HICKORYNUT LAKE LOADING STUDY AND LAKE MANAGEMENT PLAN
ORANGE COUNTY CONTRACT # Y16-903B

SCOPE OF SERVICES

Prepared By
Wood Environment & Infrastructure Solutions, Inc.

Hickorynut Lake (WBID 3170I) is a 417-acre lake south of Lake Apopka within the Reedy Creek Watershed along the eastern side of the Lake Wales Ridge. Moreover, the lake is located within the Upper Kissimmee River planning unit of the Lake Okeechobee Basin Management Action Plan area. The lake has been identified by the Florida Department of Environmental Protection (FDEP) as an impaired water body due to elevated total nitrogen (TN) concentrations pursuant to Chapter 62-303, FAC., and is currently queued for TMDL development by the FDEP. Like other lakes along the Lake Wales Ridge, Hickorynut Lake has experienced significant water elevation fluctuations over the past 20 years and is currently undergoing extensive residential development.

In advance of pending TMDL development, the Orange County Environmental Protection Department (OCEPD) wishes to characterize Hickorynut Lake by assessing the hydrology of the lake as well as potential sources and sinks of TN and other pollutants. Once the nutrient pollutant and hydrological behavior of the lake is characterized, the OCEPD would also like an initial evaluation of Best Management Practices that may be effective in remediating or mitigating the sources of nutrient pollutant loading within the Hickory Nut Lake watershed. OCEPD has requested Wood Environment & Infrastructure Solutions, Inc. (Wood) to prepare the following Scope of Services to perform a hydrological and nutrient loading assessment and lake management plan intended to improve the water quality in Lake Hickorynut.

All field work performed by Wood will conform to the FDEP’s Standard. Operating Procedures for Field Activities, DEP-SOP-001/01, dated January 2017, effective April 16, 2018. All laboratory analyses will be conducted pursuant to Chapter 62-160, FAC. Specific work efforts to be performed to achieve these objectives are outlined below.

Wood shall, at a minimum, perform the following specific tasks for the Hickorynut Lake project:

**TASK 1 - ATTEND PROJECT KICK-OFF MEETING**

A representative of Wood and Barnes, Ferland & Associates (BFA) will attend a project start-up meeting with representatives of OCEPD to review the overall project objectives, the scope of services, and the project schedule. Copies of all previous water quality investigations and data, engineering studies, and other information related to Hickorynut Lake and the surrounding watershed areas, will be provided to Wood by OCEPD. Wood will provide an initial data request prior to the kick-off meeting.
**TASK 2 - REVIEW AVAILABLE DATA**

Data provided to Wood at the project start-up meeting will be reviewed and summarized for potential use in developing hydrologic and nutrient budgets for the lake, as well as a nutrient management plan for maintaining and improving water quality characteristics. Wood will also seek and utilize, as necessary, additional data relevant to the work effort not otherwise provided by OCEPD and be available through the Orange County Water Atlas or STORET/WINS databases maintained by the FDEP. Available water quality data will be entered into a statistical database and both long term (period of record) and short term (past ten years) trend analyses will be performed to identify significant water quality trends for typical nutrient components including but not limited to TP, TN, NO3, NO2, NH4+, chlorophyll-α and Secchi disk depth. Annual geometric means will be calculated for TN and TP and will be evaluated based on the current Numeric Nutrient Criteria (NNC). TN/TP ratios and TSI values will be developed to support the limnological analyses.

**TASK 3 - PERFORM FIELD RECONNAISSANCE AND ID BMPS**

Wood personnel, with support from BFA, will perform a field reconnaissance including locating the GPS coordinates (provided in ArcGIS) of the major drainage features of the Hickorynut Lake basin ([Figure 1](#)). The Hickorynut Lake basin is relatively large, and this field reconnaissance task does not include physical inspection of the entire area. Only conveyance systems and related stormwater structures/facilities within public rights-of-way will be inspected. A figure of the drainage conveyance systems will be generated which identifies major structures, piping, ditches, and other conveyance mechanisms which may be present. The approximate sizes of conveyance structures will be recorded. However, this task does not include any field survey or information related to elevations of structures or conveyance systems. Stormwater collection systems associated with developments will be included in the figure when drainage designs are available through the SFWMD ERP site.

With assistance from BFA, Wood will prepare a table and photographic record of existing BMPs and conveyance systems within the public rights-of-way within the Hickorynut Lake basin, including their type and condition. GPS coordinates will be recorded and provided in ArcGIS format. In addition, Wood will contact the Department of Agriculture and Consumer Services (DACS) to determine which agricultural operations within the basin are part of their various BMP programs and will provide copies the appropriate agreements between the landowner and FDEP if available. Participating property owners obtained from the DACS database will be identified on a map using GIS.

**TASK 4 - DELINEATE WATERSHED SUB-BASINS**

With assistance from BFA, Wood will delineate the Hickorynut Lake watershed sub-basins based upon information in Task 3 and information provided by, but not limited to, the Orange County Public Works Department, and other information provided by OCEPD. This task involves compilation of the data collected in Task 3, and GIS tools to determine the basin boundaries. This data will be compared to the delineation data developed as part of Orange County’s previous
modeling efforts within the Reedy Creek basin. Any new basin development or improvements within the watershed will be verified for accuracy. Wood will meet with OCEPD to discuss the proposed basin boundaries for this task and determine if they are acceptable. The drainage basin area will be summarized for all sub-basins in both graphical and tabular formats. Hydromodeling, Inc. (HMI) will provide review of the basin and sub-basin boundaries.

**TASK 5 - CHARACTERIZE SURFACE WATER**

Prior to 2010, the only residential development around Hickorynut Lake occurred within a relatively small portion along Lake Hickorynut Drive on the northwest corner of the lake. There is no known stormwater collection system associated with this development. New developments are currently being constructed with stormwater treatment systems designed to meet presumptive criteria with no anticipated additional discharge volume. Because there are not likely to be any direct stormwater discharge structures, it is not anticipated that stormwater autosampling equipment will be required and loading changes from stormwater runoff will be estimated using the model discussed below in Task 7.

Orange County's Hickorynut Lake fact sheet indicates a significant drainage connection at the northeast side of the lake under SR429 to Panther Lake. There appears to be a large wetland on the western side of the lake. The western wetland is connected to an expansive wetland area to the south which likely drains at several locations across SR429 depending on stage.

Although Hickorynut Lake has a long history of surrounding agricultural activity, it has maintained an oligotrophic condition and does not appear to have any significant upstream sources of sediment loading. Lakewatch has already completed a bathymetric survey of the lake, but no details are available regarding the presence of soft sediments. Wood will conduct one north/south transect and one east/west transect along the longest portions of the lake to characterize the current sediment conditions. Soundings will be taken at 100-foot intervals and will include depth to the top of the lake bottom using a Secchi disk and a depth to refusal using a survey rod. The water elevation at the time of the depth survey will be recorded using the County’s staff gauge and will be used to determine the top of sediment elevation and the elevation of the hard bottom. The difference between the two elevations will constitute the soft sediment thickness. If there is significant variability of soft sediment at similar elevations, OCEPD may desire to have Wood perform additional soundings at additional cost, or reduced scope. Wood will review the findings of this task with OCEPD to determine if additional effort is needed.

Wood, with assistance from BFA, will collect monthly surface water samples (up to twelve months) from three locations (Figure 2) within Lake Hickorynut to include the southern lobe, the lake center and the outflow. OCEPD will provide 0.45-micron cartridge filters for 36 sample sets. Flow will be measured monthly at the western inflow and eastern discharge locations. Surface sampling locations may be re-evaluated if significant inflows are measured. Field parameters will be collected at 2 ft intervals to provide a vertical profile at all locations using a multimeter (pH, specific conductance, temperature, dissolved oxygen with % saturation and concentration in mg/L) and a Secchi disk. Water samples will be delivered on ice by BFA to SRL for following analyses:
A total of 36 surface water sample sets will be collected (3 locations x 12 monthly collection events). The concentration of particulate forms of phosphorus and nitrogen will be estimated by subtracting orthophosphate from total phosphorus and dissolved organic nitrogen from total nitrogen.

**TASK 6 - EVALUATE SEEPAGE LOADING**

Seepage is indicated as a potential source of the measured TN concentration. Wood will perform the following tasks with assistance from BFA. BFA will provide field technicians to assist Wood with the work effort described below. Services to be provided include:

a. **Installation of seepage meters:** Wood, with assistance from BFA, will install up to ten groundwater seepage meters in Lake Hickorynut to determine the quality and quantity of shallow groundwater seepage entering the lake (Figure 3). Based on the paper “Estimation of Downward Leekage in Florida Lakes” by Deevey (1988) the vast majority of seepage in Florida lakes occurs within 30 meters of the shoreline. Therefore, twelve of the sixteen seepage meters will be in areas that are within five feet of depth. The remaining four seepage meters will be installed in the deeper portion of the lake. These seepage meters will be installed in locations of the lake where depth is greater than 10 feet and will require the Wood professionally-certified dive team. The dive team will perform all deeper seepage meter installations, collections, and removal with surface assistance from BFA. The specific areas for installation of seepage meters will be selected jointly by Wood and OCEPD and should maximize the range of land use and topographic characteristics in upland areas adjacent to the seepage meters. Figure 3 shows the potential location of the seepage meters. Once installed, seepage meters will remain open to the water column for the first week to allow equalization (requires two separate installation trips). Wood will discuss the installation methodologies with OCEPD to determine how to address organic material (if present) within the seepage meter installation area. Following the equalization period, Wood will install seepage meter bags containing a known quantity of water.
b. **Routine monitoring of seepage meters:** The ten seepage meters installed as a part of Task 6a will be sampled by the Wood Dive Team approximately every two months, or as needed, for a period of up to one year for a total of 6 sampling events. BFA will provide necessary surface support. During each collection event, the quantity of seepage collected in each seepage meter will be measured, and samples of water collected from the seepage meters will be transported on ice to the laboratory for chemical analysis. Seepage bags containing less than the starting volume will not be used for analysis. A total of 60 sets of water samples (10 seepage meters x 6 bi-monthly collection events) are anticipated to be collected from the seepage meters for analysis of the following parameters by SRL:

(1) Total Kjeldahl Nitrogen  
(2) Total Nitrogen (calculated)  
(3) Total Ammonia Nitrogen  
(4) Orthophosphate  
(5) NOx (nitrite + nitrate)  
(6) Total Phosphorus

OCEPD will provide 60 0.45-micron cartridge filters for the 60 seepage sample sets. pH and conductance of seepage water will be measured with a YSI multimeter in the field provided there is sufficient sample volume.

In addition, three seepage meters will be sampled quarterly for N/O isotope, caffeine/sucralose/aspartame/sucrose, and ethylene dibromide analysis.

c. **Core samples:** Wood will collect eight intact sediment core samples for phosphorus speciation analysis using the Meis et al. method.

**TASK 7 - ESTIMATE ANNUAL RUNOFF INPUTS**

Surface water runoff modeling will be accomplished using a Microsoft Excel spreadsheet named Pollutant Loadings Assessment (PLA) tool developed in-house by Wood that is based on design criteria that was developed by FDEP and the Water Management Districts during production of the draft guidance documents conceived during statewide stormwater regulation efforts. The model utilizes the modified U.S. Environmental Protection Agency’s (EPA) Simple Method. The modeling will be performed using site-specific hydrologic characteristics for each drainage sub-basin area, including basin size, percentage of impervious areas, land use, soil characteristics, and conveyance system types. Estimates of annual runoff inputs to the lake will be generated for each contributing sub-basin area. Wood will estimate runoff from current and future land use.

**TASK 8 - DEVELOP HYDROLOGIC BUDGET**

Hydrologic budgets for current and future land use will be developed, by sub-basin, for Lake Hickorynut based upon evaluated inputs from direct precipitation, stormwater runoff, and groundwater seepage (see Task 11). The results of the hydrologic budget will be presented in both graphical and tabular formats. HMI will review the hydrologic budgets.
**TASK 9 - DEVELOP NUTRIENT BUDGET**

Nutrient budgets for current and future land use will be developed for Lake Hickorynut which will build on the hydrologic budget developed in Task 6 and will include available inputs (including aerial deposition from literature values) and estimates. The budget will account for existing BMPs and calculations of the existing nutrient load reductions. The budget will also estimate the loading from septic, sewer, and reclaimed water sources. The results of the nutrient budget will be presented in both graphical and tabular formats and will include area.

**TASK 10 - POST MODEL/DATA COLLECTION REVIEW MEETING**

Wood will meet with OCEPD to discuss the results of the water quality and hydrologic analyses.

**TASK 11 - EVALUATE ALTERNATIVES FOR WATER QUALITY IMPROVEMENT**

Appropriate in-lake treatments and watershed BMPs will be identified and ranked in a summary table. This proposal assumes three structural alternatives, but more may be added if necessary. Estimated costs (including land costs, design, construction and Operation and Maintenance) for each high-ranking BMP will be presented, along with anticipated water quality benefits. Cost efficiencies will be developed for each alternative for a 20-year life cycle. Additional non-structural alternatives will be reviewed and included as appropriate, but at a minimum will include compliance with Orange County’s fertilizer ordinance, regular maintenance of septic tanks and drainfields, and relevant components of the Florida Yards and Neighborhoods Homeowner Program.

**TASK 12 - DEVELOP WATER QUALITY MODEL**

Wood will develop a simple BATHTUB water quality model for Lake Hickorynut which will include inputs from the hydrologic and nutrient budgets developed in previous tasks. The BATHTUB model applies the load reductions from the available alternatives in Task 11 and predicts the overall water quality response within the lake. The water quality model will be calibrated using available water quality data and can be used to evaluate water quality impacts from proposed nutrient reduction projects. HMI will review the hydrologic and nutrient budgets.

**TASK 13 - POST-ALTERNATIVES ANALYSIS MEETING**

Wood will meet with OCEPD to review the alternatives developed for the project.

**TASK 14 - PREPARE DRAFT FINAL REPORT**

A Draft Final Report will be prepared and submitted electronically which presents the results of the previous tasks. All Chain-of-Custody forms including lab reports, calibration logs, and relevant field notebook and field data sheets will be provided. GIS data produced during the project will also be provided to OCEPD.
**TASK 15 - PREPARE FINAL REPORT**

After receiving comments from OCEPD, a Final Report will be prepared for the project and submitted electronically with the relevant supporting documentation.

**Completion Date: April 1, 2020**

Sincerely,

**Wood Environment & Infrastructure Solutions, Inc.**

Lance Lumbard  
Project Manager

Michael D. Phelps  
Office Manager

LL/MP: jrb

Attachments
FIGURES
Figure 1 - Proposed Surface Sampling Locations
Figure 2 - Proposed Seepage Meter Locations
ORANGE COUNTY - Lake Hickorynut Estimated Study Schedule

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