Ten Mile Canal Filter Marsh Project in Lee County

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ABSTRACT

The Ten Mile canal was constructed in the 1920's to control flooding in South Fort Myers. In the 1970's the Canal was deepened and widened, and control structures were installed to maintain the water table and to protect saltwater intrusion. The Ten Mile canal watershed covers an area of 13 square miles and flows into Mullock Creek, an outstanding Florida Water which is designated as impaired, and subsequently into Estero Bay, Florida's first aquatic preserve. The existing predominant land use includes commercial and industrial. The watershed is affected by heavy urban development, cropland, and some pastureland along the banks.

Construction of an approximately 6,000-foot long filter mash was completed in December 2005. The filter marsh is located approximately at the half-way point along the canal length. The construction involved excavating approximately 400,000 cubic yards of material from a 6,000-foot by 100-foot area adjacent to the canal and routing the canal water into the filter marsh through two (2) 30-inch diameter pipes. A maintenance road and a recreation bike path have been constructed to separate the canal from the filter marsh. The inlet with a controllable gate system is installed upstream of a weir. Water flow into the filter marsh system is regulated through the gate system. The filter marsh system is divided into four (4) different cells connected through three (3) 30-inch diameter pipes. Water depths in cells vary from 18 inches to 5 feet. The first cell acts as a settling basin with limited wetland vegetation. The second cell is shallow and planted with wetland vegetation. The third cell is deeper than any other cell and has wetland vegetation suitable for deeper water. The last cell is shallow and also has a lot of shallow water wetland vegetation. Each cell is outfitted with an outflow riser regulated by flash boards. This structure allows excess water flow back into the canal. Further, this structure is being used to lower the water level in the cells during maintenance events.

The long term goal is to implement dynamic, effective water quality enhancement for Lee County's designated impaired water bodies. Nutrient reduction is the primary focus of this project. In order to monitor the effectiveness of the system, Lee County Environmental Lab is collecting water quality samples on a monthly basis at stations established within the filter marsh in addition to established sampling stations in the canal proper. Flow and stage data within the marsh is collected to coincide with the water quality sample collection. Water quality data collected show some improvements from inflow to outflow conditions. However, data collected so far is not sufficient at this time to formulate definitive conclusions. During the initial phase of the operation of the filter marsh, it was revealed that establishment of wetland vegetation and flow through the system will take some time. The maintenance of the filter marsh includes harvesting wetland vegetation on a regular basis.

INTRODUCTION

Ten Mile Canal was constructed in the 1920s to control flooding in South Fort Myers. In the 1970s the Canal was deepened and widened, and control structures for water table maintenance and protection from saltwater intrusion were constructed. An approximately 13-square mile watershed drains into Ten Mile Canal. Since its original construction and 1970s enhancements, the area surrounding the Ten Mile Canal has developed rapidly, as the area population nearly quadrupled – from 150,000 to 550,000 – since the 1970s. This has greatly impacted the pollution level of water flowing into Ten Mile Canal and subsequently into Mullock Creek, an Outstanding Florida Water, and into Estero Bay, Florida's first aquatic preserve. Mullock Creek is considered impaired for nutrients and dissolved oxygen.

The filter marsh project is located approximately at the half-way point along the canal length. Availability of the land was a limiting factor during selection of the project site as most areas adjacent to the Canal have been developed. The canal has been suspected of being a primary contributor to the high pollutant levels in both Estero Bay and its tributary, Mullock Creek, primarily due to intense developments of industrial, commercial and urban areas within the Ten Mile Canal watershed. Construction of the filter marsh was completed in late 2005 and monitoring of the system was started in early 2006.

PROJECT DESCRIPTION

The project provides for treatment and enhancement of water quality in the Canal by constructing a multi cell filtering system. The project will be constructed in two phases due to issues related land acquisition. The phase I of the filter marsh project covers an approximately 10-acre tract of land owned by the County. The project is about 6,000 feet long. The width varies from 60 to 100 feet. The project includes littoral planting for filtration and absorption of pollutants. The phase II of the project will be constructed on a tract of land, currently owned by a Railroad company, located immediately adjacent to the phase I. The filter marsh system is constructed downstream of an existing weir in the Canal proper. An inlet box with two (2) 30-inch diameter ductile pipes is used to convey the water from upstream of the weir to the filter marsh. The water is transported to the filter marsh system under gravity flow using hydraulic head upstream of the weir. These pipes are designed to carry 30 cfs of flow into the marsh system when both phases of the project are completed. Phase II of the project will include an extension of the phase I to include additional land immediately to the east.

DESIGN AND CONSTRUCTION

An inlet box with two (2) operable structures is constructed upstream of the weir near the east bank. These two manually operated gates are used to control amount of water flow into the filter marsh system via two (2) 30-inch pipes.

The filter marsh consists of four (4) cells. The first cell is about 400 feet long by 55 feet wide. It is about 10 feet deep with an average water depth of 5 feet. The first cell receives water from the Canal and acts as a settling basin where water changes its conveyance from pipe flow to channel flow, reducing flow velocity. The second cell is approximately 2100 feet long by 60 feet wide. The second cell is about 5 feet deep with an average water depth of 2 feet. The third cell is 1350 long by 60 feet wide. This is deepest cell with a depth of 8 feet and an average water depth of 5 feet. The last cell is 2200 feet long by 75 feet wide. It is about 5 feet deep with an average water depth of 2 feet. The filter marsh is separated from the Canal proper by a 25-foot wide maintenance road. The invert pipe elevation at intake is set at +5 feet (NGVD). The design water level within the filter marsh is set at +8.5 feet (NGVD). The weir elevation within the Canal proper is at +9.75 feet (NGVD). Embankments within the cells are constructed at 2:1 slope.

Side slopes of all four cells are vegetated with littoral plants; sand Cordgrass and Madencane. Bottom of cells are planted with Fire Flag, Bulltongue Arrowhead, Softstem Bulrush, Pickelweed, and Knotted Spikerush.

Each cell is fitted with a flashboard riser pipe to allow discharge of water from the cell back to the Canal by-passing the filter marsh. Additionally, water from cell to cell is controlled with flash boards riser pipes connecting cells. During maintenance events, each cell is isolated by raising flash boards interconnecting cells and water is discharged to the canal to lower the water level in the cell. Normal water levels in the cells in the range of 2 to 5 feet have been setback during maintenance operation. Lowering water levels have been helpful in manual harvesting of vegetation during maintenance events.

OPERATION OF THE SYSTEM AND WATER QUALITY MONITORING

Project monitoring is ongoing with publications of quarterly and annual reports giving details of trend of water quality and load reduction. Lee County Environmental Lab is collecting water samples on a monthly basis at new monitoring stations that have been established within the filter marsh in addition to established sampling stations in the Canal proper. The monitoring consultant collects both stage and flow data monthly coincident with the County sampling days.

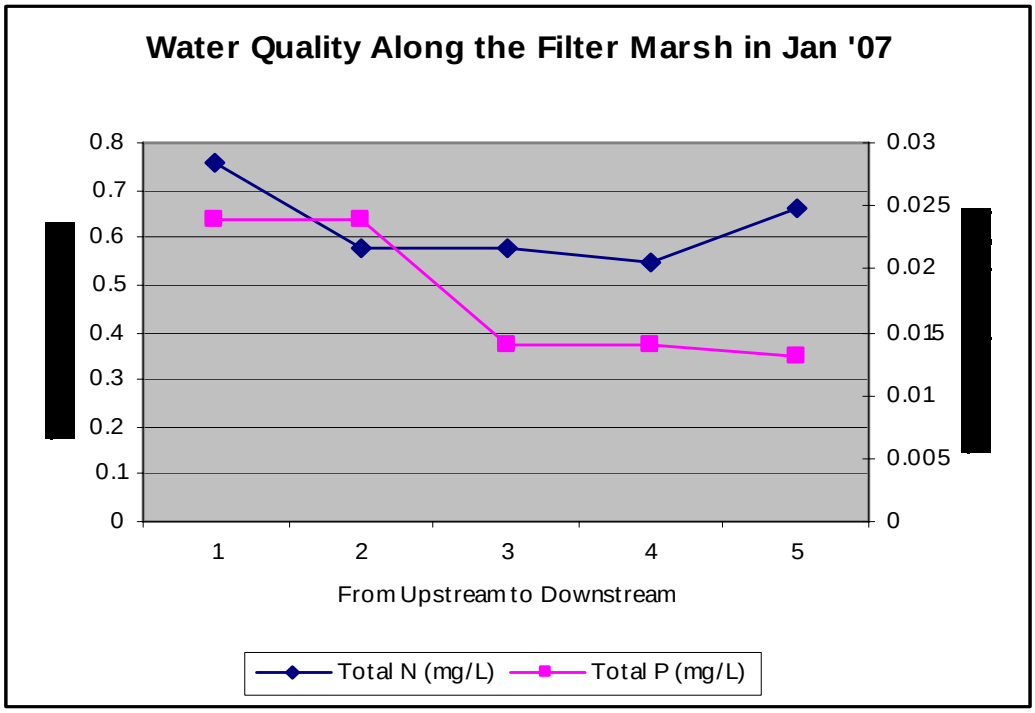
Normally, the system is set to operate with the west gate closed and east gate open approximately 3 inches to limit water levels and flow rates. During the dry season, water level falls below the weir in the Canal proper. It is intended to operate the filter marsh during the dry season when the water level is below the weir. However, it is also the intention to maintain a balance between over-draining the Canal and improving water quality within the Canal. Beginning March 2007, the water level in the Canal has been extremely low; the outflow from the last cell back into the Canal has been ceased. During the course of the operation, it is intended to experiment with the water levels by adjusting flash boards and find the optimum operating conditions.

The data collected is expected to provide measure of performance as well as information necessary to develop adaptive management practices. Auto samplers are being installed to collect water samples during storm events. The following table shows Total Nitrogen and Total Phosphorous concentrations within the filter marsh. 10MIFM02 is the upstream end of the marsh and 10MIFM06 is the downstream end of the marsh.

Table 2: Water Quality within the Filter Marsh

TN	**Nitrogen, Total (mg/L as N)**					
	Upstream	---------->	---------->	---------->	Downstream	
	10MIFM02	10MIFM03	10MIFM04	10MIFM05	10MIFM06	**MDL**
Jan 2006	0.97	0.9	0.85			0.1
Feb 2006	0.65	0.58	0.66	0.59	0.66	0.1
Mar 2006	0.681	0.6	0.4	0.6	0.637	0.1
Apr 2006	0.75	0.75	0.76			0.1
May 2006	0.736	0.91			0.73	0.1
Jun 2006	0.59	0.52	0.48	0.56	0.62	0.1
Jul 2006	0.99	1.17	0.76	0.63	0.74	0.1
Aug 2006	0.78	0.68	0.63	0.65	0.86	0.1
Sep 2006	0.837	0.77	0.63	0.57	0.589	0.1
Oct 2006	0.83	0.83	0.8	0.83	0.79	0.1
Nov 2006	0.96	0.85	1.01	0.68	0.74	0.1
Dec 2006	0.9	0.89	0.79	0.69	0.57	0.1
Jan 2007	0.76	0.58	0.58	0.55	0.66	0.1

T-PO4	**Phosphorus, Total (mg/L as P)**					
	Upstream	---------->	---------->	---------->	Downstream	
	10MIFM02	10MIFM03	10MIFM04	10MIFM05	10MIFM06	**MDL**
Jan 2006	0.01	0.01	0.01			0.02
Feb 2006	0.01	0.01	0.01	0.01	0.01	0.02
Mar 2006	0.011	0.01	0.01	0.01	0.033	0.02
Apr 2006	0.01	0.01	0.01			0.02
May 2006	0.021	0.02			0.035	0.01
Jun 2006	0.03	0.02	0.02	0.02	0.03	0.01
Jul 2006	0.04	0.03	0.03	0.02	0.03	0.01
Aug 2006	0.02	0.02	0.005	0.005	0.02	0.01
Sep 2006	0.021	0.02	0.005	0.005	0.006	0.01
Oct 2006	0.04	0.03	0.02	0.02	0.01	0.01
Nov 2006	0.02	0.02	0.01	0.01	0.02	0.01
Dec 2006	0.04	0.02	0.01	0.01	0.01	0.01
Jan 2007	0.024	0.024	0.014	0.014	0.013	0.01



MAINTENANCE OF THE SYSTEM

Maintenance of the filter marsh is conducted periodically. Use of chemicals such as herbicides or pesticides is prohibited during maintenance events in order to prevent skewing of the monitoring data and to reduce possible reintroduction of nutrients through decaying biomass. Side slopes vegetation is trimmed using weed eaters. Wetland plants below water level are harvested manually. All vegetation harvested is disposed at a location approved by the permitting agencies. The table below shows the vegetation removal quantities during maintenance of the marsh system.

Table 1: Filter Marsh Vegetation Harvesting

Date	Work Type	Quantities		Labor
		Upstream of weir	Within filter Marsh	
8/26/06	Aquatic Plant Removal	80 cy of water lettuce	80 cy of cattail	5 men and 3 canoes; 10 hr/day for 5 days
10/20/06	Aquatic Plant Removal	160 cy of water lettuce	160 cy of cattail and 850 cy of chara	14 men and 2 canoes; 10 hr/day for 10 days

Growth and control of cattail had been an issue during the initial phase of the maintenance cycle. All cattail within the cells were removed manually leaving some of the root system within the filter marsh cells. This would enable the vegetation to grow back absorbing nutrients and metals in the water column.

CONCLUSIONS

The filter marsh system is still going through a transition stage. Monitoring of water quality is ongoing. It has taken almost a year to establish vegetation within the marsh. Monitoring data collected so far shows some improvement in water quality. However, more data is necessary before establishing trends and efficiency of the system. 2007 has been one of the driest seasons in the recent history. Below average water levels have not been helpful in maintaining continuous flow through out the year.

ACKNOWLEDGEMENTS

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REFEENCES

1. Request for Grant Funding under Stormwater Retrofitting, prepared by Lee County Division of Natural Resources, September 27, 2002.
2. Ten Mile Canal Filter Marsh Project, First Quarter Report, 2006, prepared by Environmental Consulting and Technology, Inc., April 2006.

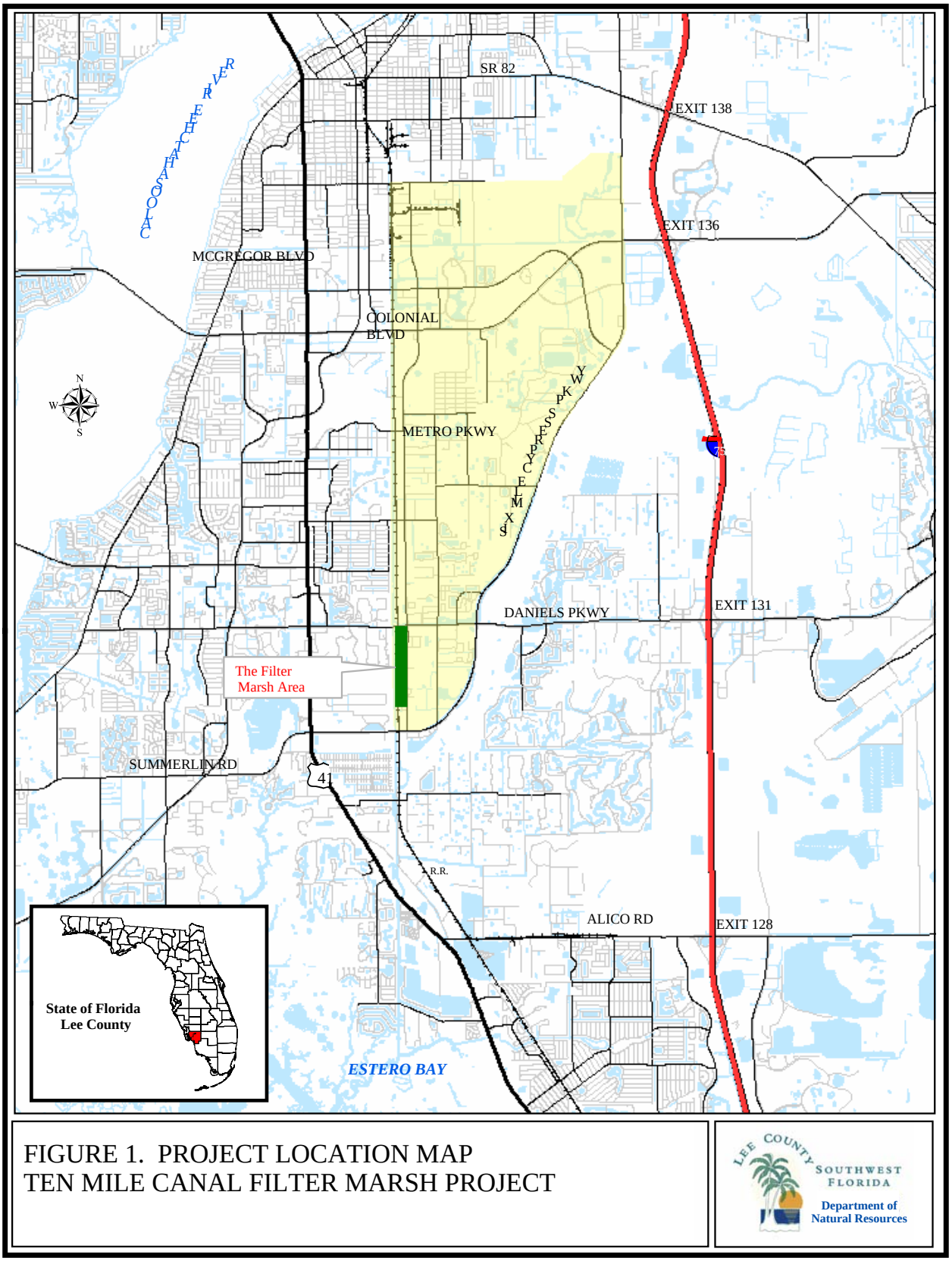

FIGURE 1. PROJECT LOCATION MAP
TEN MILE CANAL FILTER MARSH PROJECT

LEE COUNTY SOUTHWEST FLORIDA
Department of Natural Resources

Station_ID	Station_De
10MIFM02	North end of Settling Area North
10MIFM03	North end of Filter Marsh North
10MIFM04	North end of Settling Area South
10MIFM05	North end of Filter Marsh South
10MIFM01	Lee Co gauge N of Daniels Pkw y w eir
10MIGR50	Upstream face of Daniels Rd
10MIFM06	South end of Filter Marsh South at Discharge

Ten Mile Canal Filter Marsh Project Area
Figure 2: Location Map of Water Quality Monitoring Stations