unknown and seems insignificant given observations from control ponds. If impacted wetlands are to be artificially hydrated in the future (either active or passive), then what impacted amphibian populations need most out of this procedure is an increase in water residency time (hydroperiod) such that larvae will have enough time to fully metamorphose and recruit into surrounding uplands. The amphibian community of a given wetland should benefit from having standing water during drought periods when other area wetlands are dry.

The scheduling of water inputs into the active hydration sites (PO and TR) was well-conceived in this study. Water was added to wetlands during wet seasons and wetlands were given the opportunity to dry during dry seasons. This should be the approach in any future augmentations of ephemeral wetlands. Water levels should be monitored in any future augmentations in order to verify that the targeted hydrograph is attained. Water input design and scheduling were reported in CH2M Hill (2008b).

During periods of impending wetland dry-up, it would be beneficial to amphibians to augment at this time to boost hydroperiod long enough for successful metamorphosis to take place. There were several instances where the experimental pond at TR dried and all aquatic amphibian larvae were lost (Appendix E, Figure 1). If supplemental water had been added during times of low water when abundant larvae were present, then large amphibian die-offs could have been avoided. It is a natural phenomenon for amphibians to perish in drying ephemeral ponds within natural ecosystems. But if the specific goal of management of wetlands is to mitigate or avoid impacts, then managers should “turn on the water” during times when larval amphibians are in danger of perishing in a dry-up. Augmentation should, in theory, be able to supplement water levels to boost the water residency time long enough for larvae to metamorphose. Augmentation could be done on an as-needed basis.

Although it didn’t happen in this study, augmentation using calcareous (high pH) groundwater in the future may affect amphibian species diversity and reproductive success. The pH of water in isolated wetlands in Florida is normally very acidic and may be as low as 3.7 (R. C. Means, pers. obs.). Some frog species, such as the pine woods treefrog (*Hyla femoralis*), readily breed in highly acidic waters (Means and Moler 1979). Acidity of aquatic habitats can affect amphibian distribution, reproduction, and egg and larval growth (Freda and Dunson 1986). The effects of acidity on amphibians are much better understood than the effects of alkalinity. The introduction of basic groundwater into normally acidic wetlands could have serious effects on larval and adult amphibians and should be further investigated before initiating an extensive augmentation project.

Amphibian activity primarily was correlated with rainfall at all sites though some response to water residency time was also noted, particularly as pond hydroperiod approached zero. Amphibian response to rainfall is a well documented occurrence in amphibian ecology (Gibbons and Bennett 1974, Dodd 1995, R.P.M. Means 2008). A positive correlation between hydroperiod and the number of species that successfully produce juveniles and the number of individuals produced has also been documented (Pechmann et al. 1989). Additionally, several species are more likely to breed successfully when a pond dries and subsequently fills during a breeding season (Pechmann et al. 1989). Therefore, timing of inundation matters as well as hydroperiod (Paton and Crouch 2002). Many biotic and abiotic factors can influence the presence and successful metamorphosis of amphibian species from a pond such as competition, predation, fish presence/absence, fecundity, and hydroperiod.

Active or passive hydration eventually changes the hydroperiod of treated wetlands. Hydroperiod alteration could have a profound impact on the amphibians inhabiting the wetland. For example, increased hydroperiods may allow for an increase in the occurrences of amphibian predators such as fish, crayfish, and other macroinvertebrates. An increase in predation could result in the depletion or elimination of a species from the wetland. Ephemeral wetlands in Florida harbor at least 12 amphibian species that breed exclusively in this wetland type. Some of those species are considered rare or are state and federally listed species. It is important to a diverse amphibian fauna that ephemeral

ponds be managed to remain ephemeral. As a rule of thumb, impacted wetlands should be managed to mimic the historically natural hydrological regime.
The occurrence of amphibian abnormalities has been a topic of concern in amphibian biology since the mid 1990's. Observational increase in amphibian deformities is part of the global amphibian decline dilemma. Deformities can occur in amphibian populations for a number of complex, intertwined reasons (Blaustein and Johnson 2003), but they are often the result of anthropogenic factors such as pollution. The occurrence of physical deformities was extremely low and all but non-existent during this pilot study. We report that the overall physical health of amphibians encountered in the field at all study sites appeared excellent. The authors handled thousands of individuals. Of these, only one young southern leopard frog from the Port Orange Wellfield exhibited a physical abnormality. The frog had an extra, long digit emanating from the side of the right foot. Other regions of the United States, and world, report much higher occurrences of amphibian abnormalities (Blaustein and Johnson 2003).

All species encountered at all sites were considered expected occurrences in this study. Appendix C provides information comparing county records with individual study sites. The species captured per study wetland were always an expected subset of the species known to occur in that study wetland's respective county. It is expected that we did not capture all species known to occur within a given county because we sampled only a tiny subset of habitat types per county. One species that we captured, the gopher frog (*Rana capito*), is listed as a state species of special concern in Florida. Only one individual female gopher frog was captured during a heavy rain at a PO control pond during baseline. No other species of state or federal listing status were encountered.

Exotic amphibian species often were reported from all sites in this study. The greenhouse frog (*Eleutherodactylus planirostris*) existed at all sites and appeared to be naturalized. The Cuban treefrog (*Osteopilus septentrionalis*), was encountered frequently at the southernmost site (PW). Cuban treefrogs were documented as single occurrences in 2004, 2005, and 2008 at BS. Two were captured at PO (Pond 3) in 2006. Cuban treefrog data probably represent the expansion of this exotic species from the urban I-95 corridor into wilder, more natural areas inland.

This seven year study on amphibians provided more than just data for augmentation assessments. It provided a long-term profile on amphibian species diversity for four sites in heretofore poorly sampled areas—northeast and east central Florida. Data from this study can be used as baseline information in future studies.

SUMMARY

Overall Conclusions

- Amphibian activity and reproduction primarily responded to rainfall and secondarily to available surface water during baseline and hydration/operational periods. Amphibian species diversity increased with increased rainfall and decreased during drought.

- Drought conditions during the last two years of the study resulted in fewer captures and less reproduction than any other equal time period throughout the study, particularly at PO and BS. Although amphibian activity was reduced during this time, CPI scientists predict that populations will rebound once normal rainfall and wetland inundation return.

- Results regarding the potential effect of active hydration on amphibians were difficult to quantify and considered inconclusive in this study because of: 1) experimental design - there were not enough baseline data available at TR to use as a reference frame for comparisons between pre and post-augmentation; 2) limited measurable hydration effect - at PO, hydration had a minor role in influencing water levels compared to rainfall in the experimental wetland.

- Results regarding the potential effect of passive hydration on amphibians also were difficult to quantify and considered inconclusive because of: 1) experimental design - at BS, there was no control wetland used as a reference frame to determine background conditions; and at PW, there was no control wetland and a lack of quantitative sampling.

- CPI scientists believe that all four study sites harbor relatively diverse and healthy amphibian communities. Although quantification of the effects of active and passive hydration was difficult and considered inconclusive, we believe no detrimental effects to amphibian communities resulted from active and passive hydrations in this study.

Recommendations

- Hydroperiod plays a major role in determining which amphibian species will inhabit a given wetland. Ephemeral wetlands typically harbor many amphibian species that cannot tolerate the presence of predaceous fishes in order to successfully reproduce. Permanent wetlands containing predaceous fishes typically harbor a different suite of amphibian fauna. When restoring or augmenting a wetland with either active or passive hydration, the appropriate hydroperiod for the wetland type must be considered. Increasing the hydroperiod may result in changing the amphibian species composition of a wetland by introducing predators of amphibian larvae.

- When using active or passive hydration techniques, land managers should restore impacted wetlands to mimic the historically natural hydrological conditions. For example, if a wetland was naturally ephemeral, then the management approach should allow for periodic seasonal dryings.

- Whereas augmented ephemeral wetlands should be allowed to dry seasonally, active hydration also could be performed during periods of impending dry-up on an as-needed basis to boost wetland hydroperiod long enough so that larval amphibians can successfully metamorphose and recruit into the uplands. After metamorphosis, active hydration could be suspended so that ponds are allowed to dry or otherwise respond to natural conditions. Water levels within the hydrated wetlands should be monitored during reproductive periods to ensure there is sufficient water for reproductive success. Reproduction can occur year-round in Florida and varies by species, but winter, spring, and summer are the most reproductively active seasons.

- Water quality should be monitored during active or passive hydration prior to- and after implementing the strategy. Changes in surface water quality resulting from hydration should be viewed as having the potential to negatively impact amphibian communities and alter wetland ecological function.

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APPENDIX

Appendix A. Site maps and photos

Appendix B. Pond hydroperiod tables for Tillman Ridge Wellfield, Bennett Swamp, and Port Orange Wellfield

Appendix C. Data collected during the baseline and hydration periods of the project

Appendix D. Rainfall and hydroperiod data for hydration period of the project

Appendix E. Species diversity data and analyses for baseline and hydration periods

Appendix F. Select amphibian photos

Appendix G. CPI justifications for unincorporated comments by SJRWMD staff

Appendix H. Amphibian augmentation database excel file

Appendix A. Site maps and photos.

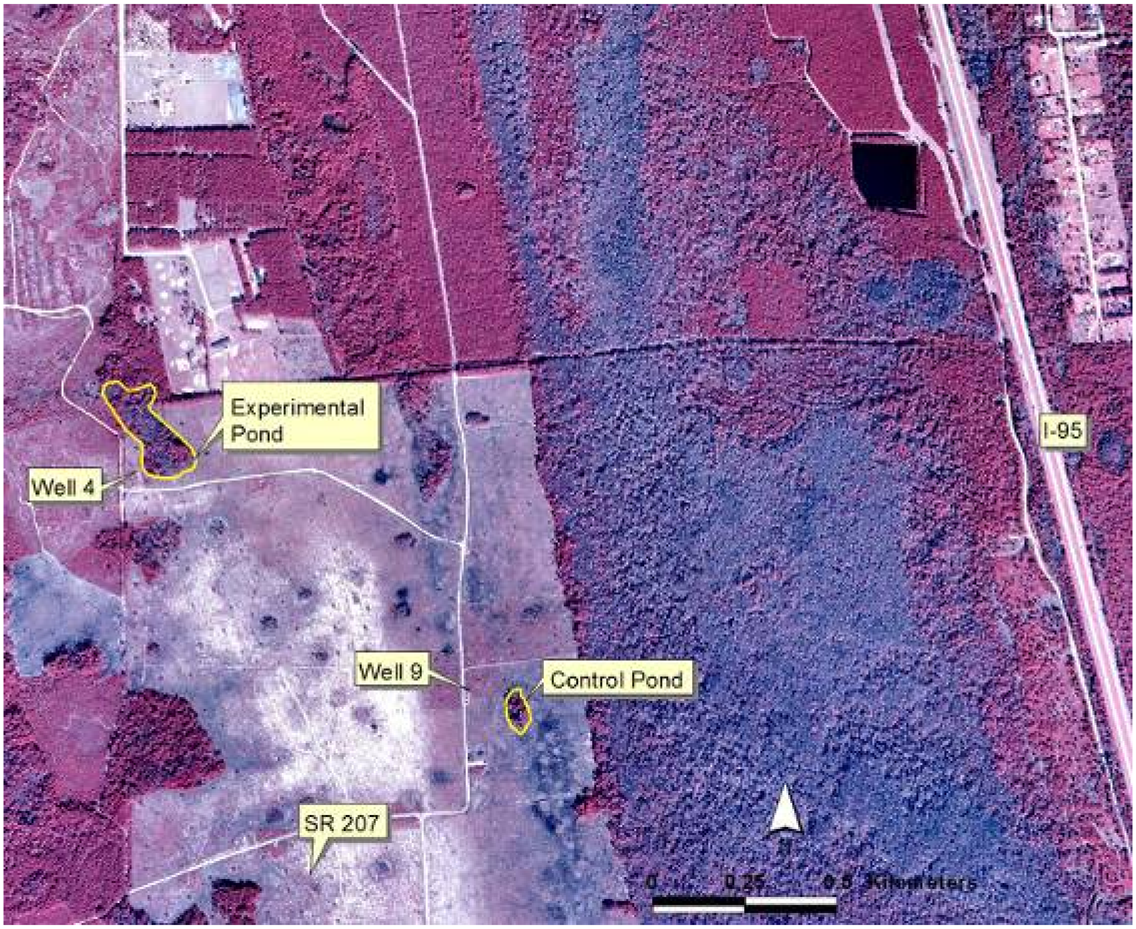

Figure 1. Map of Tillman Ridge Wellfield and surrounding area. The wellfield is five miles west of the city of St. Augustine and surrounded by swamp and low-lying pine flatwoods.

Appendix A.

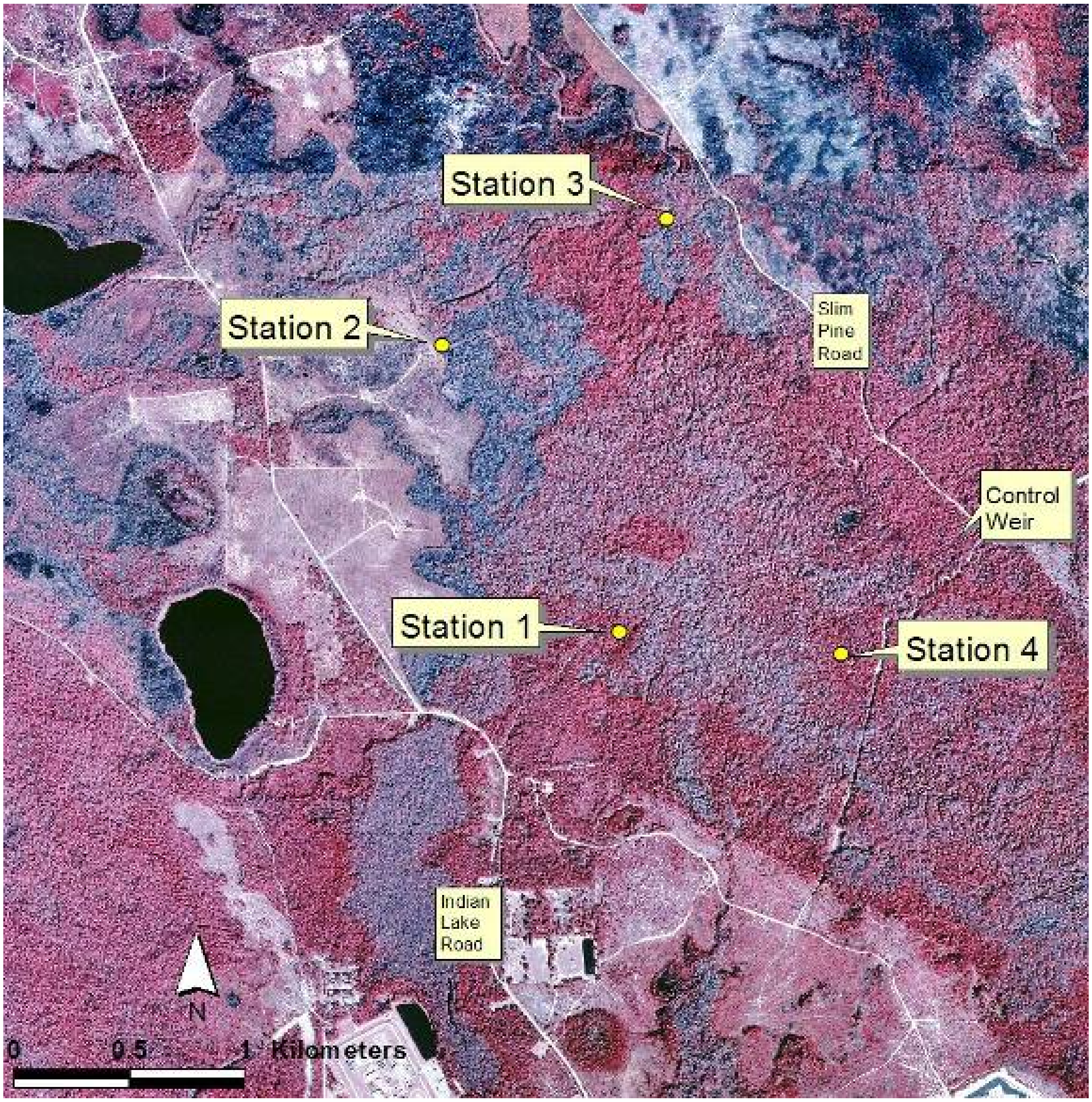

Figure 2. Map of the Bennett Swamp study area. The approximately 2540 acre wetland basin is dominated by bays, cypress, and pines.

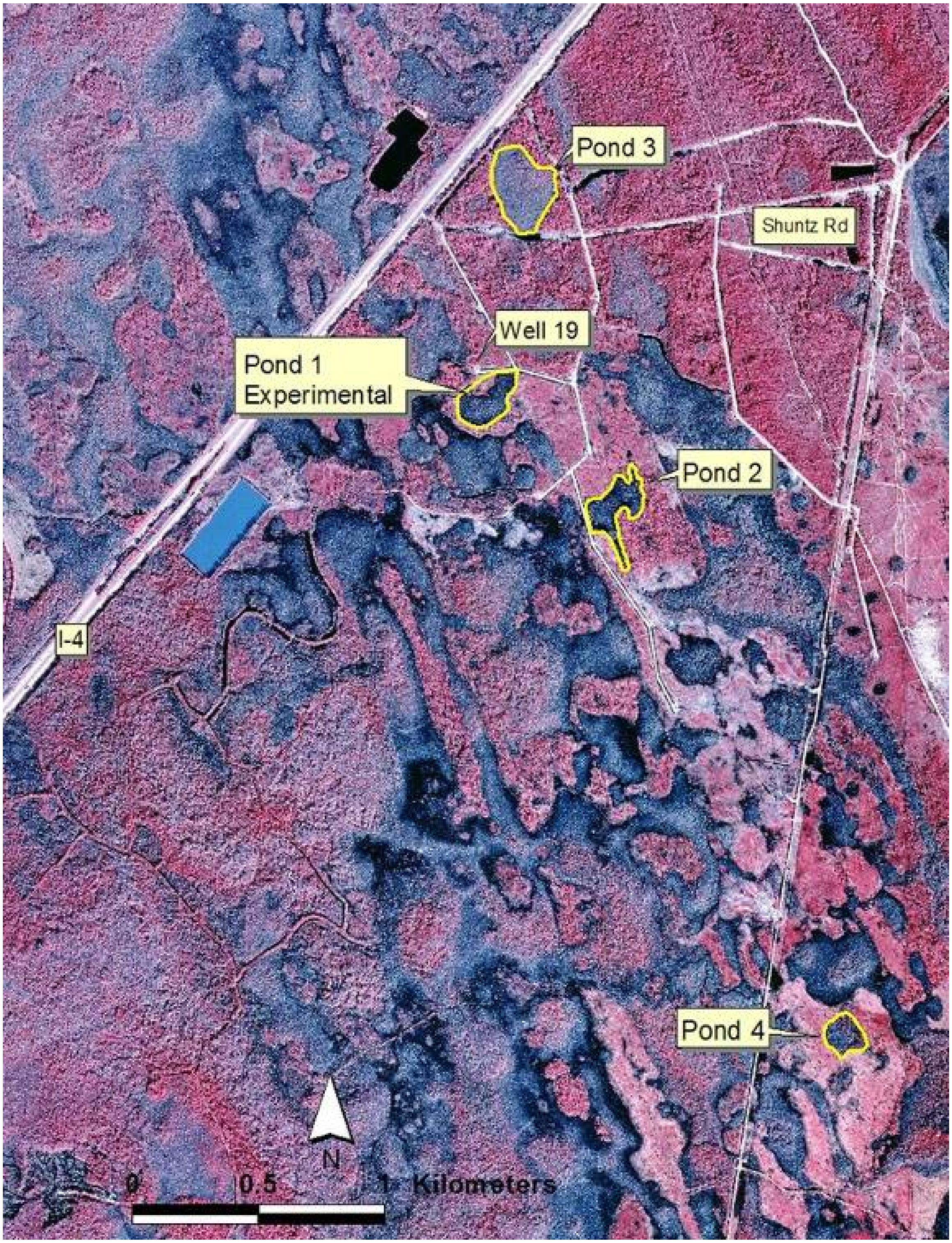

Figure 3. Map of the Port Orange Wellfield study area**.** The four study ponds are circled in yellow. The property supports extensive pine flatwoods and many isolated and connected cypress wetlands.

Figure 4. Map of the Parkland Wetland study area**.** Parkland Wetland is circled in yellow. The wetland is embedded within suburban Titusville.

Experimental Pond

Control Pond

Figure 5. Photos of Tillman Ridge Wellfield study ponds

Station 1

Station 2

Station 3

Station 4

Figure 6. Photos of the Bennett Swamp monitoring stations

Experimental
Pond (1)

Control
Pond (2)

Control
Pond (3)

Control
Pond (4)

Figure 7. Photos of Port Orange Wellfield study ponds

Station 1

Station 2

Station 3

Station 4

Figure 8. Photos of the Parkland Wetland sampling stations

Appendix B. Pond hydroperiod tables for Tillman Ridge Wellfield, Bennett Swamp, and Port Orange Wellfield

Table 1. Hydroperiod at Tillman Ridge Wellfield. Hydroperiod data are presented for January-September during the hydration period (2003-2006). Blue shading represents the presence of water.

Experimental Pond																		
Control Pond																		
	Jan 03	Feb 03	Mar 03	Apr 03	May 03	Jun 03	Jul 03	Aug 03	Sep 03	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04

Experimental Pond																		
Control Pond																		
	Jan 05	Feb 05	Mar 05	Apr 05	May 05	Jun 05	Jul 05	Aug 05	Sep 05	Jan 06	Feb 06	Mar 06	Apr 06	May 06	Jun 06	Jul 06	Aug 06	Sep 06

Table 2. Hydroperiod at Bennett Swamp. Hydroperiod data are presented for January-September during baseline (1999-2000) and hydration (2004-2008) periods. Blue shading represents the presence of water.

Baseline Period

Jan 99	Feb 99	Mar 99	Apr 99	May 99	Jun 99	Jul 99	Aug 99	Sep 99	Jan 00	Feb 00	Mar 00	Apr 00	May 00	Jun 00	Jul 00	Aug 00	Sep 00

Hydration Period

Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04	Jan 05	Feb 05	Mar 05	Apr 05	May 05	Jun 05	Jul 05	Aug 05	Sep 05

Jan 06	Feb 06	Mar 06	Apr 06	May 06	Jun 06	Jul 06	Aug 06	Sep 06	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Jan 08	Feb 08	Mar 08	Apr 08

Table 3. Hydroperiod at Port Orange Wellfield. Hydroperiod data are presented for January-September during baseline (1999-2000) and hydration (2003-2007) periods. Blue shading represents the presence of water.

Baseline Period

	Jan 99	Feb 99	Mar 99	Apr 99	May 99	Jun 99	Jul 99	Aug 99	Sep 99	Jan 00	Feb 00	Mar 00	Apr 00	May 00	Jun 00	Jul 00	Aug 00	Sep 00
Experimental Pond (1)																		
Control Pond (2)																		
Control Pond (3)																		
Control Pond (4)																		

Hydration Period

	Jan 03	Feb 03	Mar 03	Apr 03	May 03	Jun 03	Jul 03	Aug 03	Sep 03	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04	Jan 05	Feb 05	Mar 05	Apr 05	May 05
Experimental Pond (1)																							
Control Pond (2)																							
Control Pond (3)																							
Control Pond (4)																							

	Jun 05	Jul 05	Aug 05	Sep 05	Jan 06	Feb 06	Mar 06	Apr 06	May 06	Jun 06	Jul 06	Aug 06	Sep 06	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07
Experimental Pond (1)																						
Control Pond (2)																						
Control Pond (3)																						
Control Pond (4)																						

Appendix C. Data collected during the baseline and hydration periods of the project.

Table 1.	Scientific names of amphibian species captured or observed throughout assessment project
Table 2.	County list of amphibian species with a comparative species list from Tillman Ridge Wellfield.
Table 3.	County list of amphibian species with a comparative species list from Bennett Swamp and Port Orange Wellfield
Table 4.	County list of amphibian species with a comparative species list from Parkland Wetland
Table 5.	Quantitative species diversity data from the Tillman Ridge Wellfield study site
Table 6.	Quantitative species diversity data from the Bennett Swamp study site
Table 7.	Quantitative species diversity data from the Port Orange Wellfield study site

Table 1. Scientific names of amphibian species captured or observed throughout assessment project. “*” denotes non-native species.

Salamanders	
Amphiuma means	Two-toed amphiuma
Eurycea quadridigitata	Dwarf salamander
Notophthalmus viridescens	Central newt
Pseudobranchus axanthus	Dwarf siren
Frogs	
Acris gryllus	Florida cricket frog
Bufo quercicus	Oak toad
Bufo terrestris	Southern toad
Eleutherodactylus planirostris	Greenhouse frog*
Gastrophryne carolinensis	Eastern narrowmouth
Hyla cinerea	Green treefrog
Hyla femoralis	Pine woods treefrog
Hyla gratiosa	Barking treefrog
Hyla squirella	Squirrel treefrog
Osteopilus septentrionalis	Cuban treefrog*
Pseudacris crucifer	Spring peeper
Pseudacris nigrita	Southern chorus frog
Pseudacris ocularis	Little grass frog
Rana capito	Gopher frog
Rana clamitans	Bronze frog
Rana grylio	Pig frog
Rana sphenocephala	Southern leopard frog
Scaphiopus holbrookii	Eastern spadefoot

Table 2. County list of amphibian species with a comparative species list from Tillman Ridge Wellfield. County lists were based on the Florida Museum of Natural History Herpetology Database and Lannoo (2005). Tillman Ridge Wellfield list is compiled from all sampling techniques (drift fence, aural, dipnet, and visual surveys) conducted in 2000 and 2003-2006. “*” denotes non-native species.

Species	St. Johns County	Tillman Ridge Experimental Pond	Tillman Ridge Control Pond
Salamanders			
Two-toed amphiuma	X		
Dwarf salamander	X		X
Striped newt	X		
Central newt	X		
Dwarf siren	X		
Frogs			
Florida cricket frog	X	X	X
Oak toad	X	X	X
Southern toad	X	X	X
Greenhouse frog*	X	X	X
Eastern narrowmouth	X	X	X
Green treefrog	X	X	
Pine woods treefrog	X	X	X
Barking treefrog	X		X
Squirrel treefrog	X	X	
Spring peeper	X	X	
Southern chorus frog	X		
Little grass frog	X	X	
Gopher frog	X		
Bullfrog	X		
Bronze frog	X	X	
Pig frog	X	X	
River frog	X		
Southern leopard frog	X	X	X
Eastern spadefoot	X	X	X
Total Number of Species	**24**	**14**	**10**

Table 3. County list of amphibian species with a comparative species list from Bennett Swamp and Port Orange Wellfield. County lists were based on Florida Museum of Natural History Herpetology Database and Lannoo (2005). Bennett Swamp list is compiled from all survey techniques (drift fence, aural, dipnet, and visual surveys) conducted in 1999-2000 and 2004-2008. Port Orange Wellfield list is compiled from all survey techniques (drift fence, aural, dipnet, and visual surveys) conducted in 1999-2000 and 2003-2007. "*" denotes non-native species.

Species	Volusia County	Bennett Swamp	Port Orange Experimental Pond (1)	Port Orange Control Pond (2)	Port Orange Control Pond (3)	Port Orange Control Pond (4)
Salamanders						
Two-toed amphiuma	X					
Southern dusky salamander	X					
Dwarf salamander	X	X	X		X	X
Central newt	X					
Dwarf siren	X		X	X		X
Frogs						
Florida cricket frog	X	X	X	X	X	X
Oak toad	X	X	X	X	X	X
Southern toad	X	X	X	X	X	X
Greenhouse frog*	X	X	X	X	X	X
Eastern narrowmouth	X	X	X	X	X	X
Green treefrog	X	X	X	X	X	X
Pine woods treefrog	X	X	X	X	X	X
Barking treefrog	X	X	X	X	X	
Squirrel treefrog	X	X	X	X	X	X
Cuban treefrog*	X	X			X	
Spring peeper	X					
Southern chorus frog	X	X	X	X	X	X
Little grass frog	X	X	X	X	X	X
Gopher frog	X				X	
Bronze frog	X	X				
River frog	X					
Pig frog	X	X	X	X	X	X
Southern leopard frog	X	X	X	X	X	X
Eastern spadefoot	X					
Total Number of Species	**24**	**16**	**15**	**14**	**16**	**14**

Table 4. County list of amphibian species with a comparative species list from Parkland Wetland. County lists were based on Florida Museum of Natural History Herpetology Database and Lannoo (2005). Parkland Wetland list is compiled from all survey techniques (aural, dipnet, and visual surveys) conducted in 1999-2000 and 2003-2006. "*" denotes non-native species.

Species	Brevard County	Parkland Wetland
Salamanders		
Two-toed amphiuma	X	X
Dwarf salamander	X	
Central newt	X	X
Dwarf siren	X	
Frogs		
Florida cricket frog	X	X
Oak toad	X	
Southern toad	X	X
Greenhouse frog*	X	X
Eastern narrowmouth	X	X
Green treefrog	X	X
Pine woods treefrog	X	
Barking treefrog	X	
Squirrel treefrog	X	X
Cuban treefrog*	X	X
Southern chorus frog	X	
Little grass frog	X	
Gopher frog	X	
Pig frog	X	X
Southern leopard frog	X	X
Eastern spadefoot	X	
Total Number of Species	**20**	**11**

Table 6. Quantitative species diversity data from the Tillman Ridge Wellfield study site. Data represent new captures obtained by drift fence arrays and are presented for baseline (2000) and hydration (2003-2006) periods. "*" denotes non-native species.

Species	**Experimental Pond**					**Control Pond**				
	2000	2003	2004	2005	2006	2000	2003	2004	2005	2006
Salamanders										
Dwarf salamander	0	0	0	0	0	0	0	0	0	1
Frogs										
Florida cricket frog	0	6	1	12	3	2	8	0	11	0
Oak toad	2	0	0	0	0	4	2	0	1	0
Southern toad	1	41	1	17	0	1	8	1	7	3
Greenhouse frog *	3	0	0	3	0	1	0	0	1	1
Eastern narrowmouth	8	77	24	51	5	10	7	6	8	5
Green treefrog	0	0	0	0	1	0	0	0	0	0
Pine woods treefrog	7	45	22	78	33	52	68	21	86	21
Squirrel treefrog	1	22	17	89	27	2	9	1	7	2
Spring pepper	0	0	0	1	1	0	0	0	0	0
Little grass frog	1	5	2	9	0	2	2	2	2	1
Bronze frog	0	0	0	0	0	0	7	1	5	0
Pig frog	0	0	0	1	0	0	0	0	1	0
Southern leopard frog	0	42	3	81	6	0	48	13	158	5
Eastern spadefoot	0	1	145	33	0	0	0	0	1	0
Total number of individuals	**23**	**239**	**215**	**375**	**76**	**74**	**159**	**45**	**288**	**38**
Total number of species	**7**	**8**	**8**	**11**	**7**	**8**	**9**	**7**	**12**	**8**

Table 7. Quantitative species diversity data from the Bennett Swamp study site. Data represent new captures obtained by drift fence arrays and are presented for baseline (1999-2000) and operational (2004-2008) periods. "*" denotes non-native species.

Species	1999	2000	2004	2005	2006	2007	2008
Salamanders							
Dwarf salamander	0	0	1	1	0	0	0
Frogs							
Florida cricket frog	17	8	10	21	4	0	0
Oak toad	3	2	4	5	0	0	0
Southern toad	191	20	1	21	7	3	0
Greenhouse frog	35	49	17	8	7	10	0
Eastern narrowmouth toad	70	25	15	15	18	3	0
Pine woods treefrog	25	48	24	42	23	2	1
Squirrel treefrog	0	23	20	14	10	2	0
Cuban treefrog *	0	0	1	1	0	0	1
Little grass frog	3	1	3	3	0	0	0
Bronze frog	0	0	1	0	0	0	0
Pig frog	0	0	0	6	0	0	0
Southern leopard frog	34	49	3	38	2	1	0
Total number of individuals	**378**	**225**	**100**	**175**	**71**	**21**	**2**
Total number of species	**8**	**9**	**12**	**12**	**7**	**6**	**2**

Appendix C.

Table 8. Quantitative species diversity data from Port Orange Wellfield study site. Data represent new captures obtained by drift fence arrays and are presented for baseline (1999-2000) and hydration (2003-2007) periods. "*" denotes non-native species.

Species	Pond 1 (Experimental)							Pond 2 (Control)							Pond 3 (Control)							Pond 4 (Control)						
	99	00	03	04	05	06	07	99	00	03	04	05	06	07	99	00	03	04	05	06	07	99	00	03	04	05	06	07
<u>Salamanders</u>																												
Dwarf salamander	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0
Dwarf siren	0	0	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<u>Frogs</u>																												
Florida cricket frog	17	5	24	34	47	8	0	26	11	49	64	96	8	0	9	5	31	18	14	2	0	40	11	30	22	13	1	0
Oak toad	33	18	11	7	4	3	0	26	19	24	50	6	5	0	9	1	14	5	11	6	2	51	18	6	12	2	1	1
Southern toad	4	1	1	0	0	0	0	18	3	5	1	0	0	0	5	0	1	1	4	1	1	8	0	2	3	0	0	0
Greenhouse frog *	0	0	0	3	2	1	0	0	2	0	0	0	1	0	7	8	13	35	17	4	1	0	0	0	0	0	0	0
Eastern narrowmouth toad	22	17	15	30	28	15	0	45	27	20	22	17	8	0	32	14	44	26	79	51	14	13	18	10	6	6	3	1
Green treefrog	1	0	0	1	3	0	0	2	0	3	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Pine woods treefrog	35	18	20	16	20	6	2	38	14	95	46	7	15	3	23	1	50	25	69	22	7	41	26	54	28	54	18	3
Barking treefrog	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Squirrel treefrog	14	8	5	15	25	5	1	10	11	20	17	11	9	3	1	0	2	3	28	10	4	1	0	0	0	1	1	0
Cuban treefrog *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Florida chorus frog	0	1	0	3	3	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Little grass frog	2	4	7	6	12	4	0	5	11	27	31	37	7	0	17	36	43	28	137	23	0	2	0	11	8	6	2	0
Gopher frog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Southern leopard frog	6	5	153	25	55	8	0	38	10	109	37	36	14	0	2	0	164	3	50	6	2	35	20	148	15	28	4	0
Total Number of Individuals	**134**	**77**	**237**	**140**	**199**	**50**	**3**	**208**	**110**	**354**	**271**	**214**	**67**	**6**	**106**	**66**	**362**	**145**	**409**	**127**	**31**	**191**	**93**	**263**	**94**	**112**	**30**	**5**
Total Number of Species	**9**	**9**	**9**	**10**	**10**	**8**	**2**	**9**	**10**	**10**	**10**	**8**	**8**	**2**	**10**	**7**	**9**	**10**	**9**	**10**	**7**	**8**	**5**	**9**	**7**	**9**	**7**	**3**

Appendix D. Rainfall and hydroperiod data for hydration period of the project.

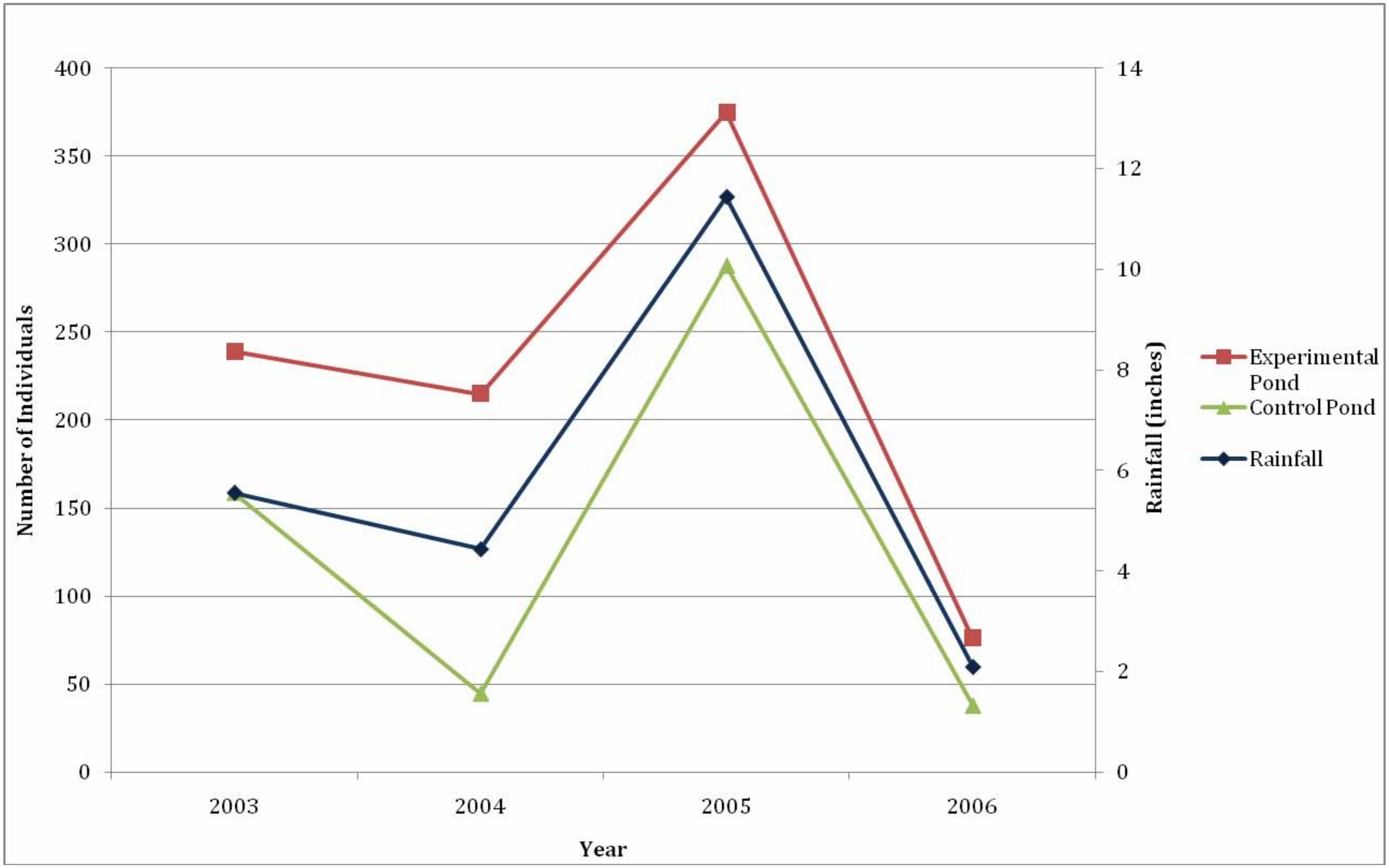

Figure 1. Comparison of number of individuals captured and rainfall per year at Tillman Ridge Wellfield. Capture data represent new captures from drift fence arrays. Capture data (left vertical axis) and rainfall (right vertical axis) are reported for the 9 sampling weeks in each year from 2003 -2006.

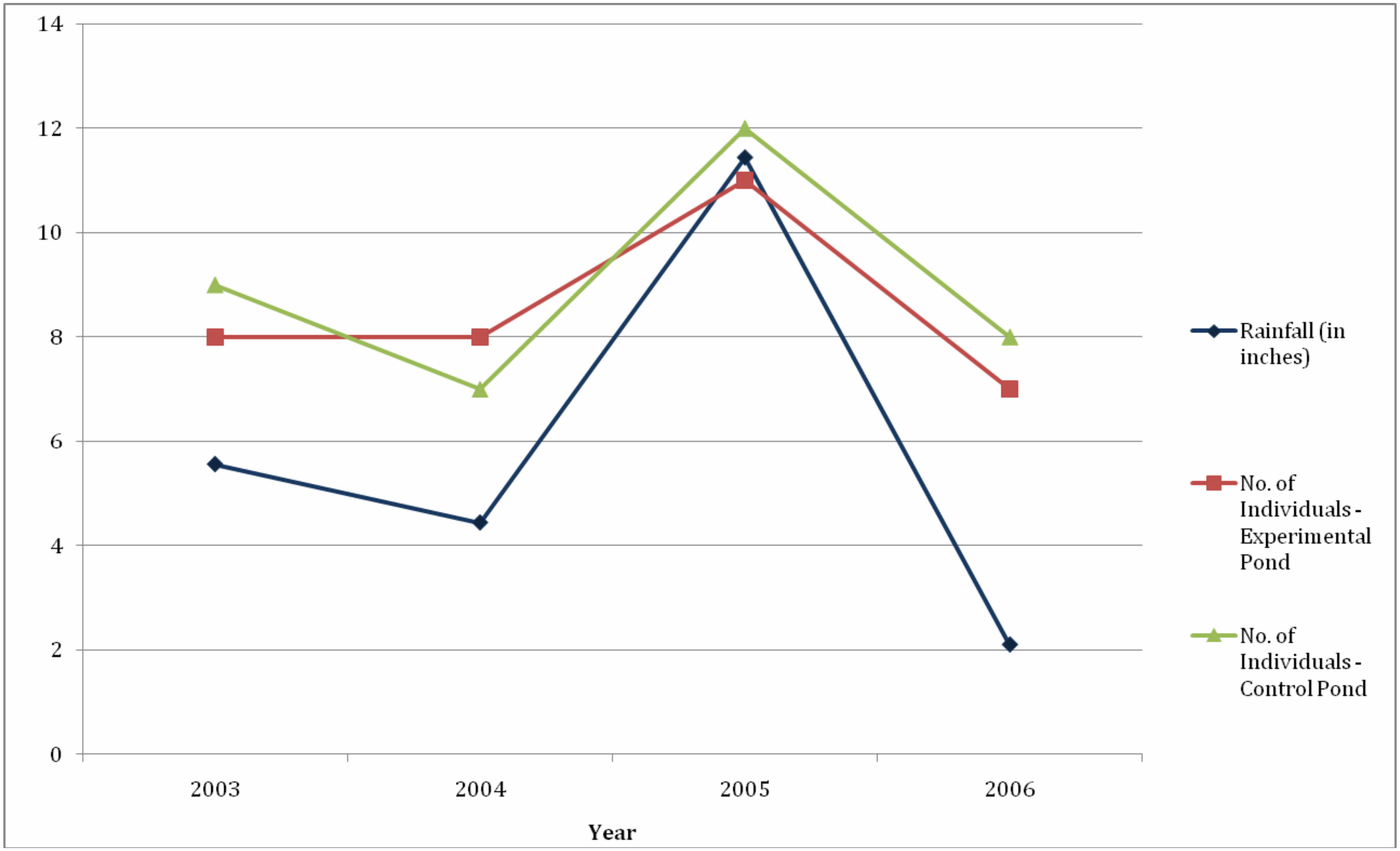

Figure 2. Comparison of number of species captured and rainfall per year at Tillman Ridge Wellfield. Species data represent captures from drift fence arrays. Rainfall and capture data are reported for the 9 sampling weeks in each year from 2003 -2006.

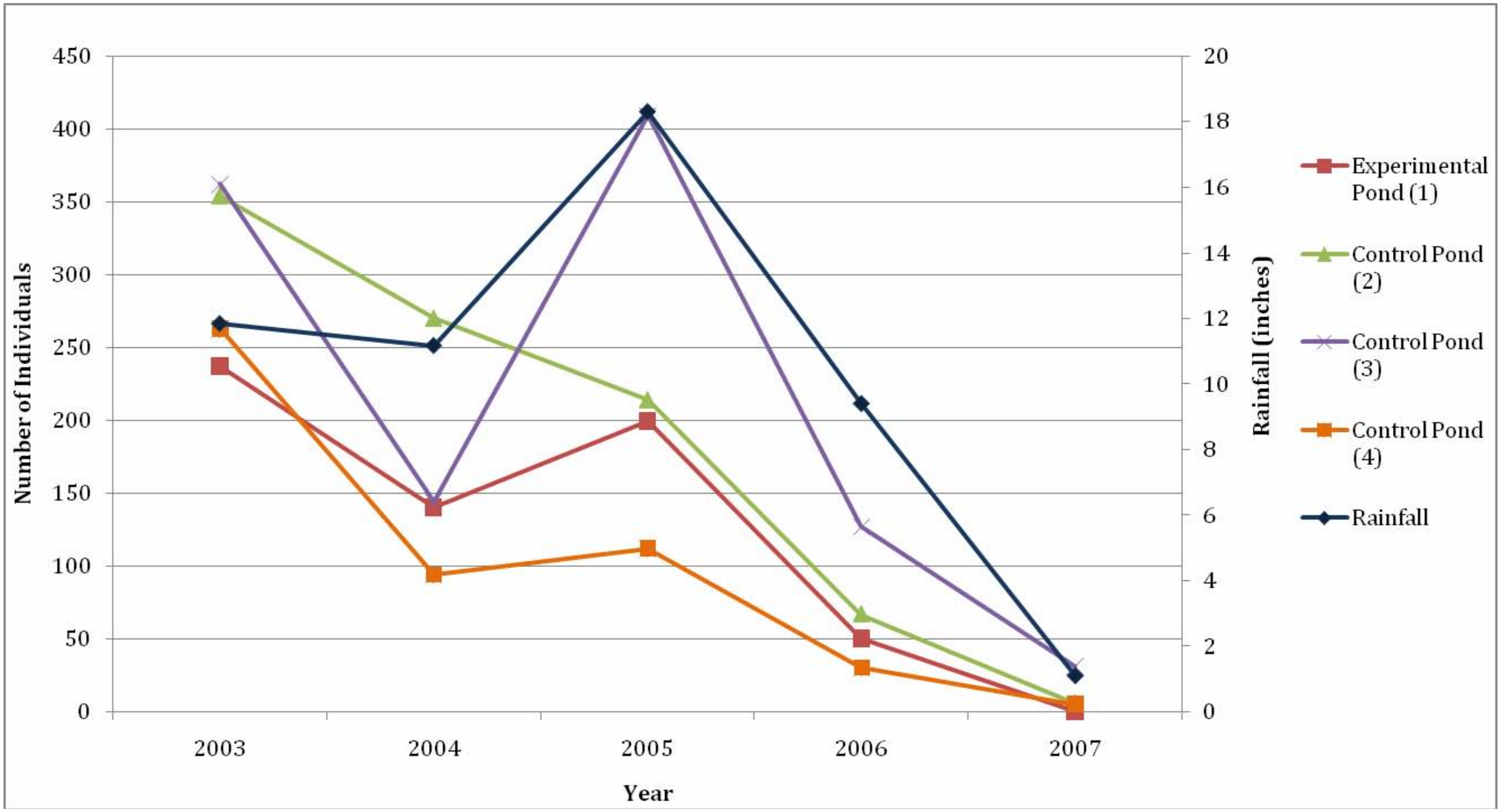

Figure 3. Comparison of number of individuals captured and rainfall per year at Port Orange Wellfield. Capture data represent new captures from drift fence arrays. Capture data (left axis) and rainfall (right axis) are reported for 9 sampling weeks in 2003 -2006 and 4 sampling weeks in 2007. Lack of rainfall data for May-September in 2007 prevented reporting of the full 9 weeks for that year.

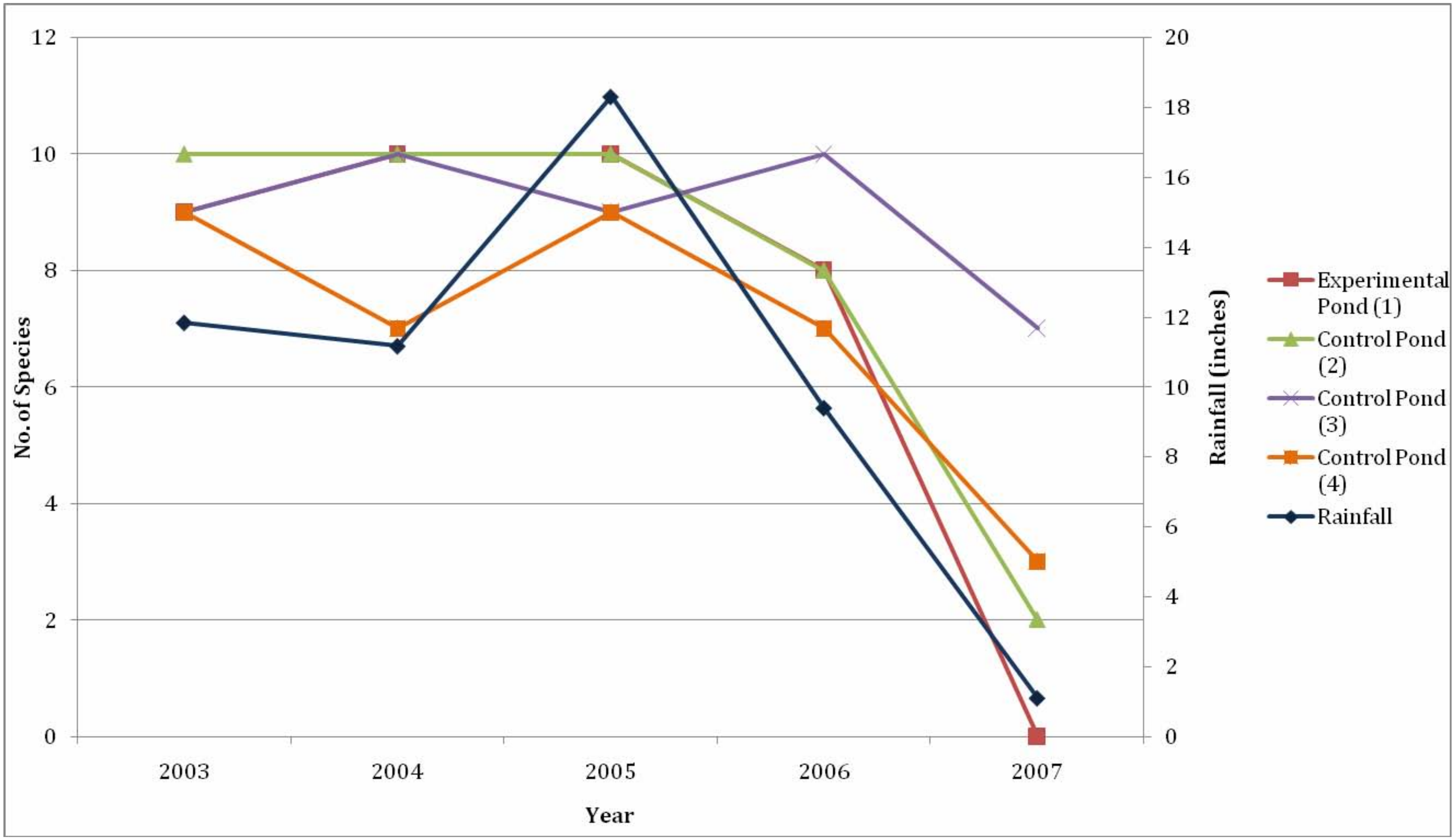

Figure 4. Comparison of number of species captured and rainfall per year at Port Orange Wellfield. Species data represent captures from drift fence arrays. Capture data (left axis) and rainfall (right axis) are reported for the 9 sampling weeks in each year from 2003 - 2006 and 4 sampling weeks in 2007. Lack of rainfall data for May-September in 2007 prevented reporting of full 9 weeks for that year.

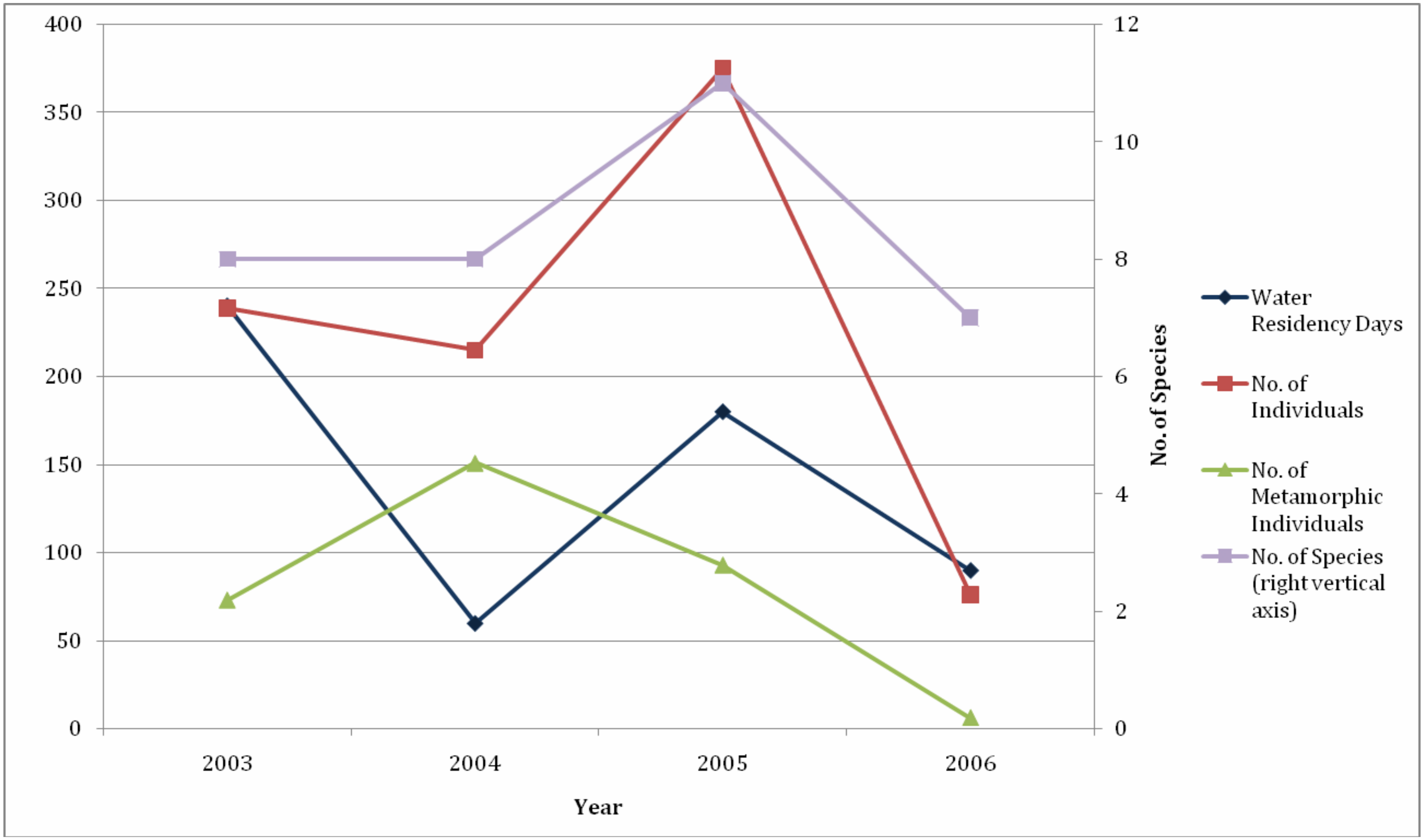

Figure 5. Comparison of water residency days and number of individuals, metamorphic individuals, and species captured at Tillman Ridge Wellfield Experimental Pond. Water residency days (left vertical axis) represents the number of days in a given year that a pond held water. Total number of individuals and number of metamorphic individuals (left vertical axis) and number of species (right vertical axis) represent new captures from drift fence arrays for the 9 sampling weeks in each year from 2003 -2006.

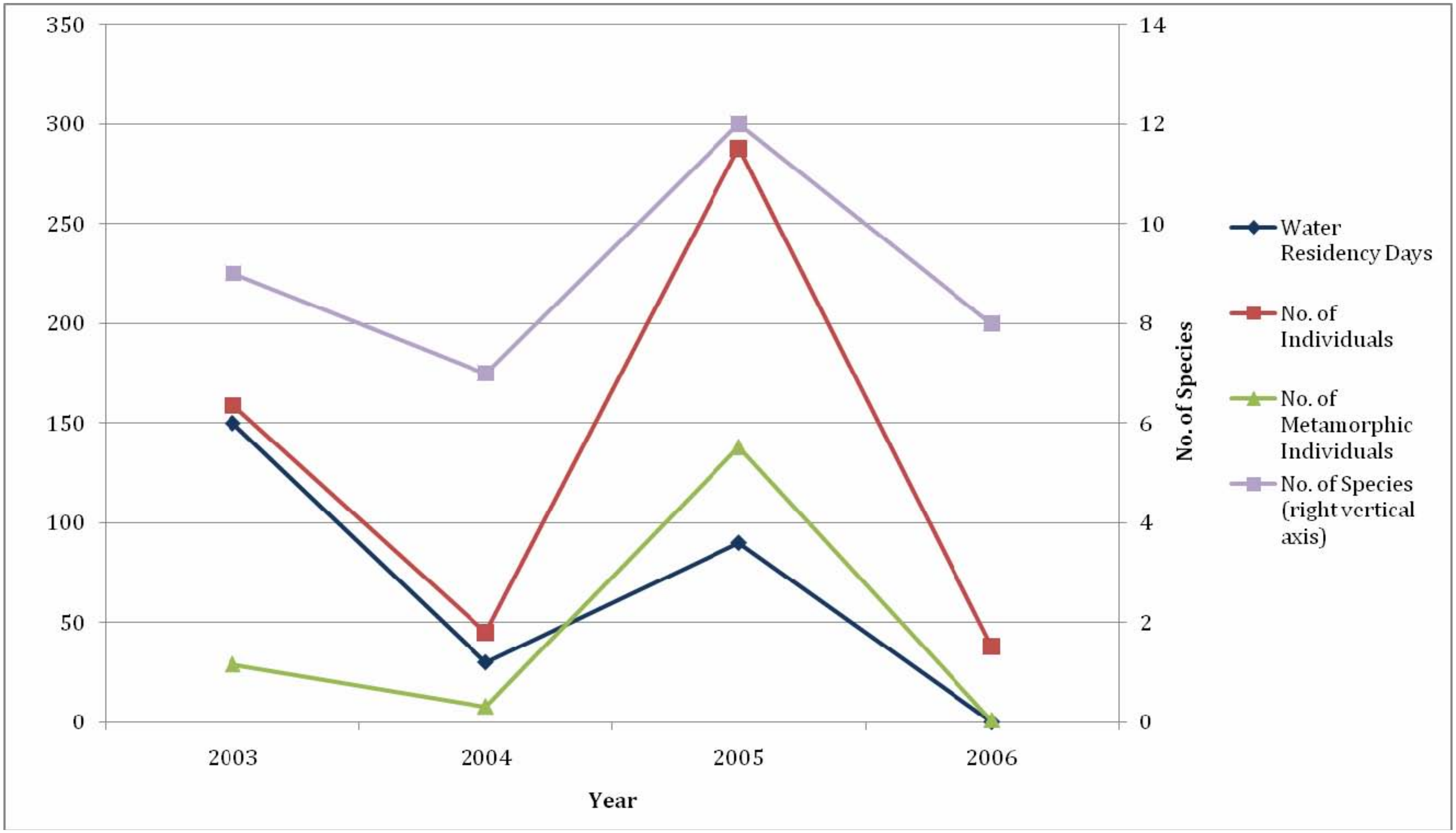

Figure 6. Comparison of water residency days and number of individuals, metamorphic individuals, and species captured at Tillman Ridge Wellfield Control Pond. Water residency days (left vertical axis) represents the number of days in a given year that a pond held water. Total number of individuals and number of metamorphic individuals (left vertical axis) and number of species (right vertical axis) represent new captures from drift fence arrays for the 9 sampling weeks in each year from 2003 -2007.

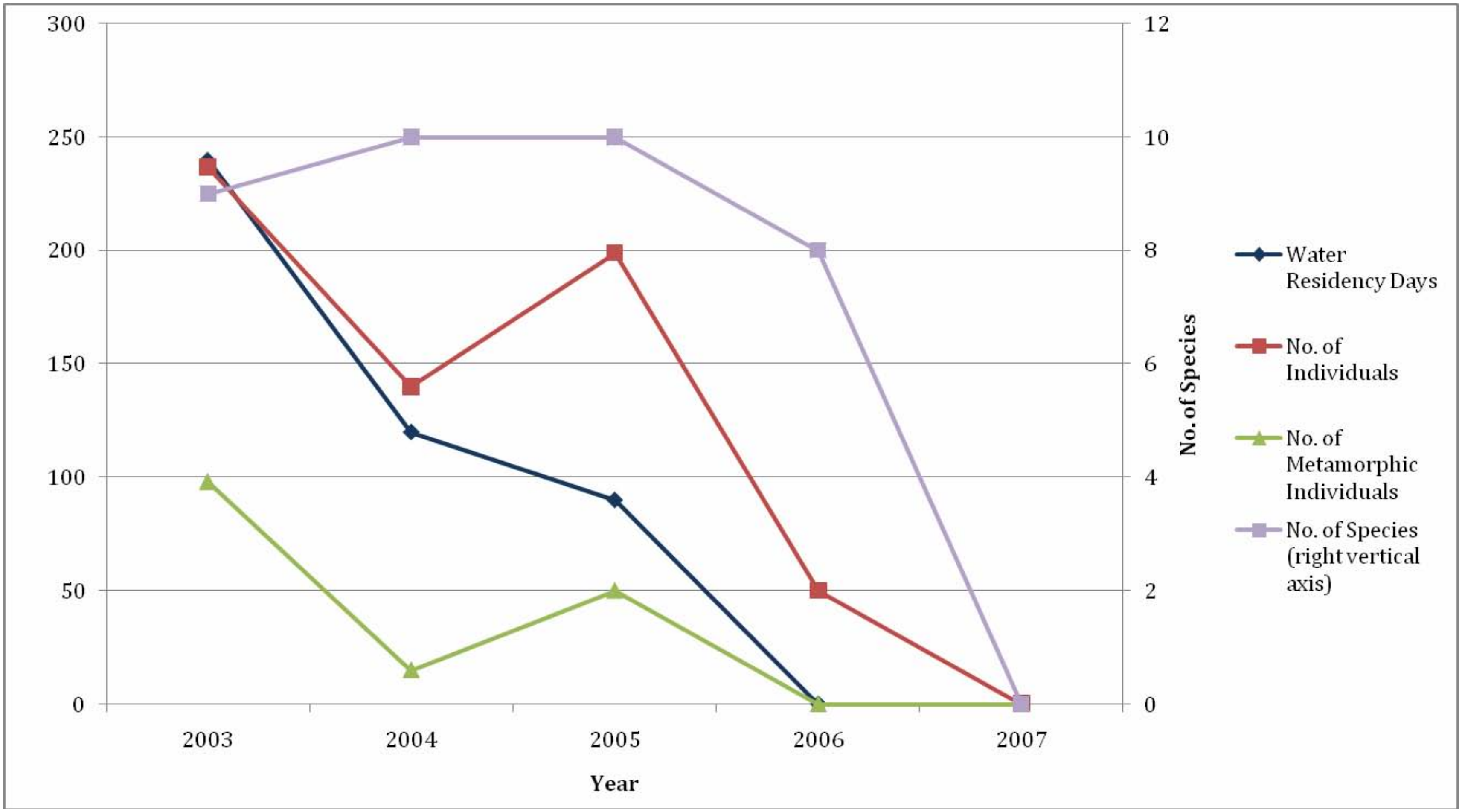

Figure 7. Comparison of water residency days and number of individuals, metamorphic individuals, and species captured at Port Orange Wellfield Experimental Pond (1). Water residency days (left vertical axis) represents the number of days in a given year that a pond held water. Total number of individuals and number of metamorphic individuals (left vertical axis) and number of species (right vertical axis) represent new captures from drift fence arrays for the 9 sampling weeks in each year from 2003 -2007.

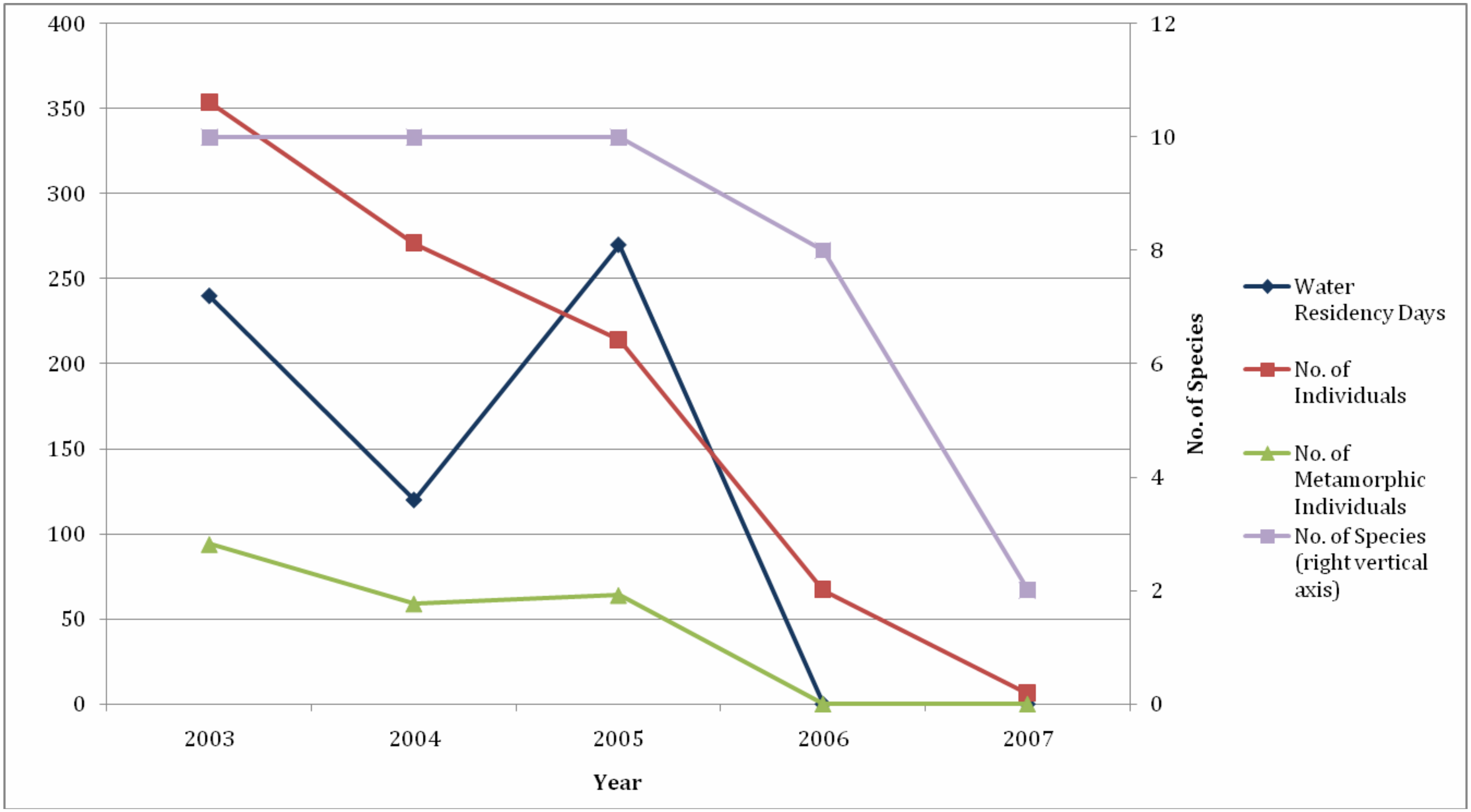

Figure 8. Comparison of water residency days and number of individuals, metamorphic individuals, and species captured at Port Orange Wellfield Control Pond (2). Water residency days (left vertical axis) represents the number of days in a given year that a pond held water. Total number of individuals and number of metamorphic individuals (left vertical axis) and number of species (right vertical axis) represent new captures from drift fence arrays for the 9 sampling weeks in each year from 2003 -2007.

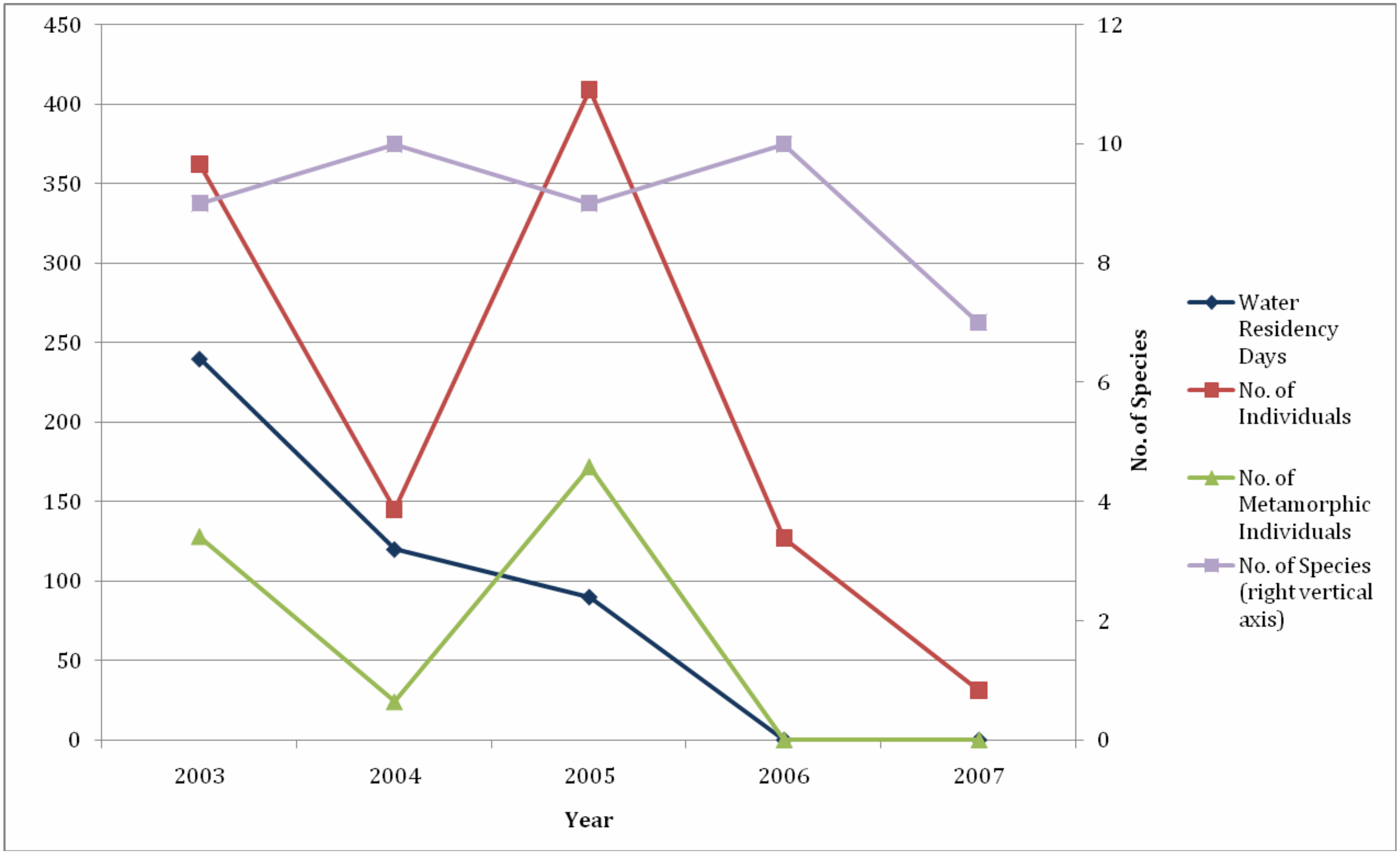

Figure 9. Comparison of water residency days and number of individuals, metamorphic individuals, and species captured at Port Orange Wellfield Control Pond (3). Water residency days (left vertical axis) represents the number of days in a given year that a pond held water. Total number of individuals and number of metamorphic individuals (left vertical axis) and number of species (right vertical axis) represent new captures from drift fence arrays for 9 sampling weeks in 2003 -2007.

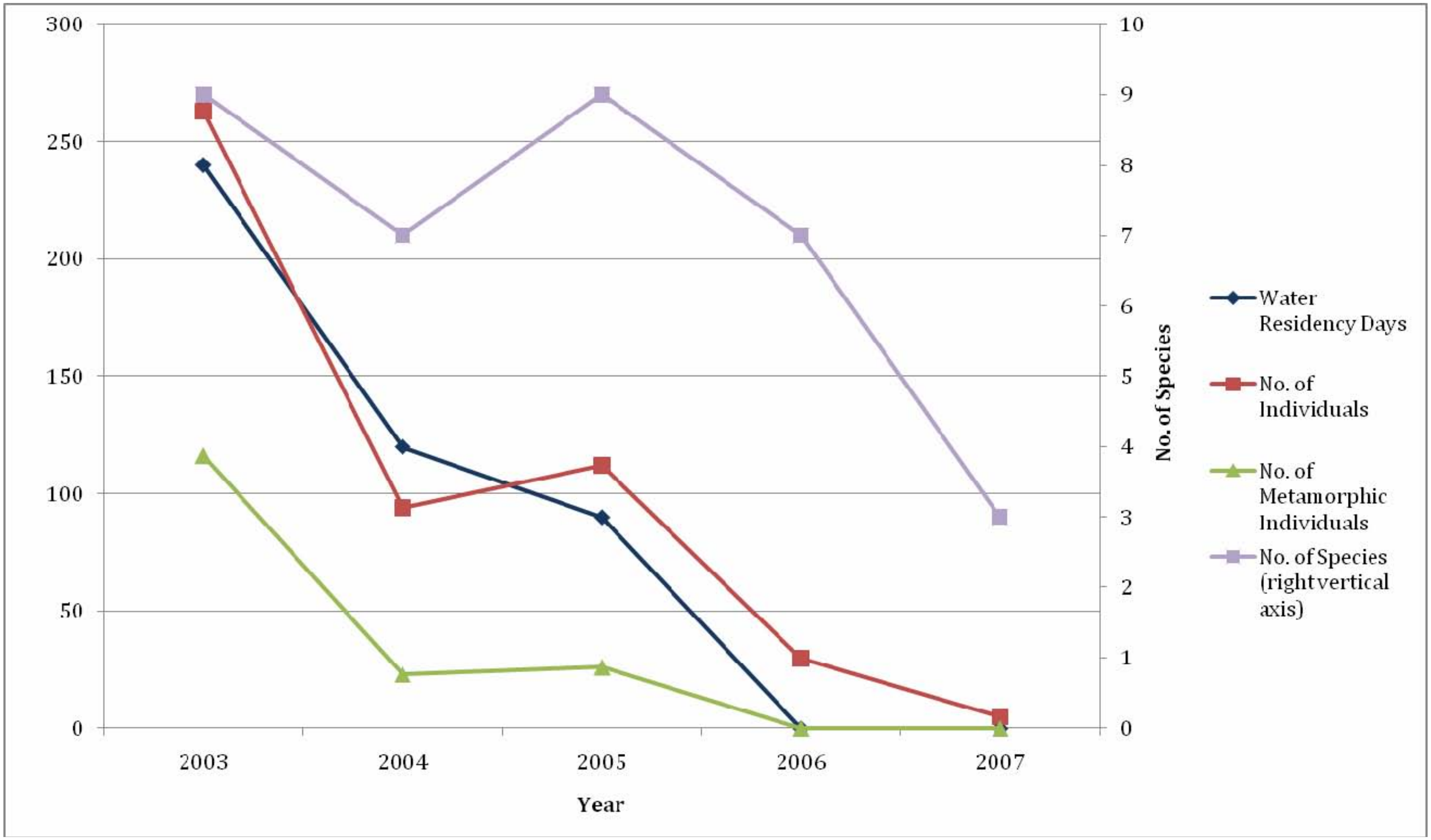

Figure 10. Comparison of water residency days and number of individuals, metamorphic individuals, and species captured at Port Orange Wellfield Control Pond (4). Water residency days (left vertical axis) represents the number of days in a given year that a pond held water. Total number of individuals and number of metamorphic individuals (left vertical axis) and number of species (right vertical axis) represent new captures from drift fence arrays for the 9 sampling weeks in each year from 2003 -2007.

Appendix E. Species diversity data and analyses for baseline and hydration periods.

Appendix E.

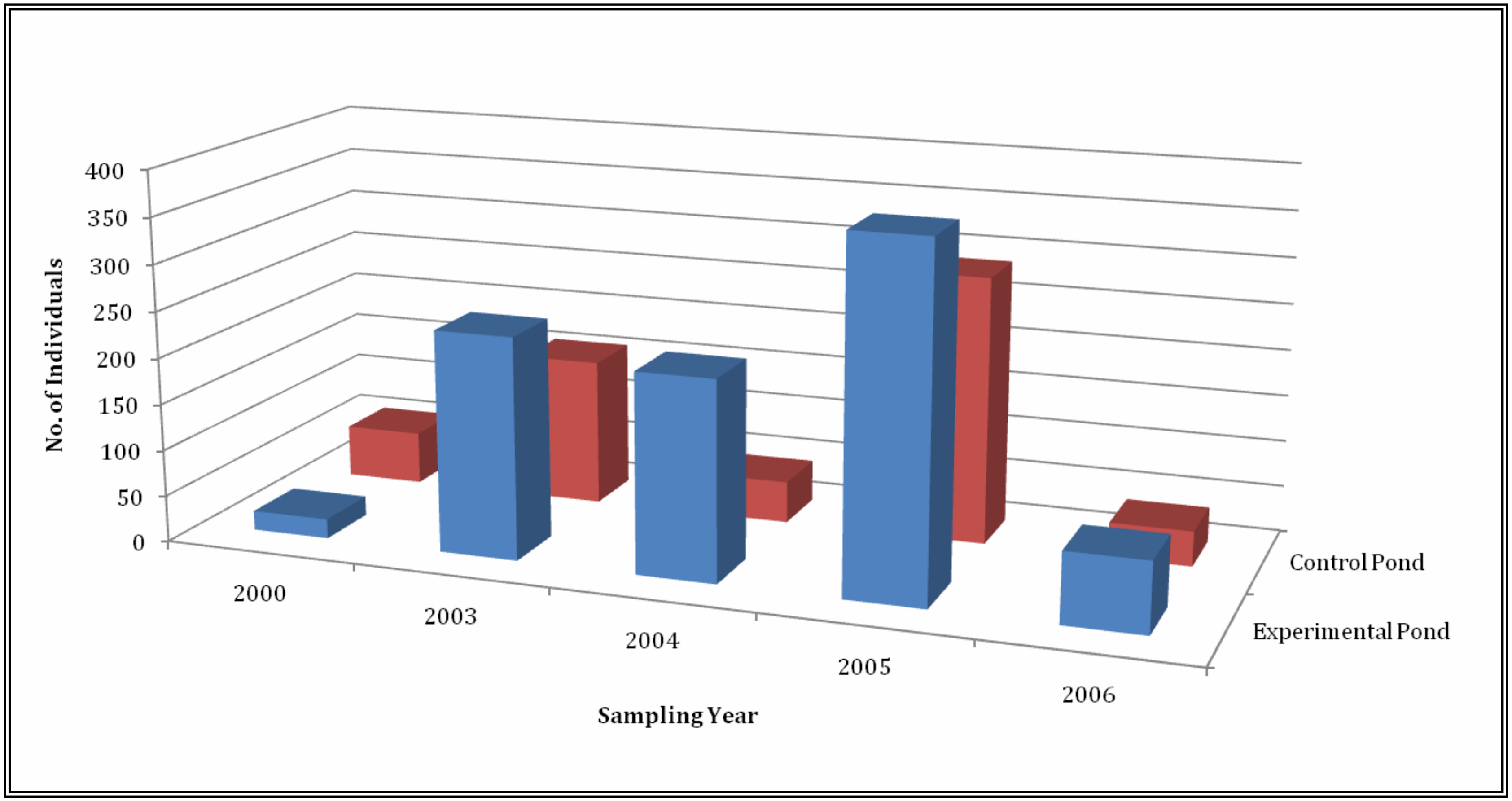

Figure 1. Yearly total amphibian abundance at Tillman Ridge Wellfield. Results represent new captures from drift fence arrays and are displayed for both baseline (2000) and hydration (2003-2006) periods.

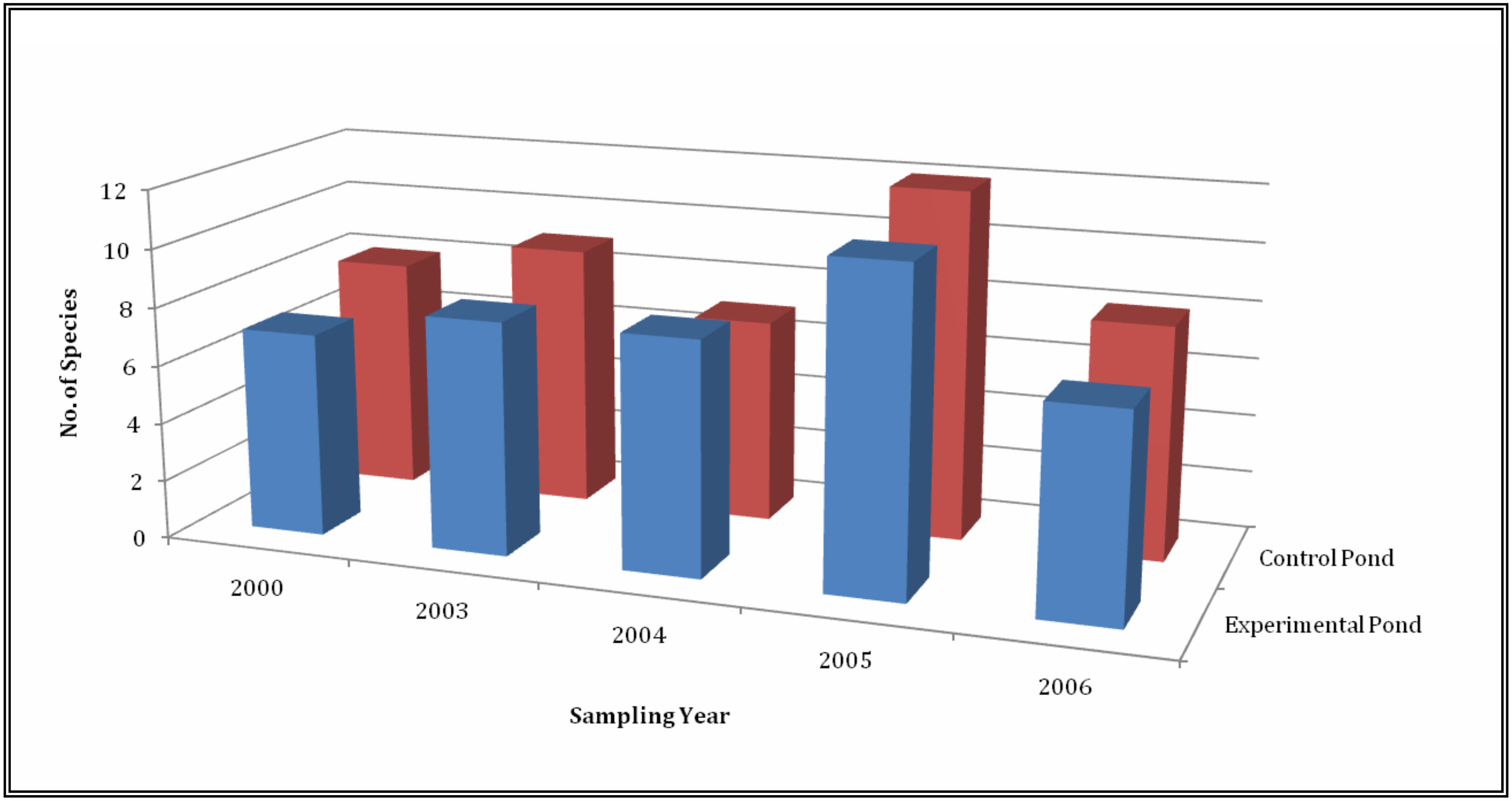

Figure 2. Yearly total amphibian species richness at Tillman Ridge Wellfield. Results are displayed for both baseline (2000) and hydration (2003-2006) periods.

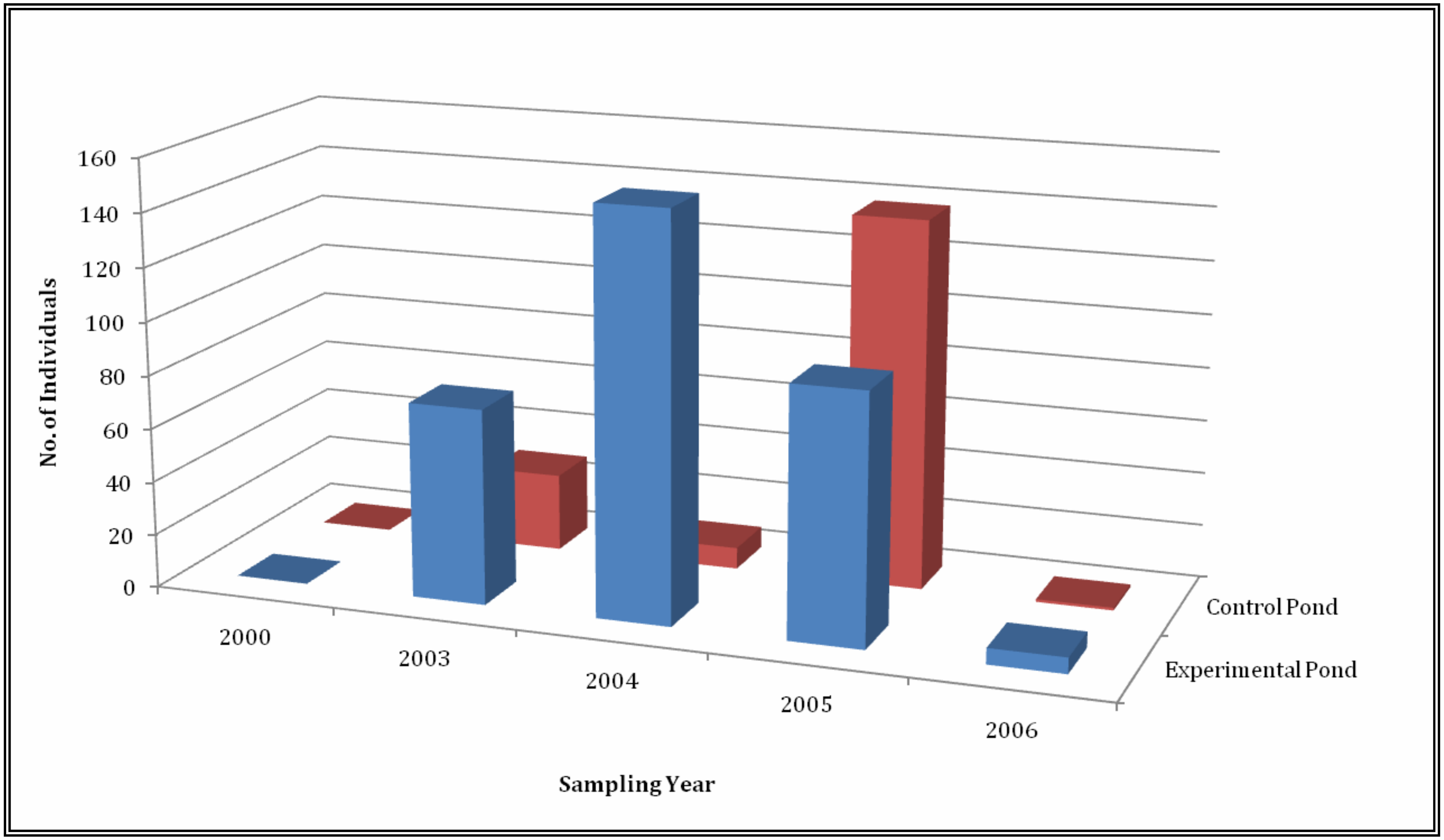

Figure 3. Yearly metamorphic amphibian abundance as a measure of reproductive success at Tillman Ridge Wellfield. Results represent new captures from drift fence arrays and are displayed for both baseline (2000) and hydration (2003-2006) periods.

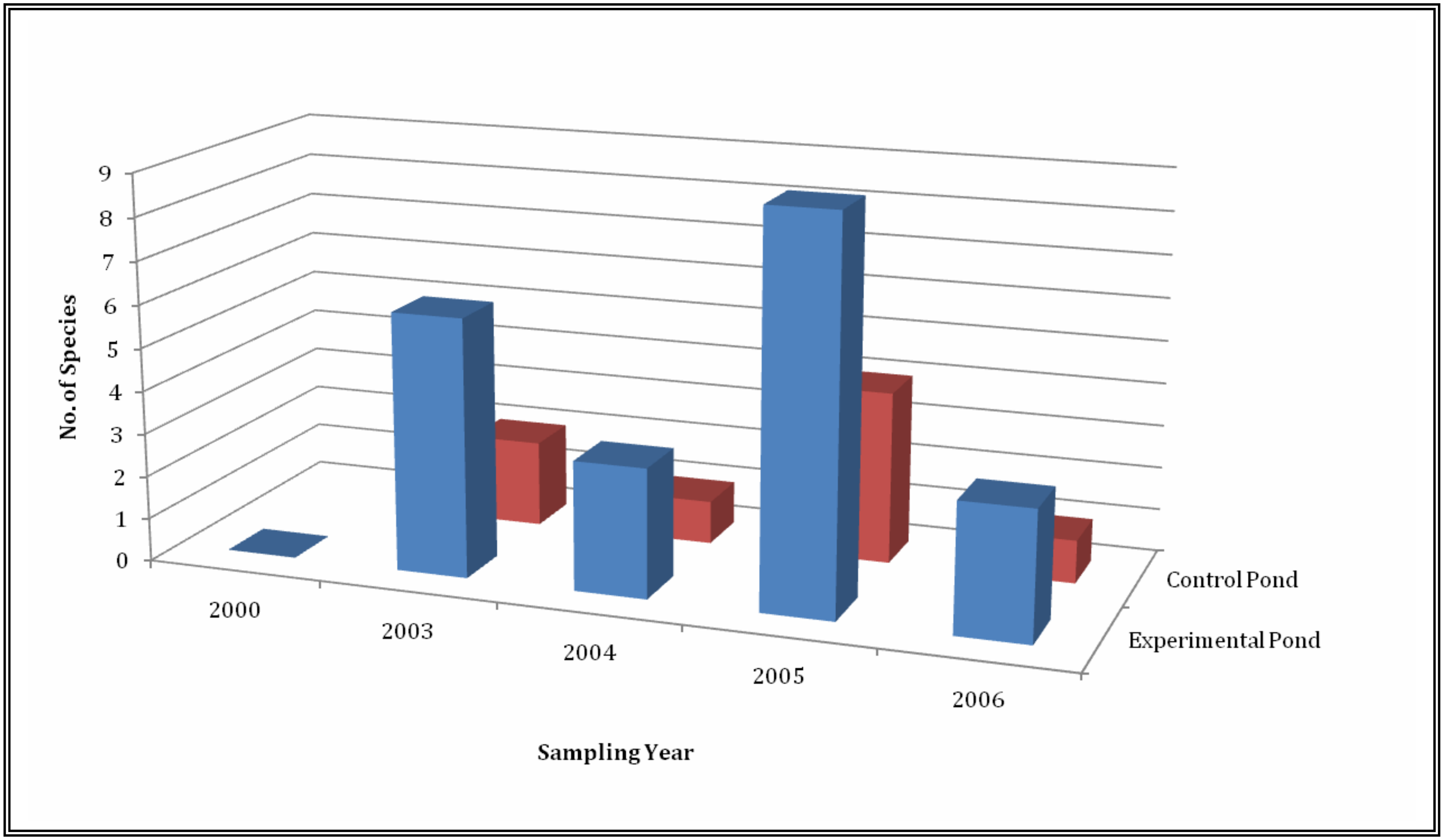

Figure 4. Yearly metamorphic amphibian species richness as a measure of reproductive success at Tillman Ridge Wellfield. Results represent new captures from drift fence arrays and are displayed for both baseline (2000) and hydration (2003-2006) periods.

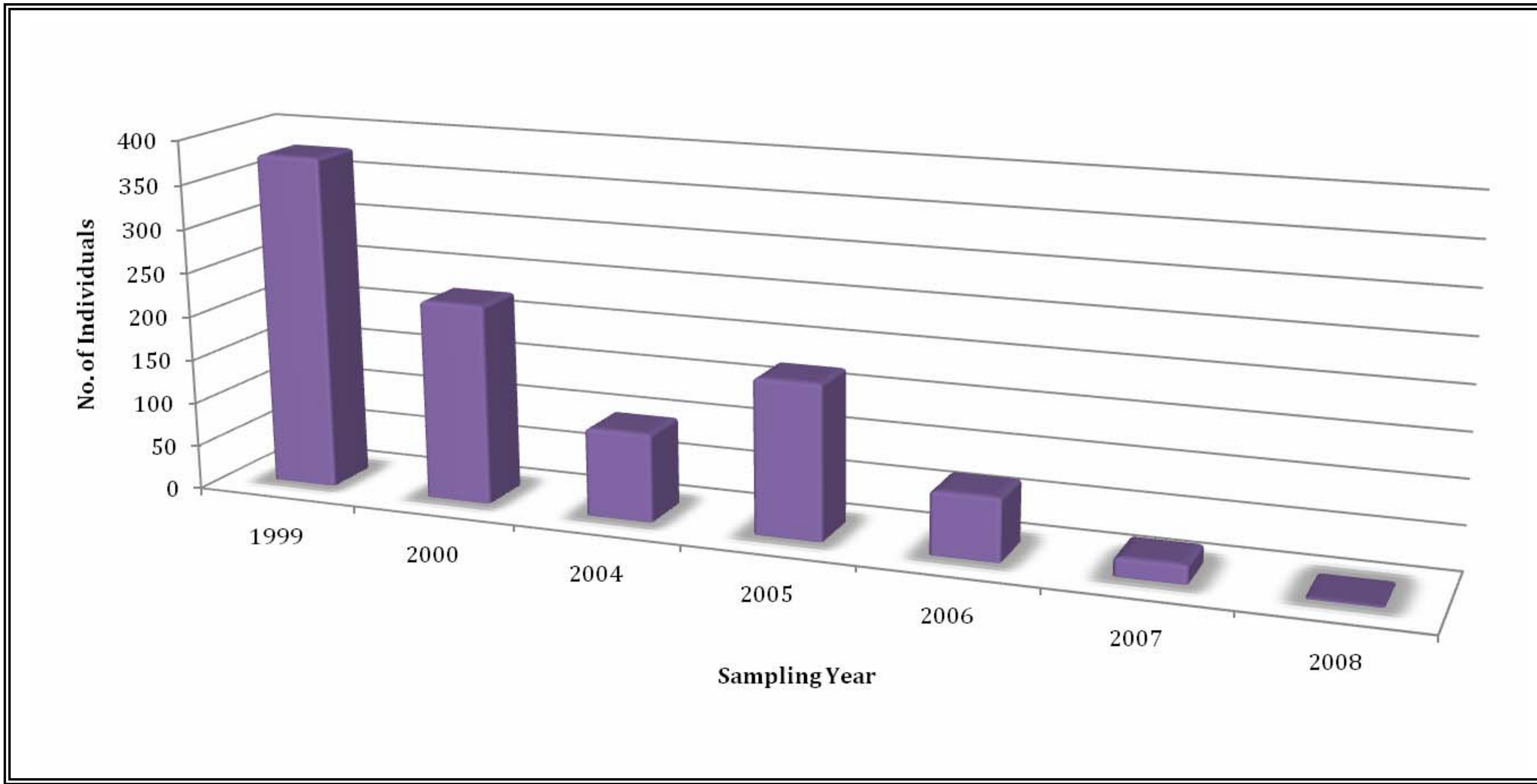

Figure 5. Yearly total amphibian abundance at Bennett Swamp. Results represent new captures from drift fence arrays and are displayed for both baseline (1999-2000) and operational (2004-2008) periods.

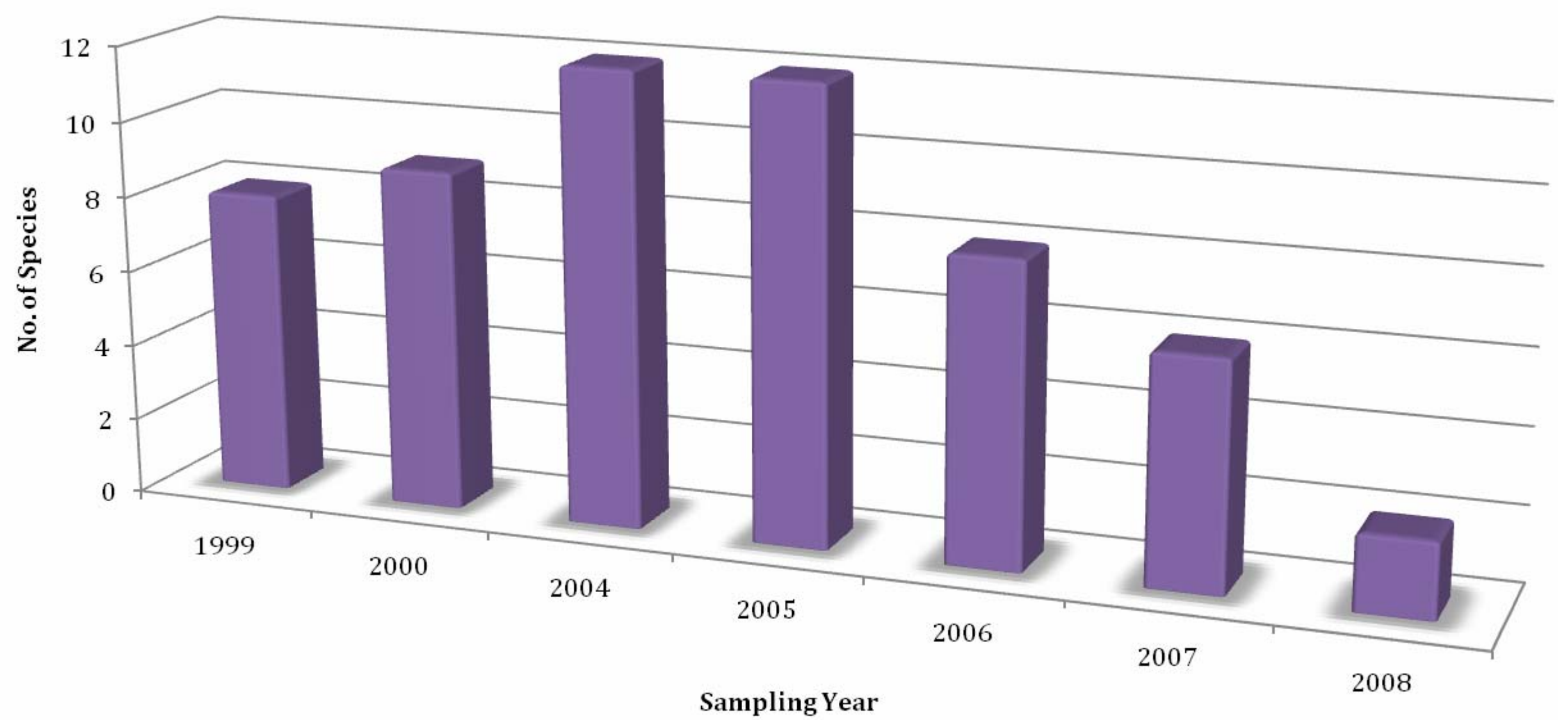

Figure 6. Yearly amphibian species richness at Bennett Swamp. Results are displayed for both baseline (1999-2000) and operational (2004-2008) periods.

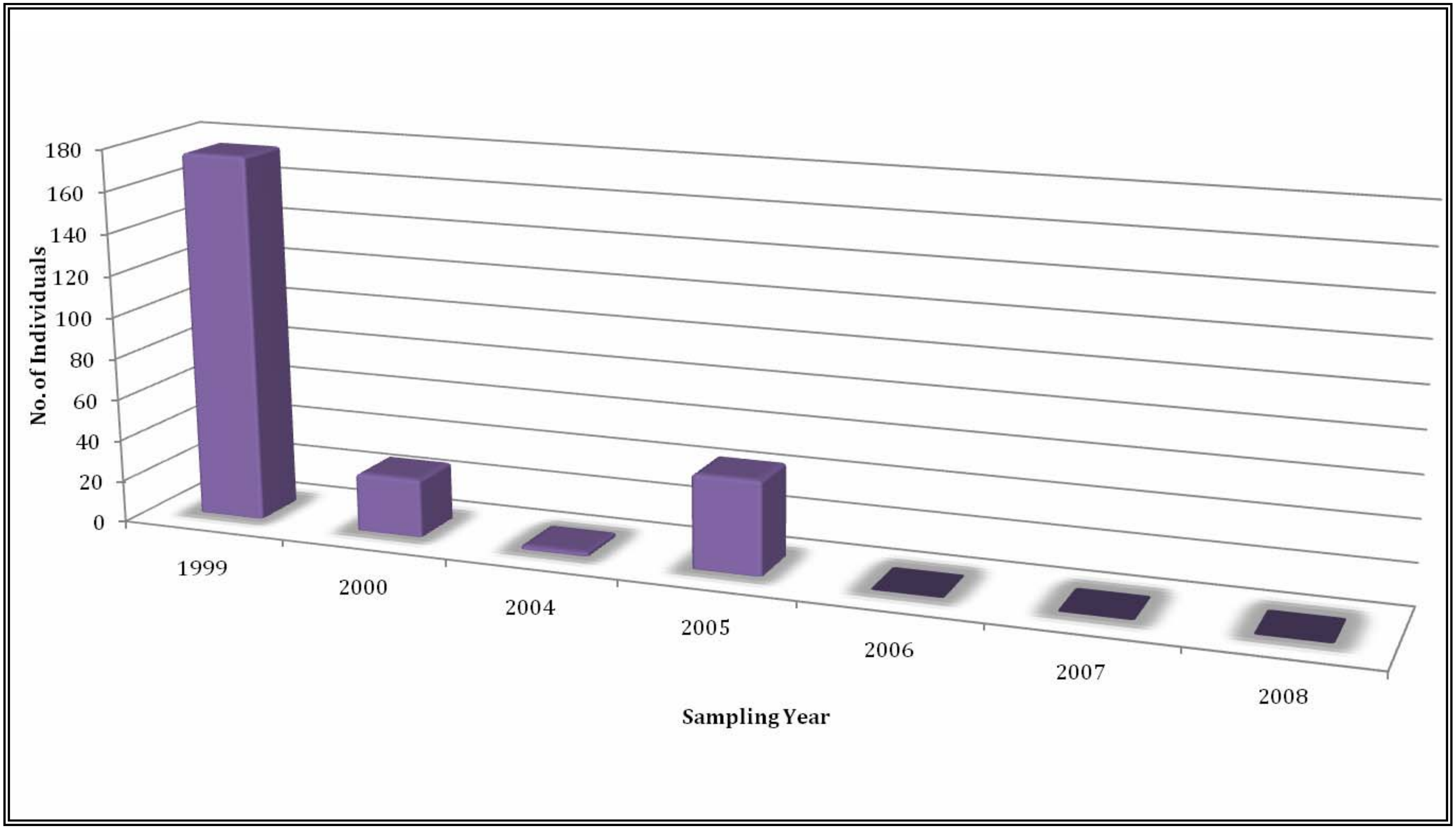

Figure 7. Yearly metamorphic amphibian abundance as a measure of reproductive success at Bennett Swamp. Results represent new captures from drift fence arrays and are displayed for both baseline (1999-2000) and operational (2004-2008) periods.

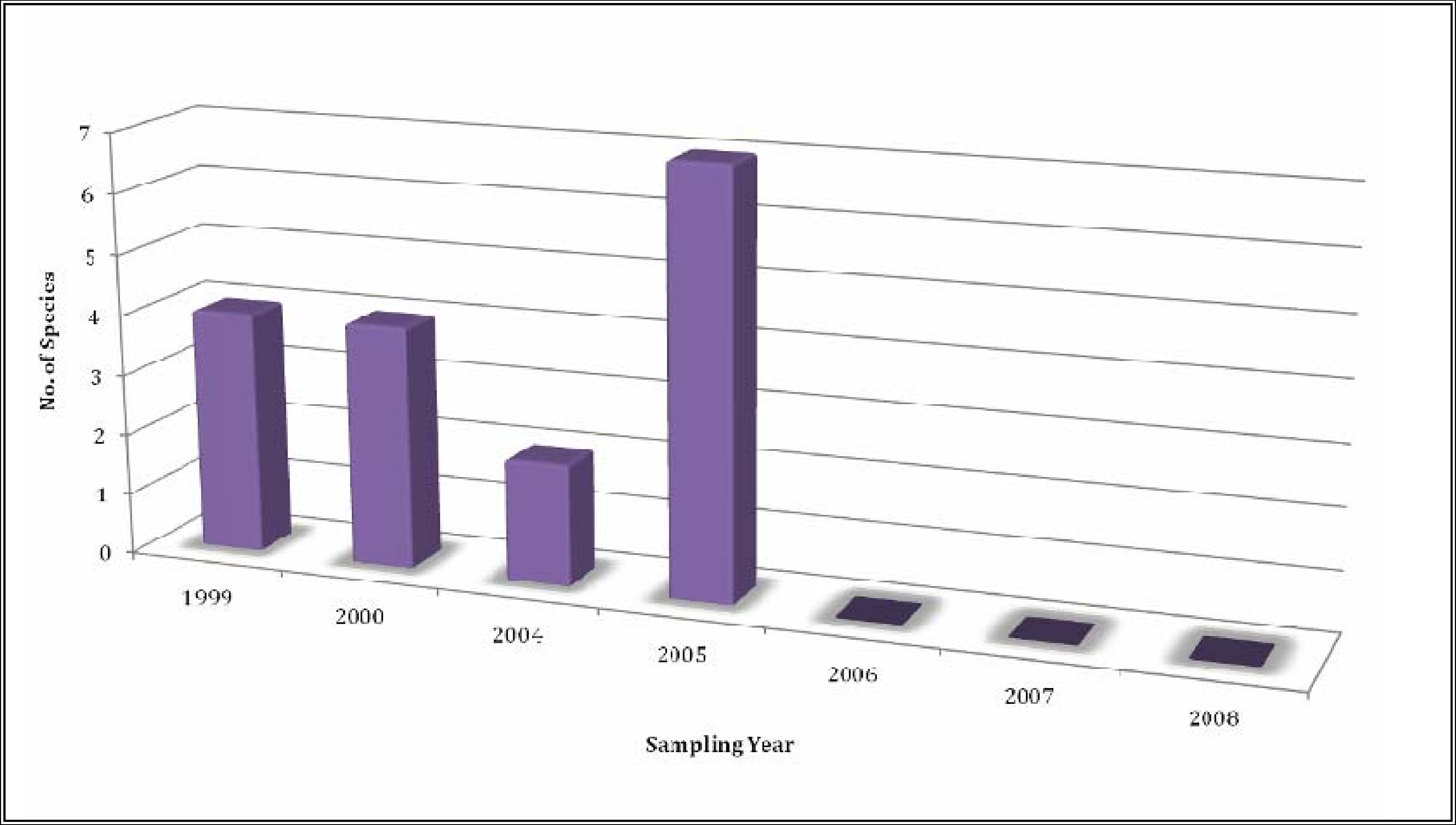

Figure 8. Yearly metamorphic amphibian species richness as a measure of reproductive success at Bennett Swamp. Results represent new captures from drift fence arrays and are displayed for both baseline (1999-2000) and operational (2004-2008) periods.

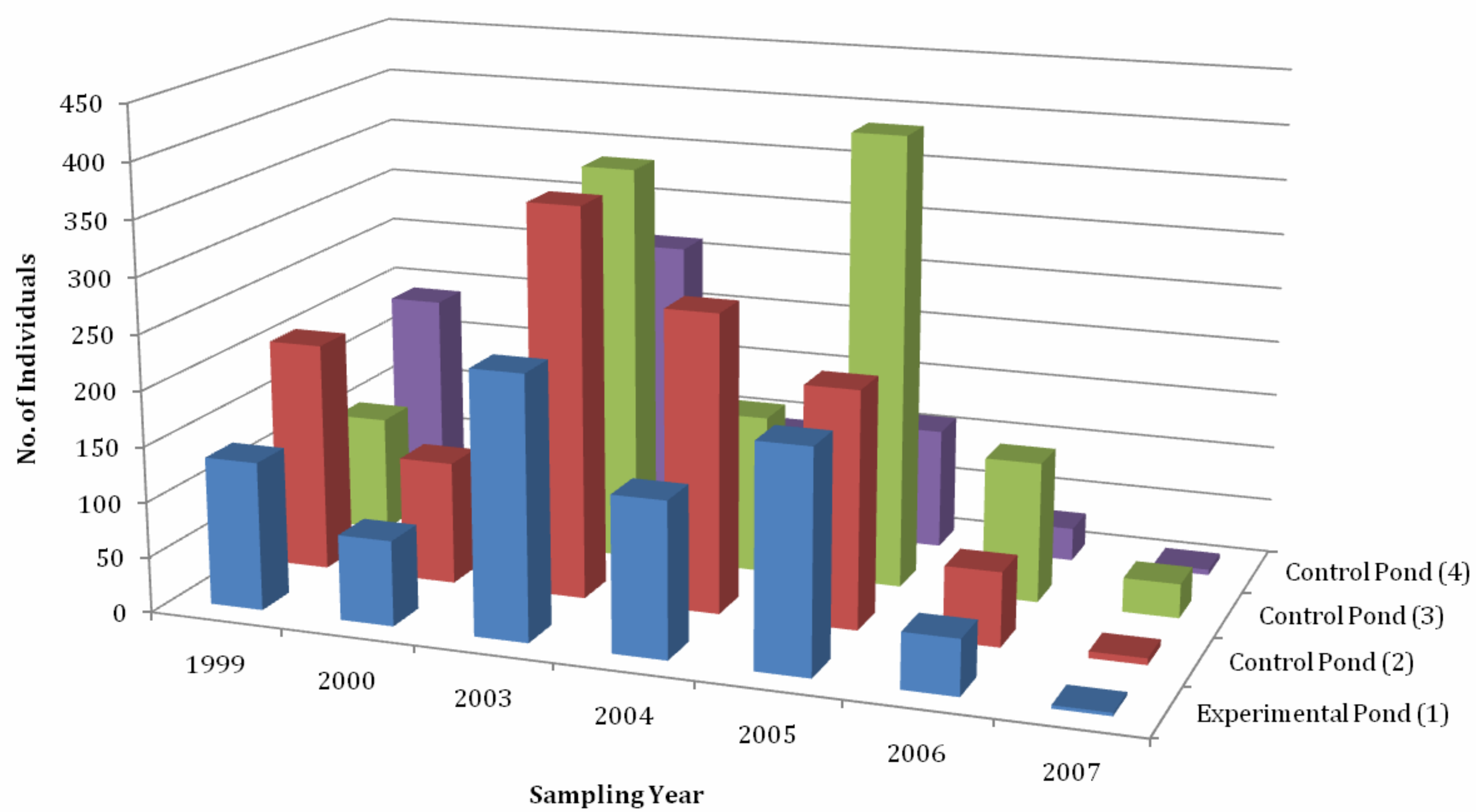

Figure 9. Yearly total amphibian abundance at Port Orange Wellfield. Results represent new captures from drift fence arrays and are displayed for both baseline (1999-2000) and hydration (2003-2007) periods.

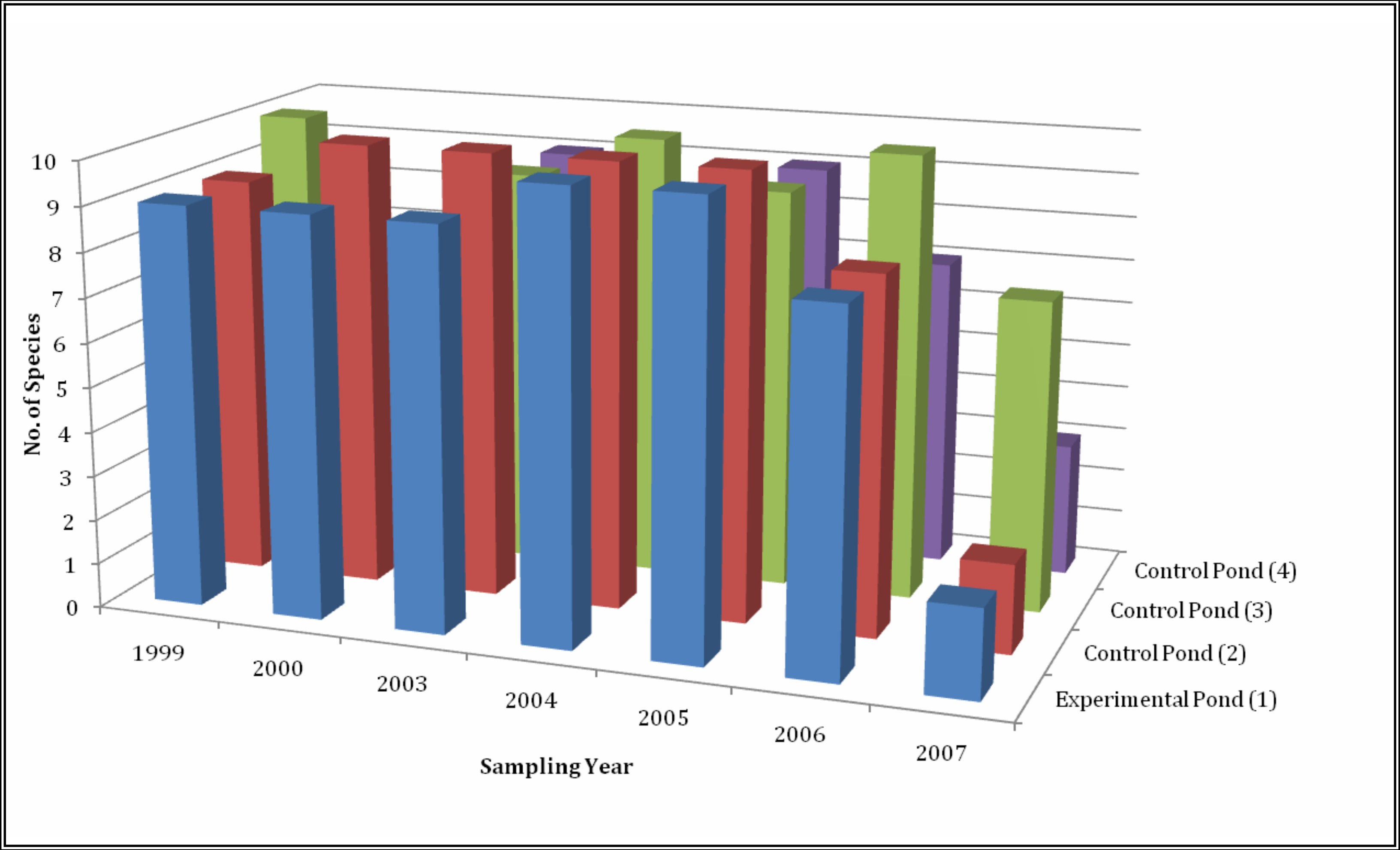

Figure 10. Yearly amphibian species richness at Port Orange Wellfield. Results are displayed for both baseline (1999-2000) and hydration (2003-2007) periods.

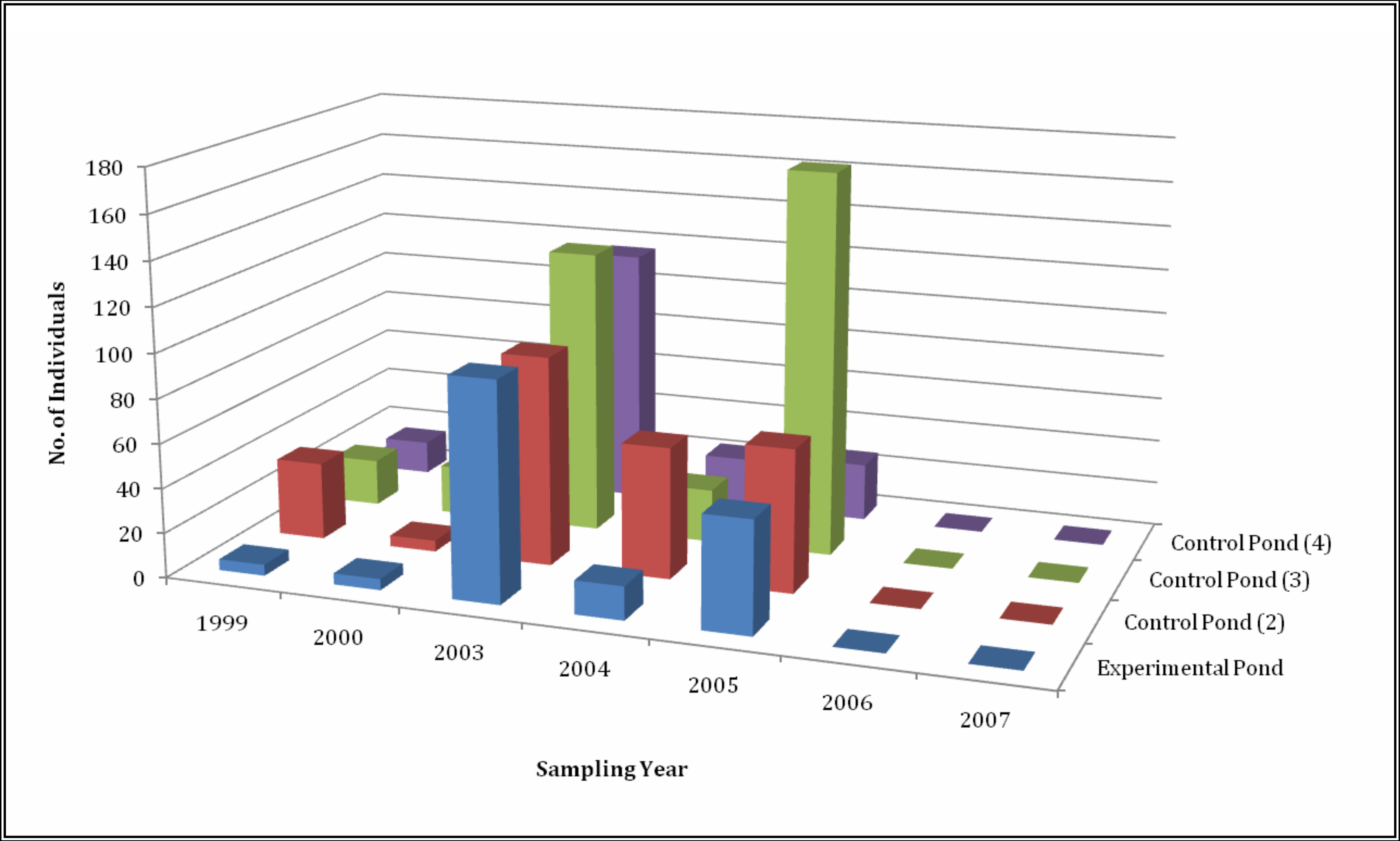

Figure 11. Yearly metamorphic amphibian abundance as a measure of reproductive success at Port Orange Wellfield. Results represent new captures from drift fence arrays and are displayed for both baseline (1999-2000) and hydration (2003-2007) periods.

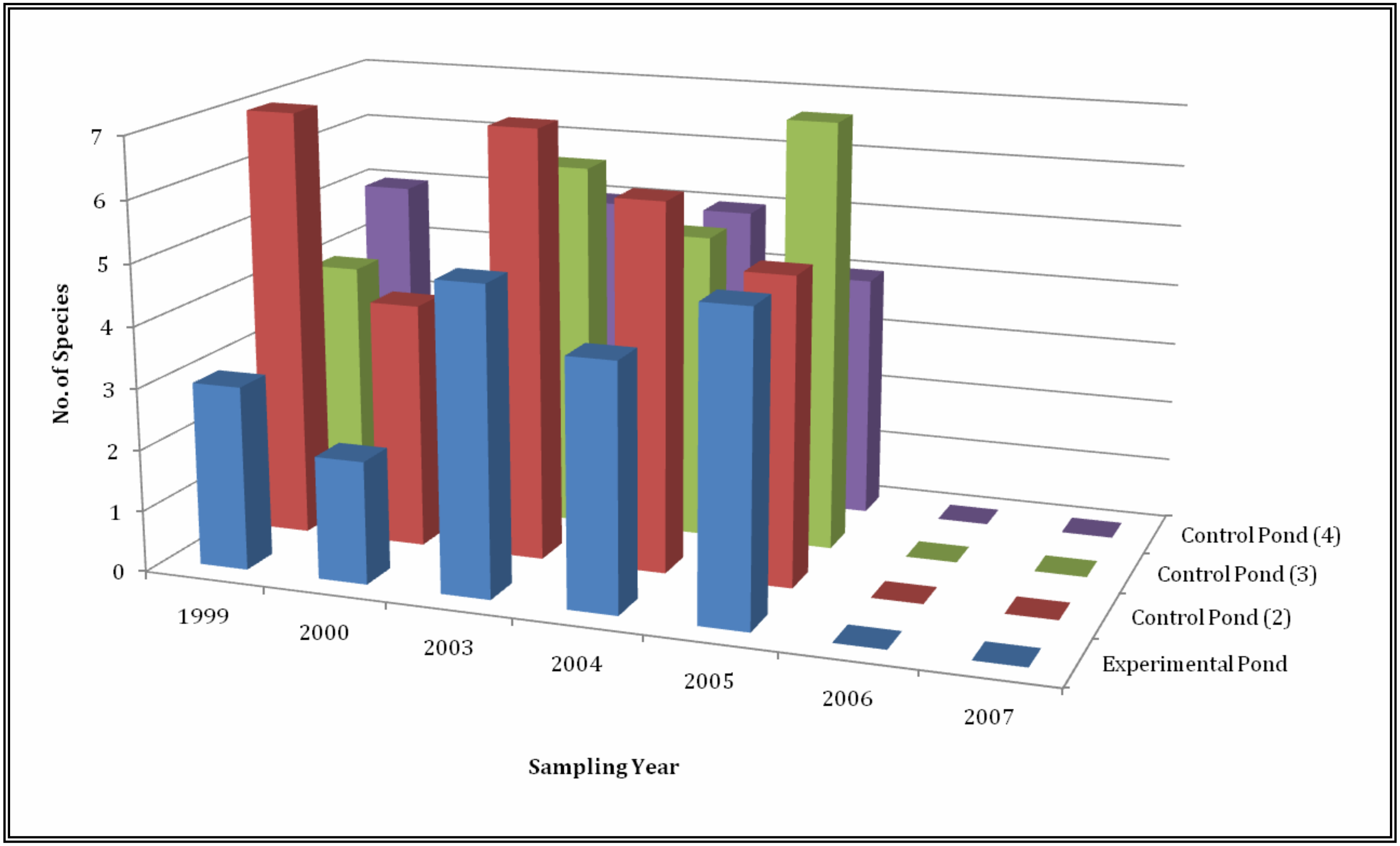

Figure 12. Yearly metamorphic amphibian species richness as a measure of reproductive success at Port Orange Wellfield. Results represent new captures from drift fence arrays and are displayed for both baseline (1999-2000) and hydration (2003-2007) periods.

APPENDIX F. Select amphibian photos.

A.

Figure 1. Experimental pond dry-up hole at Tillman Ridge (A). Amphibian larvae were concentrated and subsequently perished (B).

Appendix F.

Dwarf siren

Florida cricket frog

Oak toad metamorph

Southern toad

Greenhouse frog (non-native)

Barking treefrog

Figure 2. Select amphibians encountered during the project.

Appendix F.

Figure 2. (cont'd)

Pine woods treefrog metamorph

Squirrel treefrog metamorph

Cuban treefrog (non-native)

Spring peeper

Little grass frog

Southern leopard frog

Appendix G. CPI justifications for unincorporated comments by SJRWMD staff

Jerry Salsano Comment:

> **Jerry Salsano:** CPI statement on Page 28, Draft 1: "At the one site where sufficient study design was in place (PO), the water delivery was not substantial enough to be noticed by amphibians." Comment [JMS5]: I have a real problem with this statement and I would think that Rosanne and other CH staff would also. Why was the water delivered not substantial enough? **CPI response:** Our original sentence was edited and moved to the top of the paragraph. The gist of the sentence remains the same. The sentence now says: "At PO, there was sufficiently rigorous experimental design in order to make a definitive assessment of amphibian response to augmentation; however, from an amphibian's perspective, water input was not significant enough to measurably affect the experimental wetland." The idea in this sentence is agreed upon by CPI and CH2M Hill staff.

Bob Epting General Comments:

> **Bob Epting:** The authors state on page four that—"Some pertinent results from the hydrological portion of this study conducted by CH2M Hill will be cited within this report to provide the reader with a coherent big picture of how amphibian results relate to hydrological results." I don't find where this is done in the overall discussion of "Inconclusive results…" (P 27) or elsewhere in the report. **CPI response:** There are numerous citations of direct results from the hydrological portion of this study taken directly from the report of CH2M Hill (2008b). There are nine citations of direct CH results in the Tillman Ridge section. There are four in the Bennett Swamp section. There are eight in the Port Orange section. There are four in the Parkland Wetland section. Instead of only providing amphibian study results, CH results are laced throughout the CPI report in order to provide the reader with a big picture of what happened in the entire study, not just in the amphibian study.
>
> **Bob Epting:** I'm aware that project constraints severely limited the extent to which (page 4) "Assessments of the effects of active and passive hydration on amphibians will be made per study site." Nevertheless, the authors inform the reader that "At the end of this report in the Summary section, a general assessment of the effects of wetlands augmentation/water retention on amphibians will be made by drawing from the information learned from the four demonstration projects." A color-coded graphical summary of the type quantitative data summary mentioned above could be used to support such a general assessment. Such results would be useful in designing future augmentation projects and establishing success criteria. **CPI response:** Regarding the first part of Bob's comment, we see the irony in telling the reader that we will provide amphibian assessments, when that is not possible—because of inconclusive results. We omitted the portion of the "Objectives of the Final Report" section that represents the irony, and tell the reader here that results were inconclusive in this study instead. Regarding the color-coded graphical summary, we will not include this idea in the report because we reached inconclusive results. Since results on the effect of augmentations on amphibians were inconclusive in this study, it is therefore unnecessary to create a color-coded graph summarizing our findings as such. We don't yet know all the benefits or detriments that augmentations could have on amphibians.

Appendix G.

Marc Minno General Comments:

Comments on the Executive Summary:
Marc Minno: First paragraph is ok, but the rest needs to be rewritten. **CPI response:** The ES was reorganized but does not follow the exact recommendations provided by the reviewer. Our report is set up by site so it makes sense to summarize each site in a paragraph as we have done. This also is the format of our annual reports.

Marc Minno: Present a summary of the species found (# of amphibians, which were characteristic, which were exotic, any T&E species of concern). **CPI response:** Because the number of amphibians and the presence/absence of exotics and T&E species were not relevant to the overall objective, we did not include this information in the executive summary. However, this information is provided in the main body of the text and in the Overall Project Discussion.

Comments on Discussion and Conclusions:
Marc Minno: The discussion is too slanted toward inconclusive results and too generalized. **CPI response:** Our firm scientific opinion is that results regarding the effect of augmentation on amphibians are inconclusive in this study. We include relevant results that back up our interpretations. There is no “slanting” of our data interpretation. Scientific results often are inconclusive. It is an important part of the scientific process. Next time, investigators will be better informed and prepared as to how to conduct another amphibian/augmentation study because of what we learned in this study.

Marc Minno: Were the exotics benefiting from the hydrations? **CPI response:** We cannot say for sure whether exotic species benefited from hydrations because of inconclusiveness of our study.

Marc Minno: How did the rainfall variation affect the various species of amphibians? **CPI response:** Looking at individual species was not the main focus in our study. We looked at the amphibian community as a whole at each site in order to learn how species diversity may have been affected by augmentation. Amphibians become active during rainfall and often become stimulated to breed. This phenomenon is well known in literature and is cited in our report.

Marc Minno: The hurricane year of 2005 shows up in the data (see figures) for some sites, but not all. Which species really responded to the hurricanes and why? **CPI response:** Studying amphibian species’ response to hurricanes was not our objective. CPI shows the relationship of amphibian activity to rainfall in general at select sites, including the hurricane rains of 2005.

Marc Minno: Were any of the species found affected in a positive way or a negative way? Which species may be harmed by these hydration projects? **CPI response:** As has been stated, results regarding the effect of augmentation on amphibians in this study are inconclusive and we cannot say definitively which species may have been harmed or helped in this study.

Appendix H. Amphibian augmentation database. An excel file (Assessment of Amphibian Response to Wetlands Augmentation Database 2003-2008.xls) was provided as an attachment with this document. The file provided all the field data collected during the post-augmentation phase of this study. Data for the pre-augmentation portion of this study was previously submitted to SJRWMD by the University of Florida contractors (Franz and Means 2001).