

Jordan Lake Review

5/7/2017

LWV Environmental Roundtable Working Document

(to be up dated when appropriate)

From web search of NC DEQ, Internet Searches and Discussions with Greensboro Waste Water Treatment Staff

Background Information:

-Size – 13,940 Acres (21 sq. miles)

-Owned by United States Corps of Engineers and constructed originally as a flood control project on the Haw River and New Hope River. A disastrous tropical storm occurred in 1945 and was a major driving force behind the decision to construct the lake. Jordan Lake was also constructed to provide downstream water quality, fish and wildlife conservation and recreation. Apparently, potable water was not envisioned during the planning stage for Jordan Lake. Research Triangle Park (7,000 acres) is one of the major factors responsible for population expansion in the Raleigh, Durham and Chapel Hill areas and the need for additional portable water. When Jordan Lake was being planned, Research Triangle Park was only a small fraction of what it is today.

The Jordan Lake watershed, located in the central part of North Carolina within the Piedmont region, drains an area of 4367 km². The watershed is comprised of three sub basins: Haw, Upper New Hope, and Lower New Hope, covering 80, 13, and 7% of the total watershed area, respectively (Fig. 1). The Jordan Lake watershed has a land use composition of 46% forest, 21% urban or suburban, and 22% agriculture, of which >90% is pasture based on the 2011 National Land Cover Database (NLCD). Upper New Hope is heavily urbanized, while Lower New Hope is being rapidly developed at suburban residential densities. Fourteen wastewater treatment plants (WWTP) with individual mean annual effluents larger than 0.2 million L d⁻¹, discharge into the main streams and tributaries of Jordan Lake watershed. There are 32 permitted animal feeding operations (AFOs) within this watershed. (Reference note: This paragraph is taken directly from 1/12/2017 article by Ali Tasdighi, Mazdak Arabi and Deanna L. Osmond as published in the Journal of Environmental Quality) See the following link for the full article:

<https://dl.sciencesocieties.org/publications/jeq/articles/46/1/113>

This article is somewhat technical but never-the-less is an excellent reference. It summarizes monitoring data Jordan Lake that was collected over a 20-year period. It also contains an interactive map of Jordan Lake that allows one locate more specific information about the watershed.

-Construction started in 1967 and completed in 1983

-Max Depth 38 feet

-Average Depth 14 feet

-Jordan Lake was declared nutrient sensitive by the North Carolina Environment Management Commission (EMC) in 1983, the year it was impounded. It imposed phosphorus limits on wastewater discharges but the lake did not respond. In 2002, the EMC determined that the Upper New Hope arm was

impaired after it exceeded the state's chlorophyll-a standard. The rest of the lake exceeded the standard in 2006. The Haw River arm also exceeded the pH standard in 2006.

-Legislation and Regulation - Several pieces of key legislation directed the EMC to address Jordan Lake's impairment. The Clean Water Responsibility Act of 1997, often referred to as House Bill 515, requires the EMC to establish improvement goals for nutrient-impaired waters and to develop and implement management plans that entail sharing of responsibility for reducing nutrient inputs to these waters between point sources and nonpoint sources in a fair, reasonable and proportionate manner. A later law, S.L. 2005-190 directs the EMC to adopt permanent rules to establish and implement nutrient management strategies to protect drinking water supply reservoirs. In addition, requirements of the Federal Clean Water Act were set in motion when the lake became impaired, including the need to set load reduction limits for point and nonpoint sources, known as a total maximum daily load (TMDL), and enforce discharge limits.

-Jordan Lake Rule Development - The formal rule-making process began when the rules were published in the June 15, 2007 NC Register and brought before the NC Regulatory Review Commission. Many technical changes were made to the rules in response to objections from the RRC, but the content of the rules remained essentially unchanged. The rules were approved in 2008.

-Control Strategy - The strategy is designed around nitrogen and phosphorus percent reduction goals for each of the three arms of Jordan Lake. Separate goals were needed for each arm because of the hydrologically distinct behavior exhibited by each arm and the different inputs from each watershed. The strategy targets all major nutrient contributors throughout the watershed. Since July 2011, several NC laws have been passed delaying and/or weakening the Jordan Lake rules including deploying arrays of in-lake, long distance circulators intended to reduce harmful algae and chlorophyll a (solar bees).

-Monitoring of Jordan Lake - The North Carolina Division of Water Resources has published water quality monitoring data for the years 2009-2014 (latest available). Monitoring data are available for 9 locations throughout the lake. As expected, there is a lot of variability between location of sampling and time of the year samples were taken. It is difficult to see any trends from year to year but clearly the levels of phosphorous and nitrogen are the highest in warmer months and exceed the threshold levels established for the Jordan Lake. The lake has 3 major arms; 1) Upper New Hope, 2) Lower New Hope and 3) the Haw River. Resident times for receiving waters vary greatly. Water from the Upper New Hope arm may reside in the lake for a year while the water from the Haw River arm may reside in Jordan Lake for as little as 5 days. The Haw River watershed is 80% of the drainage area supplying water to Jordan Lake.

-Allocation of Nutrient Intake for Jordan Lake - Point and non-point sources of nutrients entering Jordan Lake need to be successfully addressed to ensure the target levels for both nitrogen and phosphorus are achieved. Point sources are regulated under NPDES permits (national pollution discharge elimination system permits). All point sources must be permitted i.e. approved. According to the Greensboro Department of Waste Water and documents on the DEQ website, all current NPDES permits for the Jordan Lake watershed collectively consume the 99.3% maximum allowable discharge of nitrogen into the Haw River watershed. Additional permitted discharge would require load reductions from somewhere within the watershed. The state has allocated 60% of the total load of nitrogen and phosphorus to urban and rural non-point sources and the remaining amount to permitted urban areas and permitted industrial sites.

No new discharges from point sources can be issued. DENR (now Department of Environmental Quality) drew up the rules. Original sources of pollution were swine, then waste water. Once it was decided that Jordan Lake was to be used for a water supply, new rules had to be put in place. This put Greensboro and other cities in precarious positions. At first there was money for action, but now the rules are unfunded. Greensboro's permit is from 1994. Waste water is treated but storm water is not. Cities have several options to dispose of the sludge generated by waste water treatment plants. Greensboro has elected to

dispose of sludge by incineration. Approximately 5 tons of sludge are incinerated per hour which equals 120 tons every day. This means that approximately 43,800 tons are incinerated annually; this the equivalent of approximately 1,100 trailer loads. By contract, Raleigh has 1,500 acres of land where they land spread sludge from their treatment plants.

-Greensboro Waste Water – Greensboro has a \$120,000,000 capital project in progress that is designed to help further remove nutrients, particularly nitrogen from treatment plants. While phosphorus is also an important factor in the eutrophication, monitoring data suggest that phosphorus levels infrequently are an issue; typically, this occurs in the warmer months of the year. GSO's treatment plant receives effluent containing about 17-18 mg/L; outflow from the plant is about 5.29 mg/L. About 67% of the nitrogen released by the Greensboro treatment plant reaches Jordan Lake. The remaining 33% is consumed in transit by microbes and other organisms.

What has Greensboro done to implement the Jordan Lake Rules – The following Information obtained from March 24, 2017 meeting with David Phlegar and staff in the Greensboro Water Resources group.

<http://www.greensboro-nc.gov/index.aspx?page=4042>
<http://www.greensboro-nc.gov/index.aspx?page=2274>

Greensboro and Jordan Lake

To date, the City of Greensboro has implemented:

- January 1, 2010 - Stage I of the Existing Development Rule
- December 1, 2010 - Stream Buffer Rule.

The following required items have been extended 3 years by a legislative action:

- August 10, 2014 (legislative extension until 2017) - New Development Rule
- March 1, 2017 (legislative extension until 2020) - Stage II of the Existing Development Rule (original compromise legislation from Session Law 2009-216 & 2009-484)
- 2018 (legislative extension until 2021) - Wastewater Discharge Rule compliance (previous legislative extension).

In this current legislative session (2017), the City of Greensboro supports additional modifications to three of the rules for the following reasons:

Stream Buffers:

- Repeal unfunded mandate for local governments to enforce state rules by requiring the state to implement the stream buffer rule.
- Amend stream buffer rules to allow for additional utilities (not just electric) to facilitate development patterns consistent with other regions of the state.
- Permit stream piping in accordance with federal requirements consistent with other regions of the state.

New Development:

- Allow small infill sites of less than one acre to be developed without nutrient treatment (instead of the current half-acre) consistent with other areas in the western Piedmont region.
- Grandfather previously developed areas and treat only new or added development (prior development is already accounted for and required to be addressed in the existing development rule).

Existing Development:

- Due to its unprecedented nature, uncertainty of ecological benefit and costs to the municipalities, the Haw River Arm Stage II existing development rule was scheduled to be the last implemented in 2017. Now that a wastewater treatment plant and new development rules have been delayed to 2018, it is appropriate to adjust the existing development rule implementation until ecological benefits of those prior rules are demonstrated.

<http://org.elon.edu/jlw/iywq/iywq.html>

See the Jordan Lake Watershed Project from Elon University's Environmental Studies Program. Hub for educational resources on water quality standards etc.

This is an important page because it lists the streams and the Metro areas and counties.

<http://org.elon.edu/jlw/kwy/kyw.html>

Additional information about Jordan Lake

1)The N.C. Environmental Management Commission is responsible for determining the amount of water that municipalities receive from Jordan Lake, which is the largest source of water for several communities in the Triangle region. The public meetings will give people a chance to provide feedback on the commission's recommended allocations for the Triangle area's water supply needs through 2045, including Cary, Raleigh and Durham.

The draft water supply allocation recommendations are as follows: Cary, Apex, Morrisville and Wake County, 46.2 percent; Chatham County, 13 percent; Durham, 16.5 percent; Holly Springs, 2 percent; Hillsborough, 1 percent; Orange Water and Sewer Authority, 5 percent; Orange County, 1.5 percent; Pittsboro, 6 percent; and Raleigh 4.7 percent.

The Relationship between Land Use and Vulnerability to Nitrogen and Phosphorus Pollution in an Urban Watershed Ali Tasdighi,* Mazdak Arabi, and Deanna L. Osmond

Published 1/12/17 – This article was also discussed earlier in this summary document

<https://dl.sciencesocieties.org/publications/jeq/articles/46/1/113>

2) Abstract Characterization of the vulnerability of water bodies to pollution from natural and anthropogenic sources requires understanding the relationship between land use and water quality. This study aims (i) to explore the influence of upstream land use on annual stream water concentrations and loads of total nitrogen (TN) and phosphorus (TP) and (ii) to characterize the vulnerability of water bodies to TN and TP pollution as a function of land use under varying

climatic conditions. Multiple linear regression models were used across 23 stream locations within the Jordan Lake watershed in North Carolina between 1992 and 2012 to explore land use–water quality relationships. The percentage of urban land use and wastewater treatment plant capacity were the most important factors with strong ($R^2 > 0.7$) and significant ($p < 0.01$) positive correlations with annual TN and TP concentrations and loads. Percent agricultural land was negatively correlated with TN in 18 out of 21 yrs. of the study period. Using analysis of covariance, significant ($p < 0.01$) differences were determined between models developed for urban land use with TN and TP loads based on annual precipitation. Using concentrations instead of loads resulted in a nonsignificant difference between models for average and wet years. Finally, a procedure was developed to characterize the vulnerability to TN and TP pollution, computed as the probability of exceeding the nutrient standard limits. Results indicated that the vulnerability to TN and TP was controlled primarily by urban land use, with higher values in dry years than normal and wet years.

3) Study for the Ongoing Assessment of Water Quality in Jordan Lake 2014 Results:

The objective of this study is to evaluate progress in reducing nutrient and nutrient-related pollution in Jordan Lake, as required by the Jordan water supply nutrient strategy (15A NCAC 02B.0262). This report summarizes results of samples collected in 2014.

<https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/ISU/Final%20Jordan%20Report%202014.pdf>

4) B. Everett Jordan Reservoir, North Carolina Phase I Total Maximum Daily Load Final Report September 2007 (EPA Approval Date: September 20, 2007)

The Jordan Lake Reservoir watershed encompasses 1,686 square miles (excluding the lake itself) and includes parts of Alamance, Caswell, Chatham, Durham, Forsyth, Guilford, Orange, Randolph, Rockingham, and Wake counties. It includes some or all of the urban areas of Durham, Chapel Hill, Cary, Burlington, Greensboro, and several other small municipalities. For the purposes of this TMDL, the reservoir was divided into three management areas. The drainage areas for the three TMDL management areas are shown in Table 1.

Table 1. Total watershed areas for Jordan Reservoir by lake management area Lake management area

Lake Management Area	Acres	Percentage
Haw River Arm	859,442	79.65%
Upper New Hope River Arm	148,146	13.73%
Lower New Hope River Arm	71,437	6.62%
Total Watershed	1,079,026	100%

The North Carolina fresh water quality standard for chlorophyll a in Class C waters (T15A: 02B.0211) states the following: not greater than 40 $\mu\text{g/l}$ for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation not designated as trout waters, and not greater than 15 $\mu\text{g/l}$ for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation designated as trout waters (not applicable to lakes and reservoirs less than 10 acres in surface area).

Editorial comment...based upon review of this document: Levels of chlorophyll are quite variable with levels low in cooler conditions while during warmer months the levels can exceed 80 micrograms/L.

5) Article on “The Relationship between Land Use and Vulnerability to Nitrogen and Phosphorus Pollution in the Urban Watershed” Journal of Environmental Quality 1/12/2017