ENVIRONMENTAL ASSESSMENT

For

A Demonstration Project Showing the Impact of Floating In-Lake Long-Distance Circulators in B.E. Jordan Lake

Lead Agency Contact:

Mr. Justin Bashaw
United States Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403
(910) 251-4581

North Carolina Department of Environment and Natural Resources Contact:

Mr. David Wainwright
North Carolina Division of Water Resources
512 North Salisbury Street
Raleigh, NC 27604
(919) 707-8787

The State of North Carolina

Department of Environment and Natural Resources

Division of Water Resources

DWR
Division of Water Resources

March 2014

Table of Contents

List of Abbreviations vi

1.0 Introduction 1

1.1 Background 2

1.2 The Demonstration Project 3

1.3 Project Area Locations 6

2.0 Purpose and Need for the Proposed Action 10

3.0 Alternatives Considered 11

3.1 No Action Alternative 11

3.2 Solar Powered In-Lake Long-Distance Circulators 12

3.3 Electrically Powered In-Lake Long –Distance Circulators 14

3.4 Wind Powered In-Lake Circulators 14

4.0 Proposed Action - Demonstration of Solar Powered In-Lake Long- Distance Circulators 16

5.0 Environmental Effects 26

5.1 Physical Environment 26

5.1.1 Topography 26

5.1.2 Geology 28

5.1.3 Soils 29

5.1.4 Floodplains 32

5.1.5 Surface Hydrology 34

5.1.6 Water Quality 34

5.1.7 Air Quality 38

5.1.8 Noise 39

5.1.9 Cultural Resources 40

5.1.9.1 The John A. Mason House 41

5.1.9.2 The James A. Thomas Farm 41

5.1.10 Hazardous Waste Sites 42

5.1.11 Aesthetics 43

5.2 Managed Lands 44

5.3 Natural Resources 45

5.3.1 Vegetation 45

5.3.2 Fish and Wildlife 45
5.3.2.3 Fisheries 46
5.3.3 Endangered and Threatened Species 49
5.3.4 Wetlands 51
5.4 Socioeconomic Characteristics 52
5.4.1 Land Use 52
5.4.2 Transportation 55
5.4.3 Recreation 55
5.4.4 Water Supply and Conservation 58
5.4.5 Energy Needs 59
5.4.6 Safety 59
5.4.7 Consideration of Property Ownership 60
5.5 Environmental Impact Comparison of Alternatives 61
6.0 Executive Orders 63
6.1 Executive Order 11988 (Floodplain Management) 63
6.2 Executive Order 1199990 (Protection of Wetlands) 63
6.3 Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low Income Communities and Low Income Populations) 63
6.4 Executive Order 11593 (Protection and Enhancement of the Cultural Environment) 63
6.5 Executive Order 13186 (Protection of Migratory Birds) 64
6.6 Executive Order 13112: Invasive Species 64
6.7 Executive Order 13045: Protection of Children from Environmental Health Risks 64
7.0 Unavoidable Adverse Impacts of the Proposed Action 64
8.0 Indirect and Cumulative Impacts 64
9.0 Public Involvement/Scoping 65
10.0 List of Recipients Receiving Copies of This Document 65
11.0 Point of Contact 66
12.0 List of Preparers 66
13.0 Finding of this Environmental Assessment 66
14.0 References 66
Appendix A (Scoping Comments Received) 70

Appendix B (Federal and State Listed Species in Chatham County) 84

Appendix C (Fish Swim Speeds) 89

Appendix D (Jordan Lake Water Quality Improvement Demonstration Project (Session Law 2013-360§14.3A.(a)) 91

Appendix E (*Study Plan for the Assessment of In-Lake Mechanical Reductions of Adverse Impacts Related to Excess Nutrients in the Morgan Creek and Haw River Arms of Jordan Lake)* 95

List of Figures

Figure 1 - Location of Jordan Lake Monitoring Stations 5
Figure 2 - Location of Jordan Lake Watershed 7
Figure 3 - Overview of Morgan Creek Arm APE 8
Figure 4 - Overview of Haw River Arm APE 9
Figure 5 - Examples of Solar Powered In-Lake Long-Distance Circulators 13
Figure 6 - Examples of AC Powered In-Lake Long-Distance Circulators 14
Figure 7 - Example of Wind Powered In-Lake Long-Distance Circulator 15
Figure 8 - Average Daily Wind Speed near Project Area 16
Figure 9 - Location of Circulators in the Morgan Creek and Haw River Arms of Jordan Lake 18
Figure 10 - Typical Circulator Anchoring 19
Figure 11 - Deep Water Circulator Anchoring 20
Figure 12 - Estimated Swing Diameters for Circulators in the Morgan Creek Arm 21
Figure 13 - Estimated Swing Diameters for Circulators in the Haw River Arm 22
Figure 14 - Surface Area Potentially Affected by Circulation in the Morgan Creek Arm 23
Figure 15 - Surface Area Potentially Affected by Circulation in the Haw River Arm 24
Figure 16 - Visibility and Safety Features of Operating Circulators 25
Figure 17 - Topographic Map of the Morgan Creek Arm of Jordan Lake 27
Figure 18 - Topographic Map of the Haw River Arm of Jordan Lake 28
Figure 19 - Soil Series Present in the Morgan Creek Arm APE 30
Figure 20 - Soils Series Present in the Haw River APE 31
Figure 21 - Flood Zones in the Morgan Creek and Haw River APEs 33
Figure 22 - Historic Properties Located in APEs 40
Figure 23 - John A. Mason House 41
Figure 24 - James A. Thomas House 42
Figure 25 – Depiction of Solar Powered Long-Distance Circulators on Jordan Lake 43
Figure 26 - Location of NCWRC Fish Attractors and Circulators 47
Figure 27 - NCWRC Fish Attractor 48
Figure 28 - Water Flow through Circulator 49
Figure 29 - Land Cover in the APEs 54

Figure 30 - Image of Circulator in Operation 56
Figure 31 – Jordan Lake Designated Recreational Areas 57

List of Tables

Table 1 - Comparison of Solar Powered Circulators 13
Table 2 - NRCS Soils in the Morgan Creek Arm and Haw River Arm Areas of Potential Effects 29
Table 3 - Summary of FEMA Designated Areas in the Areas of Potential Effects 32
Table 4 - History of 303(d) Listings in the Lake Jordan Watershed Management Area 35
Table 5 - Summary of Ongoing Assessment of Water Quality in Jordan Lake Data 2009-2012 37
Table 6 - Annual Air Quality Index Summary for Chatham County (2008-2012) 39
Table 7 - Managed Lands in the Areas of Potential Effects 44
Table 8 - Water Velocity versus Distance from Intake Hose 49
Table 9 - Federally Listed and Protected Species in Chatham County 50
Table 10 - Wetland Types in the Areas of Potential Effects 52
Table 11 - Summary of Land Cover in the Areas of Potential Effects 53
Table 12 - Water Supply Allocations from Jordan Lake 59
Table 13 - Summary of Alternatives Impacts 62

List of Abbreviations

Abbreviation:	Abbreviation Represents:
APE	Area of Potenial Effect
AQI	Air Quality Index
AU	Assessment Unit
BGPA	Bald and Golden Eagle Protection Act
CAA	Clean Air Act
CWA	(Federal) Clean Water Act
EA	Environmental Assessment
ESA	(Federal) Endangered Species Act
FEMA	Federal Emergency Management Agency
fps	Feet per Second
gpm	Gallons Per Minute
HUC	Hydrologic Unit Code
JLNMS	Jordan Lake Nutrient Management Strategy
NCDENR	North Carolina Department of Environment and Natural Resources
NCDPR	North Carolina Division of Parks and Recreation
NCDWR	North Carolina Division of Water Resources
NCEAS	North Carolina Endangered Species Act
NCNHP	North Carolina Natural Heritage Program
NCWRC	North Carolina Wildlife Resources Commission
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NSHPO	North Carolina State Historic Preservation Office
SEPA	(North Carolina) State Environmental Policy Act
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency

1.0 Introduction

B. Everett Jordan Lake (Jordan Lake) is located primarily in Chatham County, North Carolina, in the central part of the State. Jordan Lake has a surface area of 13,900 acres and drains an area of approximately 1,686 square miles in parts of Orange, Wake, Chatham, Alamance, Caswell, Randolph, Guilford, Rockingham, Forsyth, and Durham Counties. Jordan Lake is part of the Cape Fear River basin.

The history of Jordan Lake begins nearly 70 years ago, on September 17, 1945, when a category 1 hurricane swept across North Carolina after making landfall in southern Florida. Although the intensity of the hurricane wasn't severe, the storm contained a lot of precipitation. The path took the storm through central North Carolina, significantly affecting the Cape Fear River Basin. It had already rained in the area for several days prior and the storm left an additional eight inches of rain. The duration and amount of rain led to severe flooding and damage in the Cape Fear River Basin (Hudgins, 2000). Afterwards, The United States Army Corps of Engineers (USACE) was directed by Congress to comprehensively study the water resource needs and address flooding issues in the basin. It was decided that a reservoir would be built to provide five congressionally authorized purposes: flood control, recreation, water supply, water quality, and fish and wildlife enhancement. At the time, the project was known as New Hope Lake, named after the river that was to be dammed to create the reservoir. The project was approved in 1963, with construction beginning in 1967. In 1973 the project was renamed in honor of former Senator B. Everett Jordan (NCDPR). The reservoir was allowed to fill in 1981, and reached normal pool level in 1982 (USACE).

Much of the area surrounding Jordan Lake is leased to the State of North Carolina and managed by three state agencies: NC Division of Parks and Recreation, NC Wildlife Resources Commission, and the NC Forest Service. These public lands and waters are leased by the State from the Federal Government for public park, recreation, and fish and wildlife purposes (Lease No. DACW21-1-81-2603). Popular activities include camping, fishing, swimming, hunting, hiking, boating, and bird watching. Recreational infrastructure includes 16 recreation areas, 233 picnic sites, over 1,000 camping sites, numerous playgrounds, eight swimming areas, 23 miles of trails, 15 boat ramps, and one marina. Annual visits to Jordan Lake and associated recreational areas average over 970,000 persons (USACE, 2010). Most recreational facilities are overseen by the North Carolina Division of Parks and Recreation (NCDPR). The North Carolina Wildlife Resources Commission (NCWRC) manages the Jordan Lake Game Lands, manages the lake fisheries, and enforces state fishing and boating regulations. The North Carolina Forest Service (NCFS) manages the Jordan Lake Education State Forest. Water levels in Jordan Lake and the dam are operated and maintained by the USACE.

The Morgan Creek Arm has been listed on the 303(d) list of impaired waters for chlorophyll *a* since 2004; the Haw River Arm has been on the list for chlorophyll *a* since 2006. Other waters in the Jordan Lake watershed have been listed on the State's 303(d) list going back as far as 2000, including New Hope Creek, the New Hope River Arm of Jordan Lake, and the Haw River. All of these waters are included on the current 2012 list or have been included on past lists for other water quality concerns including high

pH, turbidity, and biological integrity. These listings support the ongoing need to take action to reduce these concerns.

As a result of the ongoing impairment and water quality concerns, especially regarding recreation and public water supply, the North Carolina General Assembly passed Session Law 2013-360. The law mandates that the North Carolina Division of Water Resources (NCDWR) establish a 24 month solar in-lake circulator demonstration project for the management of algal blooms and chlorophyll *a* in the Haw River and Morgan Creek Arms of Jordan Lake. The demonstration project is to specifically focus on preventing and reducing noxious algal blooms and excessive chlorophyll *a* attributed to elevated nutrient levels found in Jordan Lake.

The NCDWR has requested the use of waters within the Morgan Creek and Haw River Arms of Jordan Lake from the USACE for an in-lake long-distance circulator demonstration project. This requested use does not fall within the scope of the State's lease so a separate government real estate license is required. The Federal action for the demonstration project is the granting of a USACE real estate license to the NCDWR for placement of circulators within the Morgan Creek and Haw River Arms of Jordan Lake. The National Environmental Policy Act of 1969, as amended (NEPA) requires that the environmental consequences of Federal actions be evaluated, and the details of this proposed action, and the potential environmental consequences must be presented to the public. The purpose of this Environmental Assessment (EA) is to provide a summary of this evaluation and facilitate review by relevant government agencies and the public.

This Environmental Assessment (EA) addresses a request for a proposed demonstration project which would place a total of 36 floating in-lake long-distance circulators within Jordan Lake. Twenty-four circulators would be deployed in the Morgan Creek Arm of Jordan Lake and 12 would be placed in the Haw River Arm of Jordan Lake for a 24 month period. The circulators would upwell water from near the bottom of the hypolimnion to the surface (epilimnion) of the lake. According to the State, the circulators are expected to improve water quality by suppressing phytoplankton activity such that chlorophyll *a*, pH, and turbidity measurements would meet State water quality standards within the project areas. Water quality would be monitored within the project areas and compared with data collected outside of the project area as well as historically collected data. Such comparisons would allow the NCDWR to verify if this project is having the intended results of reducing chlorophyll *a*.

Should the use of the project areas on Jordan Lake be approved by the USACE, the demonstration project would be conducted in accordance with all requirements set forth by the USACE. This EA is being submitted so ensure that all environmental consequences of the proposed action are presented and available for interested stake holders to review. This EA has been prepared in accordance with the National Environmental Policy Act of 1969, the Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Engineering Regulation 200-2-2 (33 CFR Part 230).

1.1 Background

Section 303 of the Clean Water Act of 1972 (CWA), as amended, outlines federal water quality standards

and implementation plans to protect public waters, including streams, lakes, and coastal waters. Water quality standards established under the CWA are to be designed to protect public health or welfare, enhance the quality of water, and serve the purpose of the CWA, and shall be established in consideration of their use and value for public water supplies, propagation of fish and wildlife, and recreational purposes while also taking into consideration their use and value for navigation. The United States Environmental Protection Agency (USEPA) has delegated the development of standards meeting these requirements to the State of North Carolina.

Section 303(d) of the CWA requires States to identify those waters which are not meeting approved State water quality standards. In order to meet this requirement, the State routinely reviews historical water quality data and collects necessary data to complete the determinations. A list of all surface waters which the state has jurisdiction over is submitted to the USEPA for approval on a biannual basis (every even year). After the list is approved by USEPA, the state must address those waters which are not meeting State water quality standards and are therefore deemed impaired. In many cases impairments are addressed through a Total Maximum Daily Load, or TMDL. A TMDL is a calculation which takes into account how much of a given pollutant a waterbody can assimilate in a given day and still meet State water quality standards. This calculation is then compared to actual measured levels, and the difference is the amount of reduction in source inputs required to align the waterbody with compliance standards. To be conservative, a small percentage is added to the required reduction, placing the targeted goal slightly below the actual maximum load. This calculated reduction is then equitably allocated to all sources (point and non-point sources) of a specific pollutant within the watershed. If North Carolina does not develop a TMDL for an impaired water then the USEPA has the authority to do so. After a USEPA approved TMDL is implemented, the State is required to ensure that the TMDL allocations are having the desired pollutant reduction effect in the applicable watershed. This is accomplished through assessing post TMDL water quality data. The results of TMDL monitoring are evaluated every five years, and adjustments to required reduction goals and allocations are adjusted accordingly.

On June 20, 2007 the USEPA approved a TMDL for Jordan Lake. The TMDL addresses excessive total nitrogen and total phosphorous concentrations in seven assessment units of the Jordan Lake watershed. On September 28, 2010 an addendum to the original TMDL was approved, adding another four assessment units.

Jordan Lake was partially created as a recreational lake, and has become very popular for numerous recreational activities which help support the regional economy. It is also important as a drinking water supply reservoir. In looking at ways to preserve and improve water quality in the lake, important for both recreation and water supply, the State of North Carolina decided that a demonstration project should be undertaken to determine if in-lake long-distance circulators would help improve water quality and in turn expedite TMDL goals.

1.2 The Demonstration Project

The project is being proposed as a demonstration project. If all necessary approvals are granted and the

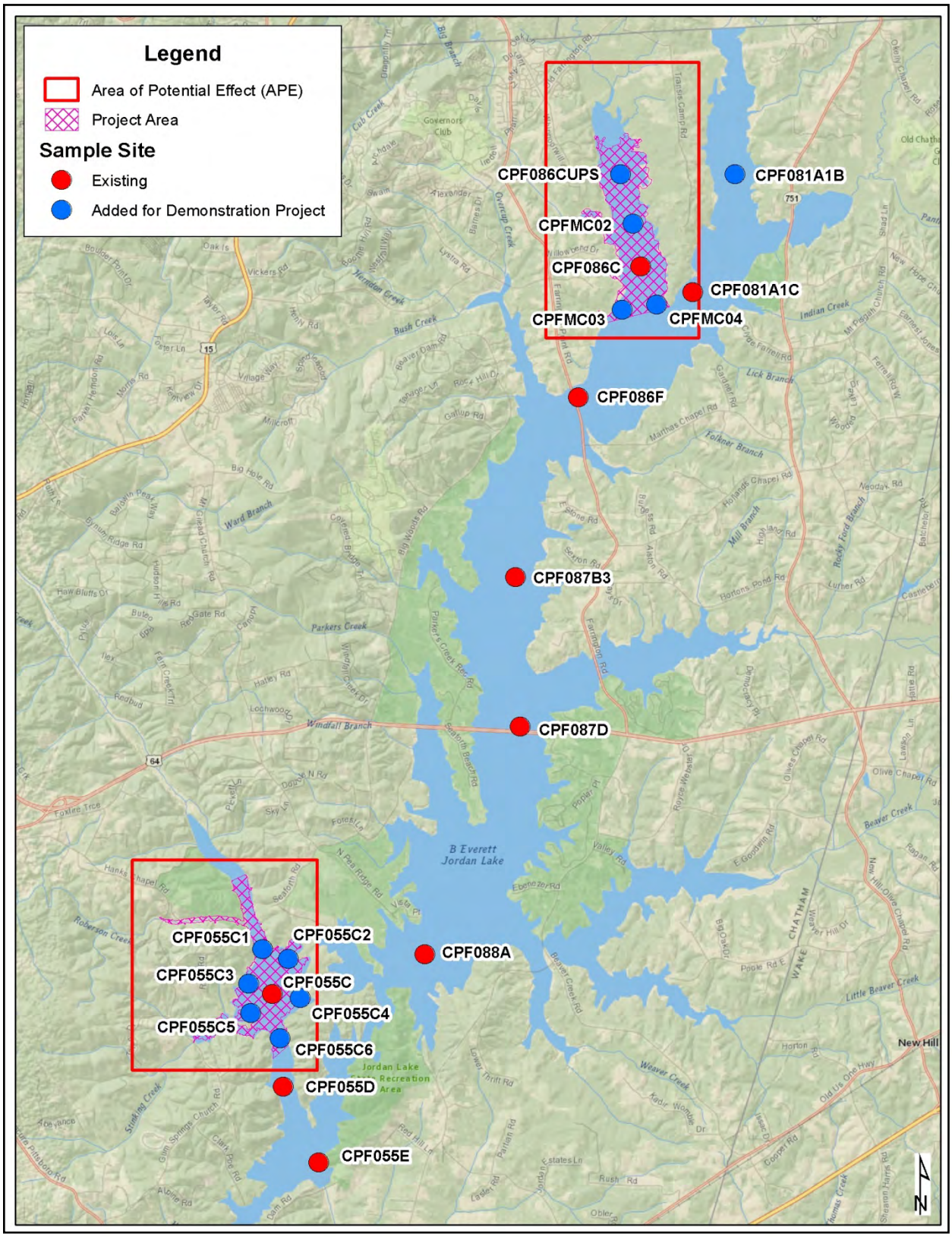
project is conducted, the circulators would be in place for 24 months. It is anticipated that the circulators would be deployed sometime in the spring of 2014, being removed in the spring of 2016.

In order to gauge the effectiveness of the demonstration project several monitoring stations have been established not only within the Morgan Creek and Haw River Arms, but also throughout the mainstem of Jordan Lake. As is shown in Figure 1, a total of 20 monitoring sites are now located on Jordan Lake. Eleven new stations have been established including four within the Morgan Creek Arm study area and five within the Haw River Arm study area. One new station is located in the New Hope Creek arm. These eleven sites have been established to monitor and determine the effectiveness of this demonstration project and have been monitored monthly since July 2013 in anticipation of the project. There are nine existing stations which have been monitored monthly from January – April and October – December, and twice a month from May – September (17 samples per year) since July 2009.

Sample collection would focus on nutrient related physical, chemical, and biological water quality parameters. Water samples tested for chemicals would be collected from the photic zone. The photic zone is defined as a vertical area from the water surface to a depth equal to two times the secchi depth, and represents the region of the water column which is most reflective of nutrient enrichment impacts. Depth stratified physical parameters would be collected at the surface (0.15 meters), at 1 meters increments to a depth of 10 meters, and every 5 meters thereafter. Phytoplankton samples would be collected at selected sites chosen by proximity to circulators. Microscopic analysis would used to determine species composition. Water quality sample collections and field operations would follow State approved Standard Operating Procedures, which include *Physical and Chemical Monitoring Version 2.1* and *Ambient Lakes Quality Assurance Project Plan Version 1* (July 2012). Data from sample collection would be used to help determine the effectiveness of using circulators to effectively reduce chlorophyll *a* concentrations in the Morgan Creek and Haw River Arms of Jordan Lake. A copy of the sampling plan for the demonstration project and sample locations is included as Appendix E.

Data collected at monitoring stations in the Morgan Creek and Haw River Arms would be compared to other data collected to help determine the effectiveness of the circulators on water quality. The primary objective of the project is to address water quality concerns associated with the TMDL. Therefore, the project would be considered completely successful if water quality goals for chlorophyll *a*, pH, and turbidity are met as they relate to the TMDL. Due to the nature of the project, varying results may be achieved. The extent to which water quality improves would aid in the state's decision to either abandon the project or extend the deployment time beyond 24 months. This EA only discusses the demonstration project for 24 months; any deployment beyond the scope of this EA would need to be evaluated on its own merit.

Figure 1 - Location of Jordan Lake Monitoring Stations



1.3 Project Area Locations

The two project areas are located in eastern Chatham County, North Carolina. A map showing the general area and the two project areas is included as Figure 2.

The Morgan Creek Arm of Jordan Lake is located in the northeastern portion of Chatham County, south of Chapel Hill. It is bordered to the north by NC 54, to the south by US 64, to the west by Farrington Road, and to the east by NC 751. The project area, which is the area which would be directly affected by the proposed project, is 803 acres and is entirely composed of Jordan Lake water surface. The Area of Potential Effect (APE), selected because it includes the areas in which any potential impacts from the project are expected to be seen, is 4,218 acres. Figure 3 shows the Morgan Creek Arm APE and project area.

The Haw River Arm is in southeast Chatham County, east of Pittsboro. It is bordered to the north by US 64, to the south by US 1, and to the west by US 15/501. The project area is 650 acres and is composed entirely of Jordan Lake water surface. The Haw River APE is 3,893 acres. Figure 4 shows the Haw River Arm APE and project area.

Both project areas are within the Piedmont ecoregion of North Carolina. The Morgan Creek Arm is wholly located within the Triassic sub basin of the Piedmont. The Haw River Arm is partially located within the Triassic sub basin and partially located within the Carolina Slate Belt sub basin. Both project areas are surrounded by lands managed primarily by the United States Army Corps of Engineers (USACE) and the North Carolina Wildlife Resources Commission (NCWRC).

These two areas of Jordan Lake were selected because they exhibit some of the highest chlorophyll *a* readings in Jordan Lake. The majority of water coming into Jordan Lake comes from the Haw River, passing through the Haw River Arm project area. The Haw River Arm accounts for 70-90 percent of the flow coming into Jordan Lake. This allows for a relatively short residence time of only five days. The Haw River Arm project area is rather deep - upwards of 35 feet in many areas. The Morgan Creek Arm is much shallower, typically less than ten feet, and has a much longer residency time of 418 days (NCDENR, 2007). The project encompasses two project areas with dissimilar characteristics, yet captures a large amount of water that passes into Jordan Lake.

Figure 2 - Location of Jordan Lake Watershed

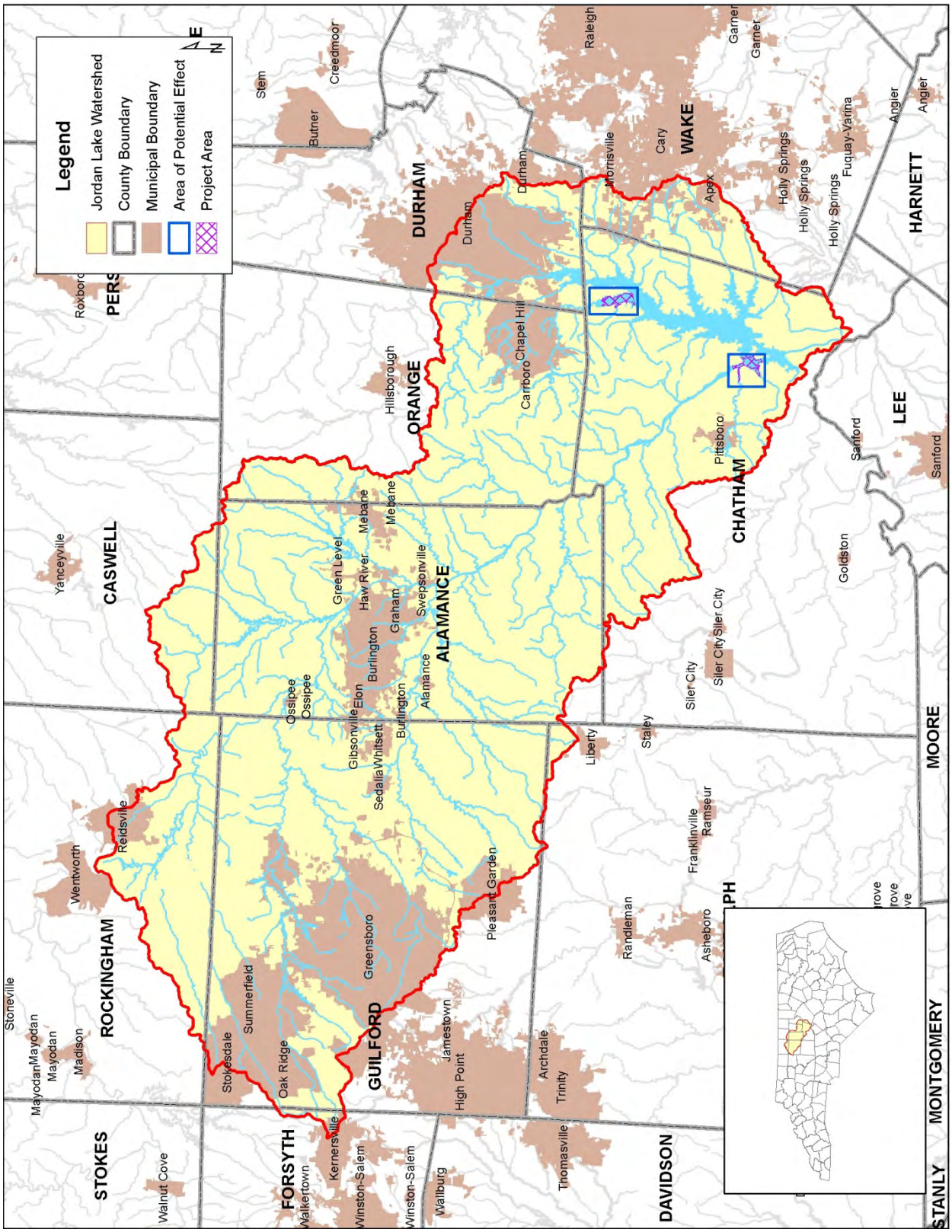


Figure 3 - Overview of Morgan Creek Arm APE

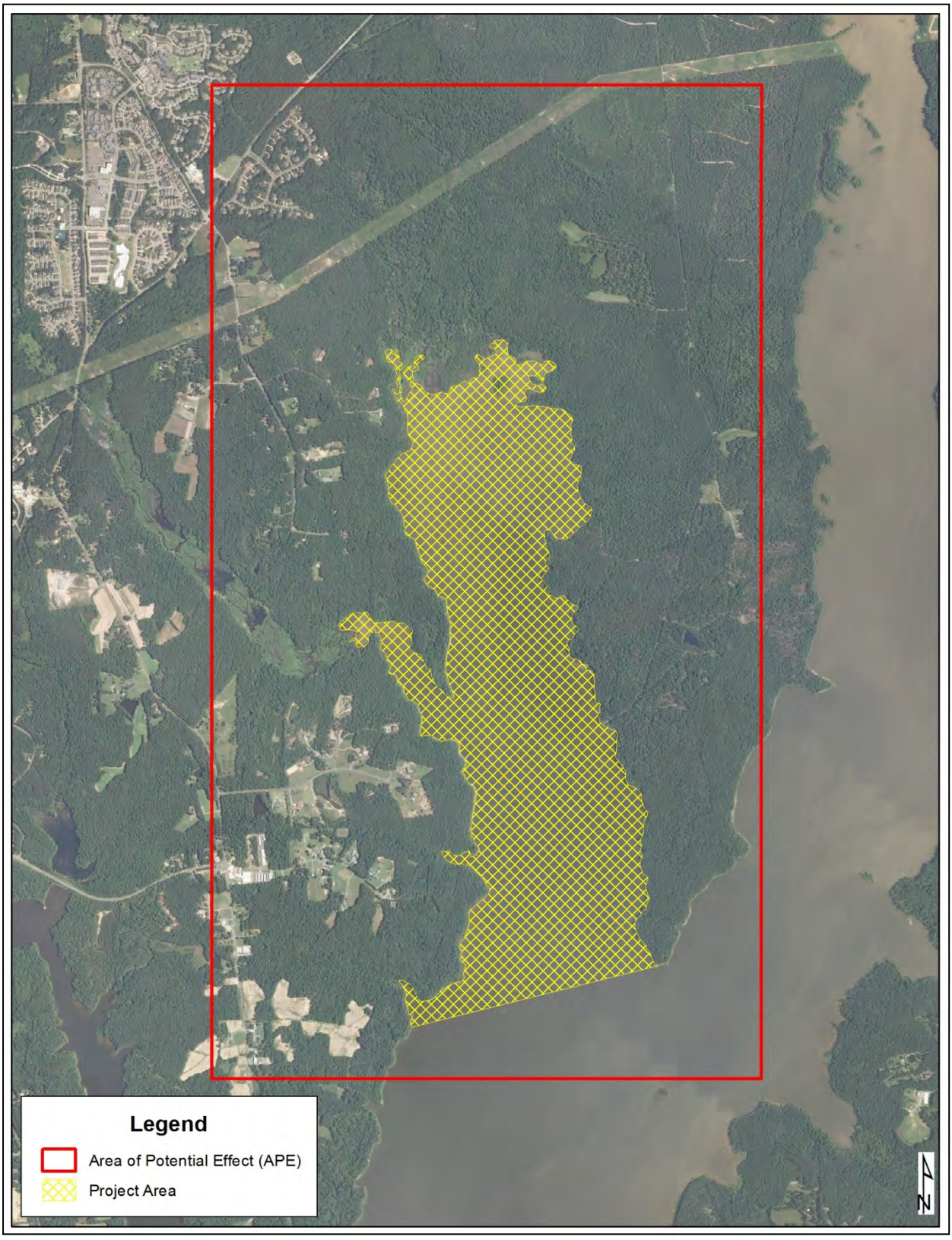


Figure 4 - Overview of Haw River Arm APE

2.0 Purpose and Need for the Proposed Action

Jordan Lake was authorized to provide flood control, drinking water, recreation, fish and wildlife enhancement, and augment low-flows for the purposes of pollution abatement and water quality control in the Cape Fear River Basin (USACE). As a drinking water reservoir, Jordan Lake is a source of drinking water for the greater Raleigh metropolitan area. As the area population continues to grow, so will the demand for clean, safe drinking water, and it should be anticipated that Jordan Lake will need to be a viable source of water to at least partially meet this demand. Additionally, Jordan Lake is also a major regional recreational attraction. In 2010, it is estimated that 970,000 people enjoyed some recreational aspect of Jordan Lake, which include swimming, camping, boating, hunting, fishing, etc. (USACE, 2010). Tourism associated with recreational activities created an estimated $32 million dollars regionally, and was responsible for creating or maintaining 361 jobs (USACE, 2010).

There is a need for water quality within the Jordan Lake watershed to meet or exceed State water quality standards in order to provide safe drinking water and reduce costs associated with treating water for consumption. From a recreational standpoint water quality needs to be maintained to protect human health and protect aquatic species. Because recreational opportunities within and around Jordan Lake are significant contributors to the regional economy, and many of the activities are water related, it is very important to improve and maintain water quality within Jordan Lake. As evident by the 2012 303(d) list, there are many waterbodies in the Jordan Lake watershed which are not meeting their designated uses or do not meet State water quality standards (discussed further in Section 5.1.6). These waters are therefore considered impaired by the State and the USEPA. Due to Jordan Lake's impact on the economy, recreation, and public water supply, it is imperative that water quality in Jordan Lake achieve, at a minimum, state standards for monitored parameters.

The biggest water quality concern in Jordan Lake is nutrient loading; specifically relating to nitrogen and phosphorus. These two nutrients have contributed to excessive chlorophyll *a* concentrations and noxious algal blooms. Excess nutrient loading can cause algal blooms which block sunlight and can shade submersed plants and aquatic life. As native plants are negatively affected, undesirable and invasive vegetation may begin to increase its presence in the lake. As excess algae die and sink to the lower depths of the water column, increases in bacterial respiration (corresponding to increased consumption of decaying algae) contribute to hypoxic conditions and may result in fish kills.

The Jordan Lake Reservoir has historically been one of the most eutrophic reservoirs in North Carolina (NCDENR, 2007). Exceedances of the state water quality standard for chlorophyll *a* have been noted frequently, especially in the Upper New Hope Arm which includes the Morgan Creek Arm. As a result of this excessive nutrient loading and the resulting increases in chlorophyll *a*, many of the streams draining into Jordan Lake, as well as the Lake itself, have been included on past lists of impaired waters.

The project purpose is to demonstrate if deployment of in-lake long-distance circulators can reduce chlorophyll *a* concentrations in Jordan Lake without negatively impacting water quality or other Jordan Lake resources. In order to meet the purpose and intent of the demonstration the circulators would need to be deployed within surface waters of Jordan Lake, and is therefore a water dependent action.

Session Law 2013-360§14.3A.(a), "Jordan Lake Water Quality Improvement Demonstration Project," (see Appendix D) directs the NCDENR to establish a 24 month demonstration project for the management of nutrients in Jordan Lake. The Law also specifically states the demonstration project will occur in the Haw River and Morgan Creek Arms of Jordan Lake. These two areas of Jordan Lake were selected because they exhibit some of the highest chlorophyll *a* readings in Jordan Lake. Additionally, the majority of water coming into Jordan Lake comes from the Haw River with the Haw River Arm accounting for 70-90 percent of the flow coming into Jordan Lake. Due to these factors, no other areas within Jordan Lake are being considered for the proposed action at this time. The locations of the Haw River and Morgan Creek Arms of Jordan Lake are shown in Figures 3 and 4.

3.0 Alternatives Considered

The State continues to have concerns over the water quality in Jordan Lake, especially those associated with increased nutrients and elevated chlorophyll *a* concentrations. While existing rules, regulations, and best management practices (BMPs) have had some effect on combatting these concerns, the State is proposing a demonstration project that would place in-lake long-distance circulators in two areas of Jordan Lake to see if water quality goals can be expedited. Due to stipulations outlined in Session Law 2013-360§14.3A.(a), consideration of installation feasibility, and likely product efficacy, solar powered in-lake long-distance circulators have been selected as the preferred action for this demonstration project.

This EA considers four different alternatives, including the no action alternative:

- No Action
- Solar Powered In-Lake Long-Distance Circulators
- AC Powered In-Lake Long-Distance Circulators
- Wind Powered In-Lake Long-Distance Circulators

3.1 No Action Alternative

The no action alternative would maintain current BMPs in Jordan Lake. With the no action alternative, it is likely that water quality concerns in Jordan Lake would gradually improve because the TMDL would remain in place. The TMDL is intended to result in reducing and managing nutrient inputs to the Jordan Lake watershed over an extended period of time. The initial TMDL approved in September 2007 set nutrient reduction goals for both point and non-point sources of total nitrogen and phosphorous inputs. A condition of the TMDL is that nutrient and chlorophyll *a* values would be evaluated annually and reviewed every five years to determine if water quality targets are being met and if required reductions would require modification to achieve required targets. It is assumed that other programs, such as stormwater BMPs, riparian buffer rules, implemented JLNMS components, and nutrient management strategies implemented through local and municipal ordinances or state statutes, designed to protect Jordan Lake as a drinking water supply that are currently in place would remain in place.

A historical summary of chlorophyll *a*, turbidity, dissolved oxygen, and pH values from 2009-2012 is presented in Table 5 and discussed in Section 5.1.6 (Water Quality). The data indicate that for the Morgan Creek Arm, the chlorophyll *a* exceedance rate has actually increased from 59 percent in 2010 to 76 percent in 2012. Although turbidity has shown annual decreases, in 2012 the exceedance rate was 12 percent, which is still above target concentrations. Dissolved oxygen had no exceedance (zero percent) from 2010-2012, and pH exceedance rate increased from 6 percent in 2010 to 12 percent in 2011 and 2012.

In the Haw River Arm, the chlorophyll *a* exceedance rate has declined from 35 percent in 2010 to 18 percent in 2012, but is still well above the 10 percent exceedance target. Turbidity exceedances have decreased from 12 percent in 2010 to no (zero) exceedances in 2012. There were no (zero) exceedances of dissolved oxygen from 2010 – 2012, and there were no exceedances of pH in 2012.

Implemented programs have shown mixed results based on reported sampling. Thus far, the chlorophyll *a* exceedance rate has declined in the Haw River Arm but increased in the Morgan Creek Arm. Based on these results, it is difficult to predict when water quality targets would be achieved under the no action alternative.

The projected time required to reach in-lake water quality targets hasn't been established, and would be difficult to predict due to lags in measurable responses associated with implemented programs. This is to say that when a program is fully implemented, the time required before measurable results manifest may be difficult to predict and span many years; in part because factors, such as weather, may play a role in the lake's response. Water quality in Jordan Lake is expected to gradually improve with this alternative. Therefore, it was retained for comparison with the proposed plan and is discussed in Section 5 (Environmental Consequences) of this EA.

3.2 Solar Powered In-Lake Long-Distance Circulators

Solar powered in-lake long-distance circulators contain an array of solar panels that power an impeller which is used to circulate water. On some models, the solar panels charge batteries that operate the impeller at night and in less than ideal solar conditions, enabling 24-hour operation. Based upon a review of the market, it has been determined that there are primarily three manufacturers of solar powered in-lake long-distance circulators. Representative circulators from these manufacturers have been considered for this demonstration project. Aquago manufactures circulators under the Sungo name; Medora under the Solarbee name; and Aeromix Systems under the LumenAER name.

Depending upon the manufacturer, the circulators are powered by either three or six solar panels which sit on the top of the unit. Circulators are approximately 10-16 feet across and rise two-to-ten feet above the water's surface (Figure 5). Solarbee and LumenAER models are equipped with an adjustable intake hose, whereas the intake hose is an optional addition to Sungo models. The circulators would be set such that the intake hose is set above the thermocline such that only water above the thermocline is circulated. With LumenAER and Solarbee models, water is drawn up through the intake hose, passed through the impeller, and discharged radially on the water's surface at a non-turbulent velocity.

Discharge velocity quickly drops with distance from the circulator's center. With LumenAER and Solarbee models, the initial discharge velocity is approximately 0.2 fps at the outer edges of the float, dissipating as the water moves away from the circulator. Sungo models operate slightly differently than LumenAER and Solarbee models, as water is circulated via a vortex created by impeller movement.

Figure 5 - Examples of Solar Powered In-Lake Long-Distance Circulators

Sungo | LumenAER | Solarbee

Table 1 - Comparison of Solar Powered Circulators

Manufacturer	Aquago	Aeromix	Medora
General Model Name	Sungo	LumenAER	Solarbee
Approximate Footprint Size (feet)	10 x 6	16 (diameter)	16 (diameter)
Approximate Height above Water (feet)	10	2	2
Onboard Batteries	Optional	Optional	Optional
Maximum Circulated Area (acres)	25	16	35

Each individual unit would be anchored to the lake bottom with one or more anchors capable of holding the circulator in place during all anticipated weather events. Enough slack in the tether line would be available to allow for changes in water level.

One advantage of solar powered models is that they are stand-alone units. This type of circulator does not require an alternating current (AC) power source, which would need to be installed and supplied from a land based source. Circulators with batteries would allow the unit to operate uninterrupted; at night or in less than ideal solar conditions, such as overcast or partly sunny days.

A disadvantage of solar powered circulators with batteries is that over time the batteries could fail, which would require battery replacement. Battery failure could affect circulator performance when battery power is required until replaced. Additionally, solar panels may need to be cleaned for optimum performance, especially during periods of little or no rain. However, the units would be inspected for proper operation and any necessary maintenance performed on a routine basis (at least weekly). It would be possible to clean solar panels at that time as required.

This alternative would meet the purpose and need of the project, and is further discussed in Section 5 (Environmental Consequences) of this EA.

3.3 Electrically Powered In-Lake Long –Distance Circulators

In addition to solar powered in-lake long-distance circulators, Medora also manufactures an alternating current (AC) powered version sufficient for use in reservoirs such as Jordan Lake (Figure 6). Aeromix manufactures a solar/AC electric hybrid model, which uses AC power when the solar panels are unable to sufficiently operate the circulator. The circulators operate in a manner similar to solar powered versions; however, they lack the batteries and operate from land based AC power. Because the operating specifications are the same as solar-powered circulators, the number required and placement would expected to be the same. Performance would also be the same as for solar powered models.

Because these circulators would require an AC power source, an onshore power source would be necessary in addition to the in-water units. The State would be responsible for the cost of power supply installation and removal upon termination of demonstration project, as well as the cost of powering the circulators, and the acquisition of any easements necessary for power line installation and maintenance. Also, the power lines would require placement along the lake bottom from shore to each circulator. Boaters would not be allowed to anchor over power lines, reducing available recreational area for certain activities. Installing necessary power lines would have greater impacts to terrestrial resources and the lake bottom as compared to other alternatives considered.

Figure 6 - Examples of AC Powered In-Lake Long-Distance Circulators

Solarbee | LumenAER (solar/AC hybrid model)

This alternative would meet the purpose and need of the project. However, this alternative would have increased adverse impacts as compared to comparable solar powered models. Because AC powered circulators would be as effective as solar powered models in disrupting the formation of algal blooms, but would have greater adverse impacts as compared to comparable solar powered models, this alternative is not being carried forward, and will not be retained for comparison in Section 5 (Environmental Consequences) of this EA.

3.4 Wind Powered In-Lake Circulators

One manufacturer of wind powered in-lake circulators was also considered for this demonstration project; Aquago offers the Ventgo line of water circulators which are dependent upon inherently

variable winds to power the units. The circulator is approximately 10 feet long, six feet wide, and rises 10 feet above the water surface (Figure 7).

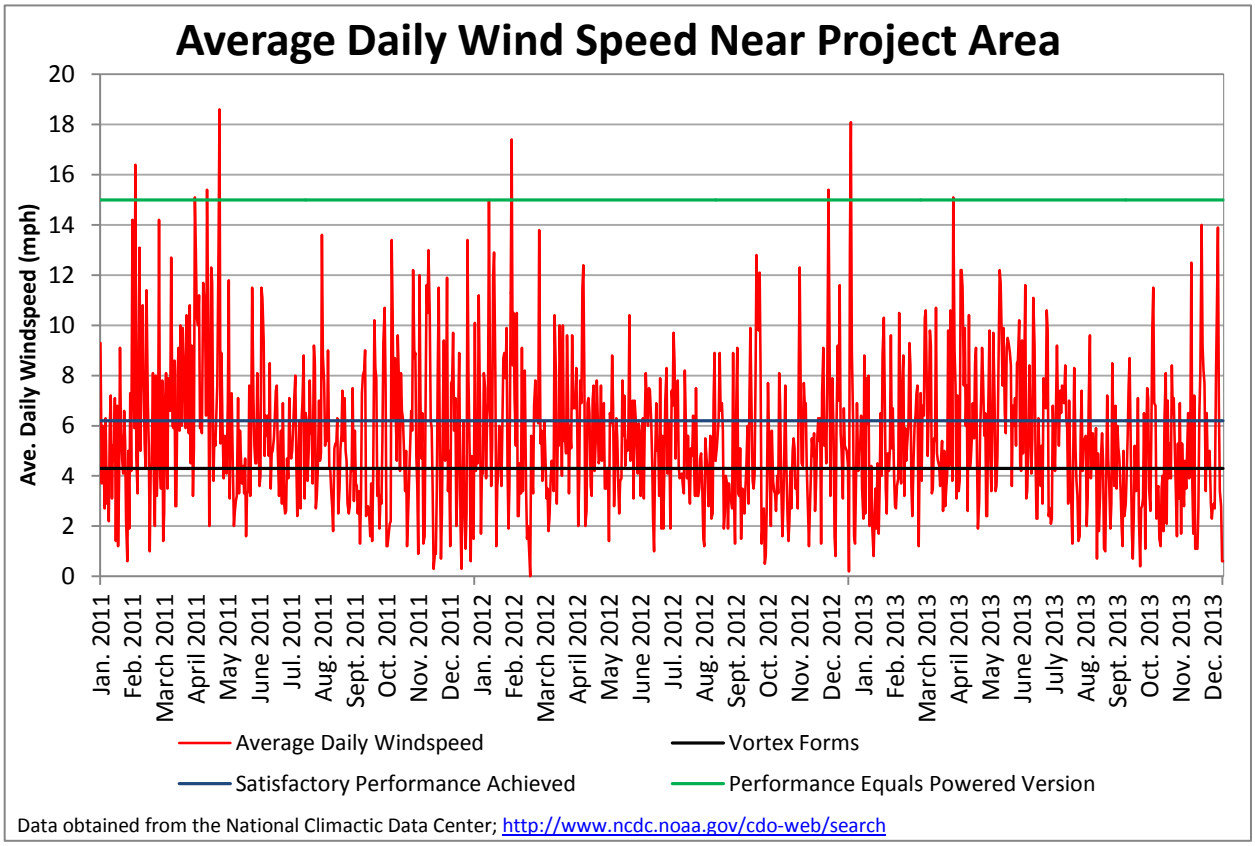
The circulator has a turbine at the top, which rotates when the wind is strong enough, and in turn drives an impeller which creates a vortex in the water column. According to company literature, the circulator impeller would begin to turn in a breeze or gust of 1.9 miles per hour (mph). A vortex begins to form with approximately 4.3 mph wind speeds. When wind speeds reach approximately 15 mph, the Ventgo would operate comparably to a solar or AC-powered unit, mixing a water surface area up to 17.2 acres. In order to achieve satisfactory performance wind speed would need to average at least 6.2 mph annually.

Figure 7 - Example of Wind Powered In-Lake Long-Distance Circulator

The closest National Climactic Data Center (NCDC) station to the project areas with historic wind speed data is Raleigh-Durham International Airport (RDU). Historical average daily wind speed data from January 1, 2011 through December 31, 2013 at RDU was obtained from the NCDC (Figure 8). This station is approximately 11.5 miles west-northwest of the Morgan Creek project area. The obtained dataset contains 1,096 observations. Data indicate that there were 1,019 days (93 percent) where the average wind speed was at least 1.9 mph, which would allow the turbine to begin to rotate. There were 692 days (63.1 percent) during which the average wind speed was 4.3 mph and a vortex may be expected to form. In order to perform as efficiently as a solar or AC-powered unit, wind would have to be at least 15 mph, of which there were nine days; less than 1 percent of the record. The average wind speed during this time was 5.6 mph, which is just below the 6.2 mph required for satisfactory operation.

An advantage of this wind powered circulator is that they, like solar powered models, are self-contained and do not require a shore-based power source. This also means that no power lines would need to be installed on the lake bottom, and no easement would be required. However, since the circulators require wind to turn the impeller, the project area would require sufficient wind speeds of long enough duration to effectively power the units. Based on nearby wind speed, there would most likely be sufficient wind speed to produce a circulating vortex on most days; however, average wind speeds in the project areas would not allow for satisfactory circulation results as compared to solar or AC-powered units. For these reasons, this alternative will not be considered a viable alternative and will not be retained for comparison in Section 5 (Environmental Consequences) of this EA.

Figure 8 - Average Daily Wind Speed near Project Area



Data obtained from the National Climactic Data Center; http://www.ncdc.noaa.gov/cdo-web/search

4.0 Proposed Action - Demonstration of Solar Powered In-Lake Long-Distance Circulators

After considering solar powered, AC powered, and wind driven in-lake long-distance circulators from various manufacturers, the State has selected solar powered in-lake long-distance circulators as the preferred alternative to be implemented for the proposed demonstration project. The use of solar powered circulators would not only supplement the existing TMDL and other programs currently in place, but would also have fewer impacts to the environment than AC powered versions and would perform better than wind powered circulators. Therefore, the NCDENR may enter into a contract with a third party that can deploy floating arrays of solar powered, in-lake, long-distance circulators to reduce or prevent the adverse impacts of excessive nutrient loads, such as algal blooms, taste and odor problems in drinking water, and low levels of dissolved oxygen in Jordan Lake.

Three manufacturers of solar powered in-lake long-distance circulators were investigated as previously described in Section 3.0, Alternatives Considered. After considering various aspects of each manufacturer's product and associated environmental impacts, the State has chosen the Solarbee SB10000 v18 model for use in this demonstration project. At nearly 10 feet high, the Sungo models

negatively impact aesthetic resources to a degree greater than do LumenAER and Solarbee models, which rise about two feet above the water surface. The Solarbee unit is capable of circulating more water than Sungo and LumenAER models (Table 1), requiring fewer circulators to meet the goals of the proposed project. The deployment of fewer circulators would reduce the overall cost of the project because there would be fewer units to lease or purchase, install, and maintain. Fewer circulators in the project areas would also reduce the demonstration project's visual and recreational impacts. For these reasons the State would prefer to deploy Solarbee models for the purposes of the proposed demonstration project.

The State of North Carolina is proposing a demonstration project which includes the installation of 36 solar powered in-lake long-distance circulators in portions of Jordan Lake (Figure 9). These circulators are capable of a direct flow rate of up to 3,000 gallons per minute (GPM) (401 ft^3 per minute) with an induced flow rate of 10,000 GPM (1,337 ft^3 per minute). The effects of this circulation could potentially reach as far out as 700 feet from the circulator. The circulators are expected to address the effects of excessive nutrient levels in the project area by suppressing phytoplankton activity such that chlorophyll *a*, pH, and turbidity samples collected within the project areas would meet State water quality standards using the current methodology to determine impairment, which is less than ten percent exceedance with at least 90 percent confidence for all parameters of concern.

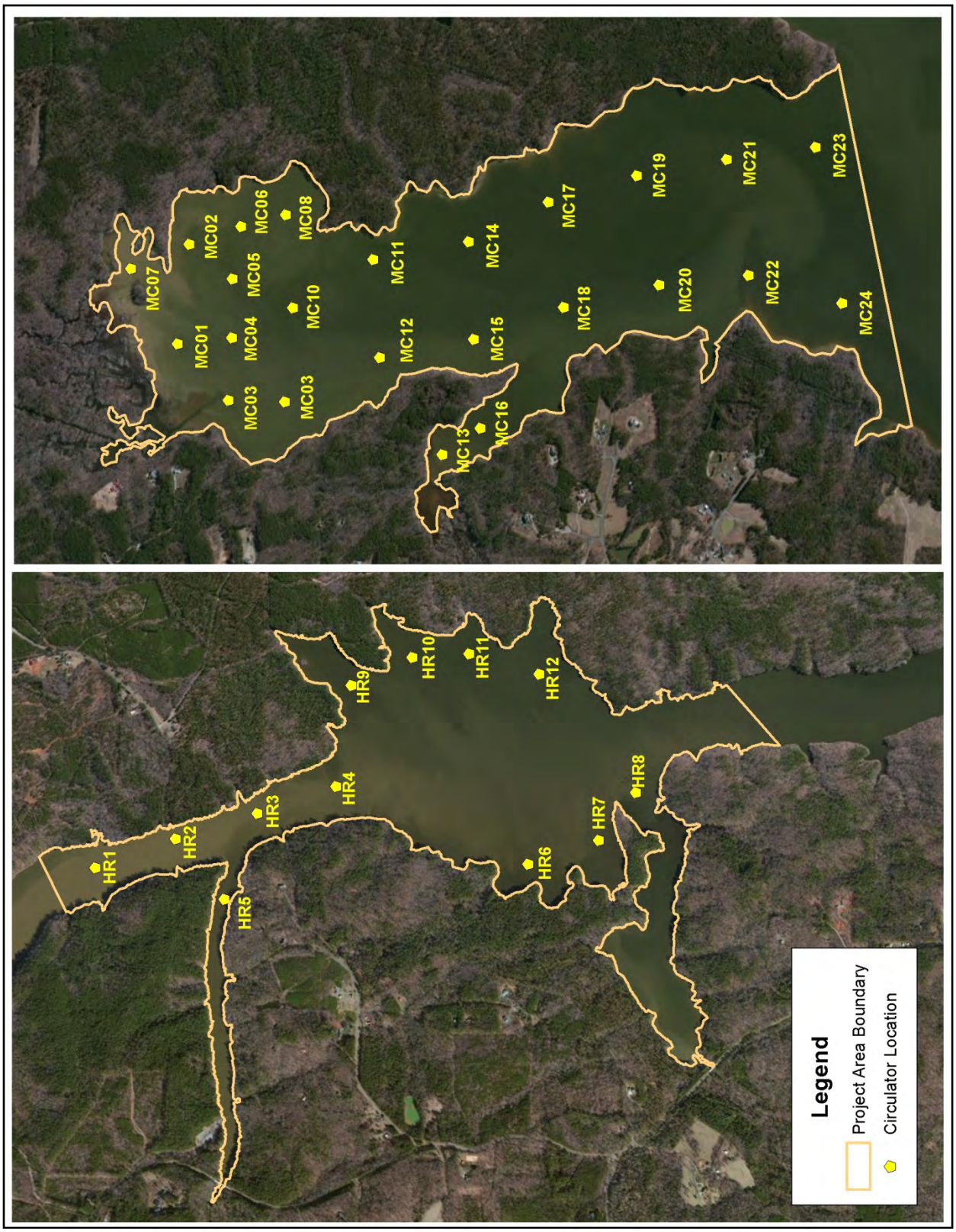
In order to meet the objectives of the demonstration project, a total of 24 circulators would be placed in the Morgan Creek Arm. Circulators placed in the northern portion of the Morgan Creek Arm would need to operate in shallow water. The deepest part of the Morgan Creek project area is near the mouth, where the depth is approximately 10-12 feet and becomes progressively shallower moving upstream, with no apparent channels (Triangle J Council of Governments, 2013). The Haw River Arm is deeper, and does have a more defined channel. The deepest parts are near the mouth where depths are about 45 feet deep and are about 35 feet deep in the upper part of the project area.

The upper (northern) part of Morgan Creek is shallow and may dry up under extreme drought conditions. As a result, circulators placed in the upper parts of Morgan Creek Arm would be configured to operate in shallow water and not suffer failure if operated out of water. Circulators can operate in as little as three feet of water, and would completely stop circulating water at approximately two-foot depth.

Because the motors are sealed, even if they continue to operate with no water passing through, they would not be damaged.

All circulators would be secured to a tether line attached to an appropriate anchor using one of two methods. Using the standard method, circulators would be anchored using two 70 pound anchors (Figure 10). The circulator would be allowed to float free on a tether line that is five-to-seven times the depth, allowing the most flexibility of movement for the circulator. Actual tether lengths would not be known until final installation as they are based on the depth at the actual individual installation sites, although it may be possible to shorten the tether lengths on circulators in the middle Haw River Arm where the water is deeper.

Figure 9 - Location of Circulators in the Morgan Creek and Haw River Arms of Jordan Lake



In deeper waters, circulator anchoring could consist of several anchors attached to a single cable with a float at the surface. The circulator is attached to the anchor line swivel at the buoy with several feet of tether cord, allowing minimal movement of the circulator around the buoy. This method, illustrated in Figure 11, would be used on Roberson Creek in the Haw River Arm. This method would help eliminate much of the swing associated with the standard method and may therefore help reduce safety concerns relating to boating navigation hazards. However, anchor retrieval at the end of the demonstration project could be extremely difficult with this method as the weight of several anchors together could allow the anchors to settle into the lake bottom. Figures 12 and 13 show estimates of the swing diameter for each unit based on the anticipated anchoring method. This information is based on bathymetry made available through the Triangle J Council of Governments with five-foot contours at a mean lake elevation at 216 feet above mean sea level which is the normal operating level. To be conservative, the measurements shown reflect the diameter of the swing of the circulator based on 1:7 depth to tether length ratio and is expected to be the maximum necessary.

The units would need to be periodically inspected by boat for proper placement (to ensure they have not moved), operation, and maintenance. It is anticipated that the units would be inspected at least once a week by NCDWR personnel as well as after significant weather and lake fluctuation events. Any adjustment necessary to ensure proper function of the units would be performed. Since boaters are the most likely members of the public to come in contact with the circulators, signs explaining the project and information about the circulators would be posted at boat ramps and would meet specification outlined in the USACE sign manual. A telephone number to call for more information or to report any issues would be posted on the signs. The placement of these signs would need to be coordinated with the appropriate boat ramp management agency or concessionaire.

Figure 10 - Typical Circulator Anchoring

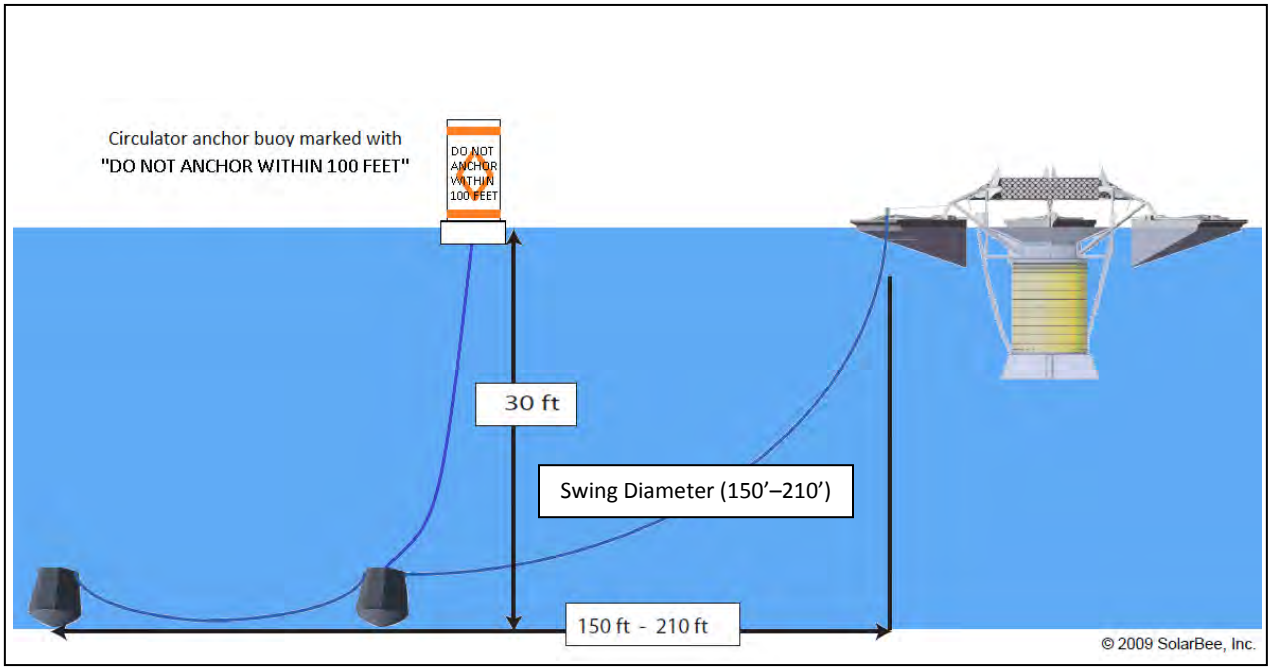
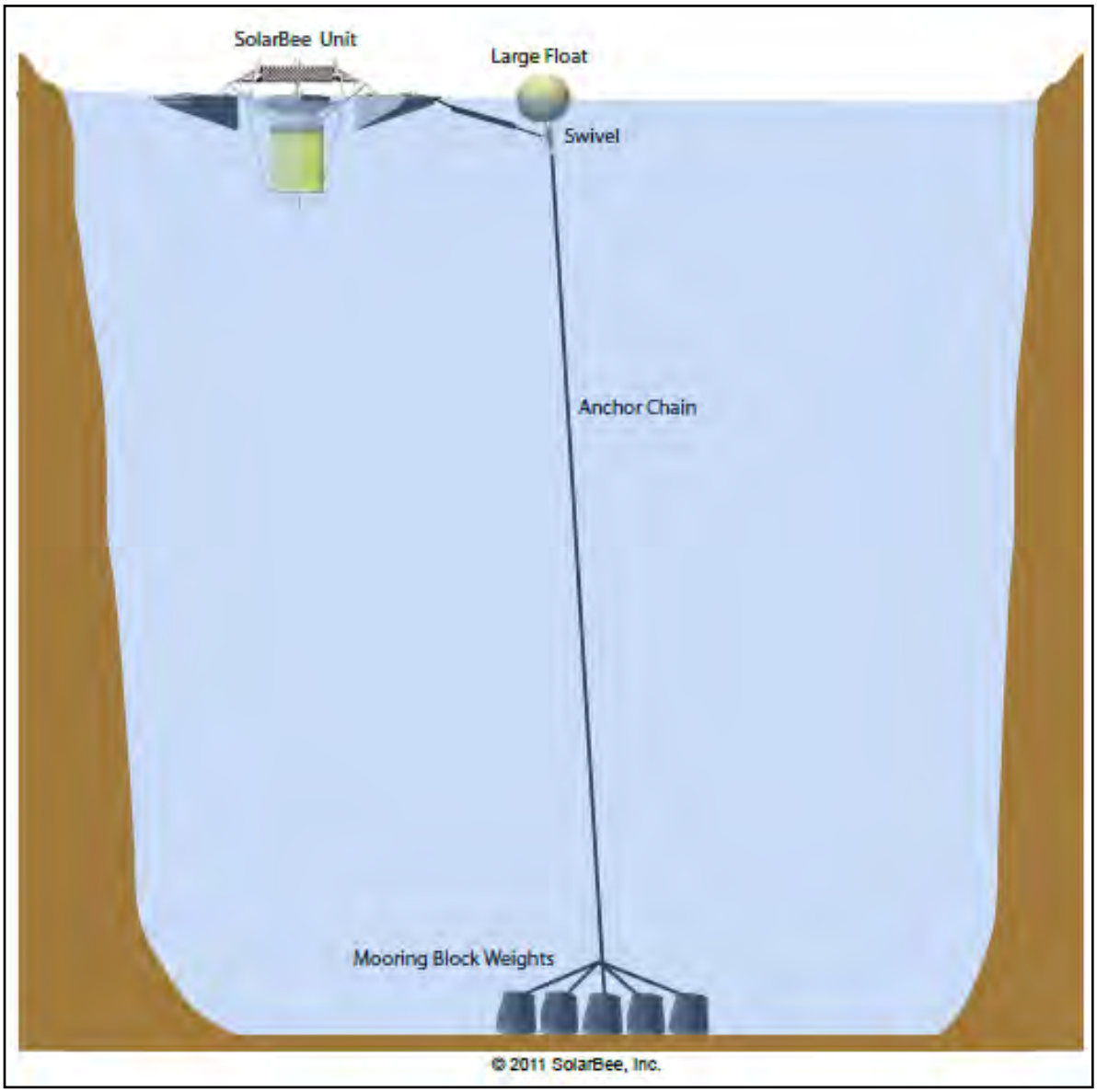


Figure 11 - Deep Water Circulator Anchoring



The units would need to be periodically inspected by boat for proper placement (to ensure they have not moved), operation, and maintenance. It is anticipated that the units would be inspected at least once a week by NCDWR personnel, as well as after significant weather events, and after major lake fluctuations. Any adjustment necessary to ensure proper function of the units would be performed. Since boaters are the most likely members of the public to come in contact with the circulators, signs explaining the project and information about the circulators would be posted at boat ramps and would meet specification outlined in the USACE sign manual. A telephone number to call for more information or to report any issues would be posted on the signs. The placement of these signs would need to be coordinated with the appropriate boat ramp management agency or concessionaire.

Figure 12 - Estimated Swing Diameters for Circulators in the Morgan Creek Arm

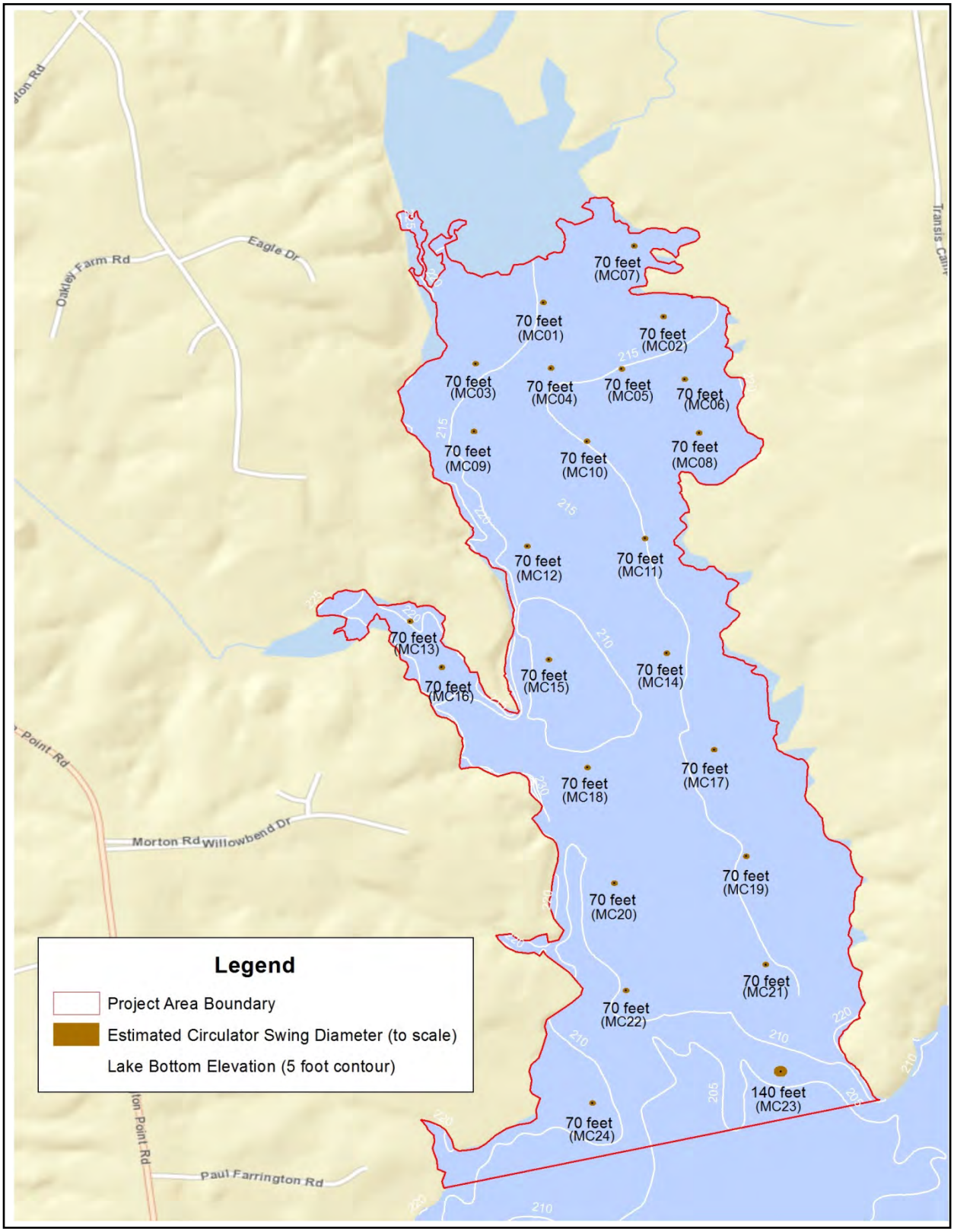


Figure 13 - Estimated Swing Diameters for Circulators in the Haw River Arm

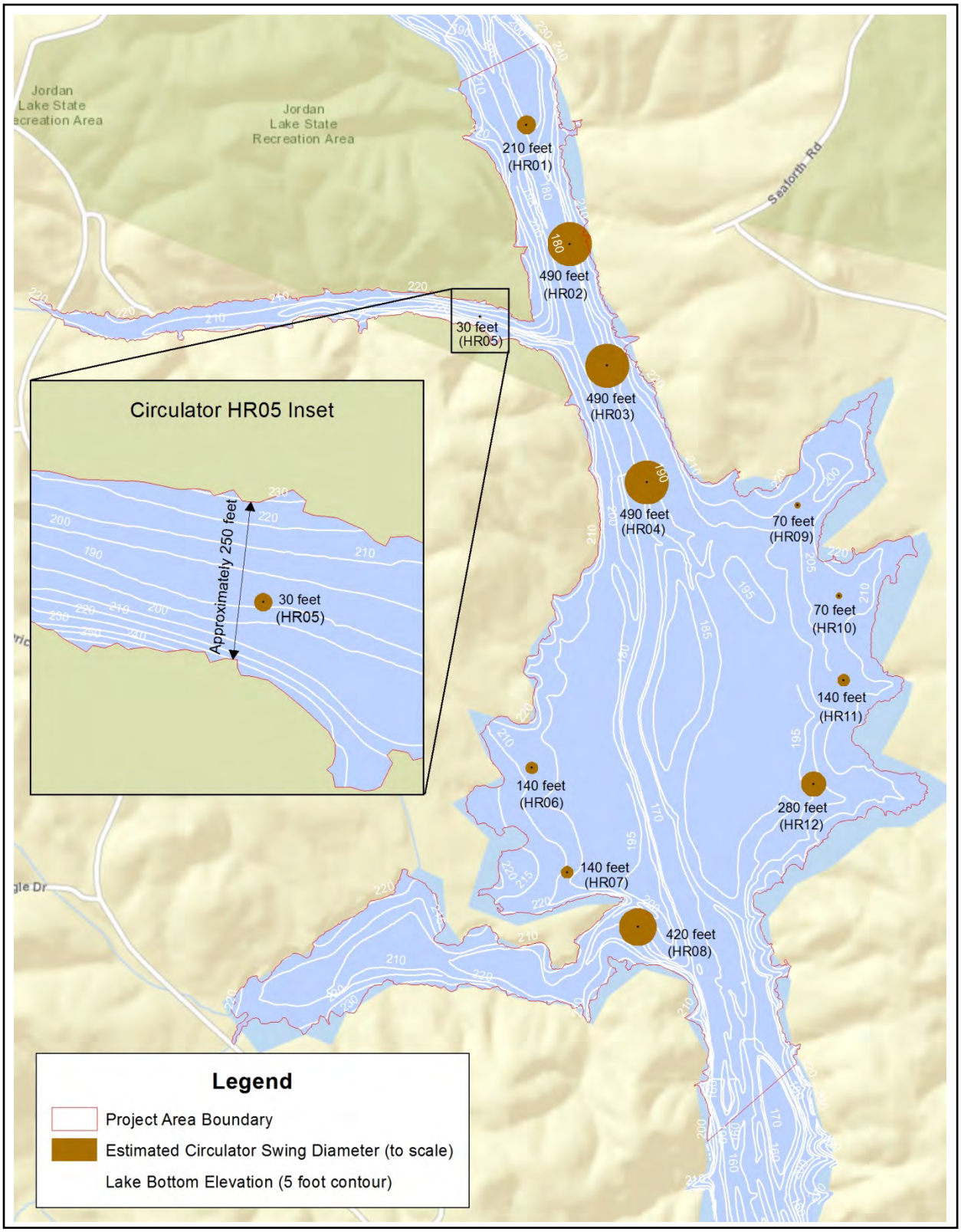


Figure 14 - Surface Area Potentially Affected by Circulation in the Morgan Creek Arm

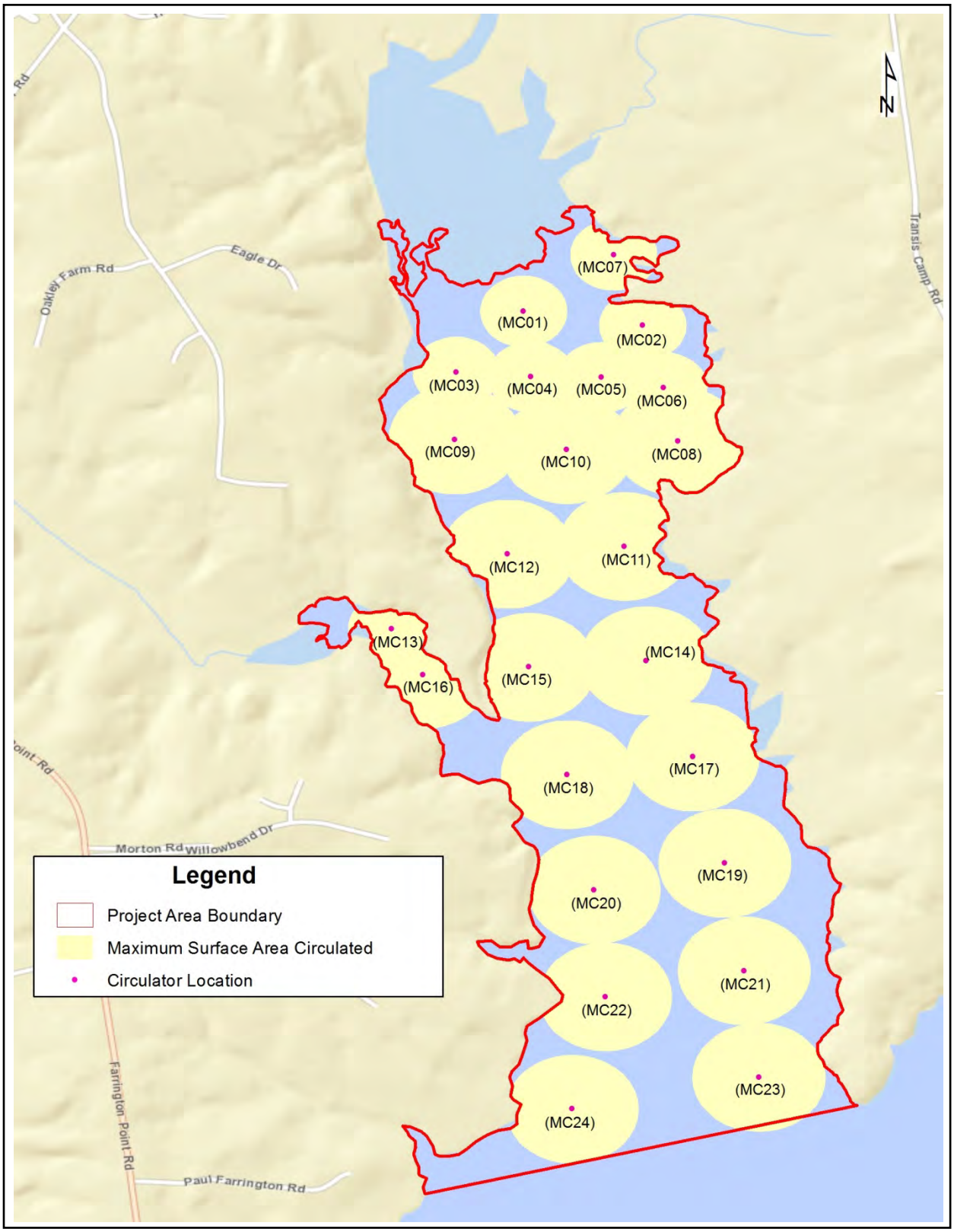
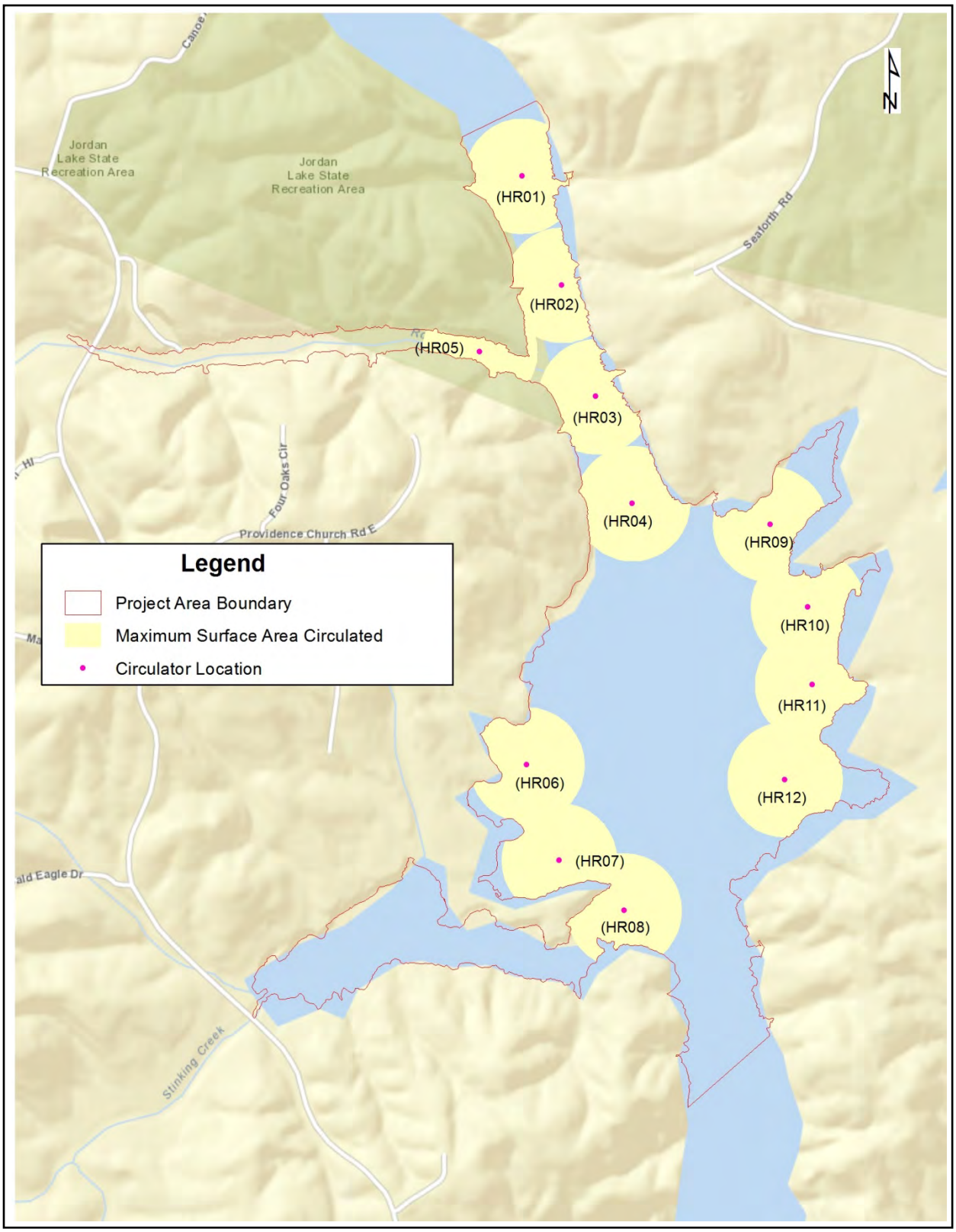


Figure 15 - Surface Area Potentially Affected by Circulation in the Haw River Arm



Circulators would be properly marked for navigation and safety purposes and would be required to meet applicable navigational marking requirements set forth in the NCWRC's *Navigation Aids and Regulatory Markers*, which apply to Jordan Lake. This would include a flashing strobe light on the top of the unit, orange reflective pylons on each float, and safety warning signs attached to the unit warning the public to stay a safe distance from the circulator. Figure 16 illustrates an operating circulator with referenced safety devices in place.

Figure 16 - Visibility and Safety Features of Operating Circulators

Photo courtesy of Medora Corporation

Circulators have an adjustable depth intake hose. This allows water to be drawn in from a desired depth. Solarbee models have an intake plate one-foot below the bottom of the intake hose which is illustrated hanging below the intake hose in Figure 28. This allows a column of water, one foot in height, to be drawn in at the desired depth. In deeper areas where a thermocline is present, the intake hose and intake plate would be set so that water just above the thermocline is drawn in and water below is not. This would establish a circulation pattern in the upper portion of the water column, above the thermocline. The thermocline itself would not be affected. In shallower areas where a thermocline is not present the unit would be set such that water near the bottom is drawn in but benthic sediment would not be disturbed.

One potential concern with upwelling water from depth is the potential for anoxic water to be brought to the surface potentially reducing dissolved oxygen at the surface. There is a possibility that anoxic conditions could be present, especially in deeper areas of Jordan Lake. However, as previously mentioned, the water would be drawn up from above the thermocline, where dissolved oxygen levels are relatively higher than those below the thermocline. Therefore, it is not likely that anoxic water would be brought to the surface from deeper areas, as this water is typically present below the thermocline. There is a possibility that hypoxic or anoxic conditions may periodically exist; however, any decrease in dissolved oxygen levels at the surface are expected to be relatively short lived, lasting no more than a few days.

There would be a transition zone between the project areas that are circulated and nearby waters in Jordan Lake. Areas beyond the demonstration project's influence would remain unchanged. Based on the resident time and quantity of water which moves through the Haw River Arm, the transition zone would expect to be larger than that of the Morgan Creek Arm where less water flows through the system and the residence time is much longer. Larger rain events or strong winds blowing from the north or northwest could also create a larger temporary transition zone.

While circulators are designed to continuously operate for many years, it is possible that a unit could malfunction. Were this to happen, the water in the immediate vicinity of the malfunctioning unit would gradually return to without-project conditions until such time repairs are made. It is unknown how long it would take for pre-circulation conditions to fully return, as this would depend on variable physical and biological factors. If the units are regularly inspected and maintained as necessary, then the incidence and duration of mechanical failure should be reduced, preventing the return of pre-circulation conditions. By minimizing time spent repairing equipment, benefits of the circulated water would remain.

The Morgan Creek Arm circulators could be deployed from the boat ramp at Farrington Point; the Haw River Arm circulators could be deployed from the Robeson Creek boat ramp (Figure 31). A small, temporary staging area would likely be needed to assemble and prepare the circulators. The location of this staging area is currently unknown. No long term or short term storage is anticipated and the boat ramps would remain open to the public during deployment. Once circulators are placed in the water, they would be towed to the individual deployment sites by boat.

5.0 Environmental Effects

5.1 Physical Environment

5.1.1 Topography

The Morgan Creek Arm study area is located on the Farrington and Green Level United States Geologic Survey (USGS) topographic quadrangle maps; the Haw River Arm study area is located on the Merry Oaks USGS topographic quadrangle maps. Both study areas are located within the Piedmont physiographic region of North Carolina. Elevations within the Morgan Creek Arm range from 214 to 302 feet above mean sea level. The Haw River Arm exhibits much more relief than the Morgan Creek Arm. Elevations in the Haw River Arm range from 218 to 446 feet above mean sea level (NRCS, 2006). Figures 17 and 18 show the project areas overlain on USGS topographic quadrangle maps.

There would be no grading or excavation associated with the proposed action in either study area, so the topography would not be changed or affected in any way with this alternative. The circulation units would be deployed from existing boat ramps and towed to the deployment site.

Neither the proposed action nor the no action alternative would affect or change topography.

Figure 17 - Topographic Map of the Morgan Creek Arm of Jordan Lake

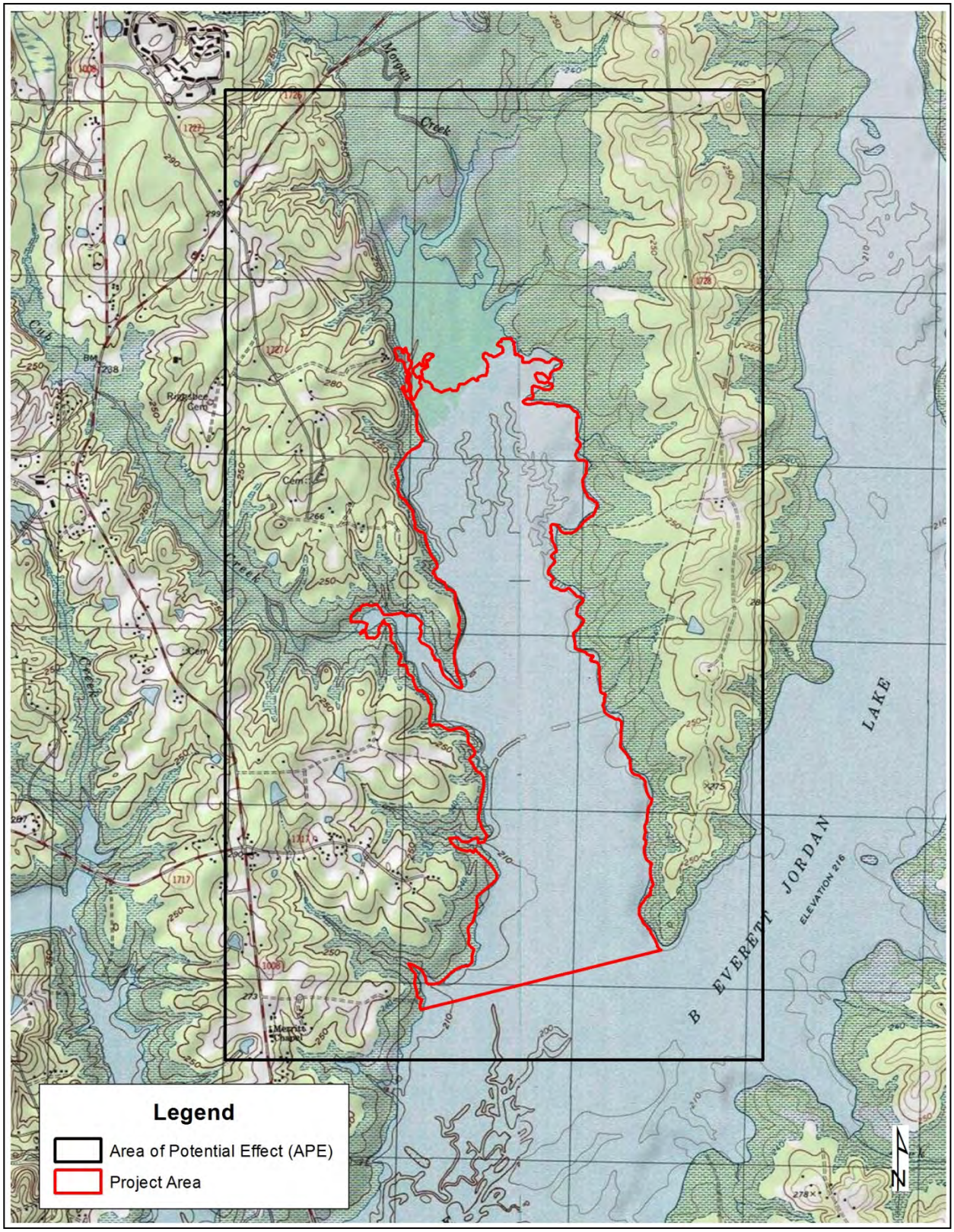
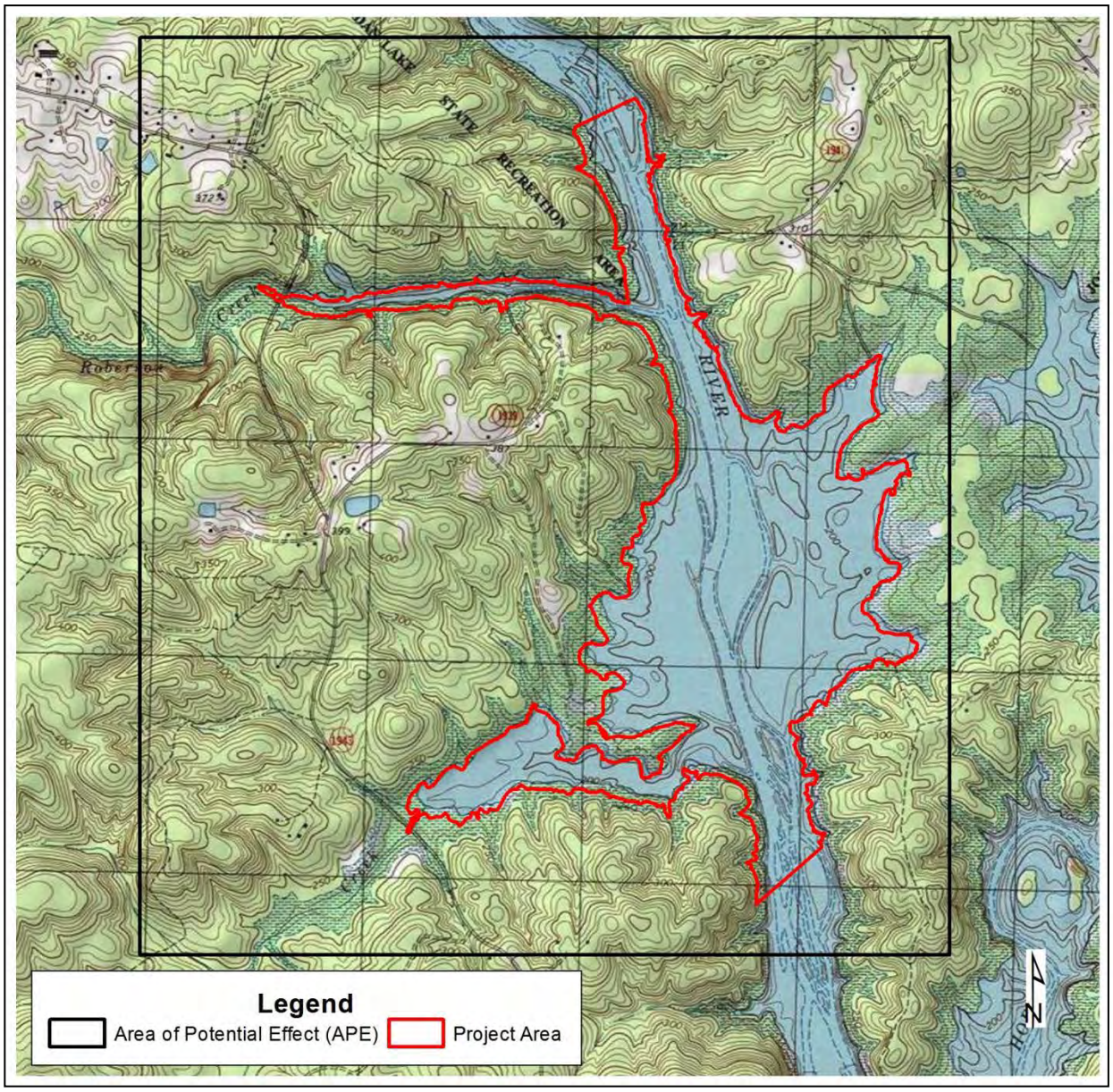


Figure 18 - Topographic Map of the Haw River Arm of Jordan Lake



5.1.2 Geology

The Morgan Creek Arm is located within the Triassic basin. The southeast half of the Haw River Arm is located primarily in the Triassic basin; with the northwestern half located in the Carolina Slate Belt. This part of the Triassic basin is part of the Deep River basin and these project areas are completely located within the Durham Sub-basin of the Deep River basin. The Deep River basin was formed by early Mesozoic rifting of the supercontinent Pangea. This rifting created a series of irregularly-shaped half-grabens along the Atlantic coast, of which the Deep River basin is the southern- most. During formation the basin filled with a variety of clastic sediments. Sediment deposits in the Deep River basin consist of conglomerate, sandstone, siltstone, clay-stone, shale, coal, and smaller amounts of limestone and chert (Clark, 2001).

The Carolina Slate Belt origins are volcanic eruptions and sedimentation during the Triassic-Jurassic period. The low-grade metamorphism gives many rocks a slaty cleavage, hence the Slate Belt name. Areas in the belt contain various granites, quartz, and feldspar (Research Laboratories of Archeology, 2006). Rock within the Carolina Slate Belt is categorized as Felsic Metavolcanic, dating to the Cambrian/Late Proterozoic era (USGS).

Neither the proposed action nor the no action alternative would affect or change the geology.

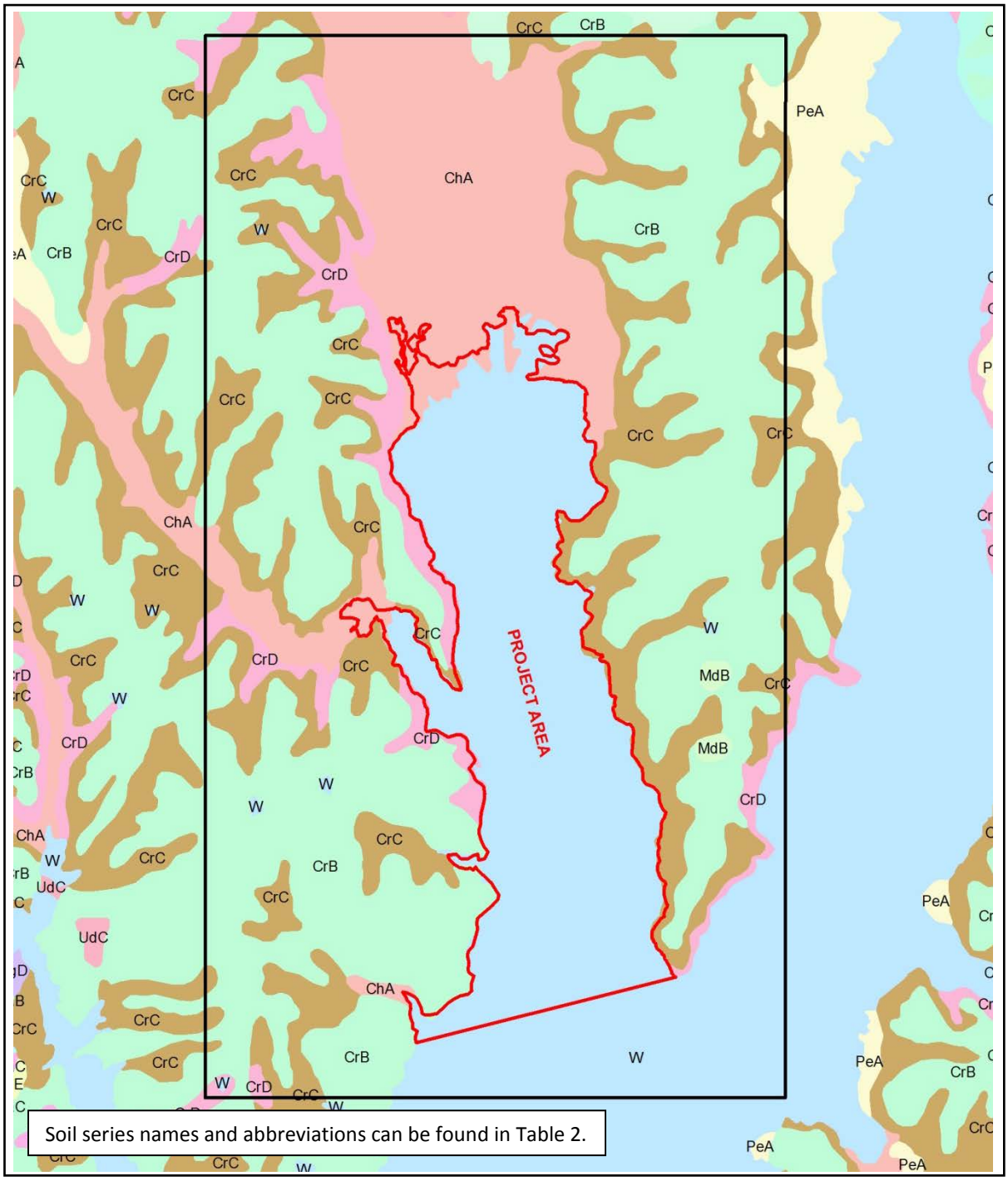
5.1.3 Soils

The project areas contain many different soil series (Figures 19 and 20; Table 2). There are several more soil series located in the Haw River Arm than in the Morgan Creek Arm.

Table 2 - NRCS Soils in the Morgan Creek Arm and Haw River Arm APEs

MORGAN CREEK ARM OF JORDAN LAKE			
Soil Symbol	**Soil Series Name**	**Acres**	**Percent of APE**
W	Water	1,812.61	36.70%
CrB	Creedmore - Green Level complex	1,590.10	32.20%
CrC	Creedmore - Green Level complex	723.66	14.65%
ChA	Chewacla and Wehadkee soils	589.84	11.94%
CrD	Creedmore - Green Level complex	187.73	3.80%
PeA	Peawick fine sandy loam	14.18	0.29%
MdB	Mayodan fine sandy loam	10.95	0.22%
WhB	White Store - Polkton complex	9.30	0.19%
	TOTAL:	4,938.36	100.00%
HAW RIVER ARM OF JORDAN LAKE			
Soil Symbol	**Soil Series Name**	**Acres**	**Percent of APE**
W	Water	1,813.43	36.63%
GkD	Georgeville- Badin complex	592.48	11.97%
NaC	Nanford - Badin complex	450.29	9.09%
BaE	Badin - Nanford complex	398.51	8.05%
GkE	Georgeville- Badin complex	324.9	6.56%
GaC	Georgeville silt loam	265.12	5.35%
NaD	Nanford - Badin complex	174.83	3.53%
MgD	Mayodan gravelly sandy loam	168.49	3.40%
GeC2	Georgeville silty clay loam	131.38	2.65%
GoE	Goldston - Badin complex	120.42	2.43%
GaB	Georgeville silt loam	104.39	2.11%
WhB	White Store - Polkton complex	90.55	1.83%
MdC	Mayodan fine sandy loam	62.83	1.27%
MhE	Mayodan - Brickhaven complex	62.33	1.26%
CcC	Carbonton - Brickhaven complex	61.64	1.24%
WhC	White Store - Polkton complex	32.1	0.65%
ChA	Chewakla and Wehadkee soils	27.65	0.56%
PsB	Pittsboro - Iredell complex	21.25	0.43%
CrB	Creedmore - Greenlevel complex	13.45	0.27%
RvA	Riverview silt loam	12.09	0.24%
NaB	Nanford - Badin complex	8.31	0.17%
CcD	Carbonton - Brickhaven complex	7.42	0.15%
PcA	Peawick fine sandy loam	7.19	0.15%
	TOTAL:	4,951.02	100.00%

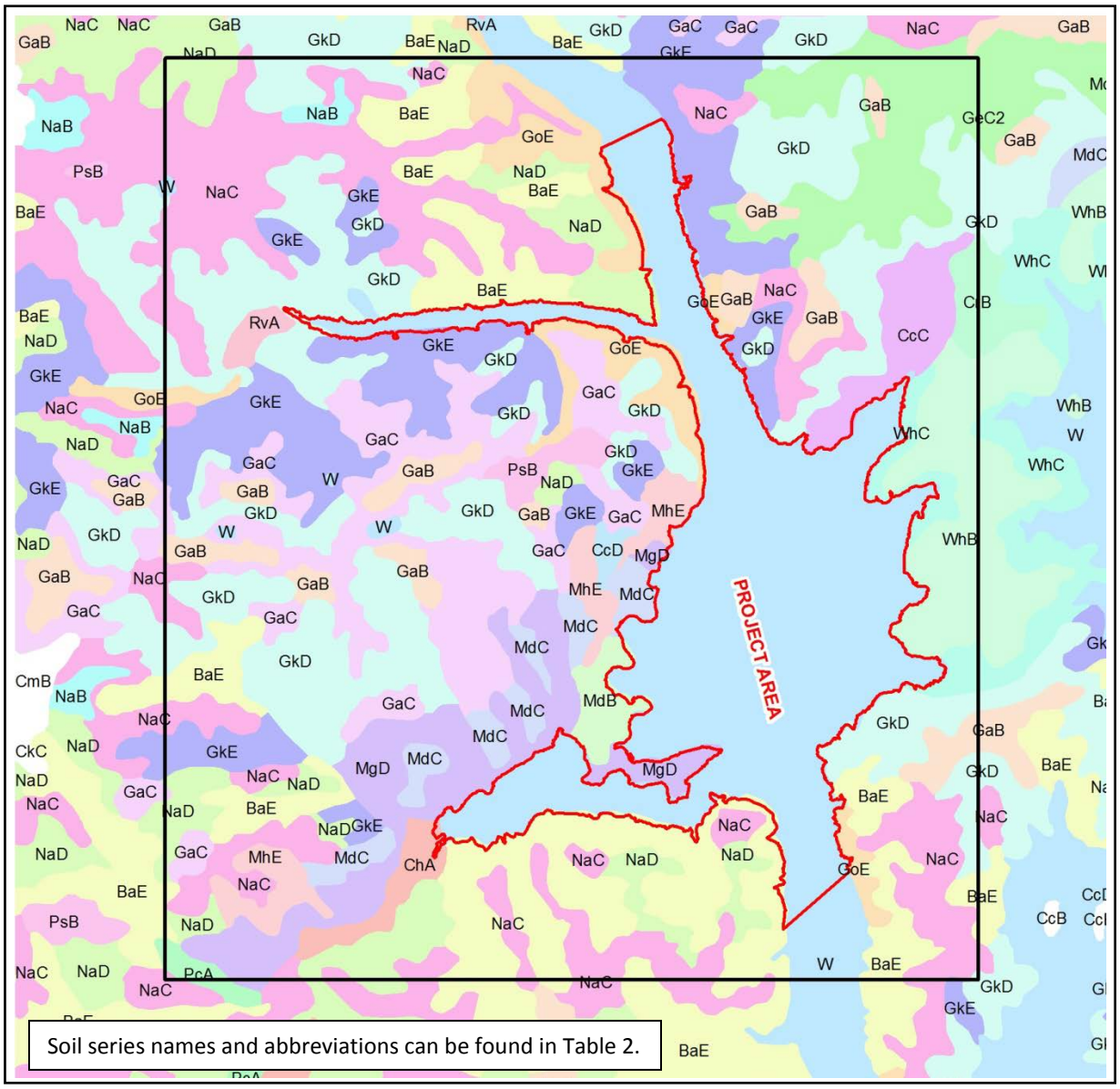
Figure 19 - Soil Series Present in the Morgan Creek Arm APE



Soils in the Morgan Creek Arm APE are predominately Creedmore – Green Level and Chewacla and Wehadkee. Creedmoore-Green Level soils are typified as somewhat poorly drained or moderately well drained, and can have low permeability. They tend to be located on gently sloping to moderately sloping terrain. Major uses are woodland, public recreation facilities, cropland, pasture and hay, and urban development (NRCS, 2006). Chewacla and Wehadkee soils are poorly drained or somewhat poorly

drained with a loamy surface and subsoil. They are located in nearly level areas and floodplains. Because they are located in floodplains and therefore subject to frequent flooding and inundation the major use is cropland (NRCS, 2006).

Figure 20 - Soils Series Present in the Haw River APE



Predominate soils in the Haw River Arm are Georgeville, Nanford, Badin, and Mayodan. These soils are typically found on gentle to steep slopes. They are a well-drained series with a silt loam or silty clay loam surface and clayey subsoil and are associated with upland areas. Major uses of these soils include woodlands, pasture and hay, cropland and urban development (NRCS, 2006).

Neither the proposed action nor the no action alternative would affect or change the soils.

5.1.4 Floodplains

Both the Morgan Creek and Haw River Arm project areas are located within the Federal Emergency Management Agency (FEMA) designated 100 year floodplain. This means that there is a one percent chance that the designated area would flood in any given year. Flood prone areas within the 100 year floodplain in the APE (Figure 21) are further designated as Zone AE (formerly A1 –30). Zone AE describes areas subject to flooding or inundation by the 1 percent chance flood event as determined by a traditional detailed survey (FEMA, FEMA, Zone AE and A1-30). Structures in this Zone are typically required to be covered under a flood insurance policy.

In the Haw River Arm, a portion of the Robeson Creek Arm is designated as a regulatory floodway. This means that property on the adjacent floodplain must be regulated by the municipality to ensure that there are no increases in upstream flood elevations (FEMA, Floodway). A small area of the Haw River Arm abutting this floodway is designated as being in the 0.2 percent floodplain, meaning these areas have a 0.2 percent chance of flooding in any given year. Other areas in the project areas are classified as Zone X. At a higher elevation than those areas in the 0.2 percent floodplain, these areas have a minimal chance of flooding and are located outside of the Special Hazard Flood Area. A summary of flood zone types within each of the two project areas is presented in Table 3.

All of the Morgan Creek Arm project area is Zone AE. Of the 650 acres in the Haw River Arm project area, 29.83 acres are in the Floodway Zone, 0.001 acres are in the 0.2 Percent Annual Flood Zone and the rest of the project area is Zone AE.

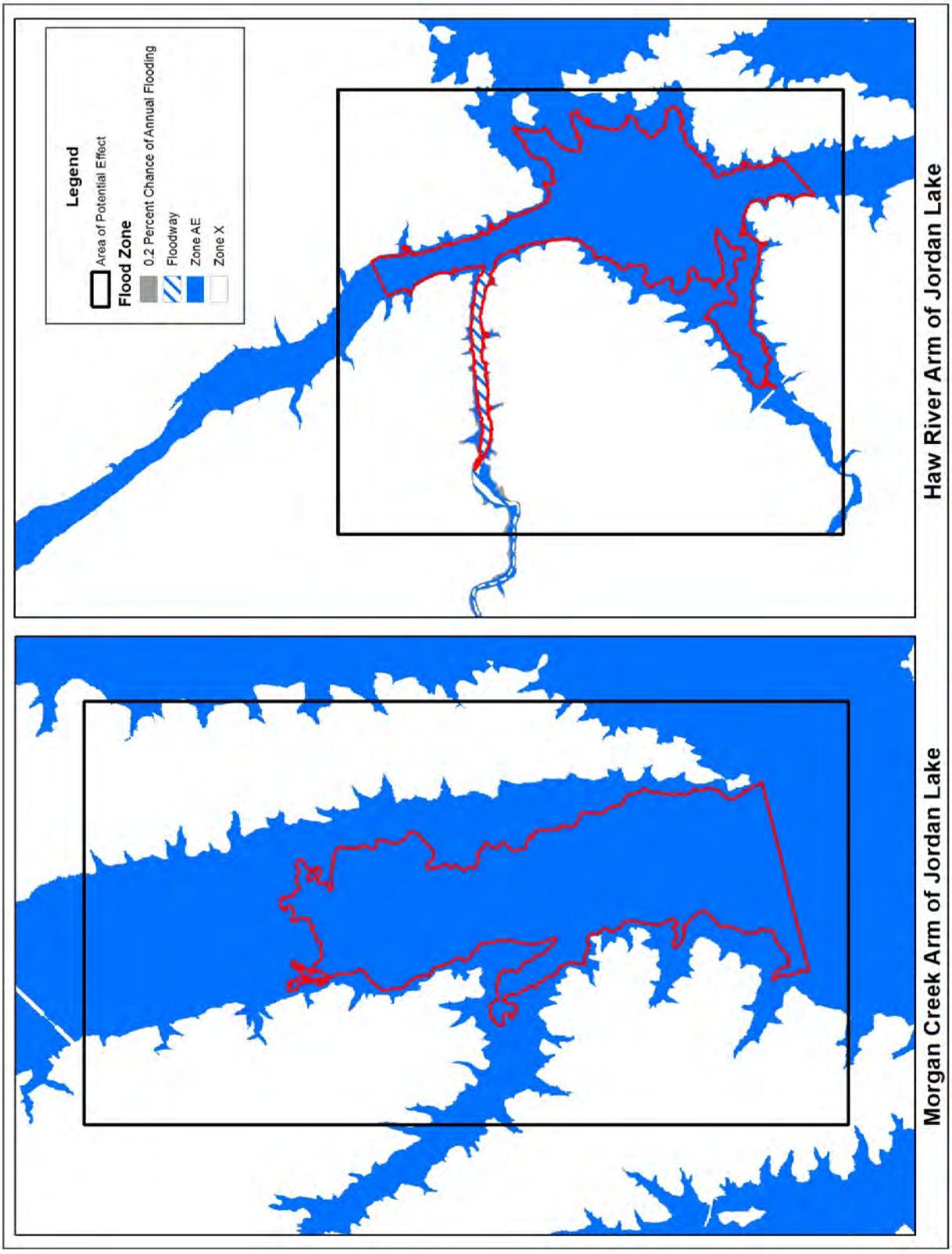
Table 3 - Summary of FEMA Designated Areas in the APEs

Project Study Area	Floodzone Type			
	AE (acres)	**Floodway** (acres)	**0.2 Percent** (acres)	**X** (acres)
Morgan Creek Arm	2,242.65	0.00	0.00	1,975.35
Haw River Arm	2,856.40	42.77	3.68	990.15

The proposed action would have no noticeable effect on the FEMA 100 year floodplain. The displacement of water the Morgan Creek Arm and Haw River Arm would be negligible and immeasurable. Additionally, the circulators would not impede the flow of water through the project area or within Jordan Lake and therefore would not adversely affect the existing designated flood zones or the regulated floodway.

Neither the proposed action nor the no action alternative would affect or change floodplains.

Figure 21 - Flood Zones in the Morgan Creek and Haw River APEs



5.1.5 Surface Hydrology

Jordan Lake is part of the Cape Fear River Basin, which is the largest watershed in North Carolina, and is entirely located within the State. The watershed drains an area of 9,322 square miles, originating in the north central part of the piedmont near Greensboro and flowing southeast to the Atlantic Ocean. The Cape Fear River originates at the confluence of the Haw and Deep Rivers near the borders of Chatham and Lee Counties (NCDENR, 2002), approximately 4.2 river miles downstream of the Jordan Lake Reservoir Dam. The Cape Fear River watershed is in Hydrologic Unit Code (HUC) 03030004.

Jordan Lake Reservoir is created by the B. Everett Jordan Dam, which is located near the lake's southern extent. The Dam is located about 25 miles southwest of Raleigh and about 202 river miles upstream of the Cape Fear's confluence with the Atlantic Ocean. The top of the conservation pool is at elevation 216 feet above mean sea level. At that elevation, the reservoir has a storage volume of 215,130 acre-feet and a shoreline of 200 miles (USACE).

The Morgan Creek Arm of Jordan Lake receives water from the Morgan Creek watershed. The watershed generally drains to the southeast and has a drainage area of approximately 59.6 square miles and is part of HUC 030300020607. The Haw River Arm primarily receives water from the Haw River along with several tributaries, and supplies 70-90 percent of water entering Jordan Lake. The Haw River watershed is approximately 1,349 square miles. The Haw River Arm Project area is in HUC 030300020704. The proposed demonstration project would not have any effect on surface hydrology.

Neither the proposed action nor the no action alternative would affect or change surface hydrology.

5.1.6 Water Quality

Both the Morgan Creek and Haw River Arms exhibit signs of poor water quality and impairments related to excessive nitrogen and phosphorous (nutrients) loading from both point and non-point sources. Point sources as a whole contribute an average of 1.5 million pounds of nitrogen and 140 thousand pounds of phosphorus to the reservoir each year. Nonpoint sources contribute an average of 2.5 million pounds of nitrogen and 350 thousand pounds of phosphorus per year (NCDENR, 2007). Heavy nutrient loading has led to increased chlorophyll *a* concentrations, increased turbidity levels, and high pH.

The State does not have water quality standards for nitrogen or phosphorous concentrations. However, the State does have a standard for chlorophyll *a,* which is 40µg/L and is currently used as a surrogate for nitrogen and phosphorous. Algae, which contain chlorophyll *a,* require nitrogen and phosphorous for growth. When concentrations of nitrogen and/or phosphorous are high enough algae can grow at accelerated rates, creating algal blooms. Algal blooms can discolor the water, lower dissolved oxygen levels, increase pH, and limit light availability within the water column. These conditions can adversely affect aquatic life and recreational opportunities, and increase costs associated with water treatment.

The Morgan Creek Arm project area has not met state water quality standards for chlorophyll *a* since at least the 2004 303(d) assessment. The Haw River Arm has not met State water quality standards for chlorophyll *a* since at least the 2006 303(d) assessment. In order to address water quality concerns the

USEPA requires a TMDL be developed for waters included on the 303(d) list. As can be seen in Table 4, the Morgan Creek Arm project area is included in assessment unit (AU) 16-41-2-(9.5) (Morgan Creek [Lake Jordan]) and has been listed for chlorophyll *a* and biological integrity. Listed impairments were high pH and turbidity on the 2012 303(d) list. The Haw River Arm project area, AU 16-(37.5)a, has been listed for chlorophyll *a* in the past and is still listed for turbidity and high pH on the 2012 303(d) list. It should be noted that data in Table 4 only reflects parameters listed as Category 5 in the applicable 303(d) lists. Once a TMDL is developed, parameters included in the TMDL are moved to Category 4T, which are not reflected in the table.

Table 4 - History of 303(d) Listings in the Lake Jordan Watershed Management Area

Assessment Unit Number	Assessment Unit Name	Impairment	Classification	303(d) Listing Year (only includes Category 5)					
				2002	2004	2006	2008	2010	2012
NEW HOPE RIVER BASIN									
16-41-2-(9.5)	Morgan Creek (Jordan Lake)	Chlorophyll a	WS-IV; NSW,CA		✓	✓			
16-41-2-(9.5)	Morgan Creek (Jordan Lake)	Biol. Integrity	WS-IV; NSW,CA		✓				
16-41-2-(9.5)	Morgan Creek (Jordan Lake)	High pH	WS-IV; NSW,CA					✓	✓
16-41-2-(9.5)	Morgan Creek (Jordan Lake)	Turbidity	WS-IV; NSW,CA				✓	✓	✓
16-41-1-(14)	New Hope Creek (Jordan Lake)	Chlorophyll a	WS-IV; NSW	✓	✓	✓			
16-41-1-(14)	New Hope Creek (Jordan Lake)	Turbidity	WS-IV; NSW				✓	✓	✓
16-41-(3.5)a	New Hope River Arm (Jordan Lake)	Chlorophyll a	WS-IV,B;NSW,CA			✓			
16-41-(0.5)	New Hope River Arm (Jordan Lake)	Chlorophyll a	WS-IV,B;NSW,CA	✓	✓	✓			
HAW RIVER BASIN									
16-(37.5)a	Haw River (Jordan Lake)	Chlorophyll a	WS-IV,B;NSW,CA			✓			
16-(37.5)a	Haw River (Jordan Lake)	High pH	WS-IV,B;NSW,CA			✓	✓	✓	✓
16-(37.5)a	Haw River (Jordan Lake)	Turbidity	WS-IV,B;NSW,CA					✓	✓
16-(37.5)b	Haw River (Jordan Lake)	Chlorophyll a	WS-IV,B;NSW,CA			✓			
16-(37.5)b	Haw River (Jordan Lake)	High pH	WS-IV,B;NSW,CA			✓	✓	✓	✓
16-(37.5)b	Haw River (Jordan Lake)	Turbidity	WS-IV,B;NSW,CA				✓	✓	✓
16-(37.3)	Haw River (Jordan Lake)	Chlorophyll a	WS-IV;NSW,CA			✓			
16-(37.3)	Haw River (Jordan Lake)	High pH	WS-IV;NSW,CA			✓	✓	✓	

Project study areas are located in Assessment Units in RED

As required by federal law, the *B. Everett Jordan Reservoir, North Carolina Phase I Total Maximum Daily Load* was developed and approved by the USEPA on September 20, 2007. The TMDL was developed to satisfy state Nutrient Sensitive Water (NSW) requirements and the federal requirement for a TMDL. The TMDL outlines nutrient load reductions required within the Upper New Hope Arm (including the Morgan Creek Arm), the Lower New Hope Arm, and the Haw River Arm. Necessary nutrient contribution reductions from point and nonpoint sources were established to meet state standards for chlorophyll *a* concentrations (NCDENR, 2007). The TMDL requires a 35 percent target reduction of total nitrogen in Upper New Hope Arm (including the Morgan Creek Arm) and an eight percent target reduction of total nitrogen in the Haw River Arm. Five percent target reductions of total phosphorous are required in both the Upper New Hope Arm and the Haw River Arm.

In addition to the TMDL, the Jordan Lake Nutrient Management Strategy (JLNMS) has been devised. There are several parts to the strategy, which include BMPs and restrictions for nitrogen and phosphorous inputs from new and existing development, agriculture, stormwater, wastewater, and a riparian buffer protection component. At least portions of all these components have been implemented, but most have not been fully implemented as of yet. The Jordan Lake Buffer Rules were fully implemented in 2009 by the adoption of Session Laws 2009-216 and 2009-484. These riparian buffer rules were established in part because the shoreline protection and water quality benefits provided by riparian buffers throughout the watershed are an important element of the overall Jordan Lake water supply nutrient input control strategy. Understanding the importance and significance of riparian buffers in nutrient control, the riparian buffer rules were established with the purpose of protecting and preserving the existing riparian buffers throughout the Jordan Lake watershed. In 2013, the portions of the JLNMS not yet fully implemented were delayed for three years (Session Law 2013-395) until 2016. However, it is anticipated that the riparian buffer rules would continue to remain in effect during the duration of the demonstration project and no new parts of the JLNMS would go into effect during this project due to the delay.

Due to partial implementation of the overall Jordan Lake nutrient management strategy rules, water quality in Jordan Lake has yet to meet State water quality standards as expected. As such, the State is exploring additional measures which may help improve and maintain water quality within Jordan Lake. This demonstration project is intended to assess the effects of circulating water within Jordan Lake as a possible measure to help ease the effects of elevated nutrients in Jordan Lake.

As discussed previously in Section 1.2, there are nine existing monitoring stations located in Jordan Lake (Figure 1). These nine stations have been monitored monthly from January – April and October – December, and twice a month from May – September (17 samples per year) since July 2009. One of the stations, CPF086C is located in the Morgan Creek Arm project area. Station CPF055C is located within the Haw River Arm study area. Station CPF055D is located just outside of the Haw River Arm project area to the southeast. Another station, CPF081A1C, is located within the Morgan Creek project area but is within the New Hope Creek Arm of Jordan Lake. Because this station is not representative of the Morgan Creek Arm, it is not included in discussions of water quality. A summary of chlorophyll *a*, turbidity, dissolved oxygen, and pH data for these three stations from 2009 through 2012 is presented in Table 5. This information was collected as mandated in Session Law 2009-216 §3.(c) to evaluate progress in reducing nutrient and nutrient related pollution in Jordan Lake.

Historical data collected at these three sites (CPF086C, CPF055C, & CPF055D) shows that chlorophyll *a* continues to be a concern (Table 5). The state standard for chlorophyll *a* (corrected) in freshwater is 40 µg/L. Data from the Morgan Creek Arm show that chlorophyll *a* readings are often above 40µg/L. The mean concentrations from 2009 to 2012 all exceeded 40µg/L. In order for the TMDL for Jordan Lake to be successful, no more than 10 percent of samples can exceed 40µg/L with 90% confidence. Exceedance rates between 2010 and 2012 were 59 to 76 percent. The turbidity standard is 25 NTU, which was exceeded many times. Dissolved oxygen levels above the state standard of 5.0 mg/L are frequently recorded in the Morgan Creek Arm as nearly all readings were above 5.0 mg/L. In freshwater systems,

the pH standard range is 6.0 – 9.0 SU. Although a portion of pH readings were greater than 9.0 SU, none were below 6.0 SU.

In the Haw River Arm at site CPF055C (in the project area), mean chlorophyll *a* concentrations were below 40µg/L except for 2009; but percent exceedance rates were all above 10 percent from 2009-2012. At site CPF055D (outside and downstream of the project area) all mean chlorophyll *a* concentrations were below 40µg/L and percent exceedance rates were much lower than at CPF055C. Mean turbidity readings for both sites were below 25 NTU. Nearly all dissolved oxygen readings for both sites were above 5.0 mg/L. There were exceedances of the pH standard at both sites, but the means were within the acceptable range.

Table 5 - Summary of Ongoing Assessment of Water Quality in Jordan Lake Data 2009-2012

Statistic	Chlorophyll *a* (µg/L)				Turbidity (NTU)				Dissolved Oxygen (mg/L)				pH (SU)			
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012
CPF086C - MORGAN CREEK ARM PROJECT AREA																
Mean	89	54	54	55	33	20	19	19	8.5	9.3	9.3	9.1	8.0	8.2	8.1	8.0
Min	20	22	12	35	16	9	6	9	4.1	6.2	7.3	5.5	7.2	7.1	7.0	7.1
Max	126	98	110	82	45	39	32	40	10.9	12.5	13.3	14.0	9.0	9.1	9.2	9.4
n	9	17	17	17	9	17	17	17	9	17	17	17	9	17	17	17
n > Standard*	7	10	11	13	8	5	4	2		0	0	0	3	1	2	2
% Exceedance**		59	65	76		29	24	12		0	0	0		6	12	12
CPF055C - HAW RIVER ARM PROJECT AREA																
Mean	42	29	31	29	17	16	10	10	7.3	9.3	9.7	9.3	7.6	8.0	8.1	7.8
Min	4.0	2.7	4.6	13.0	5.7	4.8	4.3	4.7	5.5	7.5	7.4	6.8	7.3	6.9	7.1	6.6
Max	82	54	57	53	75	85	31	55	9.7	13.0	13.6	12.0	8.4	9.5	9.2	8.7
n	9	17	17	17	9	17	1	17	9	17	17	17	9	17	17	17
n > Standard*	1	6	5	3	5	2	1	0		0	0	0	0	1	2	0
% Exceedance**		35	31	18		12	6	0		0	0	0		6	13	0
CPF055D - HAW RIVER ARM OUTSIDE PROJECT STUDY AREA																
Mean	31	25	26	29	16	14	10	6	6.9	9.0	9.0	9.1	7.7	7.9	8.0	7.8
Min	5	3	7	13	4	4	4	4	4.2	6.1	6.1	7.6	6.9	6.8	7.1	6.9
Max	46	46	48	40	75	80	32	11	9.6	12.8	12.7	11.0	8.7	9.3	9.2	8.9
n	7	17	17	17	7	17	17	17	7	17	17	17	7	17	17	17
n > Standard*	1	1	2	0	1	3	1	0		0	0	0	0	2	1	0
% Exceedance**		6	13	0		18	6	0		0	0	0		12	6	0

* Number of dissolved oxygen samples exceeding standard was not reported for 2009

** Percent exceedance of standard was not calculated for 2009 because less than 10 samples were collected

Historical data from 2009 – 2012 indicate that chlorophyll *a* values regularly exceed state standards. In nearly all years the exceedance rate for chlorophyll *a* was above 10 percent in the Morgan Creek and Haw River arms.

According to the State, implementation of circulators in the Morgan Creek Arm and Haw River Arms is expected to improve water quality by enhancing nutrient management strategies already in place. These strategies include the *B. Everett Jordan Reservoir, North Carolina Phase I Total Maximum Daily Load* (TMDL) allocations which require reductions from both point and non-point sources of nutrients, the Jordan Lake Buffer Rules which require riparian zones in the watershed to be protected, stringent stormwater collection and treatment requirements, and Unified Development Ordinance regulations in more developed areas and portions of the JLNMS. The circulators are expected to improve water quality by decreasing chlorophyll *a* concentrations, reducing turbidity, and lowering pH.

The no action alternative would be expected to improve water quality over time. The goal of the existing TMDL and JLNMS is to improve water quality in the Jordan Lake watershed. However, it is unknown how long it will take for water quality to improve with the TMDL and the partially implemented JLNMS. Water quality sampling data will be evaluated every five years and measures to improve water quality will be adjusted accordingly until water quality targets are achieved. While portions of the JLNMS have not been fully implemented and have been recently delayed, other programs and BMPs previously mentioned have been put in place to protect Jordan Lake as a drinking water supply. Because implemented programs will remain in place, water quality should be expected to improve over time.

Water quality is expected to improve under the no action alternative, although it is difficult to determine how long it may take to reach water quality goals. The proposed action is expected to help accelerate reaching water quality goals for chlorophyll *a*, turbidity, and high pH readings in the Morgan Creek and Haw River Arms when compared to the no action alternative.

5.1.7 Air Quality

Air pollutants can come from numerous sources including combustion engines, the burning of coal, wood, and oil, and manufacturing and processing processes. Pollutants in high enough concentrations can be detrimental to humans and wildlife and lead to health problems such as breathing trouble, burning eyes, and irritated throat. Long-term exposure can lead to cancer, immune system damage, and reproductive and neurological damage. The USEPA is responsible for setting limits on pollutants which are considered noxious to humans and the environment (USEPA).

The USEPA evaluates overall air quality concerns through the Air Quality Index, or AQI. The AQI is calculated for five pollutants of concern: ground-level ozone (O_3), particulate matter (PM2.5), carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). These five pollutants are regulated under the Clean Air Act of 1970 (CAA) as amended, which requires the USEPA to set limits for them. The AQI conditions are reported as colors which represent a corresponding health affect category – green (good), yellow (moderate), orange (unhealthy for sensitive groups), red (unhealthy), purple (very unhealthy), and dark red (hazardous). Chatham County meets all attainment criteria set forth in the National Ambient Air Quality Standards (NAAQS).

Annual report values for the AQI in Chatham County for 2008-2012 are shown in Table 6. The majority of time Chatham County was in the Good category for any given year, with several days in the moderate category. For all five years, only two days were in the Unhealthy for Sensitive Groups category and one

day in 2008 was in the Unhealthy category. In all years the pollutants of concern were O_3 and PM 2.5; for 2011 SO_2 was also a concern.

Table 6 - Annual Air Quality Index Summary for Chatham County (2008-2012)

Year	Number of Recorded Days in AQI Categories						Pollutants of Concern for AQI	AQI Maximum	AQI Median
	Good (0-50)	Moderate (51-100)	Unhealthy for Sensitive Groups (101-150)	Unhealthy (151-200)	Very Unhealthy (201-300)	Hazardous (301-500)			
2012	252	10	1	0	0	0	O_3/PM 2.5	127	35
2011	328	37	0	0	0	0	O_3/SO_2/PM 2.5	84	31
2010	213	47	0	0	0	0	O_3/PM 2.5	93	37
2009	231	33	0	0	0	0	O_3/PM 2.5	87	34
2008	314	50	1	1	0	0	O_3/SO_2/PM 2.5	159	33

Source: USEPA Air Quality Index Report (http://www.epa.gov/airdata/ad_rep_aqi.html)

Solar powered circulators would not produce air emissions of any type. Air emissions from the deployment, retrieval, and maintenance of solar powered circulators would produce minimal and temporary air pollution in the project areas. This would be primarily in the form of automobile and marine combustion engine exhaust. Such engines would be required for the delivery, placement, inspection, and maintenance of the circulators. Impacts to air quality would be negligible for this project.

Neither the proposed action nor the no action alternative would adversely affect air quality to any significant degree.

5.1.8 Noise

Excessive noise can affect people's daily routines and way of life as well as that of wildlife. Noise induced impacts to wildlife may include disruptions in communication, breeding, hunting, and migration.

Existing noise in the project areas is associated with traffic on local roads, maintenance of maintained areas (such as lawn mowers, weed eaters, etc.), recreational activities such as boating and swimming, and those generally associated with residential living. Noise is measured in A-weighted decibels, or dB(A), using a sound level meter that meets or exceeds criteria set forth by the American National Standards Institute (ANSI). Increases of three dB(A) or less are generally not perceivable to humans.

Chatham County has a noise ordinance which became effective on August 8, 2006. The Ordinance prohibits particular noises, such as the unnecessary blowing of car horns, unreasonably loud audio equipment, compressed air equipment (unless muffled), the sounding of any bell or gong attached to any building that unreasonably creates a disturbing noise, and the discharging of firearms in the street or elsewhere that creates an unreasonably loud or disturbing noise. The Ordinance also allows for

exceptions, such as construction operations, emergency operations, parades and other gatherings, and aircraft (Chatham County, 2006).

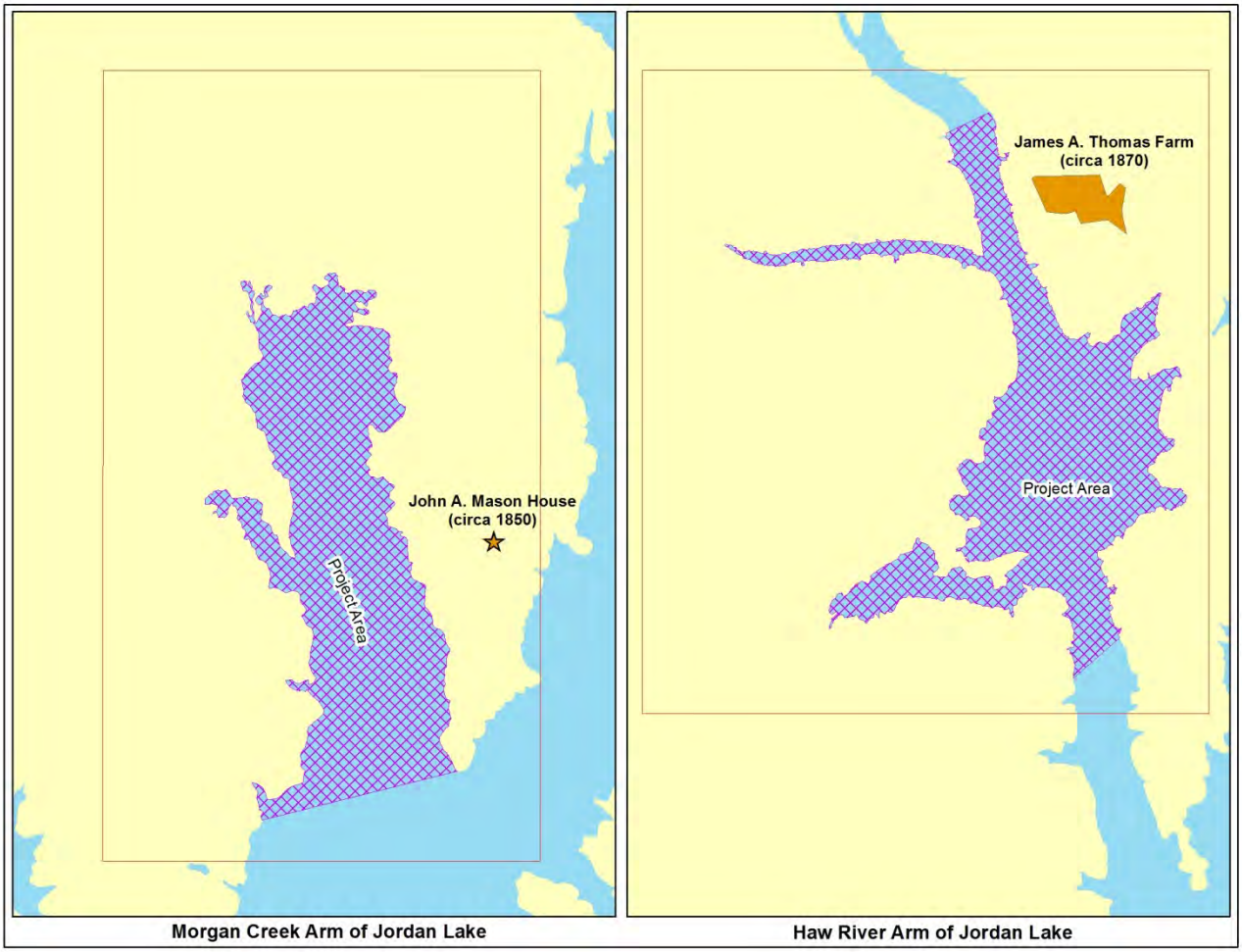
The proposed action would not lead to significant noise impacts. The circulators have low RPM motors, which are sealed to protect them from the environment. The motors produce very little noise, about 25 decibels, and are difficult to hear beyond the support floats. For comparison, the American Academy of Audiology reports that leaves rustling measure 20 decibels, and a whisper is equal to 30 decibels. Deployment, retrieval, inspection, and maintenance of the circulators would not result in noises louder than those commonly associated with recreational uses of Jordan Lake. Noise associated with the proposed action would be intermittent in nature and only during daylight hours. The circulators would not produce any noise that would be considered a negative impact to humans or wildlife and would be in compliance with the Chatham County Noise Ordinance.

Neither the no action nor the proposed action alternative would produce any noise impacts.

5.1.9 Cultural Resources

According to the North Carolina State Historic Preservation Office (NCSHPO), there are two registered existing historic properties within the APEs (Figure 22). The John A. Mason House is located on a peninsula on the eastern side of the Morgan Creek Arm (NPS, 1974). The James A. Thomas Farm is located along the shore of the Haw River Arm (North Carolina Division of Archives and History, 1983).

Figure 22 - Historic Properties Located in APEs



5.1.9.1 The John A. Mason House

The John A. Mason house is located on the eastern side of the Morgan Creek Arm on a peninsula, at the end of S.R. 1728. The house itself is located approximately 2,000 feet from the shore. The house is surrounded by forested land, so it is doubtful that views of the lake are possible from the house. The house and property were deeded to the United States on June 29, 1973 as part of the New Hope Dam Project. The property is currently managed by the North Carolina Division of Archives and History.

Figure 23 - John A. Mason House

The house is a two story Greek Revival structure believed to be built around 1850 by John Acree Mason (Figure 23). The land was deeded to John A. Mason by William Mason, his father, for $1,000 on February 30, 1835. The land was located "on the waters of New Hope and Morgan Creeks" and was approximately 600 acres in size. The land was farmed by the Mason family, with records showing significant crops of wheat, corn, and swine. More land was acquired in the following decades, eventually totaling over 1,000 acres. After John's death in March 1858, his widow, Elizabeth Herndon Mason, lived on the property, which was valued at $25,000. Upon her death in 1894, the property was divided amongst a grandson and two great-granddaughters. By 1917 the property had been heavily mortgaged and was sold to Wade Herman Scott. Mr. Scott was killed in 1961 and the property was sold to H.D. Dickerson. Mr. Dickerson sold the property to Colonel Miles Chase Shorey, Jr. in 1965, who then deeded it to the United States on June 29, 1973 (NPS, 1974).

The structure is of historical significance due to being a well preserved Greek Revival farmhouse. It is distinguished from more ordinary vernacular examples by consistent and interesting detail. These details include the treatment of the porch and corner posts, the ornament of the exterior corner blocks and the vigorous and unusual stair treatment (NPS, 1974).

5.1.9.2 The James A. Thomas Farm

The John A. Thomas Farm is located on the eastern side of the Haw River Arm project area (Figure 22), on the south side of S.R. 1941, 0.9 miles southwest of S.R. 1700. The property, which today is approximately 43 acres in size, has several structures including the main house, smokehouse, barn, two sheds, and a smaller cabin. The closest edges of the property lie approximately 625 feet from the Jordan Lake edge of water; the area containing the structures is approximately 1,400 feet from the water's

edge. The land surrounding the main house and structures is forested, so it is unlikely that views of Jordan Lake are possible from the house. The house is privately owned and not on publicly owned lands.

The house is thought to have been built in the late 1860s or early 1870s as a one-story frame cabin. It is believed that part of the original house burned in 1882. The house was rebuilt and a two-story wing was added at that time. The farm was a small, but successful operation, growing cotton, corn, wheat, and other grains. In the 1880s Mr. Thomas sold some of the farm land; the farm was decreased to 141 acres from 170 acres, and was valued at $700 in 1892. James Thomas died in 1917, leaving the farm to his son and widow. Successive generations have continued to live on the farm. Prior to the construction of the New Hope Dam project in the 1970s, the federal government purchased 98 acres of the property. These 98 acres became part of the lake but had no effect on the structures on the property (North Carolina Division of Archives and History, 1983).

Figure 24 - James A. Thomas House

The oldest portion of the main house exemplifies such vernacular elements as a steeply pitched gable-end roof extending over the front porch, six-over-six sash double-hung windows, extended rafter ends, and a large exterior stone and brick chimney. The original porch was modified in the 1890s and the kitchen was also relocated to another part of the house. The porch originally consisted of unusual tapered posts which were also modified in the 1890s; however, two of the posts still remain (North Carolina Division of Archives and History, 1983).

The proposed action would not impact either the James A. Mason house or the James A. Thomas Farm. The project would not require the use of any land associated with the houses, structures, or the farm, nor would they disturb the houses or associated structures in any way. The main houses and structures are located at least 1,500 feet from the bank of Jordan Lake and the area between the bank and the structures is forested. This forestation prevents any of the proposed action's visual or audio effects from impacting the properties.

Neither the no action alternative nor the proposed action would have an adverse effect on either historic property.

5.1.10 Hazardous Waste Sites

According to the North Carolina Division of Waste Management, there are no identified hazardous waste sites within the project areas or within one mile of the project areas. There may be hazardous materials contained in the circulator devices themselves, such as batteries and various oils and greases, but these items should not discharge directly into the water as a result of normal operation. Although

the units are sealed for protection from the elements there is a chance that these materials could reach the water should a device have a catastrophic failure; however, any materials discharged would be minimal in quantity. Should this happen, all appropriate agencies would be notified and all materials would be collected and disposed of using approved procedures.

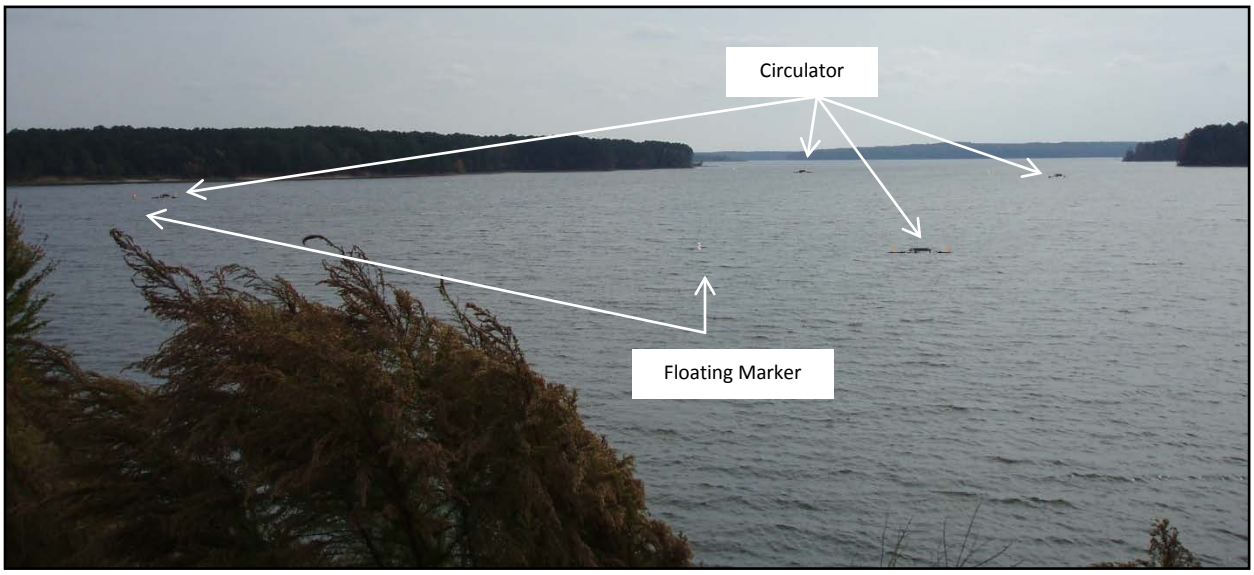
All equipment used to deploy solar powered circulators would follow proper and appropriate BMPs. No motor fuels or lubricant would be stored or handled on site. There are no anticipated effects from hazardous materials resulting from the deployment of solar powered circulators.

Neither the proposed action nor the no action alternative would affect hazardous waste sites or produce hazardous materials.

5.1.11 Aesthetics

The solar powered circulator units themselves are relatively small, measuring approximately 16 feet in diameter. The preferred circulators have a relatively low vertical profile floating with an approximate vertical height of two feet above the water. The highest vertical point on the circulators would be the solar panels. Any circulators deployed would need to be properly marked for navigational safety. A buoy or marker would be used to mark the anchor point and give warning about the circulator. These would be a highly visible color such as white or bright orange and be able to be seen from shore or from an appropriate distance away. Other safety features would include Coast Guard approved lighting, and/or reflective tape or bands, and/or highly visible signage and strobe lights for nighttime visibility. The circulators would visually affect aesthetics in a manner similar to that of a channel marker (Figure 25). Circulators and accompanying markers would present a small visual impact from shore or boat, but would not significantly impact aesthetic resources.

Figure 25 – Depiction of Solar Powered Long-Distance Circulators on Jordan Lake



The proposed action would affect the aesthetics of the project areas. Aesthetics would be impacted as the circulators would be seen floating on the water surface. However, the low profile of the circulators

would make it difficult for them to be seen at a distance. Associated markers and signage may be visible as well. The no action alternative will not affect aesthetic resources.

5.2 Managed Lands

All project areas and surrounding areas are managed by the USACE and its State partner agencies which include the NCWRC and the Triangle Land Conservancy. Table 7 summarizes land management in the two project areas.

Table 7 - Managed Lands in the APEs

MORGAN CREEK ARM OF JORDAN LAKE				
Managed Area Name	**Managing Agency/Organization**	**Type of Ownership**	**Management Strategy**	**Area in APE** (acres)
B. Everett Jordan Lake	US Army Corps of Engineers and NCWRC	Federal	Multiple Uses	3,042.01
Jordan Lake Game Land	US Army Corps of Engineers and NCWRC	Federal	Multiple Uses	249.29
Triangle Land Conservancy Preserve	Triangle Land Conservancy and NCWRC	Private	Biodiversity	6.98
HAW RIVER ARM OF JORDAN LAKE				
B. Everett Jordan Lake	US Army Corps of Engineers and NCWRC	Federal	Multiple uses	2,272.89
Jordan Lake State Recreation Area and Jordan Lake Game Lands	US Army Corps of Engineers, NCWRC, and NCDPR	Federal	Multiple uses	321.76

NCWRC - North Carolina Wildlife Resources Commission, NCDPR - North Carolina Divison of Parks and Recreation

Federal property including land and water areas on the Morgan Creek and Haw River Arms are managed by the USACE, in cooperation with the NCWRC and NCDPR, for multiple uses including flood control, recreation, waters supply, fish and wildlife enhancement, and augmentation of low flows (USACE). Private lands owned by the Triangle Land Conservancy in the project areas are managed, primarily to preserve biodiversity.

There are currently 45,369 acres managed as B. Everett Jordan Dam and Lake, of which only 1,653 acres (3.6 percent) are within the two project areas and therefore have the potential to be affected by the proposed action. The proposed project would not have an effect on the way the USACE and NCWRC currently manage resources in the project areas. No foreseen additional management or action would be required by the USACE as a result of the proposed action. Since this is a State funded project, mandated by the North Carolina Legislature, there is the possibility that the NCWRC may be tasked with assisting in the project in some way. Since the NCWRC is currently responsible for overseeing boating activity on Jordan Lake, additional oversight of boating activities within the project areas could be required. No additional land would be required by the proposed action; therefore, no change in management activities would be required on terrestrially managed areas.

The proposed action would not represent an adverse impact on managed lands. While there is the possibility that the NCWRC's enforcement of boating regulations on Jordan Lake could be expanded, it

should not be viewed as a change in how the Lake is currently managed and therefore does not represent an adverse impact.

The no action alternative would not affect managed lands or the way they are managed.

5.3 Natural Resources

5.3.1 Vegetation

The proposed action would affect the aquatic environment in the two project areas. Both submersed and emergent plant species may be encountered near the project areas; however, survey work conducted by NCDWR staff (October 18 and 22, 2013) revealed the absence of submersed macrophytes in both the Morgan Creek project area and the Haw River project area. The survey utilized a recording fathometer which mapped parts of the littoral zone at both sites, and physical sampling using a rake-type tool. The shorelines at both project areas are partially colonized by emergent species, which include Water Willow (*Justicia americana*) and Buttonbush (*Cephalanthus occidentalis*). Buttonbush was less common. A few stands of Cattail (*Typha latifolia*) were observed within the Haw River project area. Since emergent aquatic vegetation is only found in few places along the shoreline of the project areas, and not in the immediate vicinity of the circulators, the proposed action would not adversely impact aquatic vegetation. The no action alternative would not affect aquatic vegetation.

Terrestrial vegetation within the project areas was also surveyed (October 31, 2013). Terrestrial portions of the project areas are primarily forested, with some disturbed areas which are primarily rural roads and houses of low incidence. This is also supported by aerial photos and land coverage (Figures 3, 4, and 29). Most forested areas tend to be well vegetated and often contain loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), red oak (*Quercus rubra*), white oak (*Quercus alba*), eastern red cedar (*Juniperus virginiana*), yellow poplar (*Liriodendron tulipifera*)winged sumac (*Rhus copallinum*), tag alder (*Alnus serrulata*), black gum (*Nyssa sylvatica*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), willow oak (*Quercus phellos*), and sweetgum (*Liquidambar styraciflua*).

Neither the proposed action nor the no action alternative would affect vegetation.

5.3.2 Fish and Wildlife

The land around Jordan Lake and the project areas are largely undeveloped and forested providing ample habitat for abundant wildlife. According to the NCWRC, 313 bird species are found in or frequent the Jordan Lake Recreational Area including Canada goose (*Branta canadensis)*, mallard duck (*Anas platyhynchos*), northern bobwhite (*Colinus virginianus*), great blue heron (*Ardea herodias*), bald eagle (*Haliaeetus leucocephalus*), red-headed woodpecker (*Melanerpes erythrocephalus*), Carolina chickadee (*Poecile carolinensis*), and eastern meadowlark (*Sturnella magna*). Twenty-five reptiles are commonly found and include the eastern snapping turtle (*Chelydra serpentina serpentine*), northern rough green snake (*Opheodrys aestivus aestivus*), northern fence lizard (*Sceloporus undulatus hyacinthinus*), and green anole (*Anolis carolinensis*). Common mammals include Virginia opossum (*Didelphis virginiana),* eastern gray squirrel (*Sciurus carolinensis*), raccoon (*Procyon lotor*), and white tailed deer (*Odocoileus*

virginianus). There are 27 species of fish known to reside in Jordan Lake which include redbreast sunfish (*Lepomis auritus*), pumpkinseed (*Lepomis qibbosus*), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), striped bass (*Morone saxatilis*), and black crappie (*Pomoxis nigromaculatus*) (NCWRC).

The proposed action is not expected to adversely affect terrestrial wildlife including mammals, reptiles, and most amphibians. The action does not involve land disturbance of any type. The proposed action would deploy circulators in waters too deep (at least five feet) and too wide for most terrestrial wildlife to cross. Neither the proposed action nor the no action alternative would result in an adverse impact to terrestrial wildlife.

Many waterfowl frequent Jordan Lake and may rest, forage, or nest in or near the Lake. These activities would be precluded in the immediate vicinity of circulators. The velocity of water at the circulator head would be about 0.2 feet-per-second, which may be too turbulent for waterfowl to rest and possibly paddle in. However, the velocity of the water leaving the circulator head dissipates with distance. Swimming and foraging should be able to occur within a short distance of the circulator. Wading birds would be less impacted. None of the circulators would be placed very close (greater than 100 feet) to shore (Figure 9) and all would be located in water at least five feet deep, which is too deep for wading birds. It is anticipated that wading birds would be unaffected by circulators in shallower waters of the project areas. The circulators would be outfitted with bird deterrent devices to keep birds from resting or roosting on them.

Neither the proposed action nor the no action alternative would have an effect on waterfowl.

5.3.2.3 Fisheries

Fishing is one of the main recreational attractions of Jordan Lake. In 2010 it is estimated that 292,797 anglers visited Jordan Lake. The Lake supports 27 species of fish, many of which are game fish such as black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), warmouth (Lepomis gulosus), redear sunfish (*Lepomis microlophus*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), chain pickerel (*Exos niger*), white perch (*Morone americana*), white bass (*Morone chrysops*), striped bass (*Morone saxatilis*), and yellow perch (*Perca flavescens*). Nongame fish are found in the lake as well. The NCWRC regularly stocks Jordan Lake with fingerlings of multiple species. In 2013, Jordan Lake was stocked with 78,000 striped bass in the Farrington Point area and 2,400 threadfin shad in White Oak Creek at Crosswinds Campground (NCWRC, 2013). The NCWRC has also placed artificial reefs in areas of Jordan Lake to act as fish attractors and enhance fish habitat. Twenty-seven PVC barrel structures (Figure 26) have been placed throughout Jordan Lake for these purposes (Figure 27). Two of these structures have been placed in the Haw River Arm project area. The circulators are far enough from the fish attractors that fish behavior would be unaffected at the attractors.

The circulators are expected to increase dissolved oxygen in the water above the thermocline. Oxygen poor water above the thermocline would be pulled to the surface where it can then be oxygenated by surface contact. This oxygenated water would then be gradually pulled down towards the thermocline

to replace the water being pulled to the surface. This increase in dissolved oxygen would benefit fish populations and also decrease the chances of fish kills in warm, oxygen poor water typical in the summer, such as the one that occurred in August 2011. The circulation would also suppress blue-green algae and promote beneficial species of green algae, which is a food source for many juvenile fish. Blue-

Figure 26 - Location of NCWRC Fish Attractors and Circulators

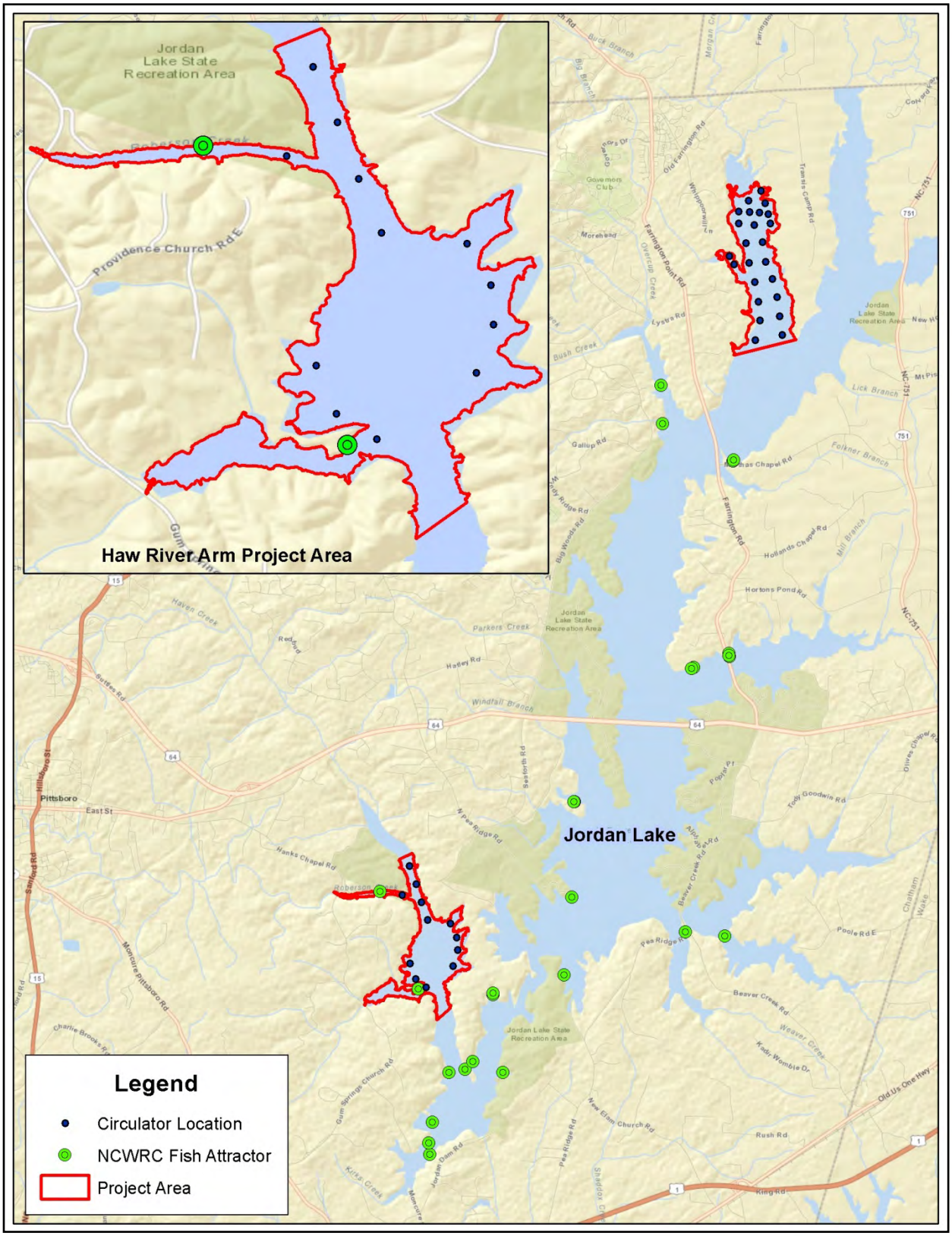


Figure 27 - NCWRC Fish Attractor

green algae prefer water with little motion and are often found near or at the surface. Beneficial green algae tend to be distributed throughout the water column. The physiology of green algae allows them to naturally migrate throughout the water column. Excess blue-green algae at the surface can prevent sunlight from filtering through the water column, which beneficial green algae need to photosynthesize. When water is circulated, as would occur with the proposed action, blue-green algae are pulled from the surface and distributed through the water column. This not only tends to disrupt the formation of blue-green algae 'mats' on the water's surface, but also makes blue-green algae more available for grazing by zooplankton deeper in the water column, further reducing populations. These two actions tend to better manage problematic blue-green algae, preventing potential algae blooms. Green algae would benefit from the proposed action and the resulting water column circulation.

Turbidity, which can clog gills in high enough concentrations, is expected to decrease as well. A decrease in turbidity would also allow for improved macrophyte growth as light would penetrate deeper in to the water column. Improved macrophyte growth provides higher quality habitat for fish foraging and spawning.

The fate of juvenile and smaller fish in regards to the circulator intake and impeller is another concern. The NCWRC has suggested that a one millimeter mesh intake screen be installed to prevent fishes from contacting the impeller. Water is drawn into the hose radially between the bottom plate and the bottom of the intake hose. With the proposed action, the velocity between the intake plate and the intake hose would be 0.2 fps. This intake velocity is well below the 0.5 fps recommended by the NCWRC. The use of an intake screen could significantly reduce the amount of water able to pass through the machine and would therefore reduce the efficiency of the circulator. Also, the use of screens would increase the potential for solids to get trapped and clog the intake. This too would also decrease the efficiency of the machine. Fish, even juvenile fish, are able to swim at speeds faster than 0.2 fps (Appendix C), allowing them to escape the water moving into the intake hose. Water is both drawn in radially and discharged radially over the discharge dish at 0.2 fps. Water velocity at the opening of the intake hose abovethe intake plate would be concentrated and could be as high as 1.0 fps. Water movement through a circulator is shown in Figure 28. The impeller turns at a rate of 80 rpm and is designed such that a four-inch solid spheroid can be safely passed through without becoming lodged. Smaller fish would be able to pass through the intake and impeller and be discharged from the top with very little danger of being harmed. Larger fish would have the swimming ability to avoid the intake altogether. The ability of small fish to pass through the impeller and intake plate allow for an environment that poses little threat to

fish. Table 8 shows the velocity of water for various distances as it approaches the intake hose (Knud-Hansen C. , 2006).

Figure 28 - Water Flow through Circulator

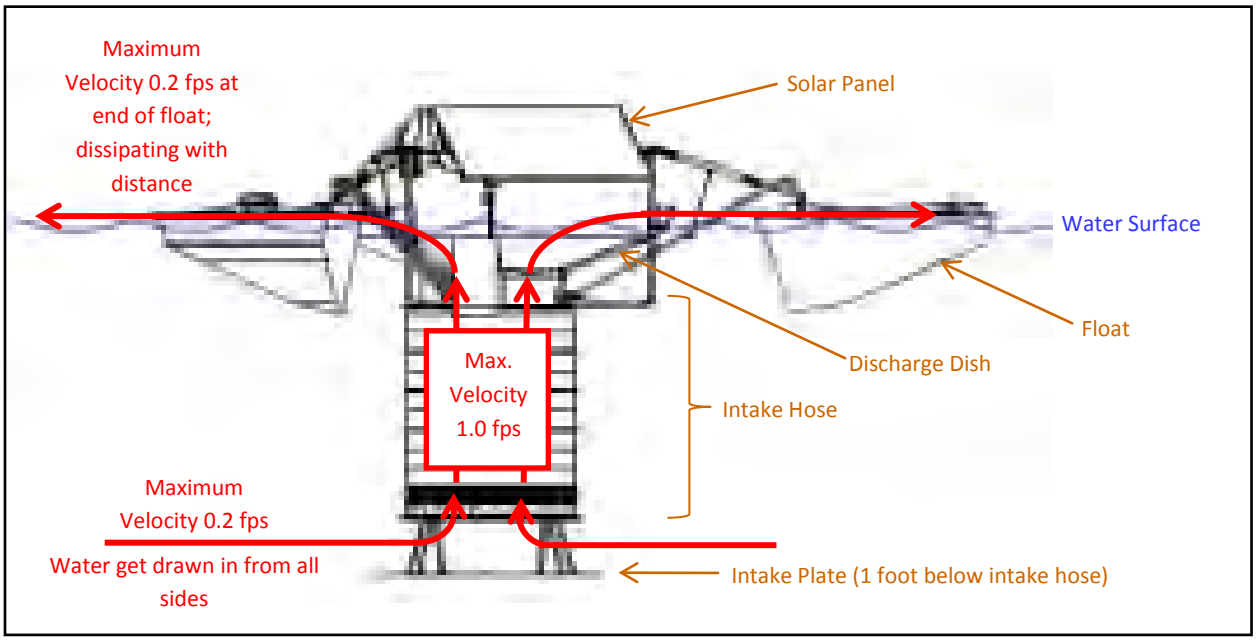


Table 8 - Water Velocity versus Distance from Intake Hose

Distance from Center of Circulator (feet)	Diameter of Flow Pattern (feet)	Velocity of flow (feet/second)	Velocity of Flow (feet/minute)	Velocity of Flow (feet/hour)
8	16	0.133	8	479
50	100	0.021	1.3	77
100	200	0.011	0.6	38
200	400	0.005	0.3	19
300	600	0.0035	0.2	13
400	800	0.0027	0.16	10
500	1,000	0.0021	0.13	8
600	1,200	0.0018	0.11	6
800	1,600	0.0013	0.08	5

The proposed action would not have an adverse impact on fish in the project areas. The no action would not affect fish populations.

5.3.3 Endangered and Threatened Species

The United States Fish and Wildlife Service (USFWS) is responsible for overseeing the Endangered Species Act (ESA) of 1973 as amended. Sections 7 and 9 of the ESA protect species listed as threatened

or endangered by the federal government. Any action that would potentially have an adverse impact on a threatened or endangered species is subject to review by the USFWS. Species listed by the USFWS as Federal Species of Concern are not afforded the same protection under the ESA.

Threatened or endangered species in Chatham County were verified using USFWS and North Carolina Natural Heritage Program (NCNHP) databases. There are many federally listed species of concern in Chatham County, but only three endangered species. The bald eagle is specifically protected under the Bald and Golden Eagle Protection Act (BGEPA) and is found within Chatham County. Endangered and protected species known to occur in Chatham County are presented in Table 9. Details of the USFWS and NCNHP database search results are included as Appendix B.

Table 9 - Federally Listed and Protected Species in Chatham County

Scientific Name	Common Name	State Status	Federal Status	Record
Picoides borealis	Red-Cockaded Woodpecker	Endangered	Endangered	Historical
Notropis mekistocholas	Cape Fear Shiner	Endangered	Endangered	Current
Ptilimnium nodosum	Harperella	Endangered	Endangered	Current
Haliaeetus leucocephalus	Bald Eagle	N/A	Protected (BGPA)	Current

The Red-cockaded woodpecker is the only North American woodpecker to nest in living trees. They prefer mature pine forests; more specifically longleaf and loblolly pines of 80-120 years and 70-100 years, respectively. A cluster may inhabit one to twenty trees or more on three to sixty acres. Breeding pairs are monogamous and raise a single brood of three-to-four chicks per year. No recorded sightings have occurred in Chatham County in the past 50 years (USFWS, 2008), and the proposed action would not affect Red-cockaded woodpeckers.

The Cape Fear Shiner is a small, yellowish minnow with a black band along the side of its body about two-inches long, first described as a new species in 1971. It can be found swimming in schools with other minnows, but is not abundant enough to be the dominant species. During breeding season from May to July, they seek slower moving waters with rocky substrates to lay eggs. The Cape Fear Shiner can be found in a very few select areas in Chatham County; primarily in about four miles of the Rocky River from NC 902 to County Road 1010 (USFWS, 2006). This area is south of Jordan Lake and the two APEs; therefore, the proposed action would not affect the Cape Fear Shiner.

Harperella is a perennial herb with hollow, quill-like leaf structures. It typically grows to a height of six to thirty six inches. It has small white flowers, which occur in heads, somewhat resembling Queen Anne's lace. Flowering may begin in May and continue until frost, depending upon location. Typical habitat includes rocky or gravel shoals and sandbars as well as along the margins of clear, swift flowing stream sections (USFWS, 2011). Since this project would occur within the confines of Jordan Lake itself, which does not provide ideal conditions for Harperella, and would not involve land disturbing activities along the shore, the proposed action is not anticipated to affect Harperella.

The bald eagle is a large predatory bird, easily identified by a brown body and white head. Females can

weigh up to 14 pounds and have a wing span of eight feet. They can often be found soaring over open water and wetland areas looking for prey. Bald eagles build large nests in the tops of large trees, which may be ten feet across and weigh 1,000 pounds. They typically lay one to three eggs per year and mate for life. Life expectancy in the wild is typically 15 to 25 years (USFWS, 2013).

Populations of bald eagle began to decline in late 1800's prompting Congress to pass the Bald Eagle Protection Act in 1940, which was expanded in 1962 to include the Golden Eagle. By 1963, only 487 nesting pairs of bald eagles were known. In 1978 the bald eagle was listed as endangered on the Threatened and Endangered Species List in all the lower 48 states. On June 28, 2007, bald eagle populations had sufficiently recovered to the point of removal from the Threatened and Endangered Species List. Today, although considered recovered, bald eagles are still protected under the Bald and Golden Eagle Protection Act (USFWS, 2013).

Bald eagles are a common sight on Jordan Lake, and watching them is a popular recreational activity. It is reported that Jordan Lake is home to the largest population of bald eagles on the east coast (NCDPR). The NCNHP has records of nesting bald eagles near the Morgan Creek Arm project area since 2011 (Weakley, 2013). The project would not affect bald eagle nests and would have no direct physical impacts on bald eagles. One of the primary sources of food for bald eagles is fish, which are abundant in waters of Jordan Lake. The circulators are not anticipated to have a negative effect on fish populations. It is quite possible that circulating water may have a positive impact on fish populations, as more desirable and edible algae would be available as food, turbidity is expected to decrease, and water could have higher dissolved oxygen levels. An increase in fish populations could be a benefit to bald eagles. The impacts of the project on fish populations are discussed further in Section 5.3.2.3. The proposed action would not affect bald eagle populations.

In addition to the species listed above, threatened and endangered mollusks and finfish included in the Natural Heritage Database for rare animal species were researched and verified as not existing in the project area. There are recorded populations of eastern lamp mussel (*Lampsilis radiata*) in Jordan Lake; however, known populations occur outside of the project areas. The proposed action would not affect threatened or endangered aquatic mollusks or finfish.

Neither the proposed action nor the no-action alternative would affect any federally-listed protected species.

5.3.4 Wetlands

According to the National Wetlands Inventory (NWI) there are wetlands located within the Morgan Creek and New Hope Arm project areas. In both project areas (Table 10) the largest wetland type (not counting the Lake surface) is the freshwater forested and shrub wetland (Table 10). Both project areas contain freshwater ponds. Additionally, the Morgan Creek Arm encompasses several acres of freshwater emergent wetlands.

The proposed action would have circulators located within Jordan Lake and would not directly affect the shoreline or terrestrial areas adjacent to the lake itself. Neither the proposed action nor the no action

alternative would require land disturbing activities associated with the proposed action and no wetlands would be affected.

Table 10 - Wetland Types in the APEs

Wetland Type	Cowardan Classification	Cowardan Classification Description	Acres	Wetland Type Total (acres)
MORGAN CREEK ARM				
Freshwater Emergent Wetland	PEM1Ch	Palustrine Emergent; persistent; seasonally flooded; diked/impounded	20.70	29.20
Freshwater Emergent Wetland	PEM1Fh	Palustrine Emergent; persistent; semipermanently flooded; diked/impounded	8.50	
Freshwater Forested/ Shrub Wetland	PFO1Ch	Palustrine Forested; seasonally flooded; diked/impounded	302.68	443.45
Freshwater Forested/ Shrub Wetland	PSS1Fb	Palustrine scrub-shrub; broad leaved deciduous; semipermanently flooded;beaver	0.34	
Freshwater Forested/ Shrub Wetland	PFO1A	Palustrine forested; broad leaved deciduous; temporarily flooded	2.91	
Freshwater Forested/ Shrub Wetland	PFO1Fh	Palustrine forested; broad leaved deciduous; semipermanently flooded; diked/impounded	8.20	
Freshwater Forested/ Shrub Wetland	PSS1Gh	Palustrine scrub-shrub; broad leaved deciduous; diked/impounded	12.56	
Freshwater Forested/ Shrub Wetland	PFO1Ah	Palustrine forested; broad leaved deciduous; temporarily flooded; diked/impounded	116.76	
Freshwater Pond	PUBHh	Palustrine unconsolidated bottom; permanently flooded; diked/impounded	8.75	9.42
Freshwater Pond	PUBHb	Palustrine unconsolidated bottom; permanently flooded; beaver	0.53	
Freshwater Pond	PAB4Hh	Palustrinie aquatic bed; floating vascular; permanently flooded; diked/impounded	0.15	
Freshwater Forested/ Shrub Wetland	L1UBHh	Lucastrine; limnetic; unconsolidated bottom; permanently flooded; diked/impounded	1,120.88	1,120.88
HAW RIVER ARM				
Lake	L1UBHh	Lucastrine; limnetic; unconsolidated bottom; permanently flooded; diked/impounded	1,241.53	1,241.53
Freswater Forested/ Shrub Wetland	PUBHh	Palustrine unconsolidated bottom; permanently flooded; diked/impounded	6.43	6.43
Freshwater Pond	PFO1C	Palustrine Forested; seasonally flooded	0.23	0.23

5.4 Socioeconomic Characteristics

5.4.1 Land Use

Land within the project areas is largely undeveloped as much of the land immediately surrounding the project areas are managed by the NCWRC. As shown in Figure 29, most of the APEs fall within a forested

land cover type, such as deciduous or evergreen. Much of the areas are also covered by open water (Fry, 2011). Table 11 compares land covers within both project areas.

The Haw River Arm encompasses approximately 3,893 acres. The largest land classification in the project area is deciduous forest at 38.82 percent, followed by evergreen forest at 28.36 percent (1,104 acres). The open water of Jordan Lake, where the project would actually be implemented, is comprised of 726 acres (18.65 percent) of the Haw Arm project area. There is no low, medium, or high density development in the Haw Arm project area (Fry, 2011).

The Morgan Creek Arm project area encompasses approximately 4,218 acres. The largest land use classification in the project area is evergreen forest, which comprises 1,235 acres (29.29 percent). Other large classifications include open water (23 percent) and deciduous forest (21 percent). Unlike the Haw River Arm, there is development in the Morgan Creek Arm study area. These areas include low density and medium density development, which combined total 0.71 percent (30 acres) of the project area (Fry, 2011).

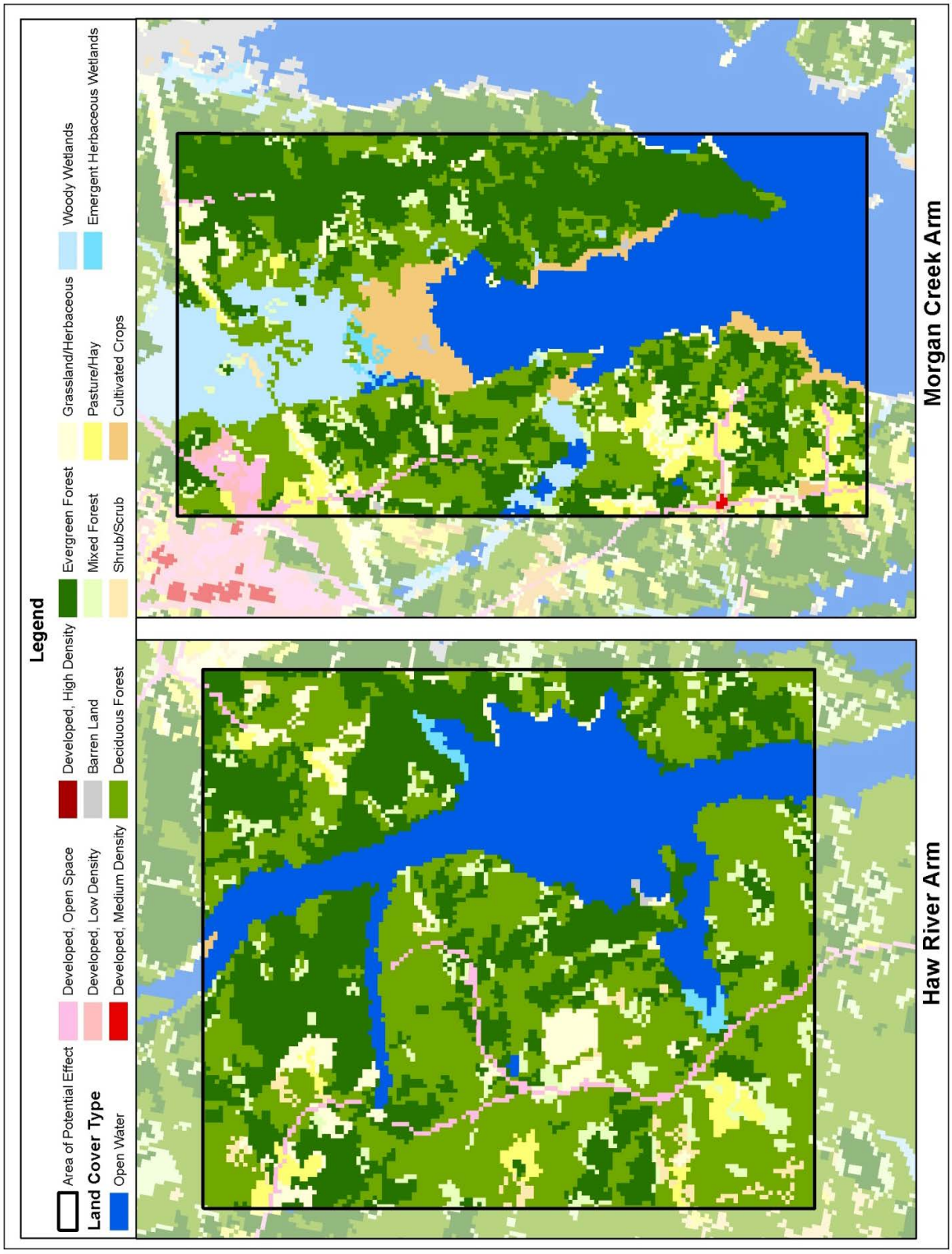
No land would be required or converted to another type for the proposed action. Neither the proposed action nor the no action alternative would have an adverse impact on current or future land use.

Table 11 - Summary of Land Cover in the Areas of Potential Effects

	HAW RIVER ARM		MORGAN CREEK ARM	
Land Cover Attribute	**Area (acres)**	**Percent of Total Area**	**Area (acres)**	**Percent of Total Area**
Deciduous Forest	1,511.22	38.82%	893.94	21.19%
Barren Land (Rock/Sand/Clay)	2.45	0.06%	5.78	0.14%
Cultivated Crops	2.47	0.06%	201.31	4.77%
Developed, Low Density	0.00	0.00%	28.26	0.67%
Developed, Medium Density	0.00	0.00%	1.78	0.04%
Developed, Open Space	51.60	1.33%	72.45	1.72%
Emergent Herbaceous Wetlands	22.46	0.58%	16.24	0.38%
Evergreen Forest	1,103.86	28.36%	1,235.30	29.29%
Grassland/Herbaceous	145.94	3.75%	174.17	4.13%
Mixed Forest	208.75	5.36%	150.53	3.57%
Open Water	725.88	18.65%	963.00	22.83%
Pasture/Hay	69.18	1.78%	143.36	3.40%
Shrub/Scrub	48.91	1.26%	5.12	0.12%
Woody Wetlands	0.00	0.00%	326.51	7.74%
TOTAL:	**3,892.72**	**100.00%**	**4,217.72**	**100.00%**

Neither the proposed alternative nor the no action alternative would affect current land uses.

Figure 29 - Land Cover in the APEs



5.4.2 Transportation

Primary roads in the general area are US 1, US 64, Interstate 40, and US 15/501. None of these roads are located within either project area. There are numerous Secondary Roads (SR) located in the general area. Secondary roads located within the Morgan Creek Arm include SR 1008 (Fearrington Road), SR 1726, SR 1728 (Transis Camp Road), SR 1727 (Whippoorwill Lane), SR 1753 (Paul Farrington Road), SR 1717 (McGhee Road) and several minor roads. Within the Haw River Arm, secondary roads include SR 1943 (Gum Springs Church Road), SR 1939 (Providence Church Road), SR 1941 (Seaforth Road), and several other minor roads.

There are no airports or railroads located within the APEs. The waters of Jordan Lake are not utilized for any type of shipping or major commercial activity. However, both project areas are used for recreational purposes, including boating.

The proposed action would not impact any roads, airports, railroads or major commercial boating activities. However, recreational boating may be affected. Potential impacts to recreational activities are discussed below in Section 5.4.3.

Neither the proposed action nor the no action alternative would impact any roads, airports, railroads or commercial boating activities.

5.4.3 Recreation

Recreational opportunities at Jordan Lake are many and include swimming, boating, hiking, camping and bird watching, to name a few. Figure 31 is a map showing the locations of recreational opportunities discussed below.

Hiking is a popular activity within the recreational areas and there are nearly 19 miles of designated hiking trails at Jordan Lake. Since hiking is a land-based activity, and the circulators would be placed on the Lake, no direct impacts to hiking activities are expected. The circulators, while in operation, would not produce noise noticeable from trails and would not present an audio intrusion on trails. It is unlikely the circulators would affect aesthetic resources as seen from marked trails and are not expected to have any effects on hiking activities.

Camping is also a popular activity within the recreational areas of Jordan Lake. There are five designated camping areas located within the Jordan Lake Recreational Area. These sites offer a variety of group, tent, and RV camping options. Designated camping areas are located at New Hope Overlook (tent camping only), Poplar Point (tent and RV camping), Crosswinds Campgrounds (tent and RV), Parkers Creek (group, tent, and RV), and Vista Point (group and RV). All five designated camping areas are on property maintained and managed by the NCDPR. None of these areas are located within either of the project areas and therefore the project would have no effect on designated camping areas.

There are twelve boat ramps on Jordan Lake. Most boat ramps are managed by the NCDPR, including the ramps in the areas of New Hope Overlook, Poplar Point, Ebenezer, Crosswinds Campground, Robeson Creek, Seaforth, Parkers Creek, Vista Point, and White Oak. The Farrington Point boat ramp is

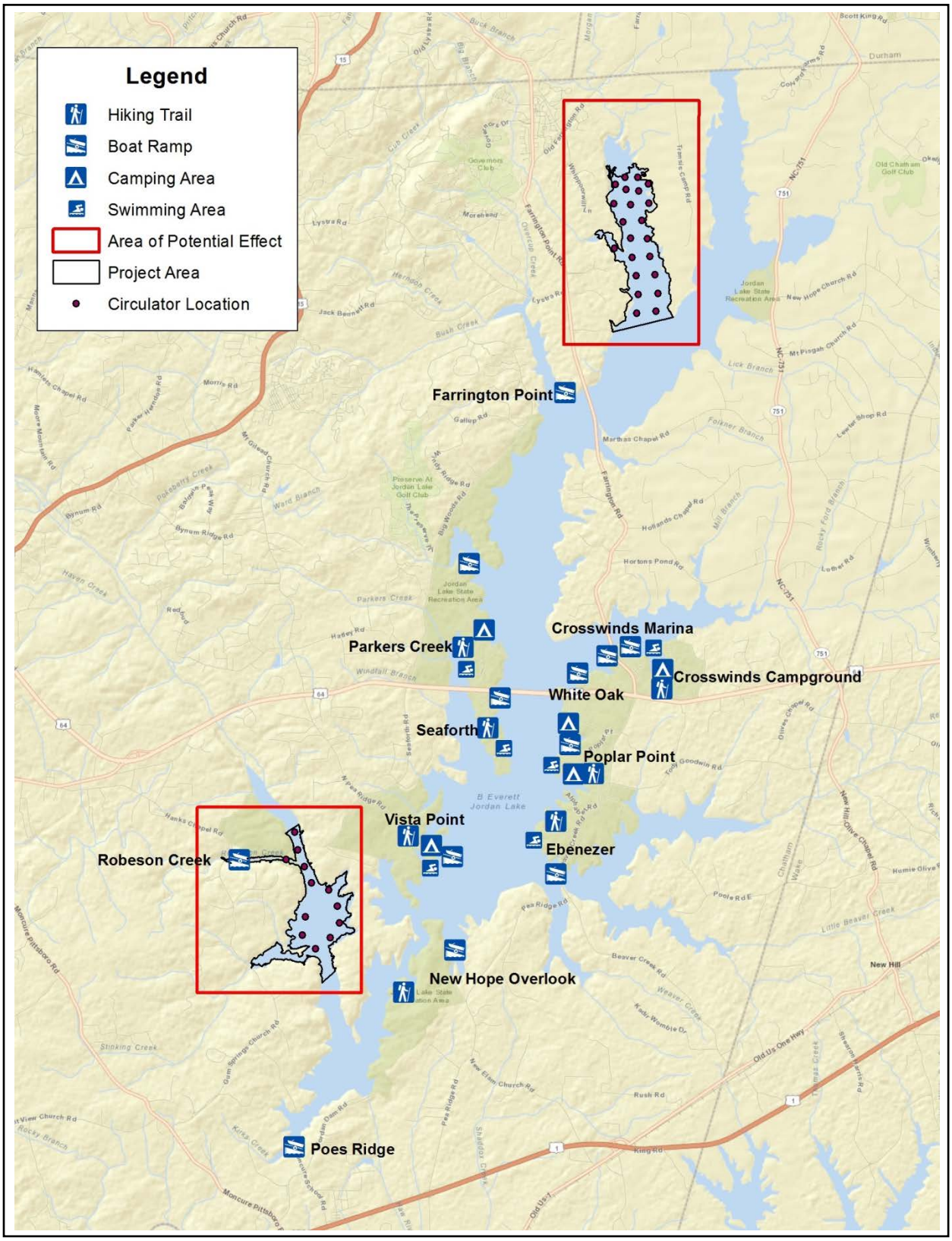
managed by the NCWRC and the Poes Ridge boat ramp is maintained by the USACE. The Robeson Creek boat ramp is located on Robeson Creek in the Haw River Arm project area, and is the only boat ramp located within either of the two project areas. A circulator is planned to be placed in Robeson Creek, approximately 0.65 miles downstream of the boat ramp. Therefore, boaters utilizing this boat ramp would need to pass by the circulator to reach the Haw River Arm and the rest of Jordan Lake. Robeson Creek is approximately 285 feet wide where the circulator would be placed. This circulator would be anchored with a deep mooring setup. A 10-15 foot tether would eliminate nearly all of the swing from the circulator. This would cause the circulator to remain in close proximity to the buoy and allow for safe navigation around the unit. All circulators, including this one, would be well marked to warn boaters of its presence (see Section 5.4.6). After deployment, known conflicts with circulators would be evaluated. It may be necessary to relocate a circulator due to boating safety concerns or other unforeseen issues.

Seven designated public swimming areas are located along the Jordan Lake shoreline. Swimming areas are located at Poplar Point, Ebenezer, White Oak, Crosswinds Campground, Seaforth, Parkers Creek, and Vista Point recreation areas. Beach sand has been brought in to these locations and swimming areas are marked off with ropes to protect swimmers. All swimming areas are managed by the NCDPR. These swimming areas are located along the central part of Jordan Lake and none are located in or near the project areas.

While swimming is encouraged only at designated swimming areas, it is possible that swimming within the project areas may occur. Despite the fact that the Medora Corporation states that there are no reported incidents in which swimmers have been injured by circulators, swimming in the immediate area of a circulator may pose a slight risk to some unexperienced swimmers due to the velocity of water being discharged. At the edges of the float the velocity is approximately 0.13 fps (1.6 inches per second or 0.09 mph). While it is not anticipated that swimmers would be between the floats, the water velocity at the circulator head is 0.2 fps (<2.5 inches per second or 0.13 mph); at 50 feet from the circulator head the velocity decreases to 0.021 fps (0.25 inches per second or 0.01 mph). Figure 30 shows a circulator in operation, with the water gently leaving the circulator. Should a swimmer get too close to a circulator and not be able to swim, they would slowly be pushed away from the circulator, not under water.

Figure 30 - Image of Circulator in Operation

Figure 31 – Jordan Lake Designated Recreational Areas



The recreational areas allow for great bird watching activities, due to the number and types of species attracted to the lake and its largely undeveloped areas. The circulators would have no effect on non-aquatic species. Wading birds are most likely to be found in shallower areas of the lake, such as along shorelines. Shorelines would be minimally impacted by the proposed project, if at all. The circulators would not be placed in less than three feet of water, where wading birds are likely to be found. At normal pool elevation, the circulators would be located in areas too deep for wading birds. The water velocity dissipates quickly with increased distance from the circulator, and by the time the water travels several hundred feet to shore areas the velocity would be negligible and unlikely to impact wading birds. The proposed action would have minimal impact on aquatic birds and bird watching activities.

Jordan Lake hosts robust fish populations and many are desirable, game fish species. This makes Jordan Lake a very popular fishing area. Fishing opportunities are available at all 12 recreational areas and throughout the Lake by boat. The NCWRC has further enhanced fish habitat by deploying fish attractors (described previously in Section 5.3.2.3) throughout Jordan Lake. The circulators would have a minimal impact on fishing. While boaters would be able to approach the circulators to fish, anchoring within 100 feet of the circulator would be discouraged as to not entangle the tether line. A floating marker indicating no anchoring would be attached to the circulator anchor warning boaters of this. The impacts of the circulators to fish are described in more detail in Section 5.3.2.3.

The proposed action would have minimal impacts on recreational opportunities. Hiking, swimming in designated areas, camping, and bird watching are not expected to be impacted by the proposed action. These activities do not generally occur within the project areas. Although boaters may be inconvenienced by having to navigate around circulators and by not being able to anchor in the immediate vicinity of the circulators, adequate space would be available for navigation and anchoring in the project areas while maintaining a safe distance from circulators. Circulators would be properly marked to alert boaters of their location, during all types of light conditions (day and night). The proposed action represents a small adverse impact to recreation in the project areas.

The no action alternative would not impact recreation.

5.4.4 Water Supply and Conservation

Jordan Lake was partially created as a reservoir to supply public drinking water to the Raleigh regional area. The Towns of Cary and Apex operate a potable water treatment facility which draws raw water from Jordan Lake. The intake is located on the east central side of the Lake, just north of highway US 64. Water is drawn in via two 54-inch pipes. Currently, 63 million gallons per day are allocated to several municipalities from Jordan Lake, Table 12 (HDR Engineering, 2012). In 2009, the Jordan Lake Partnership was created. The Partnership's purpose is to jointly plan for the expanded use of available water supply within Jordan Lake (HDR Engineering, 2012). The proposed action does not involve withdrawing or adding any water to Jordan Lake and would not affect the allocation of water within the region.

Table 12 - Water Supply Allocations from Jordan Lake

Municipality	Allocation (MGD)
Towns of Cary and Apex	32
Chatham County	6
City of Durham	10
Town of Holly Springs	2
Town of Morrisville	3.5
Orange County	1
Orange Water and Sewer Authority	5
Wake County - RTP South	3.5
TOTAL:	63

The proposed action may improve the water quality within the project areas of Jordan Lake by reducing the frequency of algal blooms, increasing dissolved oxygen, and increasing the pH in the project areas. However, due to the distance of the raw water intake to the project areas (approximately six miles from each project area), it is unlikely that any benefit would be seen at the intake. Neither the proposed action nor the no action alternative would have an adverse effect on the water supply or conservation.

5.4.5 Energy Needs

The solar powered circulators proposed for this project would not require any external energy, such as land-based electrical current, to supply power. The only energy required would be that necessary for deployment, inspection, maintenance, and retrieval of the circulators at the demonstration's conclusion. Petroleum and diesel fuels would be required to run engines in the delivery truck, any equipment necessary to unload the circulators, and for boats to place them in the water. During the course of the demonstration, fuel would be required to run the boats for inspection and maintenance. These non-solar energy uses would only be temporary and intermittent in nature. Energy requirements for the demonstration project would be minimal and insignificant. The no action alternative would not require energy use of any type.

5.4.6 Safety

A safety concern with the proposed action, deployment of circulators in Jordan Lake, is that they may pose a navigational safety hazard to boaters. With the exception of Robeson Creek, the circulators would not be placed in the main channel; should one exist. The circulators would present a navigational impediment similar to that of floating markers which already exist in some areas of Jordan Lake. The circulators would be marked appropriately to ensure visibility during both daytime and nighttime navigation, as outlined in the *U.S. Aids to Navigation System* published by the U.S. Coast Guard. Circulators would have a flashing beacon located at the unit's highest point, orange pylons, and reflective orange and white tape for nighttime navigational purposes. The bright orange tape, signs, and orange pylons would aid in daytime navigation as well. The circulators would be anchored to the lake bottom and allowed to float on tether lines to allow for minimal movement during water level fluctuations and severe weather events. Because these units float, and are not a rigidly mounted, the units would move with minimal effort should they be accidentally struck by a boat.

Another safety concern is the velocity of the water leaving the circulator and its impact to both the public and wildlife. The velocity of the water would be greatest at the circulator head itself, dissipating with distance from the circulator heads and is discussed further in Section 5.3.2.3. This velocity may make it difficult for casual approaches in canoes, kayaks, and swimmers of the circulators, as water exiting the circulator would tend to push them away (Knud-Hansen, 2013). Since the water is being pushed away horizontally from the circulator and not vertically, swimmers would not be pushed or pulled underwater. The circulators would be marked appropriately to ensure visibility during both daytime and nighttime navigation, as outlined in the *U.S. Aids to Navigation System* published by the U.S. Coast Guard. It is not anticipated that any type of powered craft would have difficulty navigating near the circulators. Non-motorized watercraft would be able to navigate around the immediate vicinity of the circulators with minimal effort.

Since the units would be solar powered, there would be no need for buried power cables. The units would, however, need to be tethered to an anchoring system. Boaters would be discouraged from anchoring in the immediate vicinity of the circulators, as boat anchors may become entangled in the tethering line. In an effort to help reduce this hazard, an anchor buoy would be deployed and secured to the anchor block. This would help boaters identify the origin of the tethering line and anchor blocks and give them an opportunity to avoid anchoring too close. These buoys would be a high visibility color, durable, of sufficient size to be easily seen, and would be marked with text notifying boaters not to anchor 100 feet of the buoy. Several of the circulators in the deeper parts of the Haw River project area would be anchored with a shorter tether line to a swivel located under a floating buoy. This example is illustrated in Figure 8. The significantly shorter tether line would further reduce potential boater anchor conflicts with the tether line.

The circulators would pose a safety risk. However, the circulators would be appropriately marked as outlined in the *U.S. Aids to Navigation System* published by the U.S. Coast Guard. Should warning signs be observed, and educational materials concerning the project be made available to the public at locations such as boat ramps, the safety risks would be greatly reduced.

The no action alternative would not have an effect on safety in the project areas.

5.4.7 Consideration of Property Ownership

The project areas are completely located within the surface waters of Jordan Lake. These areas are on government property and under the stewardship of the USACE. The area is leased to the State of North Carolina by the Federal Government for public park, recreation, and fish and wildlife purposes (Lease N. DACW21-I-81-2603). The North Carolina Wildlife Resources Commission (NCWRC) manages the lake fisheries, and enforces state fishing and boating regulations. Water levels in Jordan Lake are managed by the USACE through operation of the dam. The Department of Environment and Natural Resources, is currently seeking permission to utilize the necessary areas for this project from the USACE. The deployment of the circulators would most likely be conducted from the Farrington Point boat ramp (managed by NCWRC) for the Morgan Creek Arm and from the Robeson Creek boat ramp (managed by NCDPR) for the Haw River Arm (Figure 31). Utilization of boat ramps would only be temporary in nature,

lasting only until the circulators are deployed and operating and later during inspection, maintenance, and removal at the demonstration's conclusion. The time required would depend upon many factors, such as weather, delivery delays, unforeseen issues, etc. Under ideal conditions, the deployment in the Morgan Creek Arm would take approximately two weeks and one week in the Haw River Arm (Tormaschy, 2013). While these boat ramps are open to the public, the deployment would still be coordinated with the NCDPR and NCWRC. While not anticipated, if any long-term staging areas are necessary for storage they would be requested and coordinated through the NCDPR and NCWRC. The deployment, inspection, management, and retrieval of the circulators would be performed in such a manner that as little interruption in public access as possible would occur.

It is not anticipated that any land access other than at boat ramps would be necessary during deployment, inspection, management, or retrieval of the circulators. Circulators would be accessed via boat over the course of the project duration (24 months) and would not need to be accessed through private property. While the proposed project would require a lease agreement between the USACE and the State, this agreement would not affect property ownership (discussed in Section 5.4.7). Neither the proposed action nor the no action alternative would have a negative impact on property ownership.

5.5 Environmental Impact Comparison of Alternatives

A comparison of impacts for solar powered in-lake long-distance circulators (proposed action) and the no action alternative are presented below. No other alternatives other than in-lake long-distance circulators have been carried forward for further consideration, as they would not meet the stipulations of Session Law 2013-360§14.3A.(a). Various types of in-lake long-distance circulators, including solar powered, AC powered, and wind powered were considered and discussed in Section 3.0. All alternatives except for the no action alternative and solar powered in-lake long-distance circulators were dismissed as alternatives for various reasons and are therefore not included in the Table below.

Table 13 - Summary of Alternatives Impacts

Resource	Proposed Alternative	No Action Alternative
Physical Environment		
Geology	No adverse impact to geology in the project study areas	No adverse impact to geology in the project study areas
Topography	No adverse impact to topography in project study areas	No adverse impact to topography of the project study areas
Soils	No adverse impact to soils in the project study areas	No adverse impact to soils in the project study areas
Floodplains	No adverse impact to floodplains in project study areas	No adverse impact to floodplains in project study areas
Surface Hydrology	No adverse impact to surface hydrology in project study areas	No adverse impact to surface hydrology in project study areas
Water Quality	No adverse impact to water quality	No adverse impact to water quality
Air Quality	No adverse impact to air quality in project study areas	No adverse impact to air quality in project study areas
Noise	Adverse impact; will lead to very minimal increase of noise in project study areas	No adverse noise impacts in project study areas
Cultural Resources	No adverse impact on cultural resources in the project study area	No adverse impacts to cultural resources in the project study areas
Hazardous Waste Sites	No adverse impact; there are no hazardous waste sites in project study areas	No adverse impact; there are no hazardous waste sites in project study areas
Aesthetics	Minor adverse effect on aesthetics in the project areas	No adverse impacts to aesthetics inthe project study areas
Natural Resources		
Vegetation	No adverse impact on vegetation in project study areas	No adverse impact on vegetation in project study areas
Fish and Wildlife	No adverse impact; may improve fishery resources in project study areas	No adverse impact to fish and wildlife populations in project study areas
Threatened and Endangered Species	No affects on endangered or threatened species within project study areas	No affects on endangered or threatened species within project study areas
Wetlands	No adverse impact on wetlands within project study areas	No adverse impact on wetlands within project study areas
Socioeconomic Characteristics		
Land Use	No adverse impact on current or future land use in project study areas	No adverse impact on current or future land use in project study areas
Transportation	No adverse impact on transportation in project study areas	No adverse impact on transportation in project study areas
Recreation	Adverse impact in that boaters will not be able to anchor within 100 feet of circulator	No adverse impact to recreation
Water Supply and Conservation	No adverse impact adverseon water supply	No adverse impact adverseon water supply
Energy Needs	No additional energy needs except for those needed for deployment, maintenance, and retrieval of circulators	No additional energy requirements
Safety	Would pose minor safety concerns in project study areas	No new safety concerns in project study areas
Consideration of Property Ownership	No adverse impact to ownership; will require lease agreement with USACE	No adverse impacts to ownership in project study areas

6.0 Executive Orders

6.1 Executive Order 11988 (Floodplain Management)

This Order requires agencies to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values served by floodplains. Neither the Proposed Action nor the no action alternative would impact floodplains.

Potential effects on floodplains are discussed in detail in Section 5.1.4. Floodplains in both project areas would not be altered or impacted and no additional flooding would occur as a result of either the proposed action or the no action alternative.

6.2 Executive Order 1199990 (Protection of Wetlands)

This Order requires agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. It is intended to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

The proposed action would not affect wetlands, only surface waters of Jordan Lake. Wetlands within the project areas are discussed in Section 5.3.4. No wetlands would be filled or modified and no construction would result as a result of the proposed action. The no action alternative would not affect wetlands.

6.3 Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low Income Communities and Low Income Populations)

The EPA defines environmental justice as the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences of industrial, municipal, or commercial operations or the execution of federal, state, local, or tribal programs and policies. There are no residential neighborhoods within the project area. Based on this evaluation, neither the proposed action nor no action alternative is anticipated to have the potential for disproportionate health or environmental effects on minorities or low-income populations or communities.

6.4 Executive Order 11593 (Protection and Enhancement of the Cultural Environment)

This Order mandates that federal agencies take measures to protect and enhance the cultural environment. As discussed in Section 5.1.9, there is one historic property located within each of the

APEs. The John A. Mason house is located within the Morgan Creek Arm and the James A. Thomas farm is located in the Haw River Arm. The James A. Mason house is owned by the United States; the James A. Thomas farm is privately owned. Neither property would be affected by the project. No impacts would be expected as a result of either the proposed action, or no action alternative.

6.5 Executive Order 13186 (Protection of Migratory Birds)

Neither the proposed action nor the no action alternative would have a significant impact on migratory birds.

6.6 Executive Order 13112: Invasive Species

Section 2(a)(3) of Executive Order 13112 - Invasive Species (February 3, 1999) directs federal agencies to "not authorize, fund, or carry out actions that is believes are likely to cause or promote the introduction or spread of invasive species…". Neither the proposed action nor the no action alternative is anticipated to cause or promote the spread of invasive species.

6.7 Executive Order 13045: Protection of Children from Environmental Health Risks

This Order mandates federal agencies identify and assess environmental health and safety risks that may disproportionately affect children as a result of federal policies, programs, activities, and standards (63 Federal Register 19883 – 19888). Neither the proposed action nor the no action alternative would result in short or long-term actions that would disproportionately affect the safety and health of children.

7.0 Unavoidable Adverse Impacts of the Proposed Action

The short-term installation of solar powered in-lake long-distance circulators would not have significant unavoidable impacts within the project areas. The purpose of the proposed action is to improve water quality within the Morgan Creek and Haw River Arms of Jordan Lake. The proposed action is short-term (24 months) and any associated impacts would be eliminated with the termination of the demonstration project. No land disturbing activities or development would occur. Any impacts of the proposed action to the environment would be minimal and no mitigation would be required.

8.0 Indirect and Cumulative Impacts

Indirect or secondary effects are those that are reasonably foreseeable and caused by a project, but occur at a different time or place. Indirect or secondary effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems.

Certain parts of the JLNMS are being delayed during this demonstration project. The delay is required by N.C. General Session Law 2013-395, for the purposes of evaluating those measures, and to further explore other measures and technologies to improve the water quality of Jordan Lake. The particular technology addressed by this EA is required by N.C. General Session Law 2013-360. The particular technology does not address all of the stated reasons for the delay in implementation of parts of the JLNMS, and there is no indication that delay would not occur even if this demonstration project were not carried out. Neither the proposed action nor the no action alternative is anticipated to have indirect effects.

Cumulative effects have been defined by the CEQ in 40 CFR 1508.7 as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." No other significant future actions have been identified in the project areas; therefore, the impacts of the proposed action, when added to other past, present, and future actions, should be negligible. The proposed action would not induce any type of development, nor is the proposed action dependent upon the development or construction of any other project. The no action alternative is not anticipated to have an appreciable cumulative impact.

9.0 Public Involvement/Scoping

The project was scoped following North Carolina State Environmental Policy Act (SEPA) protocols. A copy of the scoping letter was sent to the North Carolina Department of Administration - State Clearinghouse for distribution. A notice of scoping was published in the North Carolina Environmental Bulletin on August 22, 2013 with a 30 day review period (September 23, 2013). The State Clearinghouse sent hardcopies of the Scoping Letter to appropriate State Agencies for review and comment. Copies of comments received are included as Appendix A. This EA incorporates scoping letter review comments received as applicable.

This EA will be distributed appropriately and made available for public review and comment with a minimum 30 day review period. No public meetings have been held for this project and none have been requested as of this time.

10.0 List of Recipients Receiving Copies of This Document

This EA will be circulated for review to Federal, State and Local agencies, interest groups and the general public.

11.0 Point of Contact

Any comments regarding this Environmental Assessment should be directed to:

Mr. Justin Bashaw
United States Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403
(910) 251-4581

12.0 List of Preparers

The following people aided in the preparation of this document:

Name	Position	Credentials
David Wainwright	Environmental Senior Specialist	B.S. in Biology with seven years experience issuing 401 Water Quality Certifications and working with NEPA/SEPA document reviews. Eight years of experience analyzing water quality samples and creating 303(d) lists.

13.0 Finding of this Environmental Assessment

The proposed action would not significantly impact the quality of the human environment: therefore an Environmental Impact Statement would not be required. If this opinion is upheld following circulation and review of this EA, a Finding of No Significant Impacts (FONSI) would be signed and circulated.

14.0 References

Center for Disease Control and Prevention. (n.d.). *CDC Health Studies Program*. Retrieved August 26, 2013, from Harmful Algal Blooms (HABs): http://www.cdc.gov/nceh/hsb/hab/default.htm

Chatham County. (2006, August 8). Chatham County Noise Ordinance. *A Resolution and Ordinance to Provide for the COntrol of Noise in Chatham County*.

Clark, T. P. (2001, April). Depositional and Structural Framework of the Deep Riveer Triassic Basin, North Carolina. *Field Trip Guide for the 50th Annual Meeting of the Southeastern Geological Society of America*.

FEMA. (n.d.). *FEMA, Zone AE and A1-30*. Retrieved September 17, 2013, from http://www.fema.gov/floodplain-management/zone-ae-and-a1-30

FEMA. (n.d.). *Floodway*. Retrieved September 17, 2013, from http://www.fema.gov/floodplain-management/floodway

Fry, J. X. (2011, Vol. 77(9)). Completion of the 2006 National Land Cover Database for the Conterminous United States. *PE&RS*, pp. 858-864.

Hans W. Paerl, R. S. (2001). Harmful Freshwater Algal Blooms, With and Emphasis on Cyanobacteria. *The Scientific World Journal*, 76-113.

HDR Engineering. (2012). *Environmental Assessment for Direct IMpacts of the Proposed Jordan Lake Aeration System for the Cary/Apex Water Treatement Facility.* Cary: Town of Cary.

Hudgins, J. E. (2000). *Tropical cyclones affecting North Carolina since 1586: An Historical Perspective (NOAA Technical Memorandum NWS ER-92).* Blacksburg, VA: NOAA, National Weather Service.

Knud-Hansen, C. (2006, March 23). Potential Benefits ofSolar-Powered Circulation for Lake Cochituate, with and Empahsis on Controlling Eurasion Watermilfoil. *Presentation to the Cochituate State Park Advisory Committee*.

Knud-Hansen, C. F. (2013). *Boating Safety in Lakes and Reservoirs when SolarBee Circulators are Installed for IMproving Water Quality.* Dickenson, ND: Medora Corporation.

Medora Corporation. (n.d.). *Lake and Raw Water Reservoir Circulators*. Retrieved October 24, 2013, from Product Information: http://lakes.medoraco.com/lakes/product-information

NCDENR. (2002). *Cape Fear River Basin Water Quality Plan.* Raleigh.

NCDENR. (2007). *B. Everett Jordan Reservoir, North Carolina Phase I Total Maximum Daily Load.* Raleigh.

NCDENR. (2007). *B. Everett Jordan Reservoir, North Carolina Phase I Total Maximum Daily Load.* Raleigh.

NCDPR. (n.d.). *Jordan Lake State Recreation Area, History*. Retrieved August 21, 2013, from North Carolina State Parks: www.ncparks.gov/visit/parks/jord/main.php

NCDPR. (n.d.). *Jordan Lake State RRecreational Area*. Retrieved October 21, 2013, from Activities: http://www.ncparks.gov/Visit/parks/jord/activities.php

NCDPR. (n.d.). *Natural Resources Inventory Database*. Retrieved October 1, 2013, from http://www.dpr.ncparks.gov/nrid/public.php

NCDWM. (n.d.). *ArcGIS REST Services Directory*. Retrieved August 29, 2013, from NC1Map_Hazardous_Waste (MapServer): http://services.nconemap.com/arcgis/rest/services/NC1Map_Hazardous_Waste/MapServer

NCDWR. (n.d.). Retrieved August 23, 2013, from North Carolina TMDL Program: http://portal.ncdenr.org/web/wq/ps/mtu/tmdl

NCWRC. (2013). *Fishing in North Carolina.* Retrieved October 1, 2013, from Warmwater Stocking Summary: http://www.ncwildlife.org/Fishing/HatcheriesStocking/NCWRCStocking.aspx

NCWRC. (n.d.). *Natural Resources Inventory Database (Jordan Lake Recreational Area)*. Retrieved October 1, 2013, from http://www.dpr.ncparks.gov/nrid/public.php

NCWRC. (n.d.). *Navigation Aids and Regulatory Markers.* Retrieved September 20, 2013, from Boating in North Carolina: http://www.ncwildlife.org/Portals/0/Boating/documents/VOG/UniformWaterMarkers.pdf

North Carolina Division of Archives and History. (1983). *Indivisual Report From form, James A. Thomas Farm.*

NPS. (1974). *National Register of Historic Places Inventory Nomination Form, John A. Mason House.*

NRCS. (2006). *Soil Survey of Chatham County, North Carolina.*

Research Laboratories of Archeology, U. C. (2006). *Stone Quarries and Sourcing in the Carolina Slate Belt (Report 25).* Chapel Hill.

Tetra Tech, Inc. (2003). *B.Everett Jordan Lake TMDL Watershed Model Development.*

Tormaschy, C. (2013, September 17). Personal Communication via email.

Triangle J Council of Governments. (2013, April 18). Jordan Lake Bathemytry GIS Coverage (ftp://ftp.tjcog.org/pub/planning/water/JLbathymetry/). Durham, NC.

USACE. (2010). *Value to the Nation Fast Facts*. Retrieved August 21, 2013, from Lake Level Report B Everett Jordan Dam and Lake: http://www.corpsresults.us/recreation/fastfacts/lake.cfml?lakeID=18

USACE. (n.d.). *B. Everett Jordan Dam and Lake Project, Cape Fear River Basin, NC, Pertinent Data*. Retrieved August 21, 2013, from http://epec.saw.usace.army.mil/BEJPERT.TXT

USACE. (n.d.). *U.S. Army Corps of Engineers, Wlimington District*. Retrieved August 21, 2013, from U.S. Army Corps of Engineers, Wlimington District, B. Everett Jordan History: http://www.saw.usace.army.mil/Locations/DistrictLakesandDams/BEverettJordan/History.aspx

USCG. (2011, June). U.S. Aids to Navigation System.

USEPA. (n.d.). *Air and Radiation*. Retrieved October 21, 2013, from Basic Information: http://www.epa.gov/air/basic.html

USFWS. (2006, September 25). Cape Fear Shiner (Notropis mekistocholas).

USFWS. (2008, January). Red-cockaded Woodpecker, Picoides borealis.

USFWS. (2011, July 26). *Raleigh Ecological Service Field Office*. Retrieved September 25, 2013, from Harperella (Ptilimnium nodosum): http://www.fws.gov/raleigh/species/es_harperella.html

USFWS. (2013, March 18). *Bald Eagle*. Retrieved October 21, 2013, from Fact Sheet: Natural History, Ecology, and Histroy of Recovery: http://www.fws.gov/Midwest/eagle/recovery/biologue.html

USGS. (n.d.). *Mineral Resources On-Line Spatial Data*. Retrieved September 24, 2013, from Felsic Metavolcanic Rock: http://tin.er.usgs.gov/geology/state/sgmc-unit.php?unit=NCCAZfv%3B6

Weakley, A. (2013, September 24). Repsonse to Proposed Jordan Lake Mechanical Aeration Sytem Scoping Letter.

Appendix A

Scoping Comments Received

North Carolina
Department of Administration

Pat McCrory, Governor

Bill Daughtridge, Jr., Secretary

September 30, 2013

Ms. Hannah Headrick
NCDENR
Division of Water Resources
Water Quality Programs
1611 Mail Service Center
Raleigh, North Carolina 27699-1617

Re: SCH File # 14-E-4300-0069; SCOPING; Proposed is a demonstration project for a mechanical aeration system for the management of nutrients in Jordan Lake. Project will deploy floating arrays of solar powered in-lake long-distance circulators.

Dear Ms. Headrick:

The above referenced environmental impact information has been submitted to the State Clearinghouse under the provisions of the National Environmental Policy Act. According to G.S. 113A-10, when a state agency is required to prepare an environmental document under the provisions of federal law, the environmental document meets the provisions of the State Environmental Policy Act. Attached to this letter for your consideration are the comments made by agencies in the course of this review.

If any further environmental review documents are prepared for this project, they should be forwarded to this office for intergovernmental review.

Should you have any questions, please do not hesitate to call.

Sincerely,

Crystal Best

Crystal Best
State Environmental Review Clearinghouse

Attachments

cc: Region J

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail state.clearinghouse@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

MEMORANDUM

To: Crystal Best
State Clearinghouse

From: Lyn Hardison
Division of Environmental Assistance and Customer Service
Environmental Assistance and Project Review Coordinator

RE: 14-0069 Scoping
Proposed is a demonstration project for a mechanical aeration system for the management of nutrients in Jordan Lake to include deploying floating arrays of solar powered in-lake long-distance circulators
Chatham County

Date: September 27, 2013

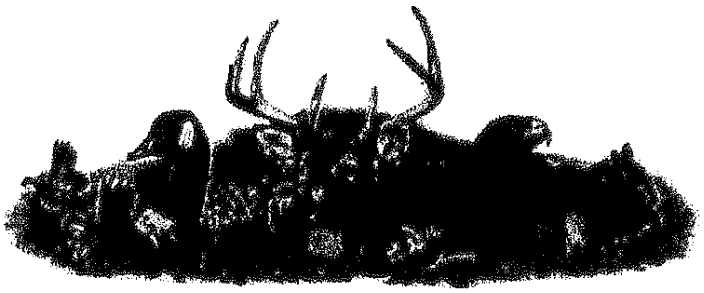
The Department of Environment and Natural Resources has reviewed the proposal for the referenced project. Based on the information provided, several of the agencies have identified permits that may be required. NC Wildlife Resources Commission has concerns that the proposed aeration system may have direct impacts to the aquatic resources and the recreational boating activities. They are requesting the applicant provide alternative options and analysis to the proposed aeration system in the environmental document. These comments are attached for the applicant review.

The Department will provide more specific comments during the environmental review process.

Thank you for the opportunity to respond.

Attachments

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-707-8600 \ Internet: www.ncdenr.gov



North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

MEMORANDUM

TO: Lyn Hardison, Environmental Assistance Coordinator
NCDENR Division of Environmental Assistance and Outreach

FROM: Shari L. Bryant, Piedmont Region Coordinator
Habitat Conservation Program

DATE: 16 September 2013

SUBJECT: Scoping for Mechanical Aeration System for the Management of Nutrients in Jordan Lake, Chatham County. DENR Project No. 14-0069.

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) have reviewed the subject document and we are familiar with the habitat values of the area. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e), North Carolina Environmental Policy Act (G.S. 113A-1 through 113A-10; 1 NCAC 25), and North Carolina General Statutes (G.S. 113-131 et seq.).

The Division of Water Resources proposes to install a mechanical aeration system to reduce adverse impacts from excessive nutrient loads and low levels of dissolved oxygen in the Morgan Creek and Haw River arms of Jordan Lake. The project areas include approximately 750 acres of the Morgan Creek arm and 700 acres of the Haw River arm. The purpose of the project is to determine whether long-distance circulation will suppress phytoplankton activity so chlorophyll *a*, pH and turbidity will meet State surface water quality standards within the project areas.

Jordan Lake supports a diverse fishery including sunfish (*Lepomis* spp.), crappie (*Pomoxis* spp.), catfish (*Ictalurus* spp.), largemouth bass (*Micropterus salmoides*), and striped bass (*Morone saxatilis*). Listed terrestrial species in the area include the state threatened bald eagle (*Haliaeetus leucocephalus*).

We are concerned about direct impacts of the aeration system on aquatic resources and recreational boating. The EA should include an alternatives analysis that evaluates other alternatives (e.g., bottom diffuser) to the proposed surface aeration system, and includes a discussion of environmental impacts from construction, operation, and maintenance of the proposed aeration system as well as the other alternatives. More specifically, we request the following information regarding the aeration system is included in the EA:

Aquatic Habitat and Fisheries

- The total number of aerators needed to improve water quality within each of the project areas.

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

- How the aeration system will be operated. According to information provided in the scoping document, the aeration system will be capable of continuous operation (i.e., a minimum of 97% of the total hours during the course of one year); however, it is unclear whether this system will be operated year-round. If the system is not operated year-round, then the months of the year it is anticipated the aeration system will be operated and whether it will be operated daily or periodically during this time period should be discussed in the EA.
- How temperature and dissolved oxygen will be affected in the area immediately surrounding the aeration system at start up particularly if the aeration system is started after a thermocline has formed.
- How temperature and dissolved oxygen will be affected should one or more of the aerators malfunction or cease to operate.
- Describe whether it is anticipated that there will be areas with low dissolved oxygen when the aeration system is first started. Also, describe the average amount of time it would take for the thermocline to disappear in the area affected by the aeration system.
- If multiple aerators are needed within each of the project areas, then describe the area (e.g., acreage) each aerator will affect.
- How temperature and dissolved oxygen will transition (i.e., abrupt change or a transitional change) between aerated and non-aerated areas.
- Detailed information regarding any screening to prevent fish from entering the aeration system, and the mechanical parts inside of the aeration system that fish would have to pass through if they became entrained in the aeration system. Based on information provided in the scoping document, flow through the hose and intake will not exceed one foot per second. NCWRC recommends that intake structures have passive screens with openings not to exceed one centimeter and with a maximum intake velocity of 0.5 feet/sec to minimize impingement and/or entrainment of fish.

Boating Traffic and Safety

- According to information provided in the scoping document, ingress/egress through the Morgan Creek and Haw River arms will be impacted, and aerator placement will be done to minimize interference within primary boating and access channels. The EA should include a figure showing the proposed locations for the aerators within the Morgan Creek and Haw River arms of Jordan Lake. We are concerned the aerators may be a navigational hazard that could create boating safety issues.
- According to information provided in the scoping document, the floating aerators will be 16-feet in diameter with highly-visible markers. Detailed information on how each of the aerators would be marked to alert daytime and nighttime boaters of its location should be included in the EA. For a similar project, we recommended the aerator was marked with strobe lighting to make it more visible during nighttime hours. We also recommended that buoys such as "Boats Keep Out" were placed approximately 20 yards from the structure to alert anglers or boaters of its presence and minimize the chances of boaters entering the area.
- According to information provided in the scoping document, the aerators will be anchored by two mooring blocks covered with polyethylene. High water levels in Jordan Lake often can relocate floating objects. If these aerators are relocated during high water levels this could create additional boating safety issues. The EA should include specific details on how the aerators will be anchored, and how frequently they will be maintained to ensure they remain in the appropriate location and are functioning properly.

Nutrients, particularly nitrogen and phosphorus, are important in developing and maintaining quality reservoir fisheries. Nutrients stimulate production and growth of the planktonic organisms that are the base of the aquatic food chain. When determining the nutrient load reduction targets for the Jordan Lake TMDL, we recommended a mean summer chlorophyll *a* lower limit of 15 µg/l for the middle section of the reservoir be used. This recommendation was based on a study by Maceina and Bayne (2001) that documented significant reductions in nutrients could adversely affect a largemouth bass fishery. However, excessive nutrients can be detrimental; high density planktonic or algal blooms can degrade water quality and increase fish stress which can manifest as disease or in extreme cases as a fish kill.

Although the proposed mechanical aeration system may improve water quality and reduce the adverse impacts from excessive nutrient loads into Jordan Lake, it will not reduce or eliminate nutrients being discharged to the lake. For long-term improvement of water quality and aquatic habitat in Jordan Lake nutrient loads in the lake also must be addressed. The EA should include a discussion regarding nutrient loads in the lake and measures that may be used to reduce these nutrient loads.

In addition to addressing the concerns outlined above, the environmental document should include a detailed assessment of existing natural resources within the project area and should discuss the potential of mitigating impacts to wetlands, waters, and high quality upland habitat. We encourage the applicant to consult the Department of Environment and Natural Resources' *Guidance for Preparing SEPA Documents and Addressing Secondary and Cumulative Impacts* in preparing the environmental document. To facilitate our review of proposed project impacts on aquatic and terrestrial wildlife resources, we request the following information is included in the environmental document. Although some of the information, requests and comments may not be applicable to this project, these should facilitate preparation of an environmental document that addresses impacts to aquatic and terrestrial wildlife resources.

1. Include descriptions of aquatic and terrestrial wildlife resources within the project area, and a listing of federally or state designated threatened, endangered or special concern species. A listing of designated species can be found on the N.C. Natural Heritage Program's website at http://www.ncnhp.org.
2. Surveys should be conducted by biologists with both state and federal endangered species permits.
3. Include descriptions of any streams or wetlands affected by the project.
4. Include project maps identifying wetland areas. Identification of wetlands may be accomplished through coordination with the U.S. Army Corps of Engineers (USACE). If the USACE is not consulted, the person delineating wetlands should be identified and criteria listed.
5. Provide information on existing, planned, and projected sewer and water infrastructure service throughout the service area. A map showing the location of the existing and projected lines and areas containing special resources should be included.
6. Define the service area for the project, including any ETJs (extra-territorial jurisdiction), and provide a map of the service area.
7. Provide a description of project activities that will occur within wetlands, such as fill or channel alteration. Acreage of wetlands impacted by alternative project designs should be listed.
8. Provide a description and a cover type map showing acreage of upland wildlife habitat impacted by the project.
9. Discuss the extent to which the project will result in loss, degradation or fragmentation of wildlife habitat (wetlands and uplands).

10. Discuss any measures proposed to avoid or reduce impacts of the project or to mitigate unavoidable habitat losses.

11. Discuss the cumulative impacts of secondary development facilitated by the proposed project. Such discussion should weigh the economic benefits of such growth against the costs of associated environmental impact.

    (a) Include specific measures (e.g., local ordinances) that will be used to address stormwater and sedimentation at the source. Include specific requirements for both residential and industrial developments and Best Management Practices (BMPs) that will be required.

    (b) Include specific measures (e.g., local ordinances) that will be used to protect stream corridors, riparian habitat, and a minimum of the 100-year floodplain from filling and development. Commitments by the project sponsors to protect area streams with riparian buffers through purchase or conservation easement are of particular interest.

12. Include a list of document preparers that shows each individual's professional background and qualifications.

At this time, the information provided is not sufficient for our staff to make definitive recommendations or conclusions concerning this project. Thank you for the opportunity to provide input in the early planning stages for this project. If we can be of further assistance, please contact our office at (336) 449-7625 or shari.bryant@ncwildlife.org.

Literature cited

Maceina, M.J. and D.R. Bayne. 2001. Changes in the black bass community and fishery with oligotrophication in West Point Reservoir, Georgia. North American Journal of Fisheries Management 21:745-755.

ec: Jessica Baumann, NCWRC
Corey Oakley, NCWRC
Reggie Barker, NCWRC
Bryan Scruggs, NCWRC

North Carolina Department of Environment and Natural Resources
Office of Conservation, Planning, and Community Affairs

Pat McCrory
Governor

Linda Pearsall
Director

John E. Skvarla, III
Secretary

September 24, 2013

MEMORANDUM

TO: Lyn Hardison, NCDENR State Clearinghouse Coordinator

FROM: Allison (Schwarz) Weakley, North Carolina Natural Heritage Program AEW

SUBJECT: Scoping – Proposed Jordan Lake Mechanical Aeration System (Chatham County)

REFERENCE: Project No. 14-0069

Thank you for the opportunity to provide information on the proposed project referenced above. The NCNHP database shows various records for rare species, high quality natural communities, significant natural areas, or conservation/managed areas within the vicinity of the proposed project sites in the Morgan Creek and Haw River arms of Jordan Lake.

The request for scoping shows lines on maps of the generalized area where the proposed mechanical aerators will be placed, but also states that the area of impact will encompass approximately 750 acres of the Morgan Creek Arm and approximately 700 acres of the Haw River Arm of Jordan Lake. It is not clear from the maps provided what larger defined area of impact is being considered, so below is a list of records for rare species from the NCNHP database from within approximately 0.5 miles of the proposed project sites displayed on the maps. Also discussed below are records for natural communities, significant natural areas, and conservation/managed areas tracked in the NCNHP database within close proximity to the proposed project sites on the map that may be considered.

Within 0.5 miles of the three individual proposed project sites, the NCNHP database shows records for documented occurrences of the following rare species (listed by taxonomic group):

SCIENTIFIC NAME	COMMON NAME	EO_STATUS	NC_STATUS	USA_STATUS
Haliaeetus leucocephalus	Bald Eagle	Current	T	BGPA
Gomphus septima	Septima's Clubtail	Current	SR	FSC
Notropis mekistocholas	Cape Fear Shiner	Historical	E	E
Scutellaria nervosa	Veined Skullcap	Historical	E	---

* For status definitions, please see the Help document at http://www.ncnhp.org/web/nhp/database-search.

The record for the Bald Eagle occurrence is located north/northeast of the proposed Morgan Creek project site on land owned by the NC Wildlife Resources Commission. The NCNHP database shows that the Bald Eagle nest was active as of 2011.

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-707-8600 \ Internet: www.ncdenr.gov

Bald Eagles were removed from the federal list of threatened and endangered species on August 9, 2007, and are no longer protected under the Endangered Species Act. However, Bald Eagles remain protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The Bald and Golden Eagle Act prohibits anyone from taking, possessing, or transporting a Bald Eagle, or the parts, nests, or eggs of such birds without prior authorization. This includes inactive nests as well as active nests. Take means to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb. Activities that directly or indirectly lead to take are prohibited without a permit. For more information, please contact the US Fish and Wildlife Service (Raleigh Office).

The record for Cape Fear Shiner is located in the lower reach of Robeson Creek at its confluence with Haw River, and is considered historical (last documented in 1968). The US Fish and Wildlife Service has begun a re-introduction program for this species in Chatham County where the species was formerly known to occur. For more information, please contact the US Fish and Wildlife Service (Raleigh Office).

The record for Septima's Clubtail is documented from the Haw River Aquatic Habitat and Haw River Levees and Bluffs Significant Natural Heritage Areas (SNHAs), in riffle habitat just north of the northernmost proposed project site on Haw River. The record for Veined Skullcap is located east of the proposed site on Morgan Creek, and is believed to have been destroyed from the impoundment of Jordan Lake.

Within or adjacent to the proposed project site below Robeson Creek in the Haw River arm, we have records for the Gum Springs Church Road SNHA, located on the western side of Haw River on land owned by the US Army Corps of Engineers. This SNHA is significant for its high quality natural communities, including Dry Basic Oak-Hickory Forest, Dry Oak-Hickory Forest (Piedmont Subtype), and Dry-Mesic Oak-Hickory Forest (Piedmont Subtype).

The NCNHP database also shows records for Colonial Wading Bird Colonies within the vicinity of the proposed project site on Morgan Creek; the closest is located in Cub Creek, ca. 1 mile north of the proposed site.

Please note that the use of Natural Heritage Program data should not be substituted for actual field surveys, particularly if the project area contains suitable habitat for rare species, important natural communities, or priority natural areas.

The new NCNHP website (www.ncnhp.org) offers access to data and other information on rare species, natural communities, significant natural areas, and lands managed for conservation. We are also glad to provide more detailed information and maps as requested.

Please feel free to contact me at 919-707-8629 or Allison.Weakley@ncdenr.gov if you have questions or need more information.

Department of Environment and Natural Resources
Project Review Form

Project Number: 14-0069 County: Chatham Date Received: 08/27/2013

Due Date: 9/18/2013

Project Description: Scoping - Proposed is a demonstration project for a mechanical aeration system for the management of nutrients in Jordan Lake. Project will deploy floating arrays of solar powered in-lake long-distance circulators.

This Project is being reviewed as indicated below:

Regional Office	Regional Office Area	In-House Review	
___ Asheville	✓ Air	___ Air Quality	___ Coastal Management (DCM)
___ Fayetteville	✓ DWR-Surface Water	___ DCM-Marine Fisheries	___ Military Affairs
___ Mooresville	___ DWR-Aquifer	✓ Parks & Recreation	___ DWR-Water Quality Program
✓ Raleigh	✓ DEMLR	___ Waste Mgmt	___ Water Quality - DOT
___ Washington	___ UST	✓ Water Resources Mgmt (DWR)	✓ Wildlife Shari Bryant
___ Wilmington		___ DWR-Water Supply	___ Wildlife - DOT
___ Winston-Salem			

Manager Sign-Off/Region:	Date:	In-House Reviewer/Agency:
Janene S. Childs	9/16/13	

Response (check all applicable)

___ No objection to project as proposed. ___ No Comment

___ Insufficient information to complete review ___ Other (specify or attach comments)

If you have any questions, please contact:

Lyn Hardison at lyn.hardison@ncdenr.gov or (252) 948-3842
943 Washington Square Mall Washington NC 27889
Courier No. 16-04-01

AUG 29 2013

State of North Carolina
Department of Environment and Natural Resources

Reviewing Office: _____

INTERGOVERNMENTAL REVIEW - PROJECT COMMENTS

Project Number: 14-0069 Due Date: _____

After review of this project it has been determined that the ENR permit(s) and/or approvals indicated may need to be obtained in order for this project to comply with North Carolina Law. Questions regarding these permits should be addressed to the Regional Office indicated on the reverse of the form. All applications, information and guidelines relative to these plans and permits are available from the same Regional Office.

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to construct & operate wastewater treatment facilities, sewer system extensions & sewer systems not discharging into state surface waters.	Application 90 days before begin construction or award of construction contracts. On-site inspection. Post-application technical conference usual.	30 days (90 days)
☐	NPDES - permit to discharge into surface water and/or permit to operate and construct wastewater facilities discharging into state surface waters.	Application 180 days before begin activity. On-site inspection. Pre-application conference usual. Additionally, obtain permit to construct wastewater treatment facility-granted after NPDES. Reply time, 30 days after receipt of plans or issue of NPDES permit-whichever is later.	90-120 days (N/A)
☐	Water Use Permit	Pre-application technical conference usually necessary	30 days (N/A)
☐	Well Construction Permit	Complete application must be received and permit issued prior to the installation of a well.	7 days (15 days)
☐	Dredge and Fill Permit	Application copy must be served on each adjacent riparian property owner. On-site inspection. Pre-application conference usual. Filling may require Easement to Fill from N.C. Department of Administration and Federal Dredge and Fill Permit.	55 days (90 days)
☐	Permit to construct & operate Air Pollution Abatement facilities and/or Emission Sources as per 15 A NCAC (2Q.0100 thru 2Q.0300)	Application must be submitted and permit received prior to construction and operation of the source. If a permit is required in an area without local zoning, then there are additional requirements and timelines (2Q.0113)	90 days
☐	Permit to construct & operate Transportation Facility as per 15 A NCAC (2D.0800, 2Q.0601)	Application must be submitted at least 90 days prior to construction or modification of the source.	90 days
☐	Any open burning associated with subject proposal must be in compliance with 15 A NCAC 2D.1900	N/A	60 days (90 days)
☐	Demolition or renovations of structures containing asbestos material must be in compliance with 15 A NCAC 2D.1110 (a) (1) which requires notification and removal prior to demolition. Contact Asbestos Control Group 919-707-5950.		
☐	Complex Source Permit required under 15 A NCAC 2D.0800		
☐	The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed. Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of $65 for the first acre or any part of an acre. An express review option is available with additional fees.		20 days (30 days)
☐	Sedimentation and erosion control must be addressed in accordance with NCDOT's approved program. Particular attention should be given to design and installation of appropriate perimeter sediment trapping devices as well as stable stormwater conveyances and outlets.		(30 days)
☐	Mining Permit	On-site inspection usual. Surety bond filed with ENR. Bond amount varies with type mine and number of acres of affected land. Any acre mined greater than one acre must be permitted. The appropriate bond must be received before the permit can be issued.	30 days (60 days)
☐	North Carolina Burning permit	On-site inspection by N.C. Division Forest Resources if permit exceeds 4 days	1 day (N/A)
☐	Special Ground Clearance Burning Permit - 22 counties in coastal N.C. with organic soils	On-site inspection by N.C. Division Forest Resources required "if more than five acres of ground clearing activities are involved. Inspections should be requested at least ten days before actual burn is planned."	1 day (N/A)
☐	Oil Refining Facilities	N/A	90-120 days (N/A)
☐	Dam Safety Permit	If permit required, application 60 days before begin construction. Applicant must hire N.C. qualified engineer to: prepare plans, inspect construction, certify construction is according to ENR approved plans. May also require permit under mosquito control program. And a 404 permit from Corps of Engineers. An inspection of site is necessary to verify Hazard Classification. A minimum fee of $200.00 must accompany the application. An additional processing fee based on a percentage of the total project cost will be required upon completion.	30 days (60 days)

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to drill exploratory oil or gas well	File surety bond of $5,000 with ENR running to State of NC conditional that any well opened by drill operator shall, upon abandonment, be plugged according to ENR rules and regulations.	10 days N/A
☐	Geophysical Exploration Permit	Application filed with ENR at least 10 days prior to issue of permit. Application by letter. No standard application form.	10 days N/A
☐	State Lakes Construction Permit	Application fees based on structure size is charged. Must include descriptions & drawings of structure & proof of ownership of riparian property.	15-20 days N/A
☐	401 Water Quality Certification	N/A	60 days (130 days)
☐	CAMA Permit for MAJOR development	$250.00 fee must accompany application	55 days (150 days)
☐	CAMA Permit for MINOR development	$50.00 fee must accompany application	22 days (25 days)
☐	Several geodetic monuments are located in or near the project area. If any monument needs to be moved or destroyed, please notify: N.C. Geodetic Survey, Box 27687 Raleigh, NC 27611		
☐	Abandonment of any wells, if required must be in accordance with Title 15A. Subchapter 2C.0100.		
☐	Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation.		
☐	Compliance with 15A NCAC 2H 1000 (Coastal Stormwater Rules) is required.		45 days (N/A)
☐	Tar Pamlico or Neuse Riparian Buffer Rules required.		

* Other comments (attach additional pages as necessary, being certain to cite comment authority)

JOHN HOLLEY - DEMLR - BASED ON THE DESCRIPTION GIVEN, IT DOES NOT APPEAR THAT EXTENSIVE LAND-DISTURBING ACTIVITIES WOULD BE REQUIRED; HOWEVER, ANY IMPACTED AREAS EXPOSING SOIL TO POTENTIAL EROSION MUST BE ADDRESSED WITH APPROPRIATE SEDIMENT CONTROL MEASURES, & GROUND COVER WOULD NEED TO BE ESTABLISHED SUFFICIENT TO RESTRAIN ACCELERATED EROSION.

REGIONAL OFFICES

Questions regarding these permits should be addressed to the Regional Office marked below.

☐ **Asheville Regional Office**
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4500

☐ **Fayetteville Regional Office**
225 North Green Street, Suite 714
Fayetteville, NC 28301-5043
(910) 433-3300

☐ **Mooresville Regional Office**
610 East Center Avenue, Suite 301
Mooresville, NC 28115
(704) 663-1699

☐ **Raleigh Regional Office**
3800 Barrett Drive, Suite 101
Raleigh, NC 27609
(919) 791-4200

☐ **Washington Regional Office**
943 Washington Square Mall
Washington, NC 27889
(252) 946-6481

☐ **Wilmington Regional Office**
127 Cardinal Drive Extension
Wilmington, NC 28405
(910) 796-7215

☐ **Winston-Salem Regional Office**
585 Waughtown Street
Winston-Salem, NC 27107
(336) 771-5000

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: CHATHAM

H12: OTHER

AUG 2 9 2013

STATE NUMBER: 14-E-4300-0069
DATE RECEIVED: 08/23/2013
AGENCY RESPONSE: 09/18/2013
REVIEW CLOSED: 09/23/2013

MS RENEE GLEDHILL-EARLEY
CLEARINGHOUSE COORDINATOR
DEPT OF CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
MSC 4617 - ARCHIVES BUILDING
RALEIGH NC

CH 13- 1866

A - NC DAH 8/31/13

Due 9/9/13

REVIEW DISTRIBUTION

CC&PS - DIV OF EMERGENCY MANAGEMENT
DENR LEGISLATIVE AFFAIRS
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
TRIANGLE J COG

S NC JOK 9/10/13

Due 9/13/13

PROJECT INFORMATION

APPLICANT: NCDENR
TYPE: State Environmental Policy Act
Scoping

DESC: Proposed is a demonstration project for a mechanical aeration system for the management of nutrients in Jordan Lake. Project will deploy floating arrays of solar powered in-lake long-distance circulators.

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: [X] NO COMMENT [ ] COMMENTS ATTACHED

SIGNED BY: Renee Gledhill-Earley DATE: 9.16.13

SEP 2013
RECEIVED
Secretary's Office
DOA

AUG 3 0 2013

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: CHATHAM H12: OTHER

STATE NUMBER: 14-E-4300-006
DATE RECEIVED: 08/23/2013
AGENCY RESPONSE: 09/18/2013
REVIEW CLOSED: 09/23/2013

MS CAROLYN PENNY
CLEARINGHOUSE COORDINATOR
CC&PS - DIV OF EMERGENCY MANAGEMENT
FLOODPLAIN MANAGEMENT PROGRAM
MSC # 4719
RALEIGH NC

RECEIVED
AUG 27 2013
N.C. Floodplain Mapping Program

REVIEW DISTRIBUTION

CC&PS - DIV OF EMERGENCY MANAGEMENT
DENR LEGISLATIVE AFFAIRS
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
TRIANGLE J COG

PROJECT INFORMATION

APPLICANT: NCDENR
TYPE: State Environmental Policy Act
Scoping

DESC: Proposed is a demonstration project for a mechanical aeration system for the management of nutrients in Jordan Lake. Project will deploy floating arrays of solar powered in-lake long-distance circulators.

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: [✓] NO COMMENT [ ] COMMENTS ATTACHED

SIGNED BY: David Halvy DATE: 8/27/13

Not in SFHA

AUG 2013
RECEIVED
GOVERNMENT OPERATIONS
DOA

Appendix B

Federal and State Listed Species in Chatham County

U.S. Fish & Wildlife Service

Endangered Species, Threatened Species,Federal Species of Concern, and Candidate Species,

Chatham County, North Carolina

Updated: 12-26-2012

Critical Habitat Designations:

Cape Fear shiner - *Notropis mekistocholas* - Approximately 4.1miles of the Rocky River from North Carolina State Highway 902 Bridge downstream to Chatham County Road 1010 Bridge; and approximately 0.5river mile of Bear Creek, from Chatham County Road 2156 Bridge downstream to the Rocky River, then downstream in the Rocky River (approximately 4.2river miles) to the Deep River, then downstream in the Deep River (approximately 2.6river miles) to a point 0.3river mile below the Moncure, North Carolina, U.S.Geological Survey Gaging Station. Constituent elements include clean streams with gravel, cobble, and boulder substrates with pools, riffles, shallow runs and slackwater areas with large rock outcrops and side channels and pools with water of good quality with relatively low silt loads.
Federal Register Reference: September 25, 1987, Federal Register, 2: 36034-36039.

Common Name	Scientific name	Federal Status	Record Status
Vertebrate:			
American eel	*Anguilla rostrata*	FSC	Current
Bachman's sparrow	*Aimophila aestivalis*	FSC	Current
Bald eagle	*Haliaeetus leucocephalus*	BGPA	Current
Cape Fear shiner	*Notropis mekistocholas*	E	Current
Carolina darter	*Etheostoma collis lepidinion*	FSC	Current
Carolina redhorse	*Moxostoma* sp. *2*	FSC	Current
Red-cockaded woodpecker	*Picoides borealis*	E	Historic
Invertebrate:			
Atlantic pigtoe	*Fusconaia masoni*	FSC	Current

Brook floater	*Alasmidonta varicosa*	FSC	Current
Carolina creekshell	*Villosa vaughaniana*	FSC	Current
Septima's clubtail	*Gomphus septima*	FSC	Current
Yellow lampmussel	*Lampsilis cariosa*	FSC	Current
Vascular Plant:			
Buttercup phacelia	*Phacelia covillei*	FSC	Current
Harperella	*Ptilimnium nodosum*	E	Current
Sweet pinesap	*Monotropsis odorata*	FSC	Current
Virginia quillwort	*Isoetes virginica*	FSC	Historic
Nonvascular Plant:			
Lichen:			

Definitions of Federal Status Codes:
E = endangered. A taxon "in danger of extinction throughout all or a significant portion of its range."
T = threatened. A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
C = candidate. A taxon under consideration for official listing for which there is sufficient information to support listing. (Formerly "C1" candidate species.)
BGPA =Bald and Golden Eagle Protection Act. See below.
FSC = federal species of concern. A species under consideration for listing, for which there is insufficient information to support listing at this time. These species may or may not be listed in the future, and many of these species were formerly recognized as "C2" candidate species.
T(S/A) = threatened due to similarity of appearance. A taxon that is threatened due to similarity of appearance with another listed species and is listed for its protection. Taxa listed as T(S/A) are not biologically endangered or threatened and are not subject to Section 7 consultation. See below.
EXP = experimental population. A taxon listed as experimental (either essential or nonessential). Experimental, nonessential populations of endangered species (e.g., red wolf) are treated as threatened species on public land, for consultation purposes, and as species proposed for listing on private land.
P = proposed. Taxa proposed for official listing as endangered or threatened will be noted as "PE" or "PT", respectively.

Bald and Golden Eagle Protection Act (BGPA):

In the July 9, 2007 Federal Register(72:37346-37372), the bald eagle was declared recovered, and removed (de-listed) from the Federal List of Threatened and Endangered wildlife. This delisting took effect August 8,2007. After delisting, the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668-668d) becomes the primary law protecting bald eagles. The Eagle Act prohibits take of bald and golden eagles and provides a statutory definition of "take" that includes "disturb". The USFWS has developed National Bald Eagle Management Guidelines to provide guidance to land managers, landowners, and others as to how to avoid disturbing bald eagles. For mor information, visit http://www.fws.gov/migratorybirds/baldeagle.htm

Threatened due to similarity of appearance(T(S/A)):

In the November 4, 1997 Federal Register (55822-55825), the northern population of the bog turtle (from New York south to Maryland) was listed as T (threatened), and the southern population (from Virginia south to Georgia) was listed as T(S/A) (threatened due to similarity of appearance). The T(S/A) designation bans the collection and interstate and international commercial trade of bog turtles from the

southern population. The T(S/A) designation has no effect on land management activities by private landowners in North Carolina, part of the southern population of the species. In addition to its official status as T(S/A), the U.S. Fish and Wildlife Service considers the southern population of the bog turtle as a Federal species of concern due to habitat loss.

Definitions of Record Status:

Current - the species has been observed in the county within the last 50 years.
Historic - the species was last observed in the county more than 50 years ago.
Obscure - the date and/or location of observation is uncertain.
Incidental/migrant - the species was observed outside of its normal range or habitat.
Probable/potential - the species is considered likely to occur in this county based on the proximity of known records (in adjacent counties), the presence of potentially suitable habitat, or both.

North Carolina Natural Heritage Program Natural Heritage Search for Chatham County

Taxanomic Group	Scientific Name	Common Name	NC Status	USA Status	State Rank	Global Rank	County Status
Freshwater Bivalve	*Alasmidonta undulata*	Triangle Floater	T		S2	G4	Current
Freshwater Bivalve	*Alasmidonta varicosa*	Brook Floater	E	FSC	S1	G3	Current
Freshwater Fish	*Ambloplites cavifrons*	Roanoke Bass	SR	FSC	S2	G3	Current
Bird	*Ammodramus savannarum*	Grasshopper Sparrow	W1,W5		S3B,S1N	G5	Current
Moss	*Anacamptodon splachnoides*	Knothole Moss	W7		S2?	G3G5	Historical
Bird	*Anhinga anhinga*	Anhinga	W2		S3B	G5	Current
Vascular Plant	*Baptisia albescens*	Thin-pod White Wild Indigo	W1		S3	G4	Historical
Natural Community	Basic Mesic Forest (Piedmont Subtype)				S3S4	G3G4	Current
Crustacean	*Cambarus davidi*	Carolina Ladle Crayfish	SR		S2S3	G3	Current
Vascular Plant	*Carex festucacea*	Fescue Sedge	W7		S2?	G5	Current
Vascular Plant	*Carex vestita*	Velvet Sedge	SC-H		SH	G5	Historical
Moth	*Catocala illecta*	Magdalen Underwing	W3		SU	G5	Current
Mayfly	*Choroterpes basalis*	a mayfly	SR		S2	G5	Current
Reptile	*Clemmys guttata*	Spotted Turtle	W1		S3	G5	Current
Vascular Plant	*Collinsonia tuberosa*	Piedmont Horsebalm	SC-V		S1	G3G4	Current
Animal Assemblage	Colonial Wading Bird Colony				S3	G5	Current
Vascular Plant	*Corallorhiza odontorhiza*	Autumn Coral-root	W1		S4?	G5	Historical

Appendix C

Fish Swim Speeds

Taken from the Town of Cary and Apex Environmental Assessment – *Direct Impacts of the Proposed Jordan Lake Aeration System for the Cary/Apex Water Treatment Facility*

Species	Life Stage	Total Length (in)	Swim Speed (ft/s)		References
			Prolonged / Critical	Burst / Startle	
Largemouth Bass	Fry	0.79-0.87	0.78-1.02	1.56-2.04	Larimore and Deuver (1968) cited in Beamish (1978)
	Juvenile	2.05-5.04	0.92-1.64	1.84-3.28	Hocutt (1973); Farlinger and Beamish (1977) cited in Beamish (1978); Larimore and Deuver (1968) cited in Beamish (1978); Dahlberg et al. (1968) cited in Carlander (1977); Kolok (1991); Otto and Rice (1974) cited in Beamish (1978);
	Juvenile	5.91-10.63	1.51-2.17	3.02-4.34	Beamish (1970) cited in Carlander (1977)
Bluegill	Juvenile	2.01-2.13	0.92	1.84	Schuler (1968); King (1969); Beamish (1978);
	Adult	3.94-5.91	1.22	2.44	Gardner et al. (2006)
	Adult	6.02	-	4.30	Webb (1978); Deng et al. (2004); Drucker and Lauder (1999)
White Crappie	Juvenile	3.03	0.18-0.52	0.36-1.04	Schuler (1968); King (1969); Smiley and Parsons (1997)
Blue Catfish	Juvenile	7.58	3.28	3.61	Beecham et al. (2009)
Hybrid Catfish (Female Channel Catfish x Male Blue Catfish)	Juvenile	6.30-9.06	3.94	7.88	Beecham et al. (2009)
Striped Bass*	Adult	47.20	7.87	32.8	Brett 1964 cited in The University of Iowa 2010; Brainbridge 1961 cited in The University of Iowa 2010
Blue Sucker	Adult	26.20	4.36	19.51	Brett 1964 cited in The University of Iowa 2010; Brainbridge 1961 cited in The University of Iowa 2011
Pallid Sturgeon	Juvenile	5.26	1.54	2.36	Hoover et al. (2005)
	Juvenile	3.59	1.51	2.42	Hoover et al. (2005)
Pallid Sturgeon	Adult	32.10	5.36	23.39	Brett (1964) cited in The University of Iowa (2010); Brainbridge (1961) cited in The University of Iowa (2010)
Shovelnose Sturgeon	Adult	28.30	4.72	20.92	Brett (1964) cited in The University of Iowa (2010); Brainbridge (1961) cited in The University of Iowa (2010)
Paddlefish	Juvenile	3.53	1.38	2.17	Hoover et al. (2005)
Paddlefish	Adult	47.20	7.87	32.8	Brett (1964) cited in The University of Iowa (2010); Brainbridge (1961) cited in The University of Iowa (2010)

* Used as surrogate for white bass

NOTE: Burst/Startle speed calculated at 50% greater than Prolonged/Critical speed based on Bell (1991) unless burst speed provided in the literature (e.g. adult bluegill, juvenile blue catfish, pallid sturgeon [Hoover et al. 2005]) and paddlefish (Hoover et al. 2005).

Appendix D

Jordan Lake Water Quality Improvement Demonstration Project (Session Law 2013-360§14.3A.(a)

JORDAN LAKE WATER QUALITY IMPROVEMENT DEMONSTRATION PROJECT

SECTION 14.3A.(a) Jordan Lake Nutrient Mitigation Demonstration Project. – The Department of Environment and Natural Resources shall establish a twenty-four-month demonstration project for the management of nutrients in Jordan Lake. The demonstration project shall specifically focus on preventing and reducing harmful algal blooms and excessive chlorophyll as well providing other nutrient mitigation measures in the Haw River arm and the Morgan Creek arm of Jordan Lake. In conducting the demonstration project, the Department shall enter into a contract with a third party that can deploy floating arrays of in-lake, long-distance circulators to reduce or prevent the adverse impacts of excessive nutrient loads, such as algal blooms, taste and odor problems in drinking water, and low levels of dissolved oxygen. At a minimum, the in-lake mechanical system chosen must meet the following criteria:

(1) Floating equipment shall be capable of continuous operation on solar power only during day, night, and extended overcast conditions 365 days per year. Continuous operation shall be defined as operating a minimum of ninety-seven percent (97%) of the total hours during the course of one year on solar power without reliance on any connection to the alternating current power grid.

(2) Achieve a total flow rate through the impellers on a continuous basis for 24 hours per day of 72,000 gallons per minute in the Morgan Creek arm and 36,000 gallons per minute in the Haw River arm.

(3) The circulation equipment shall be constructed primarily of Type 316 stainless steel metal for strength and superior corrosion resistance. Each machine shall also undergo a passivation bath, also known as stainless steel pickling, to restore corrosion resistance to the welds and other areas of imperfection.

(4) The circulation equipment shall be mechanically operated by a motor that has the following characteristics:

a. Is brushless (brush motors requiring brush replacement are not acceptable).

b. Uses a direct drive with no gearbox to avoid lubrication maintenance.

c. Contains stainless steel bearings requiring no scheduled lubrication with a rated bearing life expectancy greater than 100,000 hours of continuous operation.

d. Is designed for a marine outdoor environment by having a sealed housing with polymeric encapsulated internal windings for superior corrosion resistance capable of withstanding environmental conditions of one hundred percent (100%) humidity, -40 degree to 140 degree Fahrenheit ambient temperature range, freeze resistance, condensation resistance, and splash resistance.

e. Has a 10 year or greater replacement warranty.

(5) The circulation equipment shall be supplied with a motor controller and power management with the following features:

a. An anti-jam reverse feature that is automated and self-clearing for a locked rotor triggered by high current occurrences caused by a jammed impeller.
b. Scheduled reverse cycles with daily reverse impeller cycling for self-clearing of impeller to minimize fouling.
c. Motor health status monitoring and recording that includes scheduled speed, commanded speed, actual speed, motor current, motor voltage, and motor controller errors.
d. Temperature-compensated charging so that battery charging parameters are automatically adjusted for optimum results based on battery temperature.
e. Power conservation and continued operation mode managed by a programmed algorithm for reducing motor load and continuing operation by incremental speed reduction that is automatically enabled when extended low-sunlight conditions occur or battery reserve power is reduced.
f. A NEMA 4 enclosure for protection against condensation and moisture in a marine environment with internal circuit boards that are conformal coated for added protection against moisture.

(6) The battery power storage shall be a single battery (unless multiple batteries are connected in series) to avoid charging problems and shall have the following characteristics:
a. A battery rating capacity, at a 24-hour discharge rate in watt hours, at least 50 times the motor load in watts during normal operation (full speed, peak load).
b. Is a submergible battery to avoid temperature extremes and extend battery life.
c. Complies with DOT HMR49 nonspillable battery requirements.
d. Is UL listed and compliant to UL 1989.
e. Is maintenance-free and does not require rewatering.
f. Has a temperature sensor that monitors battery housing temperature and not ambient temperature to optimize charging cycles and extend battery life.
g. Is encased in double wall plastic and mounted in a stainless steel cage for safety and battery protection purposes.

(7) The photovoltaic modules on the unit shall have the following characteristics:
a. Have a nominal wattage rating that is five times the normal operating wattage of the motor to ensure continuous operation of the motor and impeller in all seasons.
b. Are monocrystalline and not multicrystalline to ensure adequate power collection during low-sunlight conditions.
c. Are certified to UL 1703 Class C, IEC 61215, and IEC 60364 standards.
d. Have 25-year manufacturer performance warranties.

(8) The digital controller of the machine shall have the following features:
a. Flashing light-emitting diodes in the control box readily accessible by service personnel and providing continuous electrical diagnostics so the state of the power system can easily be determined.
b. Capability to store within controller memory a 30-day rolling log of all primary machine operation parameters.

(9) The machine shall have an adjustable horizontal water intake that is capable of being field adjusted to a set level below the water surface without requiring machine removal or reinstallation. The intake shall bring a one-foot thick horizontal layer of water into the machine and include a singular hose of adequate length to reach the required intake depth setting. The flow through the hose and intake shall not exceed one foot per second.

(10) The circulation equipment shall operate normally with the following maintenance features:

a. No scheduled lubrication requirements for any system component, including motor and motor bearings.
b. No brush replacement on motor, gearbox replacement, or motor replacement to be expected during a 25-year expected life of the circulation equipment.
c. No spare parts shall be required to be kept on hand.
d. The impeller assembly shall be removable without the use of tools.
e. The circulator equipment shall have a bird deterrent system to minimize bird roostings and droppings on photovoltaic modules.

(11) The flotation equipment shall have the following features and characteristics:
a. Adjustable float arms with a one-inch diameter shaft and turnbuckle to achieve optimal performance setting. The arms shall be a closed frame to minimize torsion forces on the circulation equipment and provide balanced flotation.
b. The flotation buoyancy shall be 1,350 pounds or more to support the weight of the assembled circulation equipment with a safety factor greater than 1.5. Each machine shall weigh approximately 850 pounds.
c. Flotation shall contain expanded polystyrene foam beads that are steamed together to minimize water adsorption.
d. The flotation shall not sink should the flotation encasement be punctured. Encasements shall be resistant to damage due to animals, ice, bumps by watercraft, and contact deterioration from petroleum products and should be suitable for marine use.

(12) The circulation equipment shall be capable of being held in position by either attachment to mooring blocks at the bottom of the reservoir or tethering to the shore.

Any contract entered into under this subsection shall not be subject to Article 3 or Article 8 of Chapter 143 of the General Statutes. Once installed, the Department shall monitor and evaluate the performance of the circulators in reducing the adverse impacts of harmful algal blooms and excessive chlorophyll and in providing other nutrient mitigation measures in the Haw River arm and the Morgan Creek arm of Jordan Lake and report the results of the monitoring and evaluation as provided in subsection (b) of this section.

SECTION 14.3A.(b) Report. – No later than October 1, 2015, the Department of Environment and Natural Resources shall submit an interim report on implementation of the demonstration project to the Environmental Review Commission and the Fiscal Research Division of the General Assembly. No later than April 1, 2016, the Department of Environment and Natural Resources shall submit a final report on implementation of the demonstration project to the Environmental Review Commission and the Fiscal Research Division of the General Assembly.

SECTION 14.3A.(c) Funding. – Of the funds appropriated by this act to the Clean Water Management Trust Fund, a total of one million three hundred fifty thousand dollars ($1,350,000) for fiscal year 2013-2014 and three hundred thousand dollars ($300,000) for fiscal year 2014-2015 shall be transferred to the Department of Environment and Natural Resources to be used to implement the Jordan Lake Water Quality Improvement Demonstration Project. In addition, the Department of Environment and Natural Resources shall contribute one hundred fifty thousand dollars ($150,000) for fiscal year 2014-2015 and one hundred fifty thousand dollars ($150,000) for fiscal year 2015-2016 from available funds, including those appropriated by this act, to support the Department's Division of Water Resources activities to manage and carry out the project, including water sampling, water testing, and water analysis of samples in the lake and connecting creeks prior to and during the demonstration project defined in subsection (a) of this section.

Appendix E

Study Plan for the Assessment of In-Lake Mechanical Reductions of Adverse Impacts Related to Excess Nutrients in the Morgan Creek and Haw River Arms of Jordan Lake

Study Plan for the Assessment of In-Lake Mechanical Reductions of Adverse Impacts Related to Excess Nutrients in the Morgan Creek and Haw River Arms of Jordan Lake

Purpose

The objective of this study is to provide information for the Jordan Lake Nutrient Mitigation Demonstration Project. Specifically this includes water sampling, water testing and water analysis of samples in Jordan Lake and connecting creeks prior to and during the demonstration project detailed in Section 14.3A.(a) of S.L. 2013- 402.

Study Plan

Design

In addition to the current monitoring study in place on Jordan Lake required by section 3.(c) of S.L. 2009 - 216, eleven additional monitoring stations will be sampled as part of this study, see Figure 1. These stations will be sampled once per month in concurrence with existing Jordan Lake monitoring sites. Sites will be located to provide water quality data in the immediate vicinity of mechanical water circulators, as well as in background or control areas outside of the area affected by mechanical circulation.

Parameters

Sample collection will focus on nutrient related physical, chemical and biological water quality parameters. Sites and parameters to be evaluated in this study are shown in Table 1. Chemical water quality samples will be collected from the photic zone. The photic zone is defined as a vertical area from the water surface to a depth equal to two times the secchi depth, and represents the region of the water column which is most reflective of nutrient enrichment impacts. Depth stratified physical parameters will be collected at the surface (0.15 m), 1 m increments to a depth of 10 m, and every 5 m thereafter. Phytoplankton samples will be collected at selected sites chosen proximity to circulators to determine species composition while efficiently performing microscopic analysis. Water quality sample collections and field operations will follow DWR/ESS/ISU Standard Operating Procedures: Physical and Chemical Monitoring Version 2 (Nov 2011) and Ambient Lakes Quality Assurance Project Plan Version 1 (July 2012). Quality control documents can be found on the Environmental Sciences Section's website at: http://portal.ncdenr.org/web/wq/ess/isu. Sampling began in June 2013 and will continue through 2016 allowing for sufficient data to be collected in order to evaluate implementation of the demonstration project.

Assessment

Evaluation of water quality data collected during this study will focus on nutrient related problems including elevated pH and excessive chlorophyll *a* in the Haw River Arm and Morgan Creek Arm of Jordan Lake. According to 2012 303(d) assessment information, Jordan Lake remains impaired for chlorophyll *a* and pH. Success of the demonstration project will be measured by comparing concentrations of chlorophyll *a* and pH to water quality standards using the current assessment methodology for impairment (less than 10% exceedance with at least 90% confidence) which was approved by the Environmental Management Commission in March of 2013. If additional data are required or changes to study area are required, this study plan will be re-evaluated and updated accordingly.

Figure 1. Jordan Lake Monitoring Locations

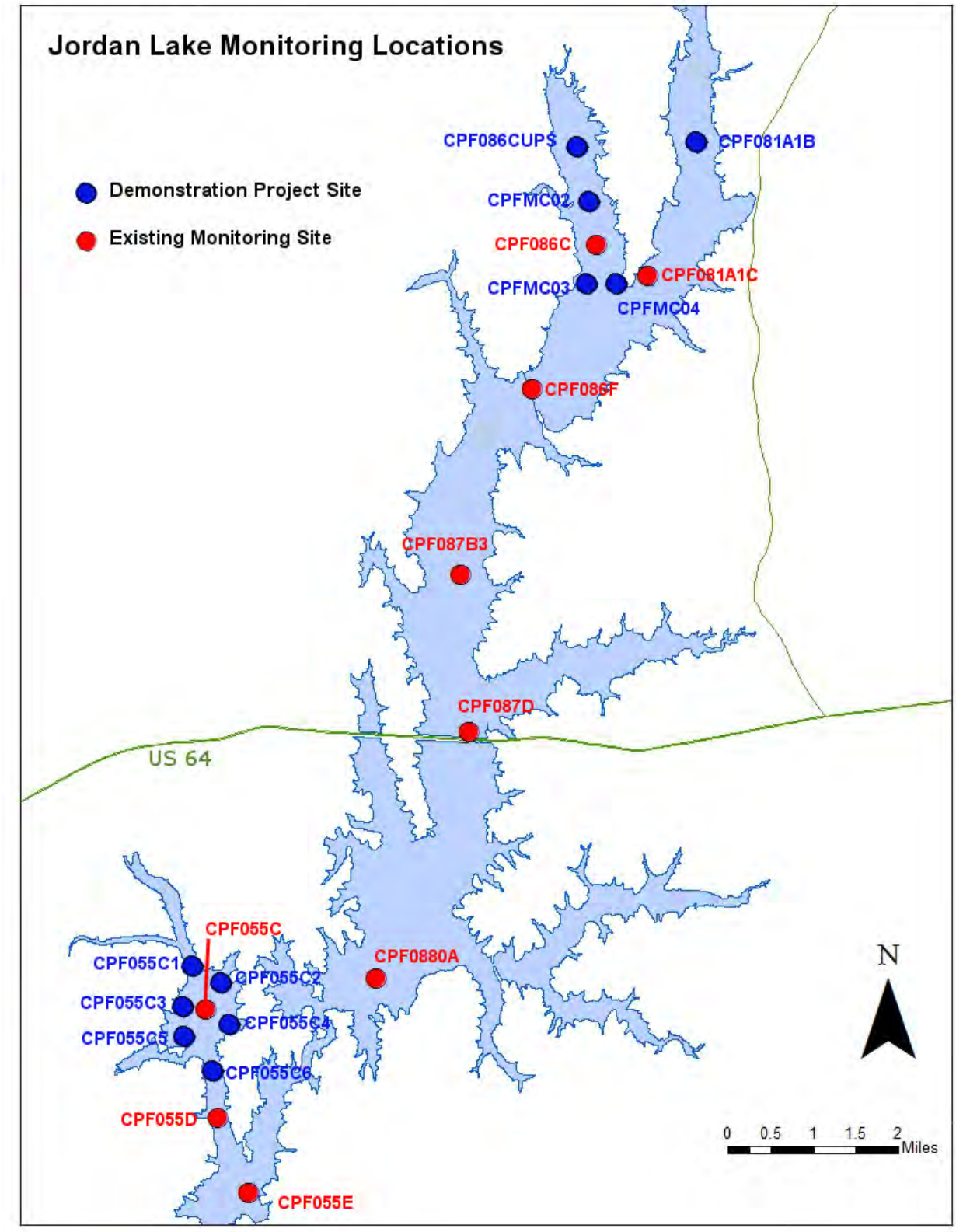


Table 1. Sites and Parameters to be Evaluated

Station	Station Description	Physical	Chemical	Biological	Parameters
CPF086CUPS	JORDAN LAKE IN UPSTREAM MORGAN CREEK ARM	X	X	X	Physical: Temperature(°C) pH Dissolved Oxygen (mg/L) Conductivity (µs/cm) Secchi Depth (m)
CPFMC02	JORDAN LAKE AT MID-CHANNEL MORGAN CREEK ARM NR CUB CREEK	X	X		
CPF086C	JORDAN LAKE AT MOUTH OF MORGAN CK NR FARRINGTON	X	X	X	
CPFMC03	JORDAN LAKE NEAR XRDS OF SR1717 AND SR1008 IN MORGAN CR ARM	X	X		
CPFMC04	JORDAN LAKE IN MORGAN CR ARM EAST OF CPFMC03	X	X		
CPF081A1B	JORDAN LAKE DOWNSTREAM OF CROOKED CREEK IN NEW HOPE CREEK ARM	X	X	X	
PF081A1C	JORDAN LAKE AT MOUTH OF NEW HOPE CREEK	X	X	X	
CPF086F	JORDAN LAKE NEAR FARRINGTON NC	X	X	X	Chemical: Chlorophyll *a (µg/L)* Nutrients- TP, TKN, NH3, NO2+NO3 (mg/L) Turbidity (mg/L)
CPF087B3	JORDAN LAKE AT BOUY #9 NEAR MERRY OAKS NC	X	X		
CPF087D	JORDAN LAKE AT MOUTH OF WHITE OAK CREEK NR SEAFORTH	X	X	X	
CPF0880A	JORDAN LAKE NEAR MOUTH OF BEAVER CREEK NEAR MERRY OAKS NC	X	X		
CPF055C1	JORDAN LAKE IN HAW RIVER ARM BAY UPSTREAM	X	X	X	
CPF055C2	JORDAN LAKE IN HAW RIVER ARM BAY NE	X	X		Biological: Phytoplankton
CPF055C3	JORDAN LAKE IN HAW RIVER ARM BAY NW	X	X		
CPF055C	JORDAN LAKE ABOVE STINKING CREEK NR PITTSBORO NC	X	X	X	
CPF055C4	JORDAN LAKE IN HAW RIVER ARM BAY SE	X	X		
CPF055C5	JORDAN LAKE IN HAW RIVER ARM BAY SW	X	X		
CPF055C6	JORDAN LAKE IN HAW RIVER ARM BAY DOWNSTREAM	X	X	X	
CPF055D	JORDAN LAKE IN CENTER OF HAW RIVER ARM	X	X		
CPF055E	JORDAN LAKE ABOVE DAM NR MONCURE NC	X	X		