Executive Summary

Introduction

Camp Dresser & McKee Inc. (CDM) was retained by the Polk County Board of County Commissioners under the direction of the Polk County Natural Resources Division to develop a restoration management plan for Lake Hancock, and the water discharging to the Peace River from Lake Hancock. The intent of this report is to assist Polk County in the development and implementation of a multiyear / multiphase effort to achieve the following objectives developed by the Lake Hancock Advisory Group:

1. Improve the quality of the water discharged from Lake Hancock by reducing Total Maximum Daily Loads (TMDLs) to the lake.

2. Preserve, and where feasible, enhance the natural greenway / wildlife corridor (Peace River / Green Swamp) through Polk County.

3. Maintain the exceptional wildlife values of Lake Hancock.

4. Enhance the diversity of the fishery of the lake.

5. Provide habitat compatible public access for nature-based recreational activities and commercial fishing.

Past industrial and agricultural activities have extensively affected the lake. These activities include domestic and industrial wastewater discharges, urban development, agricultural activities, loss of wetlands, and phosphate mining. As a result, Lake Hancock is characterized by excessive growth of persistent blue-green algal blooms. The lake contains high nutrient concentrations; has a thick layer of flocculent organic sediments; is dominated by detrital-feeding rough fish; has reduced clarity; and is characterized as having poor water quality. However, Lake Hancock and its shoreline sustain a large, highly diverse fauna. Restoration is needed for this valuable resource as well as for protection of downstream waters that are used as a public drinking water source as well as Charlotte Harbor.

In order to develop the Restoration Management Plan, CDM documented the history of restoration efforts in Lake Hancock and identified available pertinent data for Lake Hancock (including physical, chemical, and biological characteristics of the lake), as well as institutional and regulatory issues, and lake restoration techniques. Then CDM evaluated applied lake restoration techniques and lake restoration options, and selected three lake restoration options. A lake restoration implementation plan was developed for a selected option.

Lake Restoration Techniques

The restoration of eutrophic or hypereutrophic lakes requires the reduction of both external and internal phosphorus loads, as well as the implementation of other management techniques. Therefore, in order to develop the Lake Hancock restoration plan it is important to evaluate available restoration technologies that reduce external and internal loads, as well as other management techniques. Sediment inactivation techniques (dredging, drawdown and mechanical excavation, chemical inactivation, and capping) and recirculating wetlands can remove internal loads. Treatment wetlands and settling ponds can remove external tributary loads. Other in-lake restoration techniques include increasing the lake water level, biological control, and littoral zone habitat restoration. Treatment wetlands, settling ponds and filtration can be used to treat the discharge from the lake.

In order to restore this over-enriched, shallow and turbid lake and to restore a balance to the aquatic flora and fauna, it is necessary to improve the quality of water within the lake. Phosphorus loadings must be reduced from the sediments in the lake as well as from the tributaries. Over half of the annual phosphorus loading comes from the sediments and therefore, techniques that control the phosphorus input from the sediments are critical to restoration of Lake Hancock. A brief description of the restoration techniques follows:

- **Sediment Removal by Hydraulic Dredging –** A barge-mounted pumping system is used to remove submerged sediment from the lake. This technique can provide efficient removal of sediments from the lake.

- **Lake Drawdown and Mechanical Excavation –** Lake water is allowed to drain through the existing P-11 structure at South Saddle Creek, and when sufficiently dry, earth-moving equipment can be used to remove sediments from the lake shoreline.

- **Chemical Inactivation of Sediment with Alum –** Alum is used to immobilize phosphorous within the sediment. The phosphorus and alum bind and settle, becoming unavailable for release back into the water column.

- **Capping of the Sediments with an inert substance –** Clean sand, gravel, geotextiles, or synthetic liner may be used to cover the submerged sediment. This activity would also help bind nutrients within the sediment.

- **Recirculating Treatment Wetland –** This technique removes particulate phosphorous by removing algae and resuspended sediments. This is accomplished by pumping lake water into a filtration wetland, cleaning the water through nutrient uptake and settling.

- **Wetland Treatment of Inflows –** This technique involves the construction of wetlands to treat tributaries entering Lake Hancock. The wetlands capture and transform nutrients from the tributaries before they enter the lake.

- **Lake Level Manipulation –** This technique involves controlling the lake level using the P-11 structure located at the discharge of Lake Hancock. Adjustments to lake level can be used to recreate natural cyclic variations in depth, increase the depth of the lake to facilitate commercial fishing or drawdown the lake for sediment removal.

- **Biological Control/Management –** This technique involves altering biological components in the lake's community. This technique may provide a method of controlling algae growth and promoting increase in fish diversity.

- **Habitat Restoration –** This technique involves restoration of the littoral zone of the lake, which requires improved water transparency and removal of organic sediments to allow growth of submerged rooted plants.

Identification of Suitable Lands for Restoration Activities

An aggressive land acquisition plan has been identified by Lake Hancock Advisory Group as a necessary element of an overall management plan for the lake. Some of those lands will be required for restoration of the lake and an inventory of potential lands for restoration activities was developed. The present evaluation was limited to those areas, which border the lake or it's tributaries where restoration activities are likely to be conducted. Twelve property areas were initially identified and grouped into four general regions, each surrounding the lake and one of the tributaries. The properties contain areas that were formerly wetlands and offer opportunity for wetland restoration. These properties could be incorporated into a trail/greenway/wildlife corridor linking areas north of the lake with the Peace River to the south. Suitable acreage may be available for a demonstration or full-scale project.

Evaluation of Lake Restoration Options for Lake Hancock

Seventeen lake restoration techniques applicable to Lake Hancock were identified and combined into ten options in order to address all five restoration objectives. Each technique was scored for its ability to fulfill the objectives. The sum of the scores for the applied techniques in each option were used to rank the options. The highest ranked restoration options differed primarily in the technology used to address the internal phosphorus loading from the sediments.

Top Three Ranked Options

The top three ranked options included a number of common components and differed primarily in how the sediment phosphorus was controlled. The components common to all three options include:

- **Wetland Treatment of Discharge From South Saddle Creek**. This is in direct response to the need to improve the quality of water discharged from Lake Hancock (Objective 1) and would provide an environmental safeguard to other restoration activities to be conducted in the lake such as hydraulic dredging. This component would also provide a continuation of the greenway, which will enhance the wildlife value of the lake.

- **Chemical Treatment/Settling Pond Treatment of North Saddle Creek Inflow.** The largest external loading of phosphorus is from North Saddle Creek and this component would serve to reduce that loading. This component addresses Objective 1 directly. Improvements to water quality are necessary and complimentary to achieving Objectives 3 (Maintain Exceptional Wildlife) and 4 (Enhance the diversity of the fishery).

- **Wetland Treatment of Banana Creek Inflow.** This common component would improve water quality (Objective 1), increases greenway (Objective 2), improves public access (Objective 5) and enhances the wildlife of the lake (Objective 3) through increased habitat.

- **Passive Drawdown and Mechanical Excavation of the Littoral Zone.** Drawdown and mechanical excavation would be followed by replanting of the shoreline with desirable aquatic plants. This component would provide a significantly improved habitat to diversify the fishery, and provide a perimeter greenway along the lake, leading to the discharge treatment wetland. This component addresses Objectives 2, 3 and 4.

Option 9 - In addition to the common components previously described, the first plan includes a recirculating treatment wetland to address the internal phosphorus loads released from the sediments. This option (**Option 9)** is the most 'balanced' of the top ranked options in terms of equally addressing the five objectives (**Table ES-1)**. The recirculating wetland is patterned after the Lake Apopka restoration effort. Additional public access provided in conjunction with the recirculating wetland accounts for the relatively higher points score for Objective 5 (Provide Public Access for Recreational Activities and Commercial Fishing).

Option 8 - The second option **(Option 8)** utilizes hydraulic dredging to remove the internal loads. This option is slightly less effective at fulfilling Objective 5. While treatment of the decant water will include wetland treatment, the size of the wetland is considerably smaller than the recirculating treatment wetland and public access is expected to be less than with the first option. However, this option does provide the important additional benefit of deepening the lake.

Option 4 - The third option **(Option 4)** includes alum treatment of the lake to control release of phosphorus from the sediments. This option was the least balanced in terms of meeting all of the objectives and provide only a short-term solution since the sediments may be susceptible to resuspension.

Table ES-1
Relationship of Top Ranked Plan to Objectives

Restoration Objective	Option 9	Option 8	Option 4
Improve the Quality of Water Discharged from Lake Hancock by Reducing the Total Maximum Daily Load	16.8	21.6	24.0
Preserve, and Where Feasible Enhance the Natural Greenway / Wildlife Corridor Through Polk County	23.2	18.3	17.8
Maintain the Exceptional Wildlife Values on Lake Hancock	23.8	25.6	24.4
Enhance Diversity of the Lake Hancock Fishery	22.0	25.0	23.0
Provide Habitat Compatible Public Access for Nature-Based Recreational Activities and Commercial Fishing	15.0	6.8	4.2
Sum of Ranking Points	100.8	97.3	93.4

The estimated initial capital cost of the top ranked option (Option 9) is $57.0M. Of the three, this option results in the least improvement in water quality as shown in **Table ES-2**, but as previously illustrated this option results in greater improvements in the remaining four restoration objectives. The second option (Option 8) included hydraulic dredging, and the estimated initial capital cost is $86.6M. This plan provides a greater improvement to the water quality than the top-ranked option. The third option (Option 4) includes treatment of the whole lake with alum to immobilize the phosphorus and is estimated to cost the least at $49.8M. This option provides the greatest water quality improvement (lowest ISI), and the best cost-effectiveness at removing phosphorus, but is not as effective in addressing some of the remaining objectives.

Table ES-2
Water Quality Results

	Existing Conditions	Option 9 - Recirculating Wetland	Option 8 - Hydraulic Dredging	Option 4 - Alum Treatment
Total P (ug/l)	212	118	63	49
Secchi Disk (m)	0.11	0.26	0.58	0.83
Chlorophyll a (mg/m^3)	172	73	30	0.21
Florida TSI	91	78	66	60
P Removed From Lake (kg/yr)		35,524	52,036	56,955

A summary of the advantages and disadvantages of the three highest scoring lake restoration options based on the preliminary costs and cost effectiveness, technical feasibility and logistics, environmental effects, and permit requirements is presented below along with a figure illustrating the plan components. Location of the facilities illustrated in the accompanying figures is conceptual only.

Advantages Common To All	***Disadvantages Common to All***
• Improved littoral zone and fish spawning habitat	• Uncertainty of the fate of nutrients during drawdown
• Increased greenway habitat	• Negative impact on aquatic life during drawdown
• Reduction of inflow loading	• Loss of littoral habitat during drawdown
• Improved public access	• Loss of commercial fishing revenues during drawdown
• Improved quality of water discharged to the Upper Peace River	• May require in-lake berms to protect littoral zone

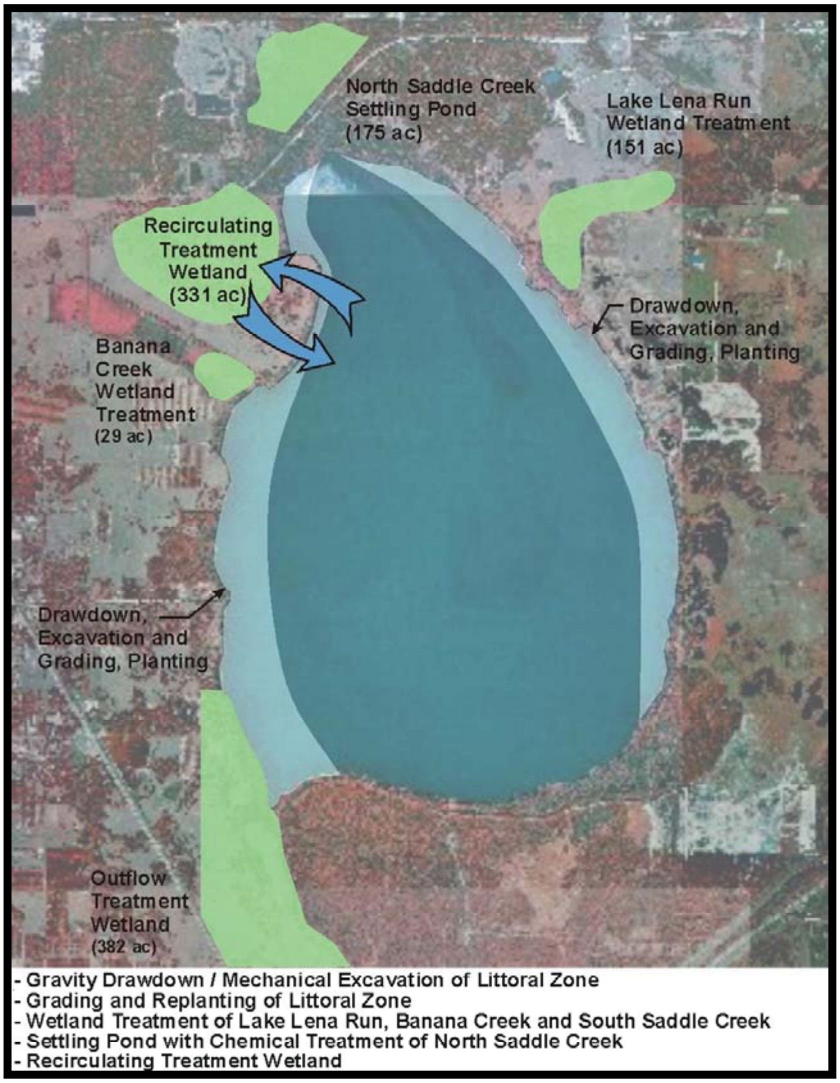
Option 9 (Including a Recirculating Treatment Wetland)

Advantages

- Least capital cost
- Minimal disruption of wildlife since no dredging or chemical treatment of lake
- Similar technology implemented at Lake Apopka

Disadvantages

- Long duration to achieve ultimate Trophic State Index (TSI) (35-56 years)
- May require in-lake berms to protect restored littoral zone from wind-driven sediments
- Does not deepen the lake
- Long-term results for recirculating treatment technology not available
- Least improvement in water clarity Trophic State Index (TSI)



Option 9
Recirculating Treatment Wetland

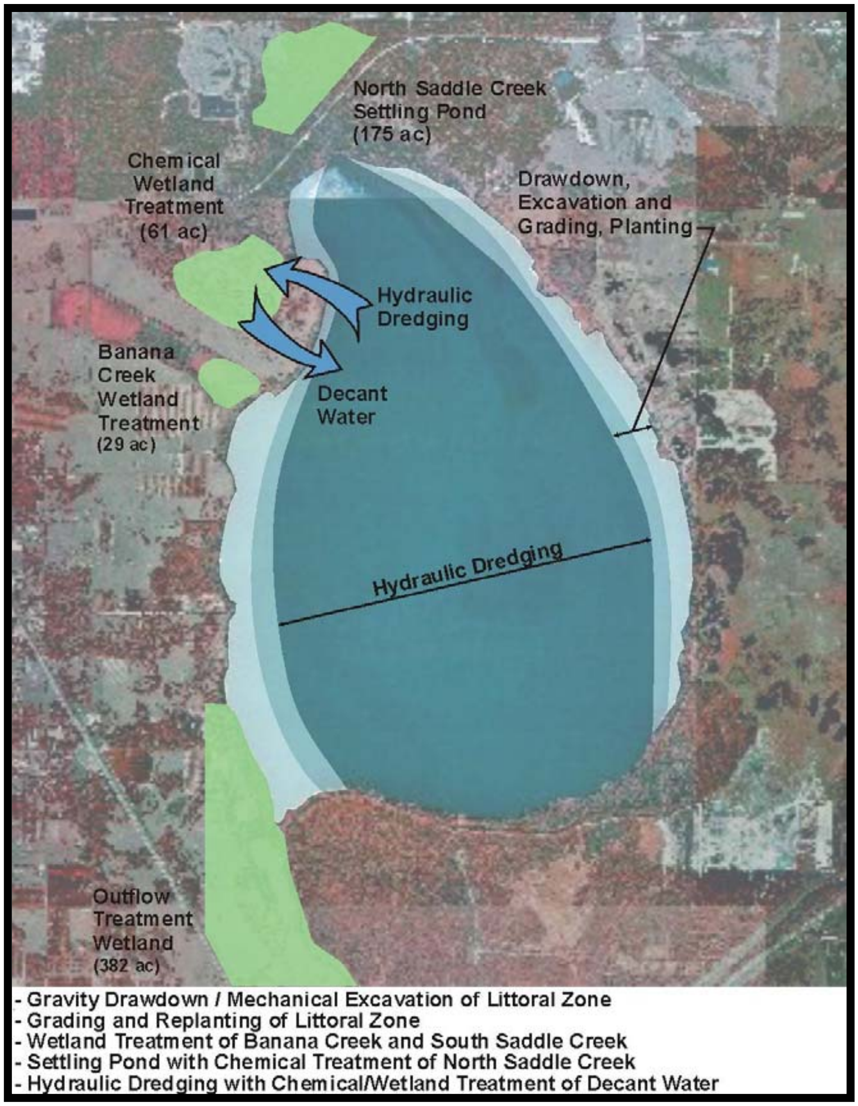
Option 8 (Including Hydraulic Dredging)

Advantages

- Physical removal of sediments
- Deepens lake
- Proven technology

Disadvantages

- Highest capital cost
- Large disposal site required for sediments
- Potential water quality declines during dredging
- Potential negative impacts on aquatic life during dredging



Option 8
Hydraulic Dredging

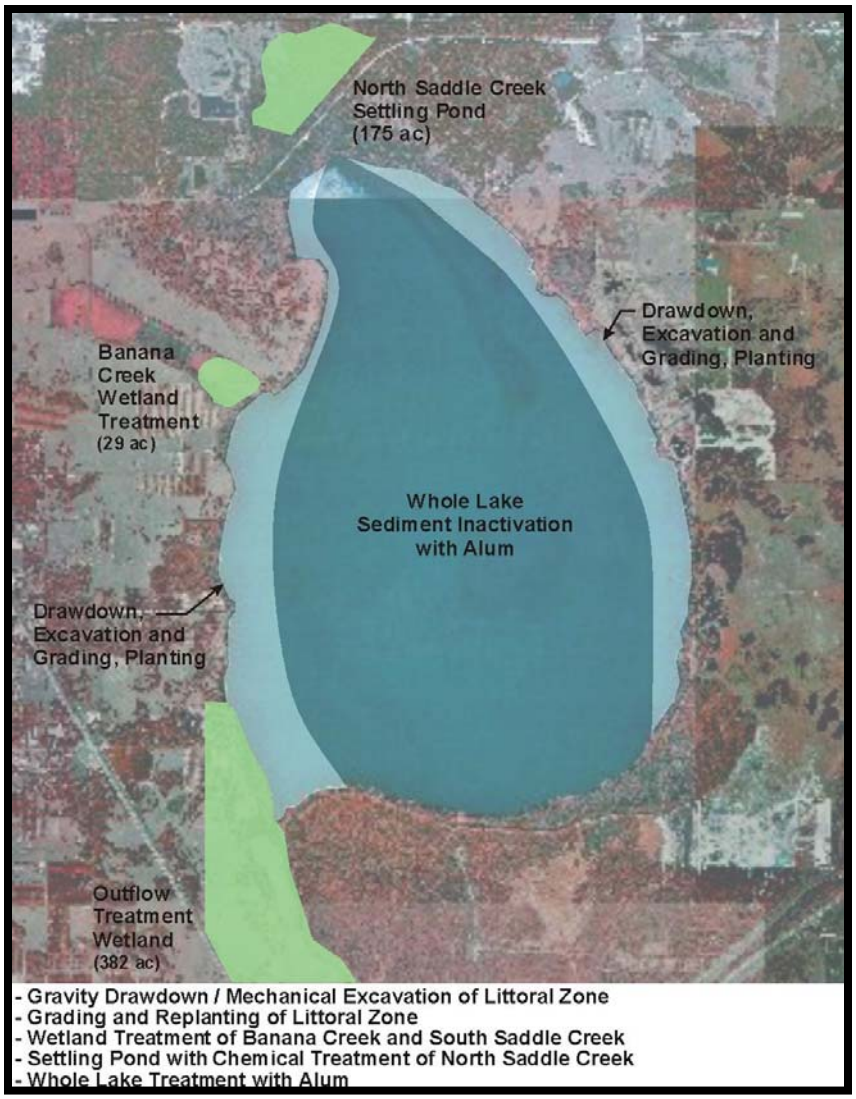
Option 4 (Including In-Lake Chemical Treatment)

Advantages

- Least capital cost
- Least time consuming
- Greatest improvement in water clarity

Disadvantages

- Stringent permitting requirements due to potential toxicity
- Does not cause deepening of lake
- Least increase in habitat
- Never attempted at this scale in Florida



Option 4
Chemical Treatment

Summary

In the absence of restoration efforts, Lake Hancock will continue to decline in water quality and continued pressure to urbanize will eliminate the possibility to acquire adjacent lands needed for habitat, greenway/wildlife corridors and treatment facilities. Any restoration plan must include control of the phosphorus release from the sediments. Based on the previous discussion of the advantages and disadvantages of the three options, and consensus of the Lake Hancock Advisory Group, it is recommended that the second ranked option (Option 8 hydraulic dredging) be implemented. This restoration plan is based on a technology proven to work at a large-scale. The plan results in a deeper lake, and additional 1,450 acres of wetland, increased public access, improved water quality and protection of downstream receiving waters.

Conclusions and Recommendations

Lake Hancock will continue to degrade if a restoration plan is not implemented. Option 8 was recommended by consensus of the Lake Hancock Advisory Group in October 2001. It is recommended that the Lake Hancock restoration include the following components:

- Construct wetland downstream of P-11
- Construct wetland treatment of Banana Creek inflows
- Construct chemical treatment/settling pond of North Saddle Creek inflows
- Increase water level
- Hydraulic dredging of organic sediments with chemical and wetland treatment of decant water
- Partial lake drawdown using P-11 structure, followed by drying, sediment removal, grading and planting of littoral zone
- Maintain elevated lake level with an annual variation

Advantages of Recommended Option 8

- Proven large-scale technologies
- Protection of downstream water quality
- 1,450 acres of additional wetlands / wildlife corridor
- Deeper lake
- Improved public access
- Improved water quality

- Enhanced fish diversity

Disadvantages of Recommended Option 8

- High cost
- Potential water quality and habitat degradation during dredging
- Duration of dredging
- Disposal of sediments
- Depending on phasing, potential need to construct in-lake berms to protect restored littoral zone from migrating organic sediment

Implementation

Following is a brief description of the recommended, multi-year, phased approach for the restoration of Lake Hancock. The recommended Option 8 includes the following ordered methods for lake restoration:

1. The projects below can be initiated at any time during implementation.

    a. Develop a treatment wetland at the Lake Hancock outfall at South Saddle Creek. Estimated to cost $15,448,046.

    b. Perform the mechanical excavation demonstration project. Estimated to cost $247,275.

    c. Develop a treatment wetland at the Banana Creek. Estimated to cost $1,745,761.

    d. Perform chemical treatment followed by settling for the North Saddle Creek inflow. Estimated to cost $8,407,698.

    e. A hydrologic engineering analysis should be performed to confirm previous established stage-storage relationships and to assess the increased flood potential of raising the lake level. A planning level cost estimate of $410,000 assumes that structure P-11 will be replaced.

2. Drawdown the lake and mechanically remove sediment from the littoral area, and plant wetland plants. Estimated to cost $11,463,420. This should be done before hydraulic dredging only if the demonstration project shows that the sediments do not redeposit in the littoral area.

3. Hydraulically dredge the remaining sediments at an estimated cost of $41,270,877.