

**Addendum to B. Everett Jordan Reservoir TMDL  
for Impaired Segments in the  
B. Everett Jordan Reservoir Watershed,  
North Carolina**

**FINAL REPORT**

**September, 2010  
EPA APPROVAL ON: September 28, 2010**

[Waterbody IDs: 16-18-(1.5)a, 16-18-(1.5)b, 16-27-(2.5)b, 16-41-2-(1.5)]

***Cape Fear River Basin***

Submitted by:  
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## Introduction

The North Carolina Division of Water Quality (DWQ) developed a Total Daily Maximum Load (TMDL) for the B. Everett Jordan Reservoir (referred to as Jordan Lake TMDL for the remainder of this document) to address chlorophyll-*a* impairment. EPA Region 4 approved the TMDL on September 20, 2007

([http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=bc043b19-0787-466f-aa7b-779717e55201&groupId=38364](http://portal.ncdenr.org/c/document_library/get_file?uuid=bc043b19-0787-466f-aa7b-779717e55201&groupId=38364)).

This addendum to the TMDL addresses chlorophyll-*a* impaired waters listed on the 2010 draft 303(d) list that are located within the Jordan Lake watershed. The impaired waters and associated assessment units (AUs) are:

- Back Creek (Graham-Mebane Reservoir): 16-18-(1.5)a, 16-18-(1.5)b
- Cane Creek (Cane Creek Reservoir): 16-27-(2.5)b
- Morgan Creek (University Lake): 16-41-2-(1.5)

## Watershed Description

This TMDL addendum covers the Jordan Lake watershed that is located partially or wholly within the North Carolina counties of Alamance, Orange, and Chatham. Table 1 provides information on the 14-Digit HUCs, counties, and municipalities for each watershed. A map is provided in Figure 1 depicting locations of the impaired reservoirs within the Jordan Lake watershed. Figures 1a-1c show the 14-Digit HUCs, municipalities, and stream network for each individual watershed. Appendix A provides information on the land cover within each watershed. The dominant land cover types for all three reservoirs are forest and pasture/hay.

Both Graham-Mebane Reservoir and Cane Creek Reservoir drain to the Haw River arm of Jordan Lake, while University Lake drains to the New Hope River arm.

Table 1. Counties and municipalities in watersheds of impaired addendum reservoirs.

| Reservoir               | 14-Digit HUC(s)   | Counties in Watershed | Municipalities in Watershed |
|-------------------------|---|-----------------------|-----------------------------|
| Graham-Mebane Reservoir | 03030002030060<br>03030002030070<br>03030002030080 <sup>1</sup> | Alamance, Orange      | Mebane, Green Level         |
| Cane Creek Reservoir    | 03030002050030  | Alamance, Orange      | n/a                         |
| University Lake         | 03030002060070  | Orange, Chatham       | Carrboro                    |

1. A small portion of the Graham-Mebane Reservoir watershed extends down into 03030002030080, see Figure 1a.

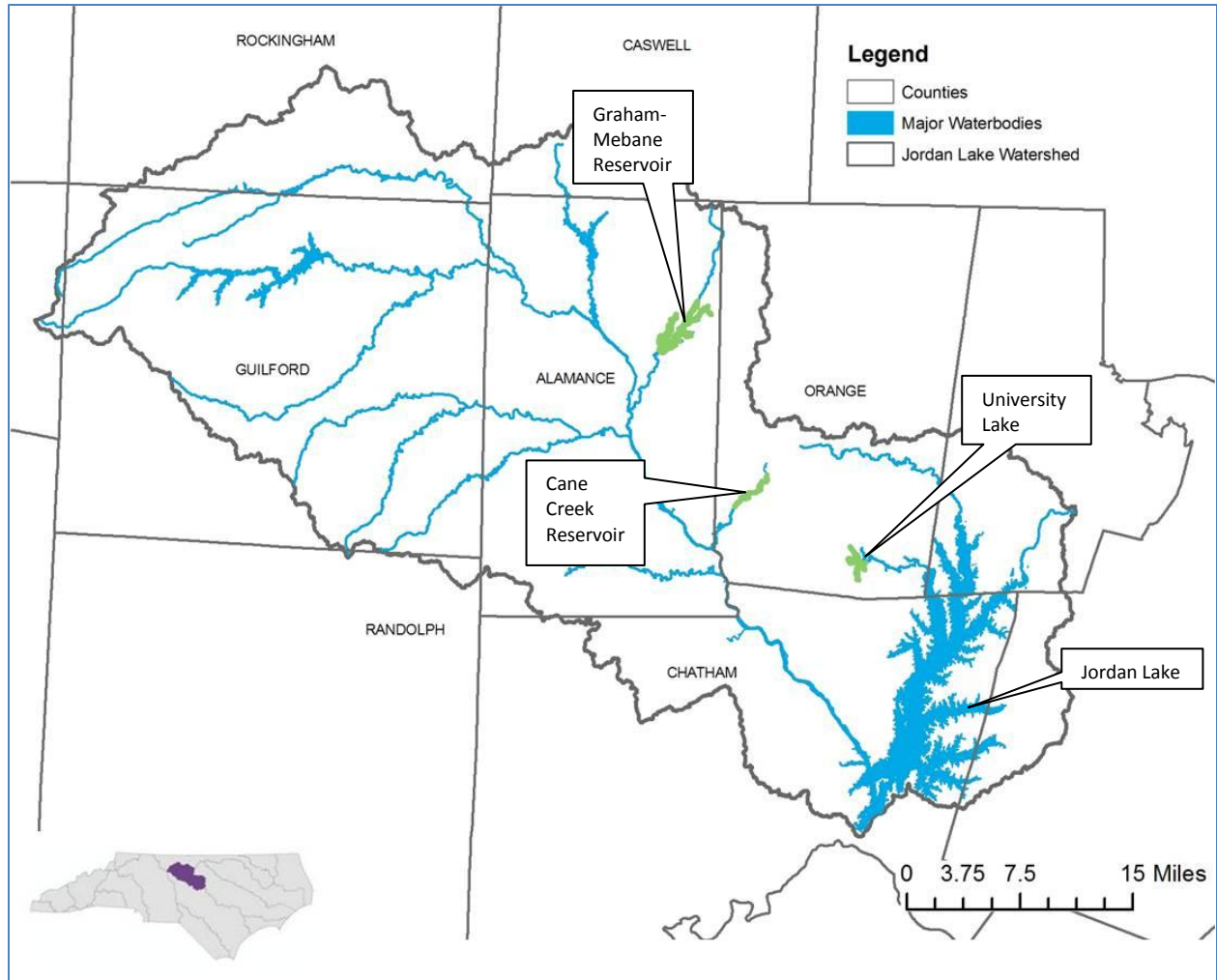


Figure 1. Locations of impaired addendum reservoirs within the Jordan Lake TMDL watershed.

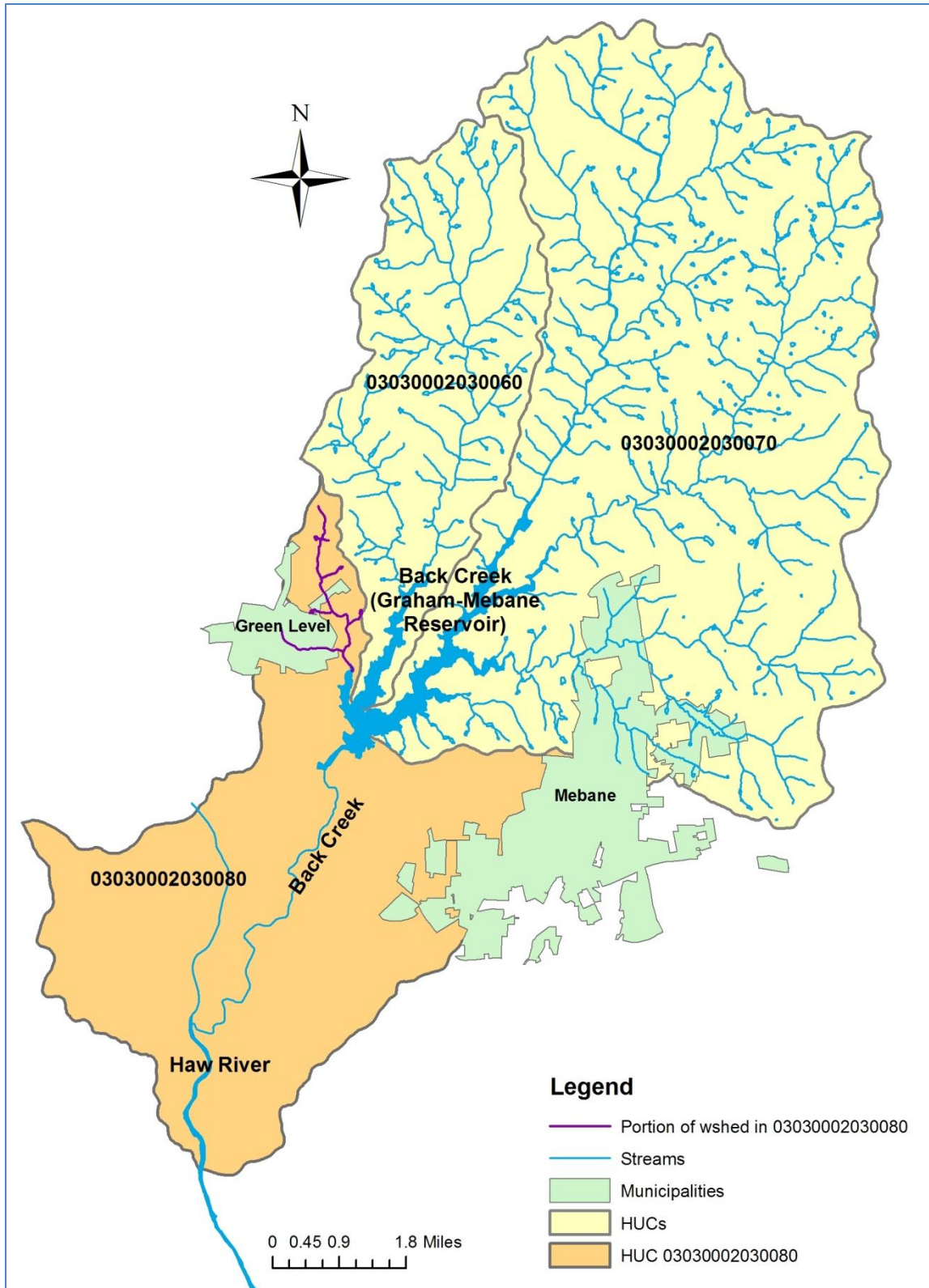


Figure 1a. Graham-Mebane Reservoir Watershed.

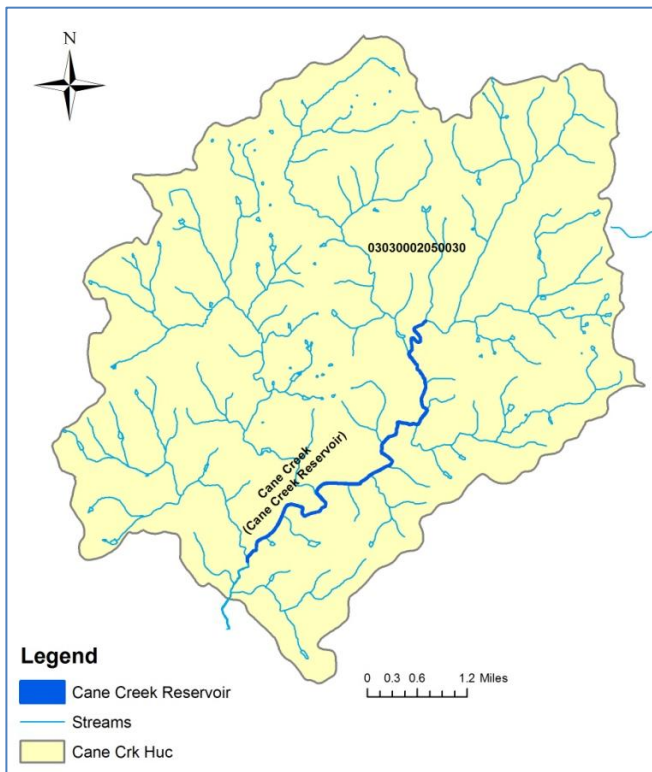


Figure 1b. Cane Creek Reservoir Watershed.

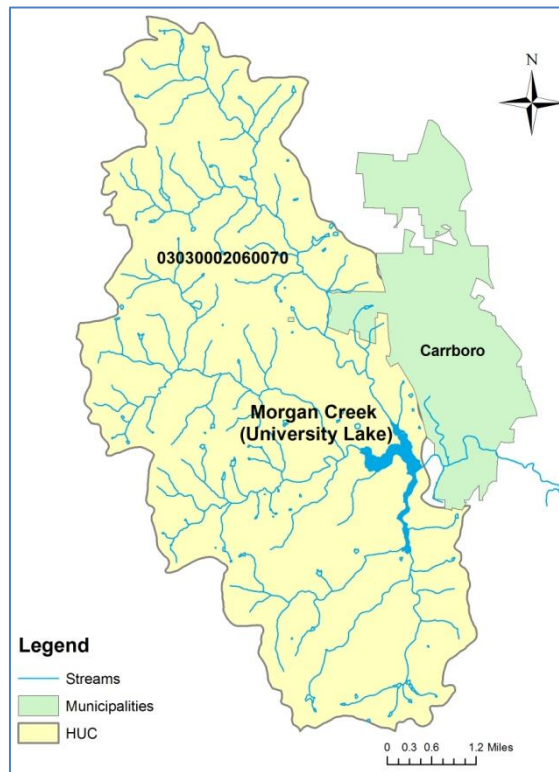


Figure 1c. University Lake Watershed.

**Impairment Description**

Graham-Mebane Reservoir, Cane Creek Reservoir, and University Lake are on the North Carolina draft 2010 303(d) list of impaired waters for chlorophyll-*a*. The NC water quality standard for chlorophyll-*a* is discussed below in section ‘Water Quality Target’. Figure 2 shows the relative locations of sampling stations in each reservoir. Appendix B contains summary statistics for secchi depth, nutrients, and chlorophyll-*a* for each station from the May through October, 2008 collection period.

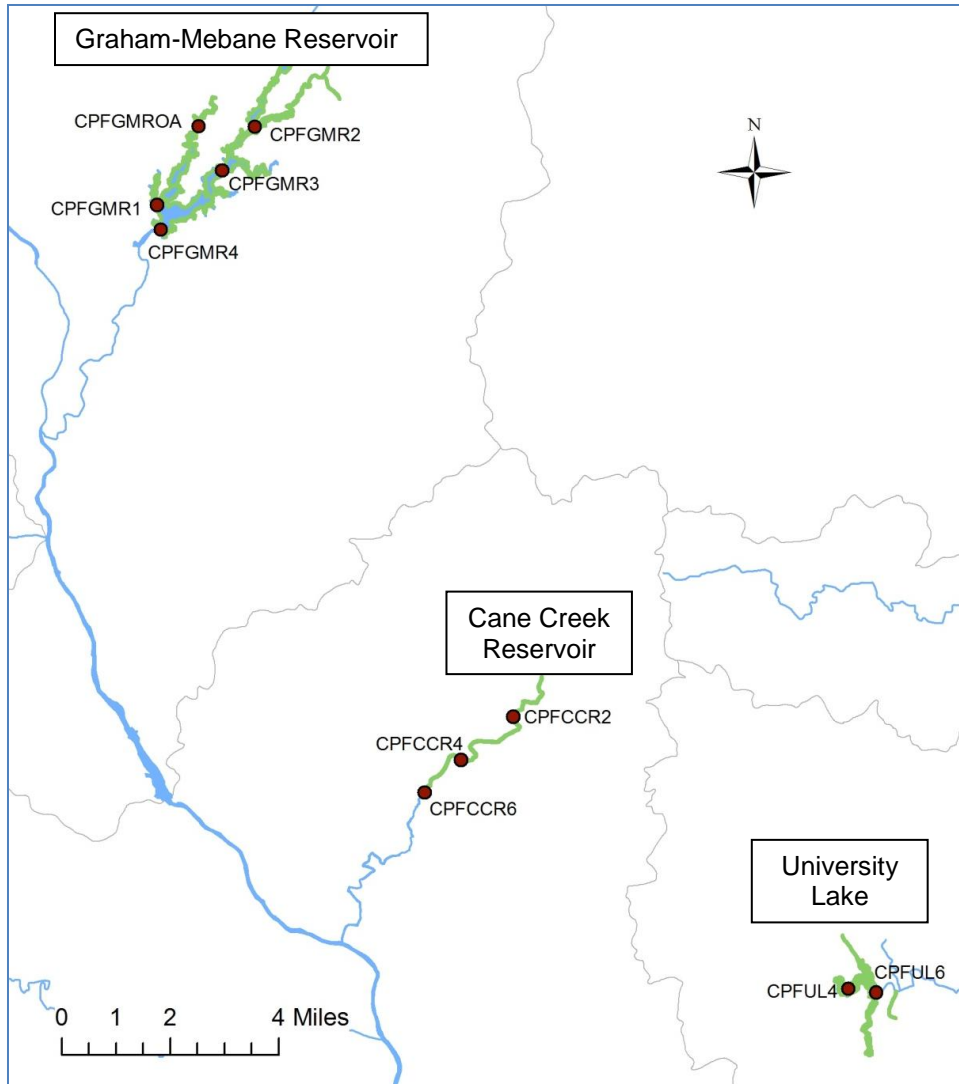


Figure 2. Locations of monitoring stations within each reservoir.

### Water Quality Target

The North Carolina fresh water quality standard for chlorophyll-*a* in Class C waters states the following: not greater than 40 µg/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 µg/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).

Nutrient controls are the most common focus of management schemes for reducing excessive algal growth and chlorophyll-*a* concentrations. Therefore, the Jordan Lake TMDL was written for total nitrogen (TN) and total phosphorus (TP) loads to the lake.



The Jordan Lake TMDL assigned separate loading reduction targets to the major arms of the reservoir for both total nitrogen (TN) and total phosphorus (TP). Nutrient load reductions targets from 1997-2001 baseline loading are shown in Figure 3 for each arm. The same percent reduction was applied to all sources throughout each watershed.

The three impaired addendum reservoirs are subject to the associated reductions required by the Jordan Lake TMDL.

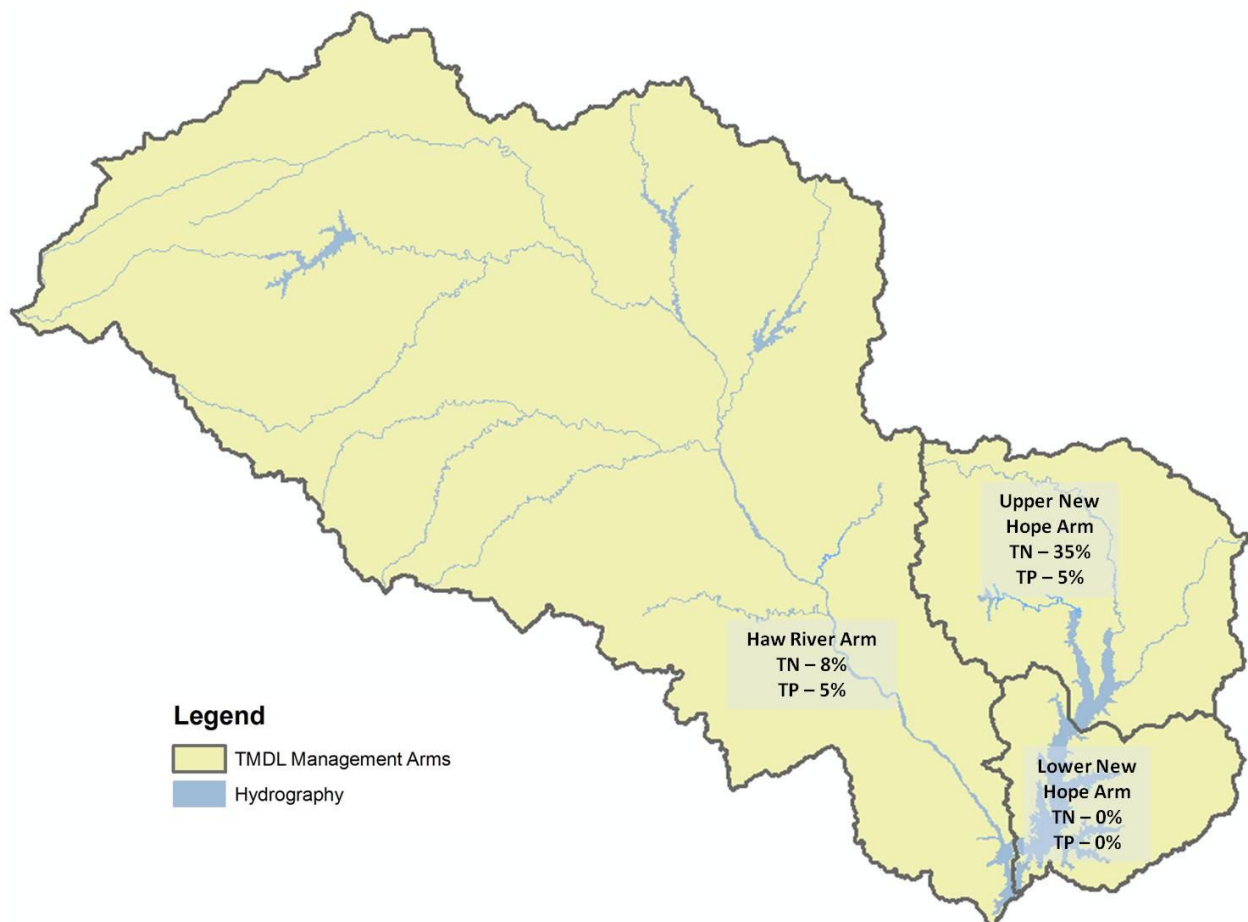


Figure 3. Nutrient load percent reduction targets from 1997-2001 baseline. Note that there is no loading reduction target for the Lower New Hope Arm; the TMDL provides a loading cap equal to 1997-2001 baseline nutrient loads.

### Jordan Lake Nutrient Management Strategy

In addition to the TMDL, North Carolina adopted mandatory Jordan Lake Rules in 2009 to reduce the amount of nutrient pollution entering Jordan Lake. Full text of the rules can be found at [www.jordanlake.org](http://www.jordanlake.org). The rules require:

- Reductions of nutrient loading from point source discharges.
- Reductions of nutrient runoff from agriculture, existing development, and new development, including from state and federal government-controlled lands.



- Protection of existing vegetated riparian buffers.
- Sound fertilizer management.

The rules apply to the entire Jordan Lake watershed and therefore also apply to the entire watersheds of Cane Creek Reservoir, University Lake, and Graham-Mebane Reservoir.

The required watershed reductions specified in the Jordan Lake TMDL and full implementation of the associated rules are expected to achieve water quality standards in the addendum reservoirs. Regular monitoring of these waterbodies will continue throughout rule implementation to ensure that standards are attained. DWQ may reevaluate the need for individual TMDLs for the reservoirs if the required reductions are determined to be insufficient.

### **Public Participation**

DWQ staff, the Triangle J Council of Governments, and the Piedmont Triad Council of Governments initialized an extensive stakeholder process in 2003 to receive stakeholder input on the Jordan Lake nutrient reduction strategy. A total of 21 stakeholder meetings were held between May 2003 and December 2004 to discuss TMDL development, modeling issues, target setting, and nutrient management strategy development.

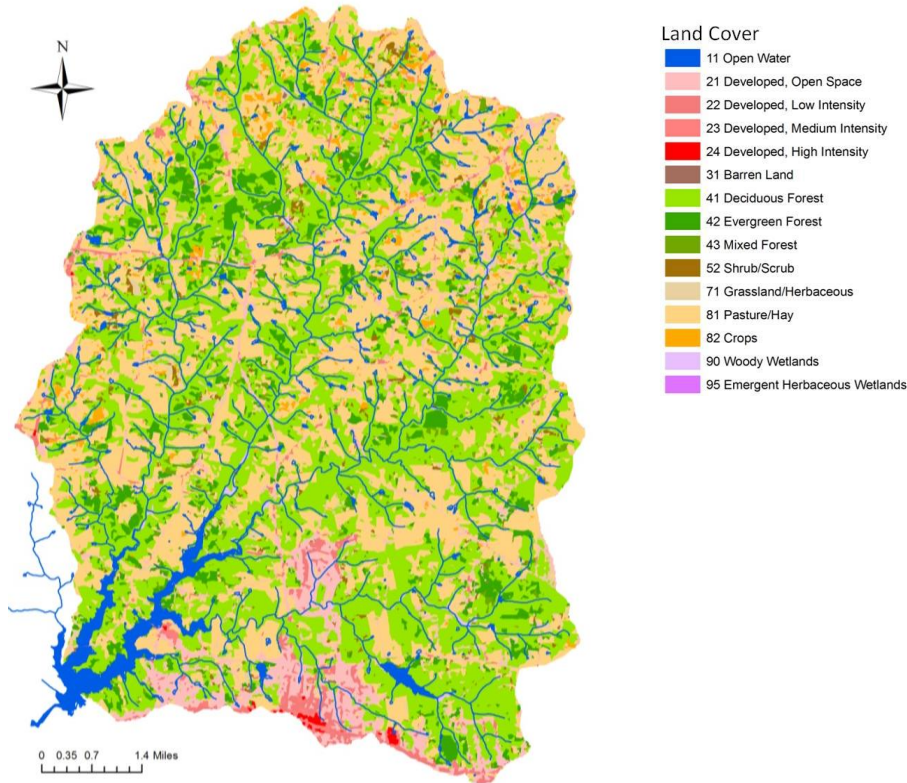
The Jordan Lake TMDL was public noticed in the relevant counties on April 1, 2007 in four local newspapers (The Durham Herald-Sun, the Winston-Salem Journal, the Greensboro News & Record, and the Raleigh News & Observer). The TMDL was also public noticed through the North Carolina Water Resources Research Institute email list serve. Finally, the TMDL was available on DWQ's website during the comment period.

A draft of this addendum to the Jordan Lake TMDL was publicly noticed through various means, including electronic notification of the draft addendum to known interested parties. The addendum to the Jordan Lake TMDL was available on the DWQ's website at <http://portal.ncdenr.org/web/wq/ps/mtu> during the comment period. The public comment period lasted from July 20 through August 20, 2010. Copies of the public notices are included in Appendix C.

DWQ received two public comments on the addendum to the Jordan Lake TMDL. Summaries of the comments and DWQ responses are included in Appendix D.

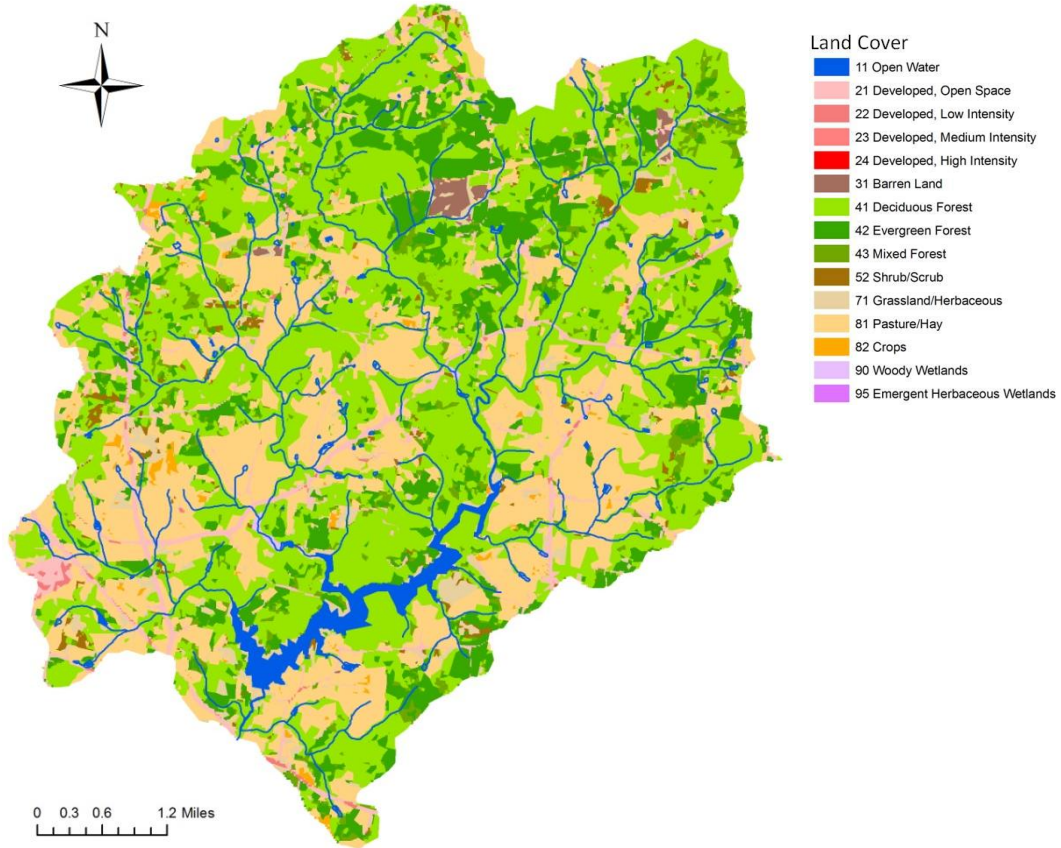
## Appendix A – 2001 Land Cover

Graham-Mebane Reservoir (HUCs 03030002030060, 03030002030070)



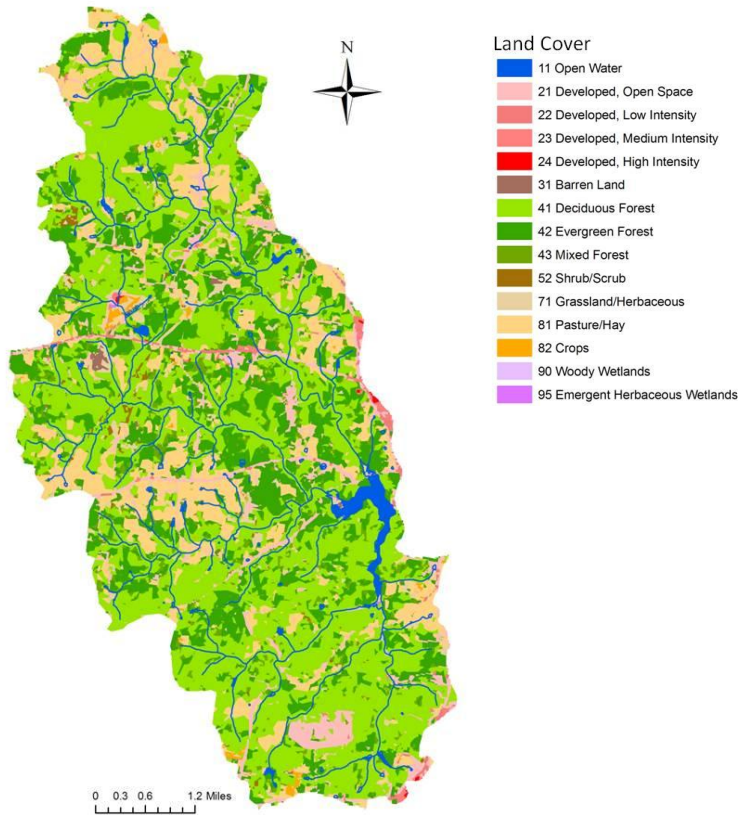
| Land Cover Category          | Sq.Miles    | %           |
|------------------------------|-------------|-------------|
| Deciduous Forest             | 24.81       | 39.2%       |
| Pasture/Hay                  | 19.48       | 30.8%       |
| Developed, Open Space        | 4.79        | 7.6%        |
| Evergreen Forest             | 4.58        | 7.2%        |
| Grassland/Herbaceous         | 2.09        | 3.3%        |
| Mixed Forest                 | 1.67        | 2.6%        |
| Open Water                   | 1.41        | 2.2%        |
| Developed, Low Intensity     | 1.37        | 2.2%        |
| Cultivated Crops             | 1.33        | 2.1%        |
| Shrub/Scrub                  | 1.07        | 1.7%        |
| Woody Wetlands               | 0.29        | 0.5%        |
| Developed, Medium Intensity  | 0.20        | 0.3%        |
| Developed, High Intensity    | 0.09        | 0.1%        |
| Barren Land                  | 0.03        | 0.0%        |
| Emergent Herbaceous Wetlands | 0.02        | 0.03%       |
| <b>Total</b>                 | <b>63.2</b> | <b>100%</b> |

Cane Creek Reservoir (HUC 03030002050030)



| Land Cover Category          | Sq.Miles    | %           |
|------------------------------|-------------|-------------|
| Deciduous Forest             | 14.11       | 42.0%       |
| Pasture/Hay                  | 8.80        | 26.2%       |
| Evergreen Forest             | 4.33        | 12.9%       |
| Developed, Open Space        | 1.56        | 4.7%        |
| Mixed Forest                 | 1.52        | 4.5%        |
| Grassland/Herbaceous         | 1.49        | 4.4%        |
| Open Water                   | 0.66        | 2.0%        |
| Shrub/Scrub                  | 0.51        | 1.5%        |
| Cultivated Crops             | 0.25        | 0.7%        |
| Barren Land                  | 0.17        | 0.5%        |
| Developed, Low Intensity     | 0.12        | 0.4%        |
| Woody Wetlands               | 0.04        | 0.1%        |
| Emergent Herbaceous Wetlands | 0.01        | 0.02%       |
| <b>Total</b>                 | <b>33.6</b> | <b>100%</b> |

University Lake (HUC 03030002060070)



| Land Cover Category          | Sq.Miles    | %           |
|------------------------------|-------------|-------------|
| Deciduous Forest             | 13.91       | 46.4%       |
| Evergreen Forest             | 5.98        | 19.9%       |
| Pasture/Hay                  | 4.37        | 14.6%       |
| Developed, Open Space        | 1.91        | 6.4%        |
| Mixed Forest                 | 1.68        | 5.6%        |
| Grassland/Herbaceous         | 1.00        | 3.3%        |
| Open Water                   | 0.36        | 1.2%        |
| Developed, Low Intensity     | 0.23        | 0.8%        |
| Shrub/Scrub                  | 0.21        | 0.7%        |
| Cultivated Crops             | 0.15        | 0.5%        |
| Developed, Medium Intensity  | 0.09        | 0.3%        |
| Barren Land                  | 0.06        | 0.2%        |
| Woody Wetlands               | 0.05        | 0.2%        |
| Developed, High Intensity    | 0.02        | 0.1%        |
| Emergent Herbaceous Wetlands | 0.01        | 0.03%       |
| <b>Total</b>                 | <b>30.0</b> | <b>100%</b> |

**Appendix B – Data Summary Statistics (collected May through October, 2008)**

| Reservoir               | Assessment Unit | Station          | Parameter        | Range       | Mean | # of Obs. |
|-------------------------|-----------------|------------------|------------------|-------------|------|-----------|
| CANE CREEK RESERVOIR    | 16-27-(2.5)b    | CPFCCR2          | Secchi Depth (m) | 0.3 - 1.7   | 1.1  | 10        |
|                         |                 |                  | TP (mg/L)        | 0.03 - 0.04 | 0.03 | 10        |
|                         |                 |                  | TN (mg/L)        | 0.59 - 1.11 | 0.83 | 10        |
|                         |                 |                  | Chl-a (ug/L)     | 16 - 61     | 31.3 | 10        |
|                         |                 | CPFCCR4          | Secchi Depth (m) | 0.6 - 2     | 1.3  | 10        |
|                         |                 |                  | TP (mg/L)        | 0.02 - 0.05 | 0.03 | 10        |
|                         |                 |                  | TN (mg/L)        | 0.57 - 1.11 | 0.80 | 10        |
|                         |                 |                  | Chl-a (ug/L)     | 12 - 62     | 29.4 | 10        |
|                         |                 | CPFCCR6          | Secchi Depth (m) | 0.6 - 2.5   | 1.4  | 10        |
|                         |                 |                  | TP (mg/L)        | 0.02 - 0.05 | 0.03 | 10        |
|                         |                 |                  | TN (mg/L)        | 0.5 - 1.27  | 0.87 | 10        |
|                         |                 |                  | Chl-a (ug/L)     | 12 - 58     | 31.9 | 10        |
| UNIVERSITY LAKE         | 16-41-2-(1.5)   | CPFUL4           | Secchi Depth (m) | 0.4 - 1     | 0.7  | 10        |
|                         |                 |                  | TP (mg/L)        | 0.05 - 0.12 | 0.07 | 10        |
|                         |                 |                  | TN (mg/L)        | 0.43 - 1.11 | 0.82 | 10        |
|                         |                 |                  | Chl-a (ug/L)     | 22 - 130    | 51.8 | 10        |
|                         |                 | CPFUL6           | Secchi Depth (m) | 0.3 - 1.2   | 0.7  | 10        |
|                         |                 |                  | TP (mg/L)        | 0.04 - 0.09 | 0.06 | 10        |
|                         |                 |                  | TN (mg/L)        | 0.56 - 0.98 | 0.77 | 10        |
|                         |                 |                  | Chl-a (ug/L)     | 14 - 100    | 38.3 | 10        |
| GRAHAM-MEBANE RESERVOIR | 16-18-(1.5)a    | CPFGMR1          | Secchi Depth (m) | 0.7 - 1.2   | 0.9  | 11        |
|                         |                 |                  | TP (mg/L)        | 0.02 - 0.04 | 0.03 | 11        |
|                         |                 |                  | TN (mg/L)        | 0.51 - 0.8  | 0.69 | 11        |
|                         |                 |                  | Chl-a (ug/L)     | 16 - 44     | 25.7 | 10        |
|                         |                 | CPFGMR2          | Secchi Depth (m) | 0.3 - 1     | 0.5  | 11        |
|                         |                 |                  | TP (mg/L)        | 0.05 - 0.08 | 0.06 | 11        |
|                         |                 |                  | TN (mg/L)        | 0.69 - 1.21 | 0.89 | 11        |
|                         |                 |                  | Chl-a (ug/L)     | 26 - 100    | 52.1 | 10        |
|                         |                 | CPFGMR3          | Secchi Depth (m) | 0.5 - 1     | 0.7  | 11        |
|                         |                 |                  | TP (mg/L)        | 0.03 - 0.06 | 0.04 | 11        |
|                         |                 |                  | TN (mg/L)        | 0.61 - 0.95 | 0.77 | 11        |
|                         |                 |                  | Chl-a (ug/L)     | 22 - 63     | 39.0 | 10        |
|                         |                 | CPFGMR4          | Secchi Depth (m) | 0.7 - 1.1   | 0.8  | 11        |
|                         |                 |                  | TP (mg/L)        | 0.02 - 0.05 | 0.03 | 11        |
|                         |                 |                  | TN (mg/L)        | 0.53 - 0.9  | 0.71 | 11        |
|                         |                 |                  | Chl-a (ug/L)     | 14 - 48     | 25.0 | 10        |
| 16-18-(1.5)b            | CPFGMROA        | Secchi Depth (m) | 0.3 - 0.5        | 0.4         | 11   |           |
|                         |                 | TP (mg/L)        | 0.05 - 0.1       | 0.08        | 11   |           |
|                         |                 | TN (mg/L)        | 0.65 - 1.31      | 0.94        | 11   |           |
|                         |                 | Chl-a (ug/L)     | 25 - 70          | 44.7        | 10   |           |

### **Appendix C – Public Notification of Addendum to the Jordan Lake TMDL**

The TMDL public comment period was announced on both the NC DWQ Modeling and TMDL Unit's website and the Water Resources Research Institute of the University of North Carolina (WRI) email listserv on July 20, 2010.

- Notice on the Modeling and TMDL Website: <http://portal.ncdenr.org/web/wq/ps/mtu>

7/20/10 The Public Review **Draft Addendum to B. Everett Jordan Reservoir TMDL** is available for review. The comment period extends through August 20, 2010. Comment submittal instructions are available with the above link.

- WRI listserv email received regarding public comment period:

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Date: Tue, 20 Jul 2010 15:45:58 -0400  
From: Kelly\_Porter@ncsu.edu  
To: <wri-news@lists.ncsu.edu>  
Subject: Available for Public Comment: DRAFT Addendum to B. Everett  
Jordan Reservoir TMDL for Impaired Segments in Reservoir  
Watershed  
Message-ID: <4C45C4B6.423B.0001.0@gw.ncsu.edu>

Now Available for Public Comment:  
DRAFT Addendum to B. Everett Jordan Reservoir Total Maximum Daily Load (TMDL) for Impaired  
Segments in the B. Everett Jordan Reservoir Watershed, North Carolina

This Draft Addendum TMDL report was prepared as a requirement of the Federal Water Pollution Control Act, Section 303(d). Interested parties are invited to comment on the draft TMDL report by August 20, 2010. Comments concerning the report should be directed to Pam Behm at [pamela.behm@ncdenr.gov](mailto:pamela.behm@ncdenr.gov) or write to:

Pam Behm  
NC Division of Water Quality  
Planning Section  
1617 Mail Service Center  
Raleigh, NC 27699

If you wish to obtain a hard copy of the Draft Addendum TMDL, please contact Linda Chavis at (919) 807-6305 or email at [linda.chavis@ncdenr.gov](mailto:linda.chavis@ncdenr.gov).

The Draft Addendum TMDL can also be downloaded from the following website:  
<http://portal.ncdenr.org/web/wq/ps/mtu/tmdl/tmdls>.

NOTE: To receive automatic email updates concerning North Carolina TMDL or 303(d) related announcements, send a blank email to [denr.dwq.TMDL303d-subscribe@lists.ncmail.net](mailto:denr.dwq.TMDL303d-subscribe@lists.ncmail.net), then reply to the confirmation email you receive.

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### Appendix D – Public Comments Responsiveness Summary

The public comment period extended from July 20 through August 20, 2010. Comments were received from the Orange Water and Sewer Authority and the City of Durham. These comments with the NC Division of Water Quality responses are provided below.

- 1) One comment expressed strong support for the Addendum to the Jordan Lake TMDL and stated that the addendum represents a common sense approach.

*Response: DWQ appreciates the stated support.*

- 2) One comment stated the following: “Nutrient enrichment was the focus of special technical studies in 1989 (University Lake) and 1996 (Cane Creek Reservoir) and the basis for aggressive management actions that were subsequently undertaken. These included mandatory large lot (5+ acres) residential zoning by Orange County and the Town of Carrboro, who exercise planning and zoning jurisdiction throughout 90% of both watersheds; OWASA’s protection of more than 2,000 acres of critical watershed land through fee simple acquisition and permanent conservation easements; and our contribution of cost-share funds to farmers implementing approved agricultural conservation plans and Best Management Practices in both watersheds.”

*Response: DWQ appreciates this information and will include it in the state database that tracks such activities.*

- 3) One comment stated concern about the approach DWQ took in developing the addendum to the Jordan Lake TMDL and stated a preference for individual TMDLs for each reservoir.

*Response: State regulations that implement the Jordan Lake TMDL require nutrient reductions from both point and nonpoint sources. Therefore, individual TMDLs for each reservoir would not likely result in any additional water quality improvement. It should be noted that the [www.jordanlake.org](http://www.jordanlake.org) website provides additional information on how the Jordan Lake rules specifically apply to each individual watershed.*

- 4) One comment requested the addition of a table of summary statistics for chlorophyll-a, secchi depth, nutrients, and number of samples.

*Response: This table has been added to the document in Appendix B.*



- 5) One comment stated that the addendum should include a delineation of each watershed, a table of land cover data for each watershed, and a table of jurisdictions for each watershed.

*Response: Table 1 has been added to the document to list the counties and municipalities that are in each watershed. In addition, Figure 1 has been modified to display counties and Figures 1a through 1c have been added to show municipalities and HUCs for each watershed. Land cover information for each watershed is provided in Appendix A. Both Cane Creek Reservoir and University Lake are delineated at the 14-Digit HUC scale. Most of the Graham-Mebane Reservoir watershed falls within two 14-Digit HUCs. However, a small portion falls outside these two HUCs (see Figure 1a) and was not considered in developing the information provided in Appendix A.*