US Army Corps of Engineers ®
Wilmington District

ENVIRONMENTAL ASSESSMENT

Aquatic Vegetation Management Program
JOHN H. KERR RESERVOIR

BOYDTON, VIRGINIA

April 2013

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Table of Contents

LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

This Environmental Assessment (EA) identifies and evaluates environmental impacts associated with management actions proposed as part of the John H. Kerr Reservoir Aquatic Vegetation Management Program (AVMP) on the Reservoir and contiguous water bodies. The John H. Kerr Reservoir Dam and Reservoir Project (Kerr Reservoir) is under the stewardship of the US Army Corps of Engineers (USACE) Wilmington District. Methods evaluated include chemical control, biological control utilizing triploid grass carp (*Ctenopharyngodon idella - triploid)*, hand removal of vegetation, and planting of native aquatic vegetation.

This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and the following implementation regulations and guidelines: The Council on Environmental Quality (CEQ) regulations as contained in 40 CFR Parts 1500 to 1508; Engineer Regulation (ER) 200-2-2 Procedures for Implementing NEPA; and ER 200-1-5 Environmental Quality – Policy for Implementation and Integrated Application of the USACE Environmental Operating Principles and Doctrine.

2.0 PROJECT DESCRIPTION AND BACKGROUND INFORMATION

Kerr Reservoir is located along the Roanoke River in Halifax, Mecklenburg, and Charlotte Counties, Virginia and Granville, Vance, and Warren Counties, North Carolina. The Kerr Reservoir project includes approximately 48,900 acres of water surrounded by approximately 55,000 acres of public land, all under the stewardship of the USACE Wilmington District. The reservoir creates over 800 miles of shoreline. The pool elevation for Kerr Reservoir follows an annual guide curve (Figure 1) fluctuating seasonally between 295.5 and 302 feet above mean sea level (ft msl). The Kerr Dam spill way elevation is 320 ft msl with a maximum surcharge pool at 326 feet msl. John H. Kerr Dam is 2,785 feet long and 144 feet tall. Kerr Dam generates an average of 426,749,000 kilowatt hours of electricity per year. Approximately two million visitors come to Kerr Reservoir annually.

Kerr Reservoir was initially authorized by the Flood Control Act of 1944 for the purposes of reducing flood damages on the Roanoke River and generating hydroelectric power. Since its construction, the Reservoir's operating authority has been expanded to include fish and wildlife conservation, recreation, and water supply by the Rivers and Harbors Act of 1958, the Flood Control Act of 1958, the Water Supply Act of 1958, and the Fish and Wildlife Coordination Act of 1958. Construction of the Reservoir began in 1946 and was completed in 1952.

Management of public lands and waters at Kerr Reservoir is accomplished in cooperation and collaboration with state and local entities including the North Carolina Wildlife Resources Commission (NCWRC), the North Carolina Division of Parks and Recreation (NCDPR), the Virginia Department of Game and Inland Fisheries (VDGIF), and the Virginia Department of Conservation and Recreation (VDCR). The VDGIF and NCWRC take the lead on management and monitoring of fish populations and regulation of sport fishing in Kerr Reservoir.

Due to concern for the increased occurrence of hydrilla (*Hydrilla verticillata*) in Kerr Reservoir, the USACE contracted North Carolina State University (NCSU) to survey the reservoir for the presence of aquatic vegetation (NCSU 2011, NCSU 2012). Hydrilla was the

most prevalent invasive species found, infesting approximately 698 acres in 2011 (Figure 2 and 3) and 888 acres in 2012 (Figure 4), mainly in Little Nutbush Creek and Nutbush Creek portion of the Reservoir, known as the Nutbush Creek Arm.

3.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

Aquatic vegetation management is needed to ensure maintenance of a healthy and sustainable native aquatic vegetation population and to address recent increases in occurrence of invasive aquatic vegetation, primarily hydrilla. The purpose of the AVMP would be to serve as a planning tool ensuring that management actions for control of aquatic vegetation are undertaken after consideration of available information and in coordination with stakeholders.

Manmade impoundments such as Kerr Reservoir create shallow water areas where sun light penetrates to the lake bottom. These shallow areas known as the littoral zone of the reservoir provide an opportunity for the growth of aquatic vegetation. The establishment and spread of aquatic vegetation in manmade reservoirs provides habitat for fish, waterfowl, and invertebrates (Carpenter and Lodge 1986, Dibble et al., 1997); improves water quality by reducing sediment, nutrients, and erosion (James and Brako 1991, James and Brako 1995, Madsen et al., 2001, Horppila and Nurminen 2005). High densities of invasive aquatic vegetation can interfere with navigation; clog intakes for drinking water and hydropower facilities; disrupt recreational activities including boating, fishing, and swimming; degrade fish and wildlife habitat; and decrease water quality (Eubanks and Morgan 2001, Kirk and Henderson 2006, Lovell et al., 2006). Invasive species of aquatic vegetation often spread into the habitat created by impoundment of manmade reservoirs more quickly than native vegetation reducing the opportunity for colonization by native vegetation (Doyle and Smart 1993, Smart et al., 1998). Invasive vegetation may out-compete native vegetation, reducing the overall abundance and diversity of aquatic vegetation in the reservoir (Boylen et al., 1999). In manmade impoundments that lack sufficient native vegetation or artificial structure to adequately support game fish populations under pressure from tournament and sport fishing, the presence of controlled populations of invasive aquatic vegetation may benefit game fish species such as crappie (*Pomoxis* sp.) and largemouth bass (*Micropterus salmoides*); however, these benefits may be reduced or eliminated as overgrowth of invasive vegetation spreads throughout the reservoir (Collee and Shireman 1980, Hoyer and Canfield 1996, Maceina 1996, Maciena and Reeves1996, Maceina and Shireman 1982, Maciena and Slipke 2003). Millions of dollars are spent annually by local, state, and federal governments, private industry, and private property owners in efforts to control/remove detrimental aquatic vegetation (Lovell et al., 2006).

The USACE Invasive Species Policy was developed to ensure agency compliance with *Executive Order 13112 Invasive Species.* The policy requires operating projects to include strategies for invasive species management in their project operations and maintenance responsibilities and that these strategies be coordinated with other Federal, State, and local agencies. *Executive Order 13112 Invasive Species* defines an invasive species as a species not native (exotic) to that ecosystem whose introduction does or is likely to cause economic or environmental harm or harm to human health. The order defines control of invasive species to mean as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking

steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions. Under*16 USC Chapter 67 Aquatic Nuisance Prevention And Control Act*, an aquatic nuisance species means a non-indigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters.

Hydrilla was designated as a federal noxious weed by the US Department of Agriculture (USDA) in 1983 and is regulated under the Federal Noxious Weed Act of 1974. The Act directs federal agencies to use an integrated management system for the planning and implementation of a program, using an interdisciplinary approach, to select a method for containing or controlling an undesirable plant species or group of species. The Act calls for using all available methods, including education; preventive measures; physical or mechanical methods; biological agents; herbicide methods; cultural methods; and general land management practices.

The extent of hydrilla infestation identified in Kerr Reservoir in 2012 (888 acres in 48,900 surface acres) is a relatively small portion of the lake surface area in comparison to other reported infestations in reservoirs such as: Lake Gaston – 4900 acres in 20,300 acre lake (Madsen 2007), Lake Seminole 13,400 acres in 37,500 acre lake (Eubanks and Morgan 2001), and Walter F George Lake - 2,400 acres in 45,190 acre lake (Burge et al., 2007). Implementation of management actions while the infestation is at a relatively low level is intended to reduce and avoid adverse impacts associated with uncontrolled growth of hydrilla.

Actions to address hydrilla in Kerr Reservoir to date include public education efforts intended to prevent spread, surveys and monitoring to document extent, and limited herbicide treatments. Herbicide treatments were undertaken by the USACE, NCDPR, and licensed herbicide applicators contracted by shoreline permit holders beginning in 2010. These treatments in areas around public boat ramps and private floating docks have had limited success resulting in localized temporary reduction in the amount of hydrilla. Based on the increasing acreage, it appears these efforts have not been effective in limiting the spread or the increase in adverse effects of hydrilla.

<u>The following needs have been identified</u>

1. Encourage the spread and establishment of populations of native aquatic vegetation.
2. Manage established populations of invasive aquatic vegetation to minimize harmful impacts.
3. Prevent introduction and establishment of invasive aquatic.
4. Develop and improve capacity to identify, report, and effectively respond to newly discovered occurrences of invasive aquatic vegetation.
5. Survey and monitor to ensure management actions are effective.
6. Collaborate with the public, stakeholders, and subject matter experts to ensure that program management actions are based on sound scientific information.
7. Utilize education, communication, and interpretative programs to convey to the public how they can help prevent, identify, detect and control invasive species; to gather public input into program plans; and to promote partnerships for implementation of the program.

Total elimination of hydrilla in Kerr Reservoir is not considered a realistic outcome given the limitations of the available control methods and the geographic extent of the current hydrilla infestation in Kerr Reservoir and in the Roanoke River Basin.

4.0 ALTERNATIVES

This chapter presents a description of the alternatives considered, and how those alternatives would meet the overall purpose and need for the Proposed Action. Also discussed are alternatives dismissed from further consideration, and the No Action alternative.

Several aquatic vegetation control methods were broadly considered for the AVMP including chemical control; mechanical controls including reservoir drawdown, mechanized harvest, and hand removal; biological control agents including open release of triploid grass carp, confined release of triploid grass carp, and insects; and planting/promotion of native vegetation. Four methods were eliminated from further consideration: reservoir drawdown, mechanical harvest, confined release of triploid grass carp, and insects as a biological control agent. Four methods were identified for further evaluation as part of the proposed alternative being considered in this EA; chemical control, open release of triploid grass carp, hand removal, and native vegetation (see section 4.1).

The No Action alternative would mean no implementation of an AVMP. Aquatic weed management at Kerr Reservoir would continue using existing methods and practices. Although the No Action alternative does not meet the purpose and need for this action, it was retained for comparison with the proposed plan and therefore, discussed in Section 5 (Affected Environment) of this EA.

4.1 Alternatives Considered and Eliminated

4.1.1 Lake Drawdown

The intent of a lake drawdown would be to expose the invasive aquatic vegetation in order to kill it and/or stunt its growth, making it more vulnerable to herbicide treatments. This alternative would require lowering of the lake pool elevation 10 feet or more below the guide curve elevation for 2 to 6 weeks during the growing season, which begins in late spring/early summer and ends in the fall. This process would require that the lake elevation be below the guide curve for an extended period of time as the water level is lowered to reach the desired draw down elevation and raised to regain the normal pool elevation.

Adverse effects of a drawdown could include disruption of recreation activities and hydropower operations, loss of native aquatic vegetation, loss of fisheries habitat critical to spawning and rearing of young fish, increased shoreline erosion, and stranding and damage to floating docks. These effects would result in significant economic losses for local businesses and communities, state and local governments, property owners, and the federal government. While drawdown would kill or stunt some portion of target species populations it could also lead to spread of some invasive species such as hydrilla to deeper areas of the lake. After water levels returned to normal, invasive plants would spread from this refuge and re-colonize areas.

Drawdown of the lake would not be a permanent solution to infestation with population of target species expected to redevelop within the lake over an unknown period of time after the drawdown is completed. Repeated drawdown would incur additional adverse impacts. Based on potential for significant environmental and economic impacts the lake draw down alternative has been eliminated from further consideration.

4.1.2 Insects as Biological Control Agents

Insects that reduce a host plant's ability to grow and reproduce by eating or damaging the plant have potential to be used as a biological control agent. Insects evaluated for use in control of hydrilla include weevils (*Bagous* sp.) and leaf-mining flies (*Hydrellia pakistanae* and *Hydrellia balciunasi*) (Balciunas et al., 2002, Cofrancesco and Grodowitz 1994; Grodowitz et al., 2003; Grodowitz et al., 2010, Wheeler and Center 2007). Leaf-mining flies are not currently considered an effective control method for monoecious hydrilla (Grodowitz et al., 2010). Monoecious hydrilla is the type found in Kerr Reservoir. Research on use of weevils for hydrilla control began in 1980's; however an effective method to establish populations of weevils for control of hydrilla has not been identified (Balciunas et al., 2002). Based on the present ineffectiveness of insect control methods, this alternative has been eliminated from further consideration. If use of insects becomes an effective treatment alternative and is proposed at Kerr Reservoir, a separate EA would be prepared to address impacts of the use of insects as a biological control agent.

4.1.3 Confined Release of Triploid Grass Carp

Confinement is used to limit the movements of triploid grass carp stocked for aquatic vegetation control. Methods used include physical barriers and electric barriers. Reasons for confinment include maximizing effects of treatment by ensuring that fish remain in the intended treatment area, avoiding impacts to native vegetation outside the treatment area, and avoiding movment of fish into adjacent water bodies where biological control of aquatic vegetation is not prescribed. Exclosures (fencing) may also be used to protect planted native aquatic vegetation from being eaten by triploid greass carp and other herbivores.

The use of confinement to prevent movement of triploid grass carp stocked in Kerr Reservoir has been eleminated from further consideration. Confined release of triploid grass carp would not meet the intended purpose of control of hydrilla throughout the reservoir.

4.1.4 Mechanical Harvest

Mechanical harvest utilizes powered machines to cut or pull aquatic vegetation to temporarily clear infested areas. Equipment is unable to remove plants at depths beyond its reach. After harvest, plants reestablish from roots remaining in the bottom. Mechanical harvesting may increase the extent of invasive vegetation as plant fragments broken off during harvest move to previously un-infested areas. Based on these considerations and the cost relative to chemical and biological control, powered mechanical harvesting has been eleminated from further consideration. Limited removal of targeted species in small areas by hand and with hand tools is a part of the prorposed action.

4.2 Preferred Alternative/Proposed Action – Kerr Reservoir AVMP

The implementation of the Kerr Reservoir AVMP is the USACE's Preferred Alternative. Implementation of the AVMP would help achieve goals of the USACE Invasive Species Policy and comply with federal laws and regulation on invasive species. The Kerr Reservoir AVMP is attached to this Environmental Assessment (Appendix I).

The AVMP includes an Action Plan that would be updated annually. The Action Plan details proposed objectives, actions, and responsibilities under the following action items: Chemical Control, Biological Control, Hand Removal, Native Aquatic Vegetation, Survey and Monitoring, Public Education, and Enforcement. Chemical control utilizing herbicides, biological control utilizing triploid grass carp, and hand removal would be used to control overgrowth of invasive aquatic vegetation. Establishment and promotion of native aquatic vegetation may be utilized in efforts to fill areas where invasive species are removed and to occupy un-infested areas. Survey and monitoring would be utilized to facilitate adaptive management decisions and development of the annual Action Plan. Public education efforts would focus on identification and methods to avoid spread of invasive species, encouraging participation in management efforts, increasing awareness of adverse impacts of invasive species, and promoting awareness of penalties for violation of nuisance and invasive species laws and regulations. Enforcement efforts would rely on existing laws and regulations.

Current statutes and regulations provide penalties for possession, transport and placement of prohibited plant species in public water. States and communities burdened with increasing costs of control of invasive species continue to strengthen laws and increase penalties as a means of preventing spread by human activity. Coordination of enforcement efforts among federal, state, and local regulatory and law enforcement agencies will ensure that violators receive penalties at all levels, as appropriate.

The USACE will schedule a meeting each spring to facilitate development of the Action Plan. To avoid duplication of efforts, and conflicts with the objectives of the Kerr Reservoir AVMP, only management activities included in annual Action Plan would be permitted on USACE property. Some activities proposed in the annual Action Plan could require additional authorizations.

4.2.1 Chemical Control

Implementation of the Kerr AVMP would include continued use of herbicides in combination with release of triploid grass carp and hand removal to control target species. Hydrilla is the most prevalent aquatic invasive plant identified in Kerr Reservoir. The limited use of herbicides in several high use areas has not controlled the spread of hydrilla in Kerr Reservoir.

Annual vegetation surveys would identify areas to be treated with herbicide. Due to the cost of herbicide treatments and limited funding, treatments would continue to be limited to high priority areas including boat ramps, swim beaches, and adjacent floating docks. Herbicide treatments would be undertaken by the USACE, lessees including NCDPR, NCWRC, VDCR, VDGIF etc., and shoreline permit holders.

The type, application rate, and method of application of herbicides would be selected based on site conditions and target species. The North Carolina Agricultural Chemicals Manual-Aquatic Weed Control section, the Virginia Pest Management Guide 2012 Horticultural & Forest Crops - Aquatic Weeds (Weed Control in Ponds and Lakes) section, herbicide labels, and other relevant publications will be utilized in reviewing and determining herbicide treatments. Potential treatment areas would be identified in the Action Plan. The proximity of treatment areas to water intakes would be reviewed during preparation of the Action Plan and during review of pre-treatment notifications. Application of herbicides would not be authorized within setback distances from potable water intakes specified on herbicide labels or by state or local requirements. Location of potable water intakes and irrigation intakes would be noted on pre-treatment notifications.

Herbicides must be applied as directed on the product label. The EPA registers and classifies pesticides as Restricted Use Pesticides (RUP), general use, or unclassified (40 CFR 152.160(a)) (EPA 2012). Once registered, a pesticide may not legally be used unless the use is consistent with the approved directions for use on the pesticide's label. In addition to the EPA registration, both North Carolina and Virginia each require registration of pesticides manufactured, distributed, sold, or used in that state. The USACE does not permit use of herbicides classified as a RUP for control of aquatic vegetation in Kerr Reservoir. Only herbicides registered for use in the appropriate state are permitted.

Information on state registration of pesticides can be found at the following websites. The Virginia Department of Agriculture and Consumer Services Pesticide Registration data website (provided by Purdue National Pesticide Information Retrieval System) http://state.ceris.purdue.edu/doc/va/stateva.html. North Carolina Department of Agriculture and Consumer Services Pesticide Registrations data web site (provided by Kelly Registrations Systems) www.kellysolutions.com/NC/.

Table 1 lists herbicide compounds recommended for control of hydrilla along with information on label restrictions from representative brand name formulations, including waiting periods for water use restrictions and setbacks from potable water intakes. The table does not include all available trade name formulations of the herbicides compounds listed. Pesticide labels can be accessed on-line at the North Carolina and Virginia registration sites listed above and through the EPA Pesticide Product Label System: www.epa.gov/opp00001/pestlabels/.

Herbicides would only be applied by applicators licensed by the appropriate state for application of aquatic herbicides. Applicator must apply for and receive a Kerr Reservoir Aquatic Herbicide Applicator Permit (Appendix B; within Appendix I, Draft AVMP) from the USACE prior to treating aquatic vegetation in Kerr Reservoir. Authorization must be renewed annually. The licensed applicator would determine the appropriate herbicide and application rate based on target species and site conditions. The applicator must submit a pre application notification and a post application report. A list of approved applicators will be provided on the USACE Kerr Reservoir web page.

Failure to follow permit conditions and unauthorized application of aquatic herbicides are considered violations of Title 36 Code of Federal Regulations, Chapter III Part 327.9, 327.12, and/or 327.18. Violators are subject to fine and/or imprisonment. Shoreline permit holders engaging in unauthorized application of herbicides are also subject to revocation of their shoreline permit. Applicators that violate terms of their applicator's authorization are subject to revocation of their authorization.

Table 1 – Herbicide compounds used for treatment of hydrilla.

		Waiting Period Before Using Water After Application of Herbicides and for Aquatic Weed Control (1)						
Herbicide Compound (2)	**Contact Or Systemic (3)**	**Trade Name/s(4)**	**Irrigation**	**Fishing**	**Watering Livestock**	**Swimming**	**Drinking**	**Setback Distance from Potable Water Intake(5)**
Complexed Copper	Contact	Komeen	No restrictions	No restrictions	No restrictions	No restrictions	No restrictions	No restrictions
Diquat	Contact	Reward	1 to 5 days	No restrictions	1day	No restrictions	1 to 3 days	400 to 1600 ft
		Tribune						350 to 1600 ft
Pentothal	Contact	Aquathol K Aquathol Super K Hydrothol 191	0 to 7 days	No restrictions	7 to 25 days	No restrictions	None if concentration < 0.1ppm	600 ft
Fluridone	Systemic	Sonar AS	7 to 30 days	No restrictions	No restrictions	No restrictions	No restrictions	1320 ft
Imazamox	Systemic	Clearcast	1 day or based on concentration reference label	No restrictions	No restrictions	No restrictions	None if concentration < 50 ppb	¼ mile
Penoxsulam	Systemic	Galleon SC	reference label based on concentration and type of plants being irrigated	No restrictions	No restrictions	No restrictions	No restrictions	No restrictions

(1) Waiting Period (In Days) Before Using Water, After Application of Herbicides For Aquatic Weed Control taken from pesticide labels for brand names listed. Reference product label for information on waiting periods relative to concentration.

(2) Herbicide compounds listed are those recommended for treatment of hydrilla in the 2012 North Carolina Agricultural Chemicals Manual, Table 7-24. Effectiveness of Herbicides and Triploid Grass Carp for Control of Weeds Commonly Found in North Carolina Ponds

(3) Reference - "Table 1. Characteristics of U.S. Environmental Protection Agency – approved aquatic herbicides" - ERDC Plant Management Information System http://el.erdc.usace.army.mil/pmis/HerbicideInformation/HerbicideInfoMain.aspx#Classification

(4) The table does not include all available trade name formulations of the herbicides compounds listed. Current pesticide labels can be accessed on-line through the EPA Pesticide Product Label System: http://www.epa.gov/pesticides/pestlabels/index.htm.http://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1

(5) Reference product label for information on applications rates and concentrations in water relative to setback distances.

4.2.2 Open Release of Triploid Grass Carp

Only grass carp certified as triploid (sterile) would be stocked for the management of invasive aquatic vegetation in Kerr Reservoir. In 1985, the U.S. Fish and Wildlife Service (USFWS) issued a biological opinion stating that use of triploid grass carp for aquatic weed control is environmentally safe and that triploid grass carp may be stocked in closed or open waters (Clugston and Shireman 1987). Triploid grass carp are produced in hatcheries through manipulation of grass carp eggs to create triploid offspring. Triploid fish have three complete sets of chromosomes in their cells resulting in the fish being unable to reproduce. The USFWS oversees certification of triploid grass carp via the National Triploid Grass Carp Inspection and Certification Program (NTGCICP). Certified triploid grass carp should not be confused with other types of Asian carp that are considered invasive species including bighead carp (*Hypophthalmichthys nobilis*), black carp (*Mylopharyngodon piceus*), silver carp (jumping carp) (*Hypophthalmichthys molitrix*), and diploid (non-sterile) grass carp (*Ctenopharyngodon idella*).

The USACE would obtain permits for triploid grass carp stocking from VDGIF and NCWRC. An initial stocking rate of 15 fish per vegetated acre of hydrilla has been identified as appropriate based on coordination with NCSU, VDGIF, and NCWRC. Intent is to stop the spread of hydrilla and reduce acreage of hydrilla throughout the reservoir substantially within 2 to 3 years of the initial stocking. Consumption rate of hydrilla will vary based on the rate of growth and mortality of the fish. Due to the demonstrated preference for grass carp feeding on hydrilla and concentration of hydrilla in the Nutbush Creek Arm it is anticipated that the grass carp released will tend to remain in that portion of the Reservoir. At the prescribed stocking rate of 15 fish per vegetated acre of hydrilla, the initial stocking would be 13,320 fish for 888 acres of hydrilla identified in the 2012 survey. The dates of stocking would be based on fish availability in 2013 and/or 2014. Fish stocked would be a minimum of 10 to 12 inches long to reduce mortality due to predation. Initial stocking would occur at five boat ramps; Steele Creek Marina, Nutbush Creek, Bullocksville, Hiberina, and County Line (Figure 5).

Restocking of fish would be prescribed as needed to maintain control of hydrilla and other target species. Restocking would be dependent on availability of funding. Restocking rates would be determined based on monitoring of vegetation and triploid grass carp populations. Restocking would likely occur annually during establishment of the grass carp population, but may occur at a longer interval depending on mortality rate of the fish. Location of restocking releases would be selected based on target area and site conditions. Stocking plans would be coordinated annually during development of the Action Plan. Because of the ability of hydrilla to re-grow from tubers and turions that persist in the bottom sediments for many years, it is likely that stocking of triploid grass carp will be a permanent part of the AVMP.

Due to the sensitive nature of this activity, the USACE does not permit private individuals and organizations to stock grass carp or any other species of fish in Kerr Reservoir. Individuals and groups interested in contributing to authorized fish stocking efforts would be provided information on how they may donate funds to assist in approved stocking activities.

4.2.3 Hand Removal

Hand removal of aquatic invasive vegetation would be used for temporarily opening small areas around docks or boat ramps, selective removal of target species from within stands of native vegetation, and stranding of floating mats of vegetation that have broken away from the bottom. Hand removal may be used in combination with chemical treatments in some areas to increase effectiveness and decrease amount of herbicide used. Due to potential for spread of invasive species through fragmentation of plants, the use of mechanical harvesting, excavation, and suction dredging aquatic vegetation are not authorized in Kerr Reservoir.

Plants would be removed by hand (pulling) or with hand tools (rakes and blades). Plants and cuttings would be removed from the water and disposed of properly. In most cases vegetation removed by hand would be kept on-site; either left to dry or buried on high ground. Transport of noxious weeds off site would require state and/or federal permits.

Shoreline permit holders and lessees wishing to remove aquatic vegetation by hand would request and receive authorization from the USACE prior to beginning removal of the vegetation (Appendix E; within Appendix I, Draft AVMP) and receive state permits as appropriate. Guidance on proper removal and disposal of nuisance/invasive vegetation would be provided in order to avoid removal of non-target vegetation, disturbance of habitat, and to avoid spread of nuisance vegetation due to fragmentation or improper disposal of the plants. Large scale hand removal activities would be identified in coordination with stakeholders and managing agencies during development of the annual Action Plan.

Transport and improper disposal of noxious weeds are violations of The Plant Protection Act - Title 7 USC Chapter 104; Federal Noxious Weed Regulations - 7 CFR Part 360; North Carolina Code - 02 NCAC 48A .1703, and the Code of Virginia - 3.2 800 - 809.

4.2.4 Native Aquatic Vegetation

Planting of selected species of native vegetation along with continued placement of artificial fish attractors in the reservoir would be used to provide structure to improve and expand aquatic habitat. Promotion of native vegetation would also help displace nuisance/invasive vegetation.

Native vegetation planting would be done utilizing techniques identified in the “Update to the Propagation and Establishment of Aquatic Plants Handbook” (Smart et al., 2005) including the use of founder colonies to establish the presence of desired species and exclusion cages to protect plants from herbivores. A survey of the littoral zone would be conducted to identify areas for planting. Areas to be planted would be selected based on water depth, bottom topography, and substrate type. Review of lessons learned from reservoirs where this method has been implemented, including Lake Gaston, Virginia and Lake Conroe, Texas, would be utilized in development of planting plans and selection of species to be planted in Kerr Reservoir. Due to the differences among reservoirs some trial and error would be required to determine what plants, locations, and methods would be most successful in Kerr Reservoir. Location and prioritization of planting and species to be planted would be identified in planting plans developed as part of the annual Action Plan.

Only native plant stock from known sources and free of invasive species would be utilized for plantings. Propagation of existing populations of plants from Kerr Reservoir could also be used as a source of stock for planting.

Due to the sensitive nature of this activity private individuals and organizations are not permitted to plant aquatic vegetation or place fish attractors in Kerr Reservoir without authorization from the USACE. Individuals and organizations interested in donating funds for and/or volunteering to assist with authorized native vegetation planting efforts and placement of fish attractors may contact the USACE for information on how to contribute to this activity.

4.3 Alternative 1 - Kerr Reservoir AVMP without Biological Control - Triploid Grass Carp

Implementation of the Kerr Reservoir AVMP for this alternative would be the same as described in the preferred alternative, with the exception that use of triploid grass carp would not be included as a control method.

4.4 No Acton Alternative

Aquatic weed management at Kerr Reservoir would continue using existing methods and practices. The No Action alternative would mean no implementation of an integrated program for control of invasive species. While the No Action alternative does not meet the identified purpose and need, this alternative has been retained for discussion in compliance with NEPA requirements.

5.0 AFFECTED ENVIRONMENT

5.1 Physical Environment

5.1.1 Geology, Topography, and Soils

Kerr Reservoir is located in the Piedmont region of Virginia and North Carolina, within the Charlotte/Chopawamsic Belt Hydrogeologic Unit of the Piedmont Physiographic Province. The Piedmont Physiographic Province generally consists of well-rounded hills and ridges which are dissected by a well-developed system of draws and streams and predominantly underlain by metamorphic rock (formed by heat, pressure and/or chemical action) and igneous rock (formed directly from molten material). Because of continued chemical and physical weathering, the rocks in the Piedmont Province are now generally covered with a mantle of soil that has weathered in place from the parent bedrock. These soils are variable in thickness and are referred to as residuum or residual soils. There are no regionally significant aquifers within these materials. Seismic activity is present in low frequency and intensity.

Kerr Reservoir and its watershed fall within the Piedmont Plateau topographic region. The topography and relief of this region have developed from differential weathering of the igneous and metamorphic rock. Ridges and hills have been developed on the less easily weathered and erodible rock. Many of the slopes along the shoreline of the reservoir are steep,

and erosion is generally severe where natural vegetation has been disturbed or where the banks are exposed to frequent wave action. The slopes extending to the south bank of the reservoir are less steep than the slopes extending to the north.

The topography in manmade impoundments such as Kerr Reservoir creates shallow water areas where sun light penetrates to the lake bottom. These shallow areas, known as the littoral zone of the reservoir, provide an opportunity for the growth of aquatic vegetation. Inundated areas with flatter topography create more potential habitat for aquatic vegetation. The littoral zone of a manmade impoundment is typically underlain by upland soils, many of which are highly erodible. Over time these soils change due to saturation, deposition and erosion of organic materials, and deposition and erosion of sediments.

The transport of sediments into the reservoir depends upon local land use activities and rainfall patterns within the drainage. Large basin-wide events can transport considerable quantities of sediments into the reservoir. Dispersal of sediments within the reservoir is dependent on the type of sediment, topography, water velocity, and other site specific conditions including presence of vegetation. Coarse grained sediments tend to settle at the interface as water slows and smaller grains remain suspend dropping out in decreasing amounts as water moves towards the dam. Wave action, currents, and turbulence influence the deposition and periodic re-suspension of the small grain sediments. Gradually, these sediments accumulate and are incorporated into the underlying bottom sediments. This process fills in the reservoirs over time. Submersed aquatic vegetation influences the rate of sediment accumulation, consolidation of sediments, and soil formation and chemistry on the lake bottom. The presence of dense growths of vegetation that occupy the entire water column, such as hydrilla, can further accelerate these processes.

5.1.2 Floodplains

The Federal Emergency Management Agency (FEMA) mapped the footprint of Kerr Reservoir as Zone A (no base flood elevation determined). The controlled flood pool of Kerr Reservoir is between 300 and 320 ft msl. At 300 ft msl the water surface area is approximately 48,900 acres. At 320 ft msl the water surface area is approximately 83,200 acres. The maximum surcharge pool elevation is 326 ft msl creating a surface area of approximately 95,500 acres.

5.1.3 Surface Hydrology

The drainage area of the Roanoke River above Kerr Dam is approximately 7,800 square miles. The Kerr Reservoir pool elevation follows a guide curve, fluctuating seasonally between 295.5 of 302 ft msl. At 300 ft msl, the reservoir creates approximately 800 miles shoreline and a water surface area of approximately 48,900 acres. The reservoir extends 39 miles up the Roanoke River and 19 miles above the Dan River, upstream of its confluence with the Roanoke River. The lake elevation guide curve (Figure 1) and releases vary seasonally in support of flood damage reduction, fish spawning, recreation, and hydropower operations.

Named tributaries that feed into Kerr Reservoir include Dan River, Roanoke/Staunton River, Anderson Swamp Creek, Nutbush Creek, Flat Creek, Beaver Pond Creek, Grassy Creek,

Beech Creek, Little Buffalo Creek, North Fork Aarons Creek, Indian Creek, Keats Branch, Hyco River, Grassy Creek, Butchers Creek, Sandy Creek, Little Bluestone Creek, and Difficult Creek.

5.1.4 Water Quality

The Virginia Department of Environmental Quality (VDEQ) identifies the designated uses of the Virginia portion of Kerr Reservoir as aquatic life, fish consumption, recreation, public water supply, and wildlife (VDEQ 2012). Kerr Reservoir is identified as impaired on the Virginia DEQ's 303(d) List of Impaired Waters for aquatic life Category 4C due to low dissolved oxygen (DO) levels and Category 5A fish consumption due to PCB and mercury contamination in fish tissue (VDEQ 2012).

The NC Division of Water Quality (NCDWQ) Water Bodies Classification system classifies the Nutbush Creek Arm of John H Ker Reservoir as Class B – Primary Recreation with tributaries classified as either Class B – Primary Recreation Freshwater or Class C Aquatic Life, Secondary Recreation, Fresh Water. Anderson Swamp Creek is also classified asWater Supply III - Moderately Developed. The NCDWQ 303 (d) List - Category 5 identifies "Nutbush Creek including Nut Bush Creek arm of John H Kerr Reservoir below normal pool elevation" as "Impaired" for "Aquatic Life" use with a "Fair Bioclassification" for Ecological/biological Integrity Benthos from source to NC 39 and Ecological/biological Integrity Fish Com and Benthos From NC 39 to SR 1317.

Application of chemical pesticides into waters of the US are regulated as point source discharges requiring a NPDES permit in compliance with the Clean Water Act (CWA). In North Carolina the NPDES program is administered by the NDCWQ; General Permit 560000. In Virginia the NPDES program is administered by the VDEQ; General Permit VAG87. Permit compliance includes pursuing control measures that minimize the discharge of pesticides.

5.1.5 Air Quality

Kerr Reservoir extends into several counties in Virginia and North Carolina. In Virginia, these counties are Charlotte, Halifax, and Mecklenburg. In North Carolina, these counties are Granville, Vance, and Warren. All of these counties are in attainment for all federal air quality standards (EPA 2010). The attainment status of abutting North Carolina counties was again confirmed on April 9, 2013 by Ms. Sushma Masemore, Environmental Program Manager I, North Carolina Division of Air Quality (Personal Communication, April 9, 2013). Despite being in compliance for these standards, portions of the area that contains the reservoir are at times subjected to temporary impacts to air quality as a result of activities like large-scale construction projects. Air quality within the project boundary is influenced by exhaust from motor vehicles and boats, the use of grills and fire pits, and other regional activities (such as large-scale construction projects prescribed fire burns). The large open area that is created by the reservoir allows for strong air currents to reduce and/or eliminate any localized air quality concerns caused by these pollutants. Specific agency consultation for physical resources is discussed in Chapter 9 of the Master Plan. Air quality is regulated by Clean Air Act and implemented by the EPA and DEQ. Air quality standards are defined in the National Ambient Air Quality Standards. Actions which result in increased emissions may require a permit issued by DEQ.

Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance provides further guidance on implementing these regulations.err Reservoir is located within an air quality attainment area. Reference EPA listing of Currently Designated Nonattainment Areas for All Criteria Pollutants EPA 2010 .

The EPA EnviroMapper for Envirofacts website identifies one "major source" of air emissions in the Kerr Reservoir area. The Mecklenburg Power Station, operated by Dominion Virginia Power, located at 204 Cogen Drive, Clarksville, Virginia EPA Registry Id: 110000342772 is a fossil fuel electric power generator. No other active "major source" facilities were identified along the shores of Kerr Reservoir.

5.1.6 Noise

Kerr Reservoir is located within rural area with little commercial industrial developed directly adjacent to the reservoir. Typical noise sources experienced at Kerr Reservoir include boat traffic, recreation vehicles, sea planes (in designated areas), and operations of Kerr Dam. Noise from these activities do not typically reach nuisance levels. Events including boat racing competitions and fishing tournaments, may temporarily raise noise levels.

5.1.7 Cultural Resources

Archaeological investigations have been carried out at John H. Kerr Dam and Reservoir for over 60 years. Large-scale surveys include Miller 1962; Garrow et al., 1980; Brockington et al., 1992; and Southerlin et al., 2009. Past surveys have documented a full range of cultural resources dating from Paleoindian period (ca. 10000 – 8000 B.C.), Archaic period (ca. 8000 – 1000 B.C.), and Woodland period (1000 B.C. – European contact) prehistoric sites, mid-eighteenth century Euro-American settlement, late-eighteenth to mid-nineteenth century plantations, and late-nineteenth to early-twentieth century homesteads.

Surveys of 220 miles of Kerr Reservoir shoreline for potential cultural resources were performed by Soil Systems, Inc. (SSI) as part of the John H. Kerr Dam and Reservoir Master Plan Design Memorandum (Garrow et al., 1980). This survey included surface collections along the shoreline at 27 planned recreation sites and shoreline surface collection and inland shovel testing performed at the, then, existing 28 recreation areas. The report indicated that wave action and collectors had destroyed most shoreline sites, though inland sites were usually less heavily damaged.

5.1.8 Hazardous and Toxic Waste

EPA's Envirofacts Data Warehouse website was queried to identify the presence of EPA regulated facilities within three miles of Kerr Reservoir. The Envirofacts databases contain information on facilities collected from regulatory programs such as RCRA, EPCRA, Superfund, Clean Water Act, and Clean Air Act and information on environmental activities that may affect air, water, and land in the project area. 73 sites were reported within the three mile radius; however, no sites were located in the Reservoir and only two sites directly abut the Reservoir. These sites, the Clarksville Wastewater Treatment Plant located at 201 East Street, Clarksville,

VA 23927, and the Mecklenburg Power Station located at 204 Cogen Drive, Clarksville, VA 23927, each maintain facilities approximately 50 yards from the Reservoir.

There are no known Hazardous and Toxic Waste Sites within the reservoir's normal operating pool limits. Kerr Lake is located primarily within a rural, undeveloped area of Virginia and North Carolina.

5.1.9 Aesthetics

Views of forested areas, open expanses of water, and undeveloped shoreline are primary aesthetic elements of Kerr Reservoir. The Kerr Reservoir Shoreline Management Plan (SMP) includes maintenance of aesthetic and environmental characteristics of the reservoir for public use and benefit as a main goal. The SMP seeks balance between permitted private uses, protection of natural and cultural resources, and public recreation. The Kerr Reservoir Operational Management Plan (OMP) includes Forest, Fish, and Wildlife Management Plans which also make provision to protect and enhance the aesthetics of Kerr Reservoir (USACE 1995).

5.2 Natural Resources

5.2.1 Aquatic Vegetation

The aquatic plant community in the reservoir has developed gradually since impoundment through colonization by native plants and introduction of invasive species. Aquatic vegetation surveys in 2011 and 2012 identified presence of native and non-native species of aquatic vegetation throughout the reservoir (NCSU 2011, NCSU 2012). Native aquatic vegetation was most prevalent in areas between Clarksville and Longrass Point on Nutbush Creek, including Mill Creek, Butcher Creek, Beaver Creek and Grassy Creek, although the acreage was not quantified. Native species identified included macroalgae (*Chara* sp./*Nitella* sp.), variable leaf pondweed (*Potamogeton diversifolius*), sago pondweed (*Potamogeton pectinatu*s), southern waternymph (*Najas guadalupensis*); smartweed *(Polygonum* sp.); *and* water willow (*Justicia americana*). Invasive species of aquatic vegetation identified include brittle naiad (*Najas minor*) and hydrilla.

Hydrilla is the most prevalent invasive species in the Kerr Reservoir vicinity, observed infesting approximately 888 acres (NCSU 2012). The majority of hydrilla is found in Little Nutbush Creek, Nutbush Creek, along with some isolated occurrences at North Bend Park, Staunton View boat ramp, Clarksville Marina, Uppy's Convenience Store dock, and scattered locations mainly along the south shore west of the Clarksville bridge. Hydrilla occurred most often in high use areas including boat ramps, marinas, and in areas with concentrations of private floating docks. Areas of undeveloped shoreline were found to contain almost no hydrilla. The 2012 survey found no hydrilla in several areas where it had been documented in 2011: small areas at North Bend Park, the Staunton View boat ramp, Occoneechee State Park, Clarksville Marina, the Uppy's Convenience Store dock, and scattered locations mainly along the south shore west of the Clarksville bridge (Figures 2, 3, 4). Low water levels during the survey may account for the absence (NCSU 2012).

Documentation of the occurrence of aquatic vegetation prior to the 2011 survey is limited. In 1992 and 1993 small patches of hydrilla (approximately 8 acres total) were documented in the area around the North Bend Park boat ramp. In July 1996 occurrences of *Chara sp*. and brittle naiad were documented in the Satterwhite Point area of Nutbush Creek. During the summers of 2009 and 2010, hydrilla was reported in North Carolina portion of Kerr Reservoir. Subsequent sampling and survey confirmed wide spread occurrence of hydrilla in Nutbush Creek and Little Nutbush Creek, however total acreage was not determined at that time.

5.2.2 Fish

Kerr Reservoir is a man made freshwater impoundment that supports a variety of game, non-game, and forage fish species. The VDGIF and NCWRC share fisheries management responsibilities for Kerr Reservoir.

Fish found in Kerr Reservoir include largemouth bass (*Micropterus salmoides*), pumpkinseed (*Lepomis gibbosus*), green sunfish (*Lepomus cyanellus*), yellow perch (*Perca flavescens*), channel catfish *(Ictalurus punctatus*), crappie (*Pomoxis* sp.), bluegill (*Lepomis macrochirus*), long-nose gar (*Lepisosteus osseus*), blue catfish (*Ictalurus furcatus*), flat head catfish (*Pylodictis olivaris*), walleye (*Stizostedion vitreum*), threadfin shad (*Dorosoma petenense*), blueback herring (*Alosa aestivalis*), freshwater drum (*Aplodinotus grunniens*), and gizzard shad *(Dorosoma cepediaum*). The striped bass (*Morone saxatilis*) population in Kerr Reservoir is a land locked reproducing population.

The VDGIF has documented the presence of largemouth bass virus (LMBV) in Kerr Reservoir, and determined that the disease is likely responsible for documented declines in the bass fishery (VDGIF 2013).

5.2.3 Wildlife

Wildlife known to occur at Kerr Reservoir includes 18 mammal species, 41 species of amphibians/reptiles, and 143 species of birds. Common birds include American goldfinch (*Carduelis tristis*), great blue heron (*Ardea herodias*), osprey (*Pandion haliaetus*), killdeer (*Charadrius vociferus*), wild turkey (*Meleagris galopavo*), barn swallow (*Hirundo ruustica*), and blue jay (*Cyanocitta cristata*). Common waterfowl include the common loon (*Gavia immer*), horned grebe (*Podiceps auritus*), pie billed grebe (*Podilymbus podiceps*), double-crested cormorant (*Phalacrocorax auritus*), Canada goose (Branta Canadensis), wood duck (*Aix sponsa*), gadwall (*Anas strepera*), American wigeon *(Anas americana),* American black duck *(Anas rubripes*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata)*, green winged teal (*Anas carolinensis*), ring-necked duck (*Aythya collaris)*, lesser scaup (*Aythya affinis*), bufflehead (*Bucephala albeola*), ruddy duck (*Oxyura jamaicensi*s) and American coot (*Fulica americana*).

The Kerr Reservoir OMP includes Forest and Wildlife Management Plans which prescribe active management for maintenance of diverse habitats for game and non-game wildlife species. There are twenty-six designated wildlife management areas located around the reservoir.

5.2.4 Wetlands

Wetlands also occur in many of the Kerr Reservoir natural areas and provide unique habitats for many species. Wetlands are lands that are wet at least part of the year due to either saturated soils or standing water. Wetlands include a variety of natural systems, such as marshes, swamps, bottomland hardwoods, and wet flats. While each wetland type looks and functions differently, all wetlands share certain properties, including characteristic wetland vegetation, hydric soils and hydrologic features. Wetlands provide essential habitat for a diverse range of species (fish, wildlife and plants). The primary wetland type that could be affected by this project are emergent marsh wetlands formed in the littoral zone along the edges of Kerr Reservoir. These wetlands generally occur within the area where the water level rises and falls due to operation of the reservoir. This fluctuation zone provides an opportunity for vegetative colonization and the formation of aquatic and emergent wetlands; however, the high frequency and magnitude of the water level fluctuations may slow the establishment of vegetation. Once established, emergent vegetation dampens waves and currents, stabilizing shorelines and reducing re-suspension of sediments. Water quality of inflows passing through emergent wetlands is improved as sediment is removed before entering the reservoir.

5.2.5 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) Information, Planning and Conservation System (http://ecos.fws.gov/ipac/) website provided a current inventory of federally-listed species in the Kerr Reservoir project area. The North Carolina Natural Heritage Program provided a list of Natural Heritage Occurrences within the Kerr Reservoir Project area in their scoping comments. The Virginia Natural Heritage Program web-site was reviewed for records of species occurrences in Halifax, Mecklenburg, and Charlotte Counties. Table 3 identifies state and federally listed species classified as endangered, threatened, or species of concern that may occur in the project area compiled from the above sources. The list also includes the bald eagle (*Haliaeetus leucocephalus*) which is protected under the federal Bald and Gold Eagle Protection Act.

Table 2: Federal and State Listed Species (E-Endangered, T-Threatened, SC- Federal Species of Concern or State Special Concern, BGPA-Bald and Gold Eagle Protection Act)

Common Name	Scientific Name	Federal Status	State Status	
			NC	VA
Vascular Plant Species				
Harperella	*Ptilimnium viviparum*	E	E	E
Nestronia	*Nestronia umbellula*	--	--	E
Shale-barren Skullcap	*Scutellaria leonardii*	--	E	--
Smooth coneflower	*Echinacea laevigata*	E	--	T
Wiry Panic Grass	*Panicum flexile*	--	T	--

Common Name	Scientific Name	Federal Status	State Status	
			NC	VA
Terrestrial Vertebrate Animal Species				
Bald Eagle	*Haliaeetus leucocephalus*	BGPA	T	T
Aquatic Vertebrate Animal Species				
Carolina Darter	*Etheostoma collis*	SC	SC	T
Roanoke logperch	*Percina rex*	E	E	E
Whitemouth shiner	*Notropis alborus*	--	--	T
Terrestrial Invertebrate Animal Species				
NONE				
Aquatic Invertebrate Animal Species				
Atlantic pigtoe	*Fusconaia masoni*	SC	E	T
Creeper	*Strophitus undulates*	--	T	--
Green floater	*Lasmigona subviridis*	SC	E	T
Dwarf wedge mussel	*Alasmidonta heterodon*	E	E	--
Notched Rainbow	*Villosa constricta*	--	SC	--
Tar River spiny mussel	*Elliptio steinstansana*	E	E	--
Triangle Floater	*Alasmidonta undulate*	--	T	--

The Natural Heritage Inventory of John H. Kerr Reservoir, North Carolina and Virginia June 1999 Summary of Plant and Animal Element Occurrences includes three state listed species; the shale-barren skullcap, bald eagle, and green floater. There are no known occurrences of currently listed federal threatened or endangered species.

The following are species descriptions for the bald eagle and the federally listed Threatened and Endangered Species that may occur in the project area.

Bald eagle – (Bald and Golden Eagle Protection Act): The bald eagle is a large raptor with a wingspan up to 8 feet and weighing up to 14 pounds. Adults have dark brown plumage with a solid white head and tail. Habitat includes estuaries, large lakes, reservoirs, rivers, and coastal areas. Nests are usually constructed in the tops or large trees near reliable food sources. Nests are typically reused and added to annually, some reaching 10 feet across. Fish are the bald eagle's primary food but they may also eat waterfowl, turtles, rabbits, snakes, other small animals, and carrion. (Reference USFWS-MPB 2013). Fourteen pairs of bald eagles were reported nesting in the vicinity of Kerr Reservoir in 2012. Bald eagles may be seen at the Reservoir year round.

Harperella - (Endangered): The Atlantic river harperella (*Ptilimnium viviparum*) is one of three species that formerly made up the *Ptilimnium nodosum*. It is a perennial herb growing 6 to 36 inches (0.15 to 1.0 meter) in height. Flowers are small and white occurring in heads or umbels. Flowering begins June or July and continuing until the first frost. Habitat is rocky or gravel shoals and sandbars along clear fast-flowing streams. (USFWS-RESFO 2013) There are no known occurrences of harperella at Kerr Reservoir.

Smooth coneflower – (Endangered)**:** The smooth coneflower (*Echinacea laevigata*) is a perennial herb which grows to around 5 feet tall. Flower petals are light pink to purplish, 2 to 3 inches long, and usually drooping. Flowering typically occurs from May - July. Habitat is usually characterized by magnesium and/or calcium rich soils with abundant sunlight and little competition in the herbaceous layer; found in open woods, cedar barrens, roadsides, clear-cuts, dry limestone bluffs, and power line rights of way. (USFWS 1999) There are no known occurrences of the smooth coneflower at Kerr Reservoir.

Dwarf wedgemussel - (Endangered): The dwarf wedgemussel (*Alasmidonta heterodon*) is a small, freshwater mussel growing to 1.5 inches long. Young shells are greenish-brown. Older shells appear dark brown or yellowish brown. Female shells are wider than male shells to allow greater space for egg development. They are found in creeks and rivers with slow to moderate current and a sand, gravel, or muddy bottom. (USFWS-AESFO 2013). There are no known occurrences of the dwarf wedgemussel in Kerr Reservoir.

Tar River spiny mussel – (Endangered): The Tar River spiny mussel (*Elliptio steinstansana*) is endemic to the Tar River and Neuse River systems in North Carolina. It has a small, semi rhomboid shell which grows to 2.4 inches. The shell is generally smooth in texture with as many as 12 spines that project perpendicularly from the surface and curve slightly ventrally. Adult specimens have often lost their spines. Habitat is relatively silt-free, un-compacted gravel and/or coarse sand in fast-flowing, well oxygenated streams. (USFWS-RESFO 2013) There are no known occurrences of the Tar River spiny mussel in Kerr Reservoir.

5.3 Socio-Economic Resources

5.3.1 Land Use

Approximately 66,263 acres of project land including government property and easement areas at Kerr Reservoir are located above the normal pool elevation, 300 ft msl. Land use allocations listed in the Kerr Reservoir Master Plan include the following: project operations 264 acres; recreation 6,885 acres; natural areas 5 acres; wildlife management/forest reserve 38,600 acres; and flowage easements 10,509 acres. Flowage easement lands are private property on which the government has an easement providing the government the right to impound water.

The Kerr Reservoir SMP regulates issuance of permits authorizing private shoreline use under authority of 36 CFR § 327.30 Shoreline Management on Civil Works Projects. There are currently 4520 active shoreline use permits on Kerr Reservoir. The Kerr Reservoir SMP designates shoreline use into the following categories: Limited Development Shoreline (31 %) - private floating docks and certain land-based facilities and activities are permitted. Public Recreation Shoreline (38%) - public recreational use areas including existing parks, quasi-public

lease areas, recreational trails, wildlife management areas and areas reserved for future recreational development. Protected Shoreline (31 %) - designated for the purpose of maintaining or restoring aesthetic quality, protecting and conserving natural and cultural resources, providing fish and wildlife habitat, and reducing conflicts between private and public activities. Shoreline Use Permits/Licenses are not allowed in these areas. Prohibited Access Shoreline (Less than 1%) - designated for safety including areas located adjacent to industrial facilities, reservoir operations facilities, and other sites that are potentially hazardous areas.

5.3.2 Recreation

Kerr Reservoir offers many opportunities for recreation, including fishing, boating, camping, hiking, wildlife viewing, and hunting; attracting around 2,000,000 visitors annually. There are currently 30 developed recreation areas offering 1,322 campsites, 228 picnic sites, 38 boat ramps, and three marinas. There are also 15 quasi-public recreation areas under lease to universities, churches, scouting councils, and other civic organizations.

The USACE "Value to the Nation" web site reports that visitors to Kerr Reservoir spend $57,136,395 annually within 30 miles of the Reservoir. The site lists groups that most often visit Kerr Reservoir (largest to smallest) including: general visitors, boaters, anglers, sightseers, swimmers, picnickers, campers, water skiers, and hunters.

The VDGIF Buggs Island Lake Report 2012 indicates that anglers spend about 900,000 hours fishing at Kerr Reservoir each year (VDGIF 2012). In 2007, 59% of the total fishing effort for Kerr Reservoir was for largemouth bass making it the most popular game fish followed by the crappie, catfish, and striped bass (VDGIF 2013). The world record blue catfish (*Ictalurus furcatus)* weighing 143 pounds was caught in Kerr Reservoir in June 2011.

5.3.3 Water Supply

The Kerr Reservoir conservation pool, between elevations 268 to 300 ft msl, provides approximately 568,000 acre-feet of water storage for water supply users. Provisions for water storage are authorized by the Water Supply Act of 1958, Public Law 85-500 72 Stat 319 (Title III).

There are four water intakes in Kerr Reservoir: the Town of Clarksville, VA water plant; the City of Henderson, NC (Kerr Lake Regional Water System) water plant; the former Burlington Industries plant near Clarksville (currently inactive); and the Mecklenburg Cogeneration Plant near Clarksville.

Shoreline permit holders and other adjacent property owners may obtain a permit for water withdrawals in accordance with the Wilmington District Policy for Incidental Water Withdrawals at John H. Kerr Dam & Reservoir (Commanders Policy #40 - 30 April 2010). The location of these temporary incidental intakes is subject to change. The water withdrawn is typically used for irrigation of lawns. The number of these withdrawals is limited to 483 based on estimated withdrawal and available storage.

5.3.4 Energy Needs

The Kerr Dam hydropower plant generates an average of 426,749,000 kilowatt hours of electricity annually. The powerhouse contains seven generators that produce electricity for sale, and two smaller generators that produce power for in-house use. The electricity is marketed by the Southeastern Power Administration (SEPA). The USACE Wilmington District prepares a weekly energy declaration based on the minimum SEPA contract amounts and additional secondary energy needed to lower lake levels for flood operations or to meet down stream flow targets for fish spawning.

6.0 ENVIRONMENTAL IMPACTS

This section compares beneficial and adverse direct and secondary environmental impacts to resource categories identified in Section 5.0 among the identified in alternatives described in Section 4.0: Proposed Alternative – Kerr Reservoir AVMP, Alternative 1– Kerr Reservoir AVMP without triploid grass carp, and No Action. Direct environmental impacts are defined as impacts that occur at the same time as the action, while secondary impacts are defined as reasonably foreseeable impacts caused by the action that occur later in time (Eccleston 2001).

6.1 Physical Environment

6.1.1 Geology, Topography, and Soils

Proposed Alternative (Kerr AVMP): This alternative would not cause adverse impacts to geology topography and soils, but would benefit these resources in Kerr Reservoir. Reductions in the occurrence of dense mats of hydrilla that occupy the entire water column, where present, would result in reduced rates of sediment and organic matter accumulation. Selective planting of native submerged and emergent vegetation would result in development of multilevel littoral plant communities, stabilizing bottom sediment and shoreline areas. Planting of native vegetation would also increase rates of sedimentation in areas that are unvegetated. However, the rate would be lower than that associated with dense mats of hydrilla. Multilevel stands of native vegetation occupy less of the water column than dense mats of hydrilla and would not spread as quickly as the overgrowth of hydrilla.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts to geology, topography and soils, however beneficial effects would be less than the proposed alternative. Implementation of the AVMP without use of triploid grass carp as a control method would limit the scope and speed of control of invasive vegetation, reducing benefits, and increasing the duration and scale of detrimental impacts relative to the proposed alternative.

No Action - the No Action Alternative would not cause adverse impacts to geology, topography and soils; however it would forgo potential project benefits. If no action is taken to manage hydrilla and other invasive species, they would be expected to continue to spread throughout the littoral zone causing increased sedimentation and accumulation of organic matter. Water depths would diminish over time, mostly affecting shallow coves and shoals.

6.1.2 Flood Storage

Proposed Alternative (Kerr AVMP) - This alternative would not cause adverse impacts to flood storage, but would benefit storage in Kerr Reservoir by reduced sedimentation. Reductions and avoidance of growth of dense mats of aquatic vegetation occupying the entire water column improves water flows and reduces sedimentation rates, avoiding adverse impacts to reservoir water storage volume and water flow.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts to flood storage, but would provide less benefit than the proposed alternative. Implementation of the Kerr AVMP without use of triploid grass carp as a control method would limit the scope and speed of control of invasive vegetation; reducing benefits, and increasing the duration and scale of detrimental impacts relative to the proposed alternative. This alternative would also cost more and require more effort to achieve the same level and extent of vegetation control as the proposed alternative.

No Action - No Action would not cause adverse impacts to flood storage, however, it would forgo potential project benefits. If no action is taken to manage hydrilla and other invasive species, they would be expected to continue to spread throughout the littoral zone causing increased sedimentation and accumulation of organic matter. Water depths would diminish over time, mostly affecting shallow coves and shoals. No action would forgo potential project benefits.

6.1.3 Surface Hydrology

Proposed Alternative -Kerr AVMP - This alternative would not cause adverse impacts to surface hydrology; however, it would benefit Kerr Reservoir by reducing impediments to surface flow caused by hydrilla. Control and avoidance of dense mats of invasive aquatic vegetation would improve water flow and circulation in the reservoir and tributaries. This would also avoid potential for future interference with releases from the dam due to movements of dense mats downstream during high water events.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts to surface hydrology, but would generate fewer benefits than the proposed alternative. Implementation of the Kerr AVMP without use of triploid grass carp as a control method would limit the scope and speed of control of invasive vegetation; reducing benefits to surface hydrology relative to the proposed alternative and increasing the duration and scale blockages in coves, narrow channels, and tributaries. This alternative would also cost more and require more effort to achieve the same level and extent of vegetation control as the proposed alternative.

No Action - No Action would not cause adverse impacts to surface hydrology, however, it would forgo potential project benefits. If no action is taken to manage hydrilla and other invasive species, they would be expected to continue to spread throughout the littoral zone causing an increasing impediment to surface flow.

6.1.4 Water Quality

Proposed Alternative - Kerr AVMP - This alternative would not cause significant adverse impacts to water quality; however, it would benefit Kerr Reservoir by reducing localized water quality problems caused by hydrilla. The proposed alternative would benefit water quality. Maintaining moderate levels of native aquatic vegetation in the reservoir would increase rates of absorption of nutrients from runoff and reduce amounts of sediment re-suspension. Reductions in overgrowth of invasive vegetation would avoid localized reductions in dissolved oxygen, increases in surface water temperature, and fluctuations in pH associated with dense mats of vegetation occupying the water column.

Any adverse impacts to water quality from herbicide use would be minor and temporary, being avoided through planning and regulation of herbicide applications. Treatments would be in compliance with the herbicide label and all applicable laws and regulations. Stocking of triploid grass carp would minimize the amount of herbicide application relative to Alternative 1.

Alternative 1 - Kerr AVMP without triploid grass carp - - This alternative would not cause significant adverse impacts to water quality, however it would generate less benefits than the proposed alternative. Implementation of this alternative would limit the scope and speed of control of invasive vegetation. This would reduce the benefits to water quality derived from control of overgrowth of invasive vegetation and increase the duration and scale of detrimental impacts. This alternative would also cost more and require more effort to achieve the same level and extent of vegetation control as the proposed alternative.

No Action - No action would not result in adverse impacts to water quality, but would forgo potential project benefits. Future localized water quality problems associated with dense stands of invasive/nuisance species would occur, including reductions in dissolved oxygen, increases in surface water temperature, and fluctuations in pH. The level of impact would increase with spread of the infestation of invasive species throughout the littoral zone of Kerr Reservoir.

6.1.5 Air Quality

Proposed Alternative - Kerr AVMP - This alternative would not cause significant adverse impacts to air quality. Implementation of the proposed alternative would result in minimal temporary increases in air emissions. Air emissions would be elevated during the operation of petroleum powered vessels used for herbicide applications and survey/monitoring.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause significant adverse impacts to air quality. Implementation of this alternative would result in minimal temporary increase in air emissions. Air emissions would be elevated during the operation of petroleum powered vessels used for herbicide applications and survey/monitoring.

No Action – The No Action alternative would not impact air quality. Air emissions may be less if interference with navigation by dense mats of aquatic vegetation reduces the use of petroleum powered vessels.

6.1.6 Noise

Proposed Alternative Kerr AVMP - This alternative would not cause significant adverse impacts to noise. Implementation of this alternative would result in insignificant temporary increase in noise levels during the operation of motor vessels used for herbicide applications and survey/monitoring.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause significant adverse impacts to noise. Implementation of this alternative would result in temporary increase in noise levels during the operation of motor vessels used for herbicide applications and survey/monitoring.

No Action - The No Action would not cause significant adverse impacts to noise. Noise levels would be reduced if interference with navigation by dense mats of aquatic vegetation would reduce use of petroleum powered vessels.

6.1.7 Cultural Resources

Proposed Alternative - Kerr AVMP – This alternative would not impact cultural resources. This alternative would not involve ground disturbance.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not impact cultural resources. This alternative would not involve ground disturbance.

No Action - This alternative would not impact cultural resources. This alternative would not involve ground disturbance.

6.1.8 Hazardous and Toxic Waste Sites

Proposed Alternative - Kerr AVM - This alternative would not impact hazardous or toxic waste sites. Pesticide containers would be disposed of or recycled according to label instructions and local/state solid waste regulations.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not impact hazardous or toxic waste sites. Pesticide containers would be disposed of or recycled according to label instructions and local/state solid waste regulations.

No Action - This alternative would not impact hazardous or toxic waste sites.

6.1.9 Aesthetics

Proposed Alternative - Kerr AVMP – This alternative would not cause significant adverse impacts to aesthetics but, would provide aesthetic benefits. Control and reduction of the spread of larger mats of invasive aquatic plants and promotion of native aquatic species would improve visual qualities of the reservoir resulting in positive aesthetic benefits. Shorelines with well managed stands of diverse native submerged and emergent vegetation are generally considered more aesthetically pleasing than bare eroded shorelines and areas choked with dense mats of vegetation occupying the entire water column.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause significant adverse impacts to Aesthetics but would provide less aesthetic benefit than the propose Alternative. Implementation of this alternative would limit the scope and speed of control of invasive vegetation; reducing benefits, and increasing the duration and scale of detrimental impacts relative to the proposed alternative. This alternative would also cost more and require more effort to achieve the same level and extent of vegetation control as the proposed alternative

No Action – No Action would not cause adverse impacts, however, it would forgo potential project benefits. If no action is taken to manage hydrilla and other invasive species, they would be expected to continue to spread throughout the littoral zone causing an increase in unsightly mats.

6.2 Natural Resources

6.2.1 Aquatic Vegetation

Proposed Alternative - Kerr AVMP – This alternative would not cause adverse impacts to native aquatic vegetation; however, it would benefit Kerr Reservoir by *reducing hydrilla* and planting native vegetation. Control of invasive species of vegetation and promotion of native aquatic vegetation would have an overall beneficial impact on the diversity and abundance of

native aquatic vegetation populations and in turn the reservoir ecosystem. Potential impacts of proposed control methods are discussed below.

Chemical control through use of herbicides would have minimal direct adverse impacts to native vegetation. Some native plants mixed with invasive vegetation or directly adjacent to treatment areas may be killed or damaged in some treatment areas. To avoid and minimize impacts to native vegetation, herbicide treatments would be limited to high infestations of invasive species and monitored for signs of un-intended spread to adjacent native vegetation. Overall use of herbicides to control invasive vegetation will have beneficial effects on native vegetation.

Incremental open stocking of triploid grass carp would have direct and secondary impacts on native aquatic vegetation throughout the reservoir. Non-selective feeding of triploid grass carp on invasive and native vegetation would result in consumption of native vegetation in some areas. Impacts of triploid grass carp would be insignificant, limited by the life span of the fish (10 to 15 years) and size of the stocked population. Use of an incremental grass carp stocking strategy with attention to times and locations of stocking would maximize control of invasive species and avoid and minimize adverse impacts to native aquatic vegetation. Re-stocking rates for triploid grass carp would be determined based on monitoring of native and non-native vegetation and the fish population. Beneficial impacts to native vegetation from stocking triploid grass carp include restoration of habitat through reduction in the extent of invasive target vegetation in areas that have not been treated with herbicides and continued removal of invasive vegetation in treated areas after herbicide effects have dissipated.

Native aquatic vegetation populations in the reservoir would benefit from planting and promotion of selected native aquatic vegetation in areas where invasive species have been reduced/removed and in un-colonized areas. Potential introduction of invasive species in planting stock would be avoided by using only native plant stock from known sources or weed-free stock from propagation of existing populations of plants in Kerr Reservoir.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause significant adverse impacts to native aquatic vegetation; however, benefit to Kerr Reservoir would be less than the proposed alternative. Use of only chemical control and hand removal methods would limit the scale and speed of control of invasive vegetation. This alternative would avoid loss of native vegetation to fish consumption. However, benefits to native vegetation relative to the proposed alternative would be less and the duration and scale of detrimental impacts of invasive vegetation would increase. This alternative would cost more and require more effort to achieve the same level and extent of vegetation control as the proposed alternative.

No Action - No action would not cause adverse impacts to native aquatic vegetation but would forgo potential project benefits. Uncontrolled spread of invasive species throughout the littoral zone of Kerr Reservoir would likely displace native species.

6.2.2 Fish

Proposed Alternative - Kerr AVMP - This alternative would not cause significant adverse impacts to fish; however, it would benefit Kerr Reservoir fish habitat by reducing hydrilla and planting native vegetation. Control of invasive plant species and promotion of native plant species would result in restoration of and improvements to fish habitat associated with native aquatic vegetation. Reduction in density of mats of invasive vegetation will avoid adverse impacts to fish populations associated with overgrowth of invasive aquatic plants. In the absence of native vegetation or other structure, the continued presence of small amounts of invasive vegetation in some areas would provide habitat for some fish.

Removal or reduction in size of stands of invasive aquatic vegetation would have temporary insignificant adverse impacts to fish utilizing those stands for forage and cover. Displaced fish may move to other available habitat. Localized increases in competition for cover and forage may occur. Over time fish populations would fluctuate as the populations of native and invasive vegetation fluctuate in response to adaptive management actions and other factors including fishing pressure, lake levels, disease, and climate.

Use of herbicide treatments on large areas of aquatic vegetation may result in reductions in the amount of dissolved oxygen in the water due to decay of dead vegetation which can lead to isolated fish kills. Reductions in dissolved oxygen would be minimized by following guidance on herbicide labels, including limiting the extent of vegetation die off at any one time through use of staggered treatments of sections in densely matted areas. Grazing by triploid grass carp would also reduce or eliminate need for large scale herbicide treatments in some areas.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause significant adverse impacts to fish; however, benefit to Kerr Reservoir fisheries would be less than the proposed alternative. Use of only chemical control and hand removal methods would limit the scope and decrease the rate of control of invasive vegetation leading to adverse impacts associated to fish populations with overgrowth of invasive aquatic plants.

No Action - No action would not cause adverse impacts to fish but would forgo potential project benefits. Uncontrolled spread of invasive species throughout the littoral zone of Kerr Reservoir would continue.

6.2.3 Wildlife

Proposed Alternative - Kerr Reservoir AVMP - This alternative would not cause significant adverse impacts to wildlife. The proposed alternative would reduce the occurrence of hydrilla beds that are used by water fowl and wading birds. The AVMP will selectively control invasive plant species and promote native plant species resulting in restoration of and improvements to wildlife habitat associated with native aquatic vegetation. Reduction in the extent of floating mats of invasive aquatic vegetation would displace water fowl and wading birds currently utilizing those mats. Birds may move to other stands of native vegetation along the shoreline or other water bodies in the vicinity, where habitat is available. Localized increases in competition for habitat may occur. Over time wildlife populations would fluctuate as

populations of native and invasive vegetation fluctuate in response to adaptive management actions and other factors including lake elevation and climate.

Control of hydrilla and other invasive plants would reduce occurrence of dense mats of aquatic vegetation that serve as hosts for a toxic epiphytic cyanobacteria (*Stigonematales* sp.). *Stigonematales* sp. is responsible for Avian Vacuolar Myelinopathy (AVM), a neurological disease affecting water fowl and raptors that consume the affected waterfowl. The toxins are transmitted through the food chain accumulating in the bodies of the birds when waterfowl eat submerged aquatic vegetation covered with cyanobacteria, then the raptors eat the waterfowl. AVM causes deterioration of the central nervous system and development of brain lesions resulting in death of the diseased birds.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause significant adverse impacts to wildlife. Implementation of the Kerr AVMP without use of triploid grass carp as control method would limit the scope and speed of control of invasive vegetation; reducing benefits to wildlife, and increasing the duration and scale of detrimental impacts relative to the proposed alternative. This alternative would also cost more and require more effort to achieve the same level and extent of vegetation control as the proposed alternative

No Action - No action would not cause significant adverse impacts to wildlife but would forgo potential project benefits to wildlife due to the uncontrolled spread of invasive species throughout the littoral zone of Kerr Reservoir.

6.2.4 Wetlands

Proposed Alternative - Kerr Reservoir AVMP – Implementation of this alternative would not have significant impacts to Kerr project wetlands. Control of dense mats of vegetation that occupy the entire water column would reduce rates of sediment accumulations (Reference 6.1.1). Reduction in sedimentation may reduce the potential for future establishment of emergent wetlands. Any reduction would be insignificant and may be offset by planting of native vegetation which would promote local sedimentation and creation of wetlands.

Alternative 1 - Kerr AVMP without triploid grass carp - Implementation of this alternative would not have significant Kerr Project wetlands. Use of only chemical control and hand removal methods would limit the scope and decrease the rate of control of invasive vegetation, increase the sedimentation rate (Reference 6.1.1), and could increase transition of shallows and shoals to wetlands relative to the Proposed Alternative.

No Action - No action would result in any significant wetland impacts.

6.2.5 Threatened and Endangered Species

Proposed Alternative - Kerr Reservoir AVMP - Implementation of the Kerr Reservoir AVMP would not result in direct or secondary impacts to federal or state-listed threatened or endangered species.

Alternative 1 - Kerr AVMP without triploid grass carp - Implementation of this alternative would not result in direct or secondary impacts to federal or state-listed threatened or endangered species.

Alternative 2 - No Action - Implementation of this alternative would not result in direct or secondary impacts to federal or state-listed threatened or endangered species.

6.3 SOCIO-ECONOMIC RESOURCES

6.3.1 Land Use

Proposed Alternative - Kerr Reservoir AVMP – This alternative would not cause adverse impacts to land use; however, it would benefit Kerr Reservoir by reducing hydrilla and planting native vegetation. Implementation of the AVMP would result in direct and secondary benefits to designated land uses identified in the Kerr Lake Master Plan and Shoreline Management Plan. Reductions in occurrence of aquatic invasive species will reduce interference with and adverse impacts to managing agency activities in areas designated for recreation, fish and wildlife management, reservoir operations (flood storage and hydropower). Removal of dense mats of vegetation around floating docks will benefit shoreline use permits holders. Adjacent property owners will benefit from avoiding reductions in property values documented in water bodies where over growth of invasive vegetation occurs.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts to land use; however, benefits to Kerr Reservoir by reducing hydrilla and planting native vegetation would be reduced. Implementation of the AVMP without release of triploid grass carp would reduce the extent of control of invasive aquatic vegetation and the benefit relative to the Proposed Alternative. Grass carp would eat vegetation in all areas of the lake while chemical control and hand removal would be targeted to high use public areas only. This alternative would increase cost incurred by the USACE, lessees, and shoreline permit holders as additional herbicide treatments would be necessary in the absence of triploid grass carp.

No Action - No action would not cause adverse impacts; but would forgo potential project benefits. Uncontrolled spread of invasive species throughout the littoral zone of Kerr Reservoir would be expected.

Dense mats of hydrilla and reductions in water depths due to sedimentation over time would interfere with navigation and access to the shoreline, reservoir storage, fish and wildlife management, and other management activities.

6.3.2 Recreation

Proposed Alternative - Kerr Reservoir AVMP - This alternative would not cause adverse impacts recreation; however, it would benefit Kerr Reservoir by reducing hydrilla and planting native vegetation. Control of dense mats of hydrilla in public recreation areas, around floating

docks, in coves, and other high use areas will directly benefit visitors by reducing and preventing interference with boating, swimming, paddling, fishing, water skiing, and other water sports.

Applications of herbicides as directed on the product label, including adherence to restrictions on use relative to human activity and water use, would avoid impacts to public health and safety of recreation users. The use of triploid grass carp as a control method is intended to reduce the need for use of herbicides to control aquatic vegetation.

Fish populations, and in turn anglers, would benefit from control of overgrowth of invasive vegetation and planting and promotion of native aquatic vegetation. Anglers that prefer fishing dense mats of hydrilla would be impacted by reduction in the occurrence of these mats. Angler's effort and success rates would continue to fluctuate as populations of game fish fluctuate in response to management of native and invasive vegetation, climate, lake levels, disease, and changes in fishing pressure (number of anglers utilizing the lake).

Insignificant impacts to waterfowl hunting could occur. Reduction in dense mats of hydrilla would reduce habitat for water fowl in some infested areas and, in turn, some waterfowl hunting opportunity. This impact is considered insignificant as the majority of hydrilla documented during the vegetation surveys is located in or near recreation areas and other high use areas where hunting is not allowed or where conditions for hunting are not favorable. Waterfowl populations and in turn hunting opportunity will benefit from planting and promotion of native aquatic vegetation.

Herbicide application efforts at Kerr Reservoir to date have targeted hydrilla, the most abundant invasive aquatic plant in the Reservoir. Table 1 lists herbicide compounds recommended for the treatment of hydrilla along with information on label restrictions use for swimming, fishing, drinking, irrigation, and watering livestock for some trade name formulations of the compounds. The Action Plan developed annually would identify target species and potential location of herbicide treatments for the coming year. The location of swim beaches and other recreation facilities would be taken into account in planning herbicide applications.

Concerns regarding potential for corrosion of aluminum pontoons in areas where copper based herbicide compounds have been applied to control aquatic weeds have been raised based on anecdotal reports at Kerr Reservoir and a published report from Lake Murray, South Carolina (SCAPMS 2002). Galvanic corrosion occurs when two or more different metals are brought into electrical contact under water. Galvanic corrosion of the metal parts of boats and docks can occur in fresh and salt water, but occurs most quickly in salt water due to its greater electrical conductivity. Galvanic corrosion can occur due to improper grounding of vessels and docks. In fresh water the rate of galvanic corrosion can increase if the corrosive potential of the water is increased through introduction of lawn fertilizers, melting salts, or other compounds due to direct application or runoff from land. Galvanic corrosion of metal parts of boats and docks may be avoided by installing a sacrificial anode on the boat hull, motor, and dock. Note that many boats, motors, and docks come equipped with sacrificial anodes. The anode must be in the water to work. The anode must be replaced periodically. Concerned boat owners may also choose to temporarily move boats from areas where copper based herbicides are being applied.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts recreation; however, benefits to Kerr Reservoir by reducing hydrilla and planting native vegetation. Implementation of the AVMP without release of triploid grass carp would reduce the extent of control of invasive aquatic vegetation and the beneficial impacts relative to the Proposed Alternative. Grass carp will eat vegetation in all areas of the lake while chemical control and herbicides would be targeted to high use areas only. This would increase direct and secondary negative impacts to recreation including boating, swimming, fishing, water skiing and other water based recreation. Recreation area managers and shoreline permit holders would have increased cost and effort to control invasive vegetation in their areas.

No Action - This alternative would not cause adverse impacts to recreation; however, benefits to Kerr Reservoir recreation would be forgone. Uncontrolled spread of invasive species throughout the littoral zone of Kerr Reservoir would be expected

6.3.3 Water Supply

Proposed Alternative - Kerr Reservoir AVMP - This alternative would not cause adverse impacts; however, it would benefit Kerr Reservoir water supply by reducing hydrilla. Implementation of the AVMP would result in direct and secondary benefits to water supply. Water intakes can be clogged by growth of nuisance vegetation around the intake and by floating mats of vegetation that break free for other infested areas during high water events. Control of hydrilla and other aquatic nuisance vegetation would help avoid clogging of water supply intakes. Impacts to water supply from herbicide treatments would be avoided by using registered herbicides as directed on the product label and in compliance with state requirements. Herbicides would not be applied within required setback distances from potable water intakes. The release of triploid grass carp and hand removal would provide herbicide free control of vegetation in proximity to intakes.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts; however, benefits to Kerr Reservoir water supply would be less than the proposed alternative. Implementation of the Kerr Reservoir AVMP without release of triploid grass carp would reduce the extent of control of invasive aquatic vegetation and the beneficial impacts relative to the Proposed Alternative. Grass carp will eat vegetation in all areas of the lake including in proximity to intakes where herbicide applications are restricted. The potential for clogging of water intakes would increase with this alternative. Water supply intake operators would have increased cost and effort to control invasive vegetation in their areas.

No Action - No action would not cause adverse impacts but potential water supply benefits would be forgone. Water intakes may be clogged by growth dense mats of nuisance vegetation around the intake and by floating mats of vegetation that break free during high water events. Cost of facility operation and maintenance and water treatment could increase.

6.3.4 Energy Needs

Proposed Alternative - Kerr Reservoir AVMP - This alternative would not cause adverse impacts; however, it would benefit Kerr Reservoir energy need by reducing risks associated with

uncontrolled hydrilla growth. Implementation of the Kerr Reservoir AVMP would result in direct and secondary benefits to energy needs. Control of nuisance aquatic vegetation would reduce the potential for large mats of vegetation clogging hydropower generator intakes. Clogging of intakes would lead to loss of efficiency of the generator, shutting down of power generation, and/or damage to the intake and generator units.

Alternative 1 - Kerr AVMP without triploid grass carp - This alternative would not cause adverse impacts; however, benefits to Kerr Reservoir energy needs would be reduced. Implementation of the AVMP without release of triploid grass carp would reduce the extent of control of invasive aquatic vegetation and the beneficial impacts relative to the Proposed Alternative. This alternative would increase the risk of direct and secondary adverse impacts to energy needs. Herbicides would be targeted to high use areas allowing for growth of large mats of vegetation in untreated areas. Dense mats of hydrilla may break free during high water events and accumulate at the face of the dam interfering with hydropower intakes and decreasing quality of water passing through the dam. Cost of facility operation and maintenance would increase.

No Action – This alternative would not cause adverse impacts; however, no action would forgo potential project benefits to energy needs. Uncontrolled spread of invasive species throughout the littoral zone of Kerr Reservoir would be expected.

6.4 Environmental Impact Comparison of Alternatives

Table 3 provides a brief summary and comparison of negative direct and secondary impacts to the physical and natural environment for the alternatives considered.

Table 3: Environmental Impact Comparison of Alternatives

Resource	Alternatives		
	Proposed Action Kerr Reservoir AVMP	**Kerr Reservoir AVMP - without triploid grass carp**	**No Action**
Geology, Topography, and Soils	- reduced sedimentation rate - avoid reduced water depths and shoaling	- less benefit relative to preferred alternative	- increased sedimentation rates - increased shoaling - reductions in water depths
Floodplains/Flood Storage	- reduced sedimentation rate - avoid loss of storage volume	- less benefit relative to preferred alternative	- increased rates of sedimentation, loss of reservoir storage volume
Surface Hydrology	- improved water flow - reduced sedimentation rate - avoid reduced water depths and increased shoaling	- less benefit relative to preferred alternative	- reduced water flow - increased sedimentation rate - reduced water depths - increased shoaling
Water Quality	- increased absorption of nutrients from runoff - reduced sediment re-suspension	- less benefit relative to preferred alternative	- localized poor water quality due to reduced dissolved oxygen, increased surface water temperatures, and

Resource	Alternatives		
	Proposed Action Kerr Reservoir AVMP	**Kerr Reservoir AVMP - without triploid grass carp**	**No Action**
	- avoid localized poor water quality		fluctuations of pH
Air Quality	- temporary increase in air emissions	- temporary increase in air emissions	- reduction in air emissions
Noise	- temporary increase in noise	- temporary increase in noise	- reduction in noise
Cultural Resources	- no impact	- no impact	- no impact
Hazardous and Toxic Waste Sites	- no impact	- no impact	- no impact
Aesthetics	- improve aesthetics	- less benefit relative to preferred alternative	- degrade aesthetics
Aquatic Vegetation	- improve native vegetation - reduce invasive vegetation	- less benefit relative to preferred alternative	- reduction in native vegetation - overgrowth of invasive vegetation
Fish	- improve native fish habitat	- less benefit relative to preferred alternative	- degrade fish habitat
Wildlife	- improved native wildlife habitat	- less benefit relative to preferred alternative	- degraded wildlife habitat
Wetlands	- insignificant decrease in potential for creation of peripheral wetlands relative to other alternatives	- insignificant decrease in potential for creation of peripheral wetlands relative to no action	- no impact
Land Use	- reduce and avoid interference with designated uses - avoid reduction in adjacent property value	- less benefit relative to preferred alternative - increased cost of control	- restricted shoreline access - loss of storage volume - increased shoaling - reduced adjacent property value
Recreation	- reduce and avoid interference with water based recreation	- less benefit relative to preferred alternative	- increased interference with water based recreation
Water Supply	- reduce and avoid water intake clogging	- less benefit relative to preferred alternative	- water intake clogging
Energy Needs	- reduce and avoid hydropower intake clogging	- less benefit relative to preferred alternative	- hydropower intake clogging

7.0 CUMULATIVE 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." Implementation of the preferred alternative, the Kerr Reservoir AVMP, will complement current management actions to control invasive aquatic vegetation in the Roanoke River Basin, including Lake Gaston and Smith Mountain Lake. Control of invasive aquatic vegetation will reduce the amount of resources and funding available causing delay or cancelation of other operations and maintenance activities. Control of aquatic invasive vegetation would avoid and minimize potential adverse economic impacts to the federal government, state and local governments, and the local economy, that would occur if no action were taken.

8.0 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

Upon completion of the NEPA process, the *Proposed Alternative* will be in compliance with the applicable Federal Laws and Policies and Executive Orders identified in Tables 5 and 6 below that were considered relevant to the project.

8.1 Federal Laws and Policies

Table 4 - Compliance of the Proposed Action with Federal Laws and Policies

Title of Public Law	US CODE	Compliance Status
Affirmative Action for Workers with Disabilities	29 USC 793	In Compliance
American Recovery and Reinvestment Act – Reporting Requirements	111-5	In Compliance
Applicable Law for Breach of Contract Claim	Pub. L 108-77, 108-78	In Compliance
Aquatic Nuisance Prevention And Control Act	16 USC 67	In Compliance
Archeological and Historic Preservation Act of 1974, As Amended	16 USC 469	In Compliance
Archeological Resources Protection Act of 1979, As Amended	16 USC 470	In Compliance
Bald and Gold Eagle Protection Act	16 USC 668	In Compliance
Clean Air Act of 1972, As Amended	42 USC 7401 et seq.	In Compliance
Clean Water Act of 1972, As Amended	33 USC 1251 et seq.	In Compliance
Coastal Barrier Resources Act of 1982	16 USC 3501-3510	In Compliance

Title of Public Law	US CODE	Compliance Status
Coastal Zone Management Act of 1972, As Amended	16 USC 1451 et seq.	In Compliance
Combating Trafficking in Persons	22 USC 7104(g)	In Compliance
Comprehensive Environmental Response, Compensation and Liability Act of 1980	42 USC 9601	In Compliance
Contractor Code of Business Ethics and Conduct	41 USC 251 note.	In Compliance
Electronic Submission of Payment Requests and Receiving Reports	10 USC 2227	In Compliance
Emergency Flood Control Funds Act of 1955, As Amended	33 USC 701m	In Compliance
Employment Eligibility Verification	--	In Compliance
Endangered Species Act of 1973	16 USC 1531	In Compliance
Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and other Eligible Veterans	38 USC 4212	In Compliance
Exemption from Application of the Service Contract Act to Contracts for Certain Services – Requirements	41 USC 351 et seq.	In Compliance
Exemption from Application of the Service Contract Act to Contracts for Maintenance, Calibration or Repair of Certain Equipment – Requirements	41 USC 351 et seq.	In Compliance
Federal Noxious Weed Act of 1974	7 USC 2801 et seq	In Compliance
Federal Water Project Recreation Act of 1965, As Amended	16 USC 4601	In Compliance
Fish and Wildlife Coordination Act of 1958, As Amended	16 USC 661	In Compliance
Flood Control Act of 1944, As Amended, Section 4	16 USC 460b	In Compliance
Historic and Archeological Data Preservation	16 USC 469	In Compliance
Historic Sites Act of 1935	16 USC 461	In Compliance
Land and Water Conservation Fund Act of 1965	46 USC 4601	In Compliance
Magnuson Fishery Conservation and Management Act	16 USC 1801	In Compliance
Marine Mammal Protection Act of 1972, As Amended	16 USC 1361	In Compliance

Title of Public Law	US CODE	Compliance Status
Marine Protection, Research and Sanctuaries Act of 1972	33 USC 1401	In Compliance
Migratory Bird Conservation Act of 1928, As Amended	16 USC 715	In Compliance
Migratory Bird Treaty Act of 1918, As Amended	16 USC 703	In Compliance
National Environmental Policy Act of 1969, As Amended	42 USC 4321 et seq.	In Compliance
National Historic Preservation Act of 1966, As Amended	16 USC 470	In Compliance
National Historic Preservation Act Amendments of 1980	16 USC 469a	In Compliance
Native American Religious Freedom Act of 1978	42 USC 1996	In Compliance
Noise Control Act of 1972, As Amended	42 USC 4901 et seq.	In Compliance
Notice of Total Small Business Set-Aside	15 USC 644	In Compliance
Payment by Electronic Funds Transfer – Central Contractor Registration	31 USC 3332	In Compliance
Post Award Small Business Program Representation	15 USC 632(a)(2)	In Compliance
Preference of Privately Owned U.S. Flag Commercial Vessels	46 USC Appx 1241 (b) and 10 USC 2631	In Compliance
Prohibition of Segregated Facilities	48 CFR 52.222-21	In Compliance
Promoting Excess Food Donation to Nonprofit Organizations	Pub L. 110-247	In Compliance
Protest After Award	31 USC 3553	In Compliance
Resource Conservation and Recovery Act of 1976	42 USC 6901-6987	In Compliance
River and Harbor Act of 1888, Sect 11	33 USC 608	In Compliance
River and Harbor Act of 1899, Sections 9, 10, 13	33 USC 401-413	In Compliance
River and Harbor and Flood Control Act of 1962, Section 207	16 USC 460	In Compliance
River and Harbor and Flood Control Act of 1970, Sections 122, 209 and 216	33 USC 426 et seq.	In Compliance
Service Contract Act of 1965	41 USC 351, et seq.	In Compliance

Title of Public Law	US CODE	Compliance Status
Utilization of Small Business Concerns	15 USC 637 (d)(2) and (3)	In Compliance
Whistleblower Protections under the American Recovery and Reinvestment Act of 2009	1153 111-5	In Compliance

8.2 Executive Orders

Table 5 - Compliance of the Proposed Action with Executive Orders

Executive Orders	Number	Compliance Status
Invasive Species	13112	In Compliance
Equal Opportunity	11246	In Compliance
Protection and Enhancement of Environmental Quality	11514/11991	In Compliance
Protection and Enhancement of the Cultural Environment	11593	In Compliance
Convict Labor	11755	In Compliance
Floodplain Management	11988	In Compliance
Protection of Wetlands	11990	In Compliance
Federal Compliance with Pollution Control Standards	12088	In Compliance
Environmental Effects Abroad of Major Federal Actions	12114	In Compliance
Invasive Species	13112	In Compliance
Federal Compliance with Right-To-Know Laws and Pollution Prevention	12856	In Compliance
Federal Actions to Address Environmental Justice and Minority and Low-Income Populations	12898	In Compliance
Implementation of the North American Free Trade Agreement	12889	In Compliance
Energy Efficiency and Water Conservation at Federal Facilities	12902	In Compliance

Executive Orders	Number	Compliance Status
Federal Acquisition and Community Right-To-Know	12969	In Compliance
Protection Of Children from Environmental Health Risks and Safety Risks	13045	In Compliance
National Invasive Species Council	13112	In Compliance
Child Labor – Cooperation with Authorities and Remedies	13126	In Compliance
Responsibilities of Federal Agencies to Protect Migratory Birds	13186	In Compliance
Notification of Employee Rights Concerning Payment of Union Dues or Fees	13201	In Compliance

8.3 Foreseeable Permits and Authorizations Associated with the Proposed Action

National Pollution Discharge Elimination System (NPDES) requirements for discharges of pesticides into waters of the US/state shall be in accordance with North Carolina Division of Water Quality (NDCWQ) General Permit 560000 and Virginia Department of Environmental Quality (VDEQ) General Permit VAG87.

9.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The local short-term use of the environment will be minimal and necessary in order to provide long-term stabilization of the aquatic ecosystem and the control of invasive aquatic vegetation in Kerr Reservoir. Minor impacts to resources will be necessary but these impacts will be outweighed by the positive outcome and avoidance of long-term impacts to resources.

10.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

A commitment of resources is irreversible when its primary or secondary impacts limit the future option for a resource. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable. Commitment of resources to implement the proposed alternative is appropriate and consistent with the authorized uses of Kerr Reservoir. This proposed action would not result in irreversible and irretrievable commitments of resources.

11.0 PUBLIC AND AGENCY INVOLVEMENT

11.1 Initial Coordination

A scoping letter discussing the proposed project and alternatives considered was mailed to federal, state, and local agencies and other interested groups and individuals for a 30-day initial

comment period on October 2, 2012. Public information sessions were held on November 13 and 15, 2012. Comments received were reviewed and addressed in the EA.

11.2 Coordination of this Document

This Environmental Assessment is being provided to a standard list of Federal, State, and local agencies; elected officials; environmental groups; and interested individuals for review and comment. After a 30-day review period, input received will be considered related to the proposed action. We invite your comments and suggestions regarding the proposed action.

11.3 Recipients of this Environmental Assessment

The recipients of this Environmental Assessment include municipalities, counties, State and Federal agencies, environmental and business organizations, and elected officials with an interest in the operational aspects of John H. Kerr Dam and Reservoir and the lower Roanoke River Basin.

12.0 POINT OF CONTACT

Written comments regarding this Environmental Assessment should be sent to the address or e-mail below. Questions may be directed to Mr. Robert Dennis at 434-738-6101 extension 160 or e-mail below.

Mr. Robert Dennis
US Army Corps of Engineers Or e-mail to JHKERR@usace.army.mil
1930 Mays Chapel Road
Boydton, Virginia 23917

13.0 DRAFT FINDING OF NO SIGNIFICANT IMPACT

The proposed action is not expected to significantly affect the quality of the human environment. If this judgment is confirmed through coordination of this EA, an Environmental Impact Statement will not be required, and a Finding of No Significant Impact (FONSI) will be signed prior to the initiation of the proposed action. The signed FONSI will be made available to the public.

14.0 REFERENCES

Balciunas, J. K., M. J. Grodowitz, A. F. Cofrancesco and J. F. Shearer. 2002. Hydrilla ,pp. 91-114. *In:* Biological Control of Invasive Plants in the Eastern United States. R. Van Driesche, S. Lyon, B. Blossey, M. Hoddle, and R. Reardon (editors) USDA Forest Serv. Publ. FHTET-2002-04, Morgantown, WV.

Boylen, C.W., L.W. Eichler and J.D. Madsen. 1999. Loss of native aquatic plant species in a community dominated by Eurasian water-milfoil. Hydrobiologia 415: 207-211.

Brockington, Paul. E. Jr., Ashley A. Chapman, Bobby G. Southerlin, Connie M. Huddleston, Marian D. Roberts, Christopher T. Espenshade, Jeffrey W. Gardner, David Diener and C. Scott. 1992 Historical and Archaeological Investigations In Support of a Proposed Historic Properties Management Plan For John H Kerr Dam and Reservoir Near Boydton, Virginia, Brockington and Associates, Atlanta, Georgia.

Burge, T.K; Morgan, D.; and Eubanks M. J. 2007 Invasive Aquatic Plant Expansion In Walter F. George Lake, Proceedings of the 2007 Georgia Water Resources Conference, University of Georgia.

Carpenter, S. R., and Lodge, D. M. 1986. Effects of submersed macrophytes on ecosystem processes. Aquatic Botany, 26:341-370.

Clugston, J. P., and Shireman, J. 1987. Triploid Crass Carp for Aquatic Plant Control, Fish and Wildlife Leaflet 8, Fish and Wildlife Service, US Department of the Interior, Washington, DC.

Colle, D.E. and J.V. Shireman. 1980. Coefficients of condition for largemouth bass, bluegill, and redear sunfish in hydrilla-infested lakes. Transactions of the American Fisheries Society 109:521-531.

Cofrancesco, A.F. and M.J. Grodowitz. 1994. Status of insect biocontrol against hydrilla and eurasian watermilfoil. Proc., Grass Carp Symp. 7-9 March 1994. pp. 55-62.

Dibble, E. D., Killgore, K. J., and Harrell, S. L. 1997. Assessment of fish-plant interactions. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. Aquatic Plant Research Program Miscellaneous Paper A-97-6

Doyle, R. D., and Smart, R. M. 1993. Potential use of native aquatic plants for long-term control of problem aquatic plants in Guntersville Reservoir, Alabama. Report 1. Establishing native plants," Miscellaneous Paper A-95-3, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Eccleston, Charles H. Effective Environmental Assessments, How to Manage and Prepare NEPA EAs, 2001.

Eubanks, Michael J. and Morgan Donald M. Proceeding of the 2001 Georgia Water Resources Conference, March 26-27, 2001 Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, University of Georgia, Athens, Georgia.

Garrow, Patrick H., Max E. White, G. Michael Watson, Steven D. Nicklas, Stephen H. Savage, Jenalee Muse, Jana Kellar, Linda France, John B. Green, Jeanne Metropol, Lynda N. Morgan and Kim S. Savage. 1980 Site Description Supplement, Sites Identified During the John H. Kerr Reservoir Survey, Virginia – North Carolina. Soil Systems, Marietta, Georgia.

Grodowitz, M. J., A. F. Cofrancesco, R. M. Stewart, J. Madsen, and D. Morgan. 2003b. Possible impact of Lake Seminole Hydrilla by the introduced leaf-mining fly Hydrellia pakistanae. ERDC/EL TR-03-18. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Grodowitz, M. J, Nachtrieb J., Harms N., and Freedman J. 2010 Suitability of Using Introduced *Hydrellia* spp. for Management of Monoecious *Hydrilla verticillata* (L.f.) Royle ERDC/TN APCRP-BC-17. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Horppila, J. and Nurminen, L. 2005: Effect of different macrophyte growth forms on sediment and P resuspension in a shallow lake. Hydrobiologia 545: 167-175.

Horton, Jr. J. Wright and Zullo A. Victor. The Geology of the Carolinas. University of Tennessee Press, 1991.

Hoyer, M. V. and D. E. Canfield Jr. 1996. Largemouth bass abundance and aquatic vegetation in Florida Lakes: an empirical analysis. J. Aquat. Plant Manage. 34: 23-32.

James, W. F. & J. W. Barko, 1991. Influences of submersed aquatic macrophytes on zonation of sediment accretion and composition, Eau Galle Reservoir, Wisconsin. Technical Report A-91-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS, 23 pp.

James, W. E., and Barko, J. W. 1995. Effects of submersed macrophytes on sediment resuspension in Marsh Lake, Minnesota, Proceedings, 29th annual meeting, Aquatic Plant Control Research Program. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. Aquatic Plant Research Program Miscellaneous Paper A-95-3

Kirk, J. P., and J. E. Henderson. 2006. Management of hydrilla in the Santee Cooper Reservoirs, South Carolina. Journal of Aquatic Plant Management 44:98-103.

Lovell, Sabrina J., Stone, Susan F. and Fernandez, Linda, 2006. The Economic Impacts of Aquatic Invasive Species: A Review of the Literature Agricultural and Resource Economics Review 35/1 (April 2006) 195–208

Maceina, M. J. 1996. Largemouth bass abundance and aquatic vegetation in Florida lakes: An alternative interpretation. J. Aquat. Plant Manage. 34: 43-47.

Maceina, M. J., and W. C. Reeves. 1996. Relations between submersed macrophyte abundance and largemouth bass tournament success on two Tennessee River impoundments. Journal of Aquatic Plant Management 34:33-38.

Maceina, M.J. and J.V. Shireman. 1982. Influence of dense hydrilla infestation on black crappie growth. Proceedings of the Annual Conference of Southern Association of Game and Fish Agencies 36:394-402.

Maceina, M. J. and Slipke, J.W. 2003. Response of Adult Largemouth Bass and Aquatic Plants to Small-scale Applications of Aquathol K in Lake Seminole, Georgia, Proceedings of the Annual Conference of the Southeast Association Fish and Wildlife Agencies 57:35-43

Madsen, J., Chambers, P., James, W., Koch, E., & Westlake, D. 2001: The interaction between water movement, sediment dynamics, and submersed macrophytes. *Hydrobiologia* 444 : 71-84.
North Carolina State University 2011, Kerr Lake Vegetation Survey October-November 2011

Madsen, J. 2007: Assessment of Lake Gaston Hydrilla Management Efforts in 2006, A Final Report to the Lake Gaston Weed Control Council, GeoResources Institute Report 5010 Mississippi State University January 5, 2007

Miller, Carl F. 1962 Archaeology of the John H. Kerr Reservoir Basin, Roanoke River, Virginia – North Carolina River Basin Survey Papers Number 25. Bureau of American Ethnology Bulletin 182. Smithsonian Institution, Government Printing Office, Washington D.C.

North Carolina Department of Environment and Natural Resources – Division of Water Quality 2012 303(d) List of Impaired Waters : http://portal.ncdenr.org/web/wq/ps/mtu/assessment

North Carolina Department of Environment and Natural Resources – Division of Water Quality surface water classification: http://portal.ncdenr.org/web/wq/ps/csu/classifications

North Carolina Natural Heritage Program web page: http://www.ncnhp.org/

North Carolina State University 2012: Kerr Lake Vegetation Survey 2011 (Appendix III)

North Carolina State University 2013: Kerr Lake Vegetation Survey 2012 (Appendix IV)

Smart, R. M., Dick, G.O., and Doyle, R.D. 1998, "Techniques for establishing native aquatic plants, Journal of Aquatic Plant Management 36: 44-49

Smart, R. M., Dick, G.O., and J. R. Snow. 2005. Update to the propagation and establishment of aquatic plants handbook. U.S. Army Engineer Research and Development Center, Lewisville Aquatic Ecosystem Research Facility, Report ERDC/EL TR-05-4. 44pp.

Southerlin, B., O'Neal, K.M., Reid D., Tibbetts R. and Kim Villemez K. 2009 Phase I Archaeological Survey of the Rocky Branch, Eagle Point, and Coleman Sale Timber Tracts, John H. Kerr Dam and Reservoir, Mecklenburg County, Virginia. Archaeological Consultants of the Carolinas, Clayton, North Carolina.

U.S. Army Corps of Engineers, Engineering Division Wilmington District. 1995. Shoreline Management Plan for John H. Kerr Dam and Reservoir, Appendix VI of the Operational Management Plan, North Carolina and Virginia.

U.S. Army Corps of Engineers - Water Control Plan for John H. Kerr Reservoir and Dam, Reservoir Regulation Manual, Appendix A, for Kerr Reservoir. October 1995.

U.S. Environmental Protection Agency 2010, Currently Designated Nonattainment Areas for All Criteria Pollutants: www.epa.gov/oaqps001/greenbk/ancl.html

U.S. Environmental Protection Agency Envriomapper for Envirofacts web site: www.epa.gov/emefdata/em4ef.home

U.S. Fish and Wildlife Service 1999, Smooth Coneflower, *Echinacea laevigata* fact sheet, U.S. Fish and Wildlife Service, Virginia Field Office

U.S. Fish and Wildlife Website. Federally-listed species in Halifax, Mecklenburg, and Charlotte Counties, Virginia. www.fws.gov/northeast/virginiafield/endspecies/county_lists.html

U.S. Fish and Wildlife Raleigh Ecological Field Office species descriptions:
harperella -- http://www.fws.gov/raleigh/species/es_harperella.html
spinnymussel - http://www.fws.gov/raleigh/species/es_tar_spinymussel.html

U.S. Fish and Wildlife Service Migratory Bird Program species description :
bald eagle - www.fws.gov/migratorybirds/baldeagle.htm

U.S. Fish and Wildlife Service Asheville Ecological Services Field Office – species description:
dwarf wedgemussel- www.fws.gov/asheville/htmls/listedspecies/dwarf_wedgemussel.html

Virginia Department of Environmental Quality 2012, Draft Water Quality Assessment 305(b)/303(d) Integrated Report, March 2012

Virginia Department of Game and Inland Fisheries 2012, Buggs Island Lake Report 2012 http://www.dgif.virginia.gov/fishing/waterbodies/display.asp?id=25&section=reports

Virginia Department of Game and Inland Fisheries 2013, Wildlife Diseases - Largemouth Bass Virus in Virginia - http://www.dgif.virginia.gov/wildlife/diseases/largemouth-bass-virus/

Virginia Natural Heritage Program – Search for Natural Heritage Resources web site: http://www.dcr.virginia.gov/natural_heritage/dbsearchtool.shtml

Wheeler, G.S. and Center ,T.D. 2007 Hydrilla stems and tubers as hosts for three Bagous species: Two introduced biological control agents (Bagous hydrillae and B. affinis) and one native species (B. restrictus) Environmental Entomology 36 (2), 409-415

Appendix I – DRAFT Kerr Reservoir AVMP

DRAFT AVMP will be revised based on comments received during the EA process.

THIS IS A DRAFT DOCUMENT SUBJECT TO REVISION BASED ON COMMENTS RECEIVED DURING THE ENVIRONMENTAL ASSESSMENT PROCESS.

John H Kerr Reservoir

Aquatic Vegetation Management Program

U.S. Army Corps of Engineers

North Carolina Wildlife Resources Commission

North Carolina Division of Parks and Recreation

Virginia Department of Game and Inland Fisheries

Virginia Department of Conservation and Recreation

North Carolina Cooperative Extension Service

North Carolina State University

DRAFT

March
2013

THIS IS A DRAFT DOCUMENT SUBJECT TO REVISION BASED ON COMMENTS RECEIVED DURING THE ENVIRONMENTAL ASSESSMENT PROCESS.

Table of Contents

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I. Introduction

John H. Kerr Dam and Reservoir is a federally owned multipurpose civil works project under the stewardship of the US Army Corps of Engineers (USACE), Wilmington District. The Congressionally authorized purposes of the project are flood damage reduction, hydropower, water supply, recreation, and fish and wildlife conservation.

Kerr Reservoir is located in the Roanoke River basin on the border of Virginia and North Carolina. The project includes approximately 48,900 acres of water and 55,000 acres of land surrounding the reservoir. There are approximately 800 miles of shoreline. The reservoir and surrounding lands are managed by the USACE in partnership and collaboration with multiple state agencies, municipalities, and other stakeholders.

To combat the spread of invasive species the USACE adopted the USACE Invasive Species Policy on June 2, 2009 in accordance with Executive Order 13112 and the National Invasive Species Management Plan. The USACE Invasive Species Policy requires operating projects to include strategies for invasive species management in their project operations and maintenance responsibilities and that these strategies be coordinated with other federal, state, and local agencies

The AVMP has been prepared in coordination with the North Carolina Wildlife Resources Commission, the North Carolina Division of Parks and Recreation, the Virginia Department of Game and Inland Fisheries, the Virginia Department of Conservation and Recreation, North Carolina Cooperative Extension Service, North Carolina State University, and the USACE Engineering Research Development Center (ERDC).

The intent of the John H Kerr Reservoir Aquatic Vegetation Management Program (AVMP) is to maintain a healthy and sustainable reservoir ecosystem dominated by native aquatic vegetation.

Kerr Reservoir AVMP Goals:

1. Encourage the spread and establishment of populations of native aquatic vegetation.
2. Manage established populations of invasive aquatic vegetation to minimize harmful impacts.
3. Prevent introduction and establishment of invasive aquatic vegetation to avoid negative impacts.
4. Develop and improve capacity to identify, report, and effectively respond to newly discovered occurrences of invasive aquatic vegetation.
5. Survey and monitor to ensure management actions are effective.
6. Collaborate with the public, stakeholders, and subject matter experts to ensure that program management actions are based on sound scientific information.
7. Utilize education, communication, and interpretative programs to convey to the public how they can help prevent, identify, detect and control invasive species; to gather public input into program plans; and to promote partnerships for implementation of the program

To accomplish these goals an Action Plan will be developed annually detailing proposed objectives, actions, and responsibilities. The USACE will schedule a r agency meeting annually each

spring to facilitate development of the Action Plan. To avoid duplication of effort and conflicts with the objectives of the Kerr Reservoir AVMP, only management activities included in the annual Action Plan may be undertaken on USACE property. Some activities may require additional authorizations and/or permits.

II. Aquatic Vegetation in Kerr Reservoir

In 2011 and 2012 the USACE contracted with North Carolina State University (NCSU) to survey the shoreline for the presence of aquatic vegetation (NCSU 2011, NCSU 2012). Native aquatic vegetation was most prevalent in areas between Clarksville and Longrass Point on Nutbush Creek, including Mill Creek, Butcher Creek, Beaver Creek and Grassy Creek; acreages were not quantified. Native species identified included macroalgae (*Chara sp./Nitella* sp.), variable leaf pondweed *(Potamogeton diversifolius)*, sago pondweed (*Potamogeton pectinatus)*, southern waternymph (*Najas guadalupensis*); smartweed *(Polygonum sp.*); and water willow (*Justicia americana*).

Invasive species of aquatic vegetation identified include Naiads (*Najas minor*) and hydrilla (*Hydrilla verticillata*). Hydrilla is the most prevalent invasive exotic species observed infesting approximately 888 acres (NCSU 2012). The majority of hydrilla was found in Little Nutbush Creek, Nutbush Creek, along with some isolated occurrences at North Bend Park. The 2012 survey found no hydrilla in several areas where it had been documented in 2011including small areas at North Bend Park, the Staunton View boat ramp, Occoneechee State Park, Clarksville Marina, the Uppy's Convenience Store dock, and scattered locations mainly along the south shore west of the Clarksville bridge. Low water levels during the survey were may account for the absence.

Documentation of the occurrence of aquatic vegetation prior to the 2011 and 2012 surveys is limited. In 1992 and 1993 small patches of hydrilla (approximately 8 acres total) were documented in the area around the North Bend Park. In July 1996 occurrences of *Chara sp*. and brittle naiad (*Najas minor)* were documented in the Satterwhite Point area of Nutbush Creek. During the summers of 2009 and 2010, hydrilla was reported in the North Carolina portion of Kerr Reservoir. Subsequent sampling and surveys confirmed wide spread occurrence of hydrilla in Nutbush Creek and Little Nutbush Creek, however total acreages were not determined at that time. Hydrilla was also reported in the Staunton River upstream of Staunton View Park.

Once hydrilla has become established it is difficult and expensive to control. Total elimination of hydrilla in Kerr Reservoir is not considered a realistic outcome given the geographic extent of the current hydrilla infestation in Kerr Reservoir and the Roanoke River Basin, and the high variability in effectiveness and limitations of the available control methods.

III. Aquatic Vegetation Management

The USACE, state agencies, lessees, shoreline permit holders, and other stakeholders may participate in activities identified in the Action Plan (Appendix A). All activities must be coordinated with the USACE to avoid duplication of effort and conflicts with the objectives of the AVMP. Certain activities may require additional authorizations and/or permits.

USACE management actions are dependent on available funding. Unless specific appropriations are made for aquatic vegetation management, funding for management activities will be prioritized along with other authorized missions i.e. power plant maintenance, recreation management, and other natural resources management activities.

The following aquatic vegetation management methods may be utilized individually or in combination:

A. <u>Chemical Control</u>

The type, application rate, and method of application of herbicides will be selected based on site conditions and target species. Guidance and recommendation from the North Carolina Agricultural Chemicals Manual –Aquatic Weed Control, pesticide labels and other appropriate publications will be utilized in planning treatments.

Only licensed and insured commercial pesticide applicators and trained licensed public agency employees will be authorized to use chemical controls for aquatic plants on USACE property. Shoreline permit holders and lessees may hire licensed commercial herbicide applicators that have been authorized by the USACE to treat aquatic vegetation.

Commercial pesticide applicators wishing to obtain authorization to apply aquatic herbicides in Kerr Reservoir must complete and submit a Kerr Reservoir Aquatic Herbicide Applicator Permit (Appendix B). Authorization must be renewed annually. A list of approved applicators can be found on the Kerr Reservoir Shoreline Management Program web page.

Failure to follow Applicator Permit conditions and any unauthorized application of aquatic herbicides are considered violations of Title 36 Code of Federal Regulations, Chapter III Part 327.9 , 327.12, 327.14, and/or 327.18. Violators are subject to fine and/or imprisonment. Shoreline permit holders engaging in unauthorized application of herbicides are also subject to revocation of their shoreline permit. Applicators that violate terms of their applicator's authorization are subject to revocation of their authorization.

<u>NOTE:</u> Concerns regarding potential for corrosion of aluminum pontoons in areas where copper based herbicide compounds have been applied to control aquatic weeds have been raised based on anecdotal reports at Kerr Reservoir and other reservoirs. Galvanic corrosion occurs when two or more different metals are brought into electrical contact under water. Galvanic corrosion of the metal parts of boats and docks can occur in fresh and salt water, but occurs most quickly in salt water due to its greater electrical conductivity. Galvanic corrosion can occur due to improper grounding of vessels and docks. In fresh water the rate of galvanic corrosion can increase if the corrosive potential of the water is increased through introduction of lawn fertilizers, melting salts, or other compounds due to direct application or runoff from land. Galvanic corrosion of metal parts of boats and docks may be avoided by installing a sacrificial anode on the boat hull, motor, and dock. Note that many boats, motors, and docks come equipped with sacrificial anodes. The anode must be in the water to work. The anode must be replaced periodically. Concerned boat owners may also choose to temporarily move boats from areas where copper based herbicides are being applied.

B. Biological Control – Stocking of triploid grass carp (*Ctenopharyngodon idella*)

Stocking of triploid grass carp in Kerr Reservoir is subject to approval of the USACE and receipt of permits from the State of North Carolina and the Commonwealth of Virginia. Due to the sensitive nature of this activity private individuals and organizations are not permitted to stock grass carp or any other species of fish in Kerr Reservoir. Individuals interested in contributing to authorized fish stocking efforts may contact the USACE for information on how to contribute to this activity.

Only grass carp certified as triploid (sterile) will be used for aquatic weed management in Kerr Reservoir. The US Fish and Wildlife Service oversees certification of triploid grass carp via the National Triploid Grass Carp Inspection and Certification Program (NTGCICP). Triploid grass carp stocking will occur at a rate (fish/acre of vegetation) and frequency appropriate to address the target species and areas. Monitoring of target vegetation and fish populations will be utilized to assess effectiveness of stocking and need for additional stocking. Details of any proposed stocking will be coordinated with state fisheries managers and included in the Action Plan.

Unauthorized biological control activities are considered violations of Title 36 Code of Federal Regulations, Chapter III Part 327.9, 327.12, 327.14, and/or 327.18. Violators are subject to fine and/or imprisonment. Shoreline permit holders engaging in unauthorized activities are also subject to revocation of their shoreline permit.

C. Hand Removal

Limited removal of invasive aquatic vegetation by hand and utilizing hand tools may be authorized for management of small areas. Mechanical harvesting, excavation, and suction dredging of aquatic vegetation are not authorized.

Harvesting/removal of vegetation must be done correctly in order to avoid removal of non-target vegetation and disturbance of habitat and to minimize spread of invasive vegetation due to fragmentation of the plants. Plants may be removed by hand (pulling) or with hand tools (rakes and blades). Plants and cuttings must be removed from the water and disposed of properly. Floating mats may be pulled to shore and stranded on high ground.

Shoreline permit holders and lessees wishing to remove aquatic vegetation by hand must request and receive authorization from the USACE prior to beginning removal of the vegetation (Appendix E Application for removal of invasive aquaticvegetation). Permittees are responsible for complying with all laws and regulations regarding handling and disposal of noxious weeds.

In most cases vegetation removed by hand will be left to dry on high ground. Improper disposal or transport of aquatic vegetation classified as a noxious weed is a violation of the state and federal law (The Plant Protection Act - Title 7 Chapter 104, North Carolina - 02 NCAC 48A .1703, Virginia?).

D. Native Aquatic Vegetation

Selected species of native vegetation may be planted to improve aquatic habitat and displace nuisance vegetation. Plantings may be done in combination with other management activities in order to maximize benefits.

Native vegetation planting will utilize techniques identified in the "Update to the Propagation and Establishment of Aquatic Plants Handbook" (Smart et al 2005) including planting of "founder colonies" to establish the presence of desired species and use of exclusion cages to protect plants from herbivory. Areas to be planted will be selected based on water depth, bottom topography, and substrate type. Location and prioritization of planting and species to be planted will be identified in planting plans developed as part of the annual Action Plan.

Planting will not be done in areas where presence of native aquatic vegetation may interfere with human activities. Only native plant stock from known sources and free of nuisance species will be utilized for plantings. Propagation of existing populations of plants in Kerr Reservoir may also be used as a source of stock for planting.

Due to the sensitive nature of this activity private individuals and organizations are not permitted to plant aquatic vegetation in Kerr Reservoir. Individuals and organizations interested in donating funds for and/or volunteering to assist with authorized native vegetation planting efforts may contact the USACE for information on how to contribute to these activities.

Unauthorized activities are considered violations of Title 36 Code of Federal Regulations, Chapter III Part 327.9, 327.12, and/or 327.14. Violators are subject to fine and/or imprisonment. Shoreline permit holders engaging in unauthorized activities are also subject to revocation of their shoreline permit.

E. Public Education

Public education efforts will focus on informing boaters and fishermen of the importance of cleaning boats, trailers, and other equipment to avoid spreading aquatic nuisance species; facts about native and non-native aquatic vegetation in Kerr Reservoir; and the status of ongoing aquatic vegetation management activities including how the public may get involved.

Activities will include installation and maintenance of nuisance aquatic plant warning signs at all public boat ramps (responsibility of agency managing the access area); posting of aquatic plant management program documents, action plans, and status updates on the USACE website; distribution of general and species specific fliers and pamphlets about aquatic vegetation management through visitor centers, recreation area gate houses, and marinas (responsibility of agency managing the area); and as appropriate inclusion of information on aquatic vegetation management activities in news releases and interpretive programs. Specific actions and responsibilities will be identified in the Action Plan.

F. Survey and Monitoring

Reservoir wide surveys will be conducted as needed, subject to availability of funding, to determine location and extent of aquatic vegetation. Reports of invasive aquatic vegetation will be investigated and actions to address occurrences will be recommended based on extent and severity. Pre and post treatment monitoring will be conducted to determine effectiveness of chemical control, biological control, and native plantings. The USACE will maintain records of survey and occurrence data including Geographical Information System (GIS) database for use in tracking distribution of native and nuisance species and the effectiveness of management actions.

G. Enforcement

Enforcement of existing laws and regulations will be utilized to discourage activities that lead to spread of noxious/invasive aquatic vegetation. Additional laws and regulations may be adopted to address specific concerns. Reward

Unauthorized chemical control activities, biological control activities, removal of vegetation, and/or planting of vegetation on USACE property are considered violations under USACE Rules and Regulations - Title 36 Code of Federal Regulations, Chapter III Part 327.

$1000 REWARD for information leading to the arrest and prosecution of individuals causing damage to USACE property at Kerr Reservoir including the intentional spread of federally listed noxious weeds including hydrilla, unauthorized application of pesticides, and unauthorized release of fish including grass carp. This reward would be provided through the Corps Watch program, a neighborhood crime-watch deterrence program to protect USACE assets from property damage due to vandalism, larceny, arson, and environmental and cultural degradation. To help fight these crimes and reduce operations and maintenance costs, the USACE has been authorized to offer cash rewards of up to $1,000.00 for information leading to the arrest and prosecution of individuals causing damage to USACE property. Individuals who witness or suspect that a crime has been committed against Corps property are encouraged to use the toll-free number, *1-866-413-7970*, to report information of theft, vandalism, or any other threats or suspicious activity against Corps property 24 hours a day. Callers can remain anonymous. This program does not replace the 911 emergency notification system.

Other applicable laws/regulations include:

North Carolina
- Noxious Aquatic Weed List - 15A NCAC 02G .0602
- Noxious Weed Act - 02 NCAC 48A 1702 - 1703

Virginia
- Title 2.2 Chapter 2 -Virginia Code § 2.2-220.2
- Title 3.2 Chapter 8 - Virginia Code § 3.2-800 – 809

Federal
- Nonindigenous Aquatic Nuisance Prevention And Control Act - Title I of Public Law 101-646 104 Stat. 4761, 16 U.S.C. 4701
- Lacey Act - 18 USC 42-43 - 16 USC 3371-3378

- Federal Noxious Weed Act Public Law. 93-629, 88 Stat. 2148
- The Plant Protection Act – Public Law 106-224 7 U.S.C. 7701 et seq.

IV. **References:**

North Carolina State University 2012: Kerr Lake Vegetation Survey 2011

North Carolina State University 2013: Kerr Lake Vegetation Survey 2012

Smart, R. M., Dick, G.O., and Doyle, R.D. 1998, "Techniques for establishing native aquatic plants, *Journal of Aquatic Plant Management* 36: 44-49

AVMP Appendix A: AVMP Annual Action Plan

THIS IS A DRAFT DOCUMENT SUBJECT TO REVISION BASED ON COMMENTS RECEIVED DURING THE ENVIRONMENTAL ASSESSMENT PROCESS.

2013 Kerr Reservoir AVMP Action Plan (DRAFT)

Date: March 2013 (DRAFT will be updated with comments received during EA process)
Current Status of Invasive Vegetation: 2012 survey estimates 888 acres of hydrilla
Proposed Actions: All proposed actions are dependent on availability of funding.

A. Chemical Control – herbicide treatments

Objective: Target herbicide treatments of hydrilla in high use and high threat areas.

Actions:

1) USACE
   a. Treat hydrilla at USACE managed boat ramps – as needed
   b. Review applicator authorization requests
      - approved applicators for 2013 will be posted upon review of permit requests
   c. Review pre-treatment requests – none received - dependant on dock owner participation
   d. Review - Post treatment information on
2) NC Division of Parks and Recreation
   a. Treat 5 or more acres – date and location to be determined – subject to available funding

B. Biological Control - stocking of triploid grass carp

Objective: Decrease acreage of hydrilla throughout the reservoir with emphasis on Nutbush and Little Nutbush Creek

Actions:

1) USACE
   a. Apply for NC and VA permits to stock triploid grass carp.
   b. Stock fish at rate of 15 fish per vegetated acre x 888 acres of hydrilla = 13,320. Stocking locations - boat ramps at Nutbush Creek, Bullocksville, Hiberina, and County Line, and Steele Creek boat ramps. Stocking Dates – dependant on availability funding and fish

C. Hand Removal

Objective: Temporarily open areas congested with hydrilla and remove plants in small areas, concentrating on high use and high threat areas

Actions:

1) USACE
   a. Review request for hand removal – none received to date

D. Native Aquatic Vegetation

Objectives: Promote native aquatic vegetation in areas where invasive plants have been removed and suitable areas that have not been colonized by native vegetation

Actions:

1) USACE
   a. Survey shoreline to identify locations for planting
   b. Identify sources for native vegetation
   c. Draft planting plans for 2014

E. Survey and Monitoring

Objectives: Assess effectiveness of control measures and population of aquatic vegetation

Actions:

1) USACE
    a. Fund 2013 NCSU to complete Kerr Lake Aquatic Vegetation Survey

F. Public Education

Objective: Inform the public and stake holders about how to identify native and invasive aquatic vegetation, report occurrences of invasive species, avoid spreading invasive vegetation, participate and/or contribute to aquatic vegetation management activities, and report unauthorized treatment and illegal transport or dispersal of invasive plants.

Actions:

1) All Managing Agencies - install/replace hydrilla warning/information signs at all boat ramps
2) USACE
    a. Maintain AVMP web page
        i. Copies of actions plan, surveys, herbicide treatment information, etc.
        ii. Information and links on identifying aquatic vegetation and avoiding the spread of invasive vegetation on the AVMP web page
        iii. Reporting link for invasive species occurrence and unauthorized activities
    b. Include printed information on aquatic vegetation in shoreline permit holder mailings

G. Enforcement

Objective: Ensure compliance with existing laws and regulations pertaining to aquatic weeds, herbicide application, fish stocking, and planting of aquatic vegetation

Actions:

1) All Managing Agencies – monitor actions and enforce existing laws and regulations
2) USACE – monitor actions and ensure compliance with AVMP – pesticide treatments, fish stocking, and planting of aquatic vegetation.
3) USACE – Publicize information on the Corps Watch program which may provide a $1000 REWARD for information leading to the arrest and prosecution of individuals causing damage to USACE property at Kerr Reservoir. This reward applies to any property damage including the intentional spread of federally listed noxious weeds including hydrilla, unauthorized application of pesticides, and unauthorized release of fish including grass carp.
4) USACE – Consider adoption of a posted restriction prohibiting anyone from launching, hauling, or attempting to enter or exit a watercraft from Kerr Reservoir with any plant or animal material visible to the eye in or attached to the watercraft. Failure to abide by posted restrictions is a violation of Title 36 Code of Federal Regulations, Chapter III Part 327. Violators would be subject to fine and/or imprisonment.

AVMP Appendix B:

Aquatic Herbicide Applicator Permit

Kerr Reservoir - Aquatic Herbicide Applicator Permit

Permit #:_____

Permit Instructions:
1. Read the entire permit (2 pages)
2. Complete Applicator Information (If multiple applicators are working for the same company each applicator will need their own applicator permit)
3. Sign Permit (by signing the permit the applicator agrees to all terms and conditions)
4. Attach a current certificate of insurance and current aquatic herbicide applicators license/s
5. Submit original signed permit in person or by mail to USACE, 1930 Mays Chapel Road, Boydton, VA 23917
6. If approved, a signed copy of this permit will be returned to you.
7. Prior to any herbicide treatments authorized applicators must submit the required Pre-Notification and receive approval (see Permit Condition 4 below)

NOTICE: Only licensed and insured commercial pesticide applicators and trained licensed public agency employees will be authorized to use herbicides for control of aquatic plants on US Army Corp of Engineers (USACE) property at John H Kerr Reservoir. Unauthorized activities are a violation of Title 36, Code of Federal Regulations (CFR) Part 327.

Applicator Name (print):	**State Applicator License #:**	**Applicator Signature:** **I certify that I have read and understand the conditions of this permit.**
Company Name:		
Company Address:		
Telephone:	**Cellular Telephone:**	**E-mail:**

Approved by:

Signature **Print Name** ***Date**

USACE John H Kerr Dam and Reservoir – Authorized Representative ***Permit expires at end of the calendar year**

This USACE authorization is provided based on presentation of proof of valid insurance and licensing documents by the applicator. This is not an endorsement or guarantee of quality of the services provided by the applicator. Shoreline permit holders may contract with any applicator holding a current authorization from the USACE to apply aquatic herbicides for the purpose of aquatic vegetation control at Kerr Reservoir. Applicators are responsible for compliance with all applicable laws and regulations including NPDES reporting requirements as administered by the appropriate state.

Permit Conditions:

1. Applicators must be licensed in the aquatics category by the appropriate state(s).
2. Applicators will utilize application equipment that is capable of metering the pesticide as it is applied to assure proper application rate in accordance with herbicide label instructions.
3. Commercial applicators must furnish a copy of their state applicator license/s and a Certificate of Insurance showing a minimum of $100,000 for property damage, $100,000 for personal injury to or death of one person, and $300,000 per occurrence.
4. Applicators must provide the USACE a completed Pre-Treatment Notification a minimum of 5 business days prior to proposed treatment date. Applicator must not proceed with treatment prior to receiving an approved Pre-Treatment Notification from the USACE.

5. Applicators must provide the USACE a complete Post Treatment Report within 14 days after the treatment.
6. Applicators must comply with all applicable federal, state and local laws and regulations including NPDES reporting requirements.
7. Pesticides used must be registered in the appropriate State. Use of pesticides classified as "restricted use" by the U.S. Environmental Protection Agency is prohibited.
8. Applicators must coordinate with the operators of water intakes of any type (drinking water, irrigation, industrial) in the vicinity of the application site to ensure compliance with all applicable water use restrictions and set back distances listed on the pesticide label and/or state pesticide regulations.
9. Applicators are responsible for posting notices of restrictions on site if required by the herbicide label and/or applicable state laws and regulations.
10. Applicators and the parties that have contracted the applicator's services are responsible for coordination with vessel owners to move vessels out of the herbicide application area and adjacent areas as desired prior to herbicide application.
11. Applicators release and agree to save and hold the United States harmless from any and all causes of action, suits at law or equity of claims or demands or from any liability of any nature whatsoever for or on account of any injuries or damages to persons or property growing out of the execution of and activities under this permit.
12. Applicators assume full responsibility for any damage claims arising from their activities. This includes damage to vessels and other personal property and replacement of or restitution for non-target vegetation, wildlife, or fish killed as a result of herbicide applications.
13. Applicators are responsible for reporting and cleanup of any spills and unauthorized discharges arising from their activities. In addition to any required state and federal reporting requirements, applicators must report any spills and unauthorized discharges to the USACE within 24 hrs.
14. Violation of permit conditions may result in revocation of this authorization.
15. Violation of permit conditions may be considered a violation of Title 36 Code of Federal Regulations, Chapter III Part 327. Violators are subject to fine and/or imprisonment. Shoreline permit holders engaging in unauthorized activities are also subject to revocation of their shoreline permit.
16. The USACE may terminate this permit at any time by giving written notice to the applicator.

AVMP Appendix C

Aquatic Herbicide Pre-Treatment Notification form

Kerr Reservoir - Aquatic Herbicide Pre-Treatment Notification

(to be completed by the applicator and submitted to the USACE for review and approval prior to the herbicide application)

Date: _____
Applicator Name*: _____ Phone # :_____
USACE Aquatic Pesticide Applicator Permit # :_____
Customer Name:_____ Phone #:_____
USACE Shoreline Permit # (if applicable):_____
Location/Address:_____
>>Attach aerial photograph identifying the treatment area.

Proposed date for herbicide application:_____
Target pest:_____
Pesticide Trade Name, EPA #, and classification**:_____
_____
Form to be applied (liquid, granular): _____

Application Area (sq ft or acres):_____
Application Rate: _____
Mixture: _____
Quantity: _____
Application Equipment:_____

Applicable label water use restrictions:_____
_____
_____

Distance from nearest water intake/s***:
Drinking Water:_____+
Irrigation:_____
Industrial:_____

Name/s of POC/s for intake/s: _____

Other label restrictions to be Implemented:_____
_____

Approved:

Signature: **Print Name:** **Date:**
USACE John H Kerr Dam and Reservoir – Authorized Representative
Authorization expires at end of the calendar year

*The pesticide applicator is responsible for compliance with requirements on the USACE Kerr Reservoir Aquatic Pesticide Applicator Permit, the pesticide label, and all applicable local, state, and federal laws and regulations, including NPDES reporting requirements.
**The pesticide applicator is responsible for determining the appropriate herbicide and application rate in compliance with the product label and all applicable laws and regulations, including NPDES requirements.
***The pesticide applicator is responsible for notification of and coordination with water intake operators.

AVMP Appendix D

Aquatic Herbicide Post Treatment Report

John H Kerr Reservoir - Aquatic Herbicide Post Treatment Report

(to be completed by the applicator and submitted to the USACE after the herbicide treatment)

Date: _____

Applicator Name*: _____ Phone # :_____

USACE Kerr Reservoir Aquatic Pesticide Applicator Permit # :_____

Customer Name:_____ Phone #:_____

USACE Shoreline Permit # (if applicable):_____

Location/Address:_____

Target pest:_____

Date of herbicide application:_____

Time of Day:_____

Pesticide Trade Name, EPA #, and classification**

_____

_____

Application Area (sq ft or acres):_____

Form applied: _____

_____

Mixture: _____

Application Rate: _____

Quantity Applied: _____

Application Equipment:_____

Air Temperature:_____

Water Temperature:_____

Relative Humidity: _____

Wind Speed and Direction: _____

Cloud Cover: _____

Name/s of water intake point/s of contact notified and date of notification***:_____

_____

_____

_____

Other Label Restrictions Implemented:_____

_____

_____

Post Treatment Evaluation (within 14 days of treatment), indicate amount of biomass reduction (% of reduction):_____

_____

Comments/Observations:_____

_____

_____

Date of evaluation: _____ (attach before and after photos if available)

USACE Receipt Confirmation -- Received by: _____Date: _____

*The pesticide applicator is responsible for compliance with requirements on the USACE Kerr Reservoir Aquatic Pesticide Applicator Permit, the pesticide label, and all applicable local, state, and federal laws and regulations, including NPDES requirements

**The pesticide applicator is responsible for determining the appropriate herbicide and application rate in compliance with the product label and all applicable laws and regulations, including NPDES reporting requirements.

***The pesticide applicator is responsible for notification of and coordination with water intake operators.

AVMP Appendix E

Aquatic Vegetation Hand Removal Permit

Kerr Reservoir - Aquatic Vegetation Hand Removal Permit

Permit #:_____

Permit Instructions:
1. Read the entire permit
2. Complete Applicant Information
3. Sign Permit (by signing the permit the applicant agrees to all terms and conditions)
4. Submit original signed permit in person or by mail to USACE, 1930 Mays Chapel Road, Boydton, VA 23917
5. If approved, a signed copy of this permit will be returned to you.

Name (print):	Signature: I certify that I have read and understand the conditions of this permit.	
S		
Address (location of proposed hand removal:		
Mailing Address (if different from location above):		
Telephone:	Cellular Telephone:	E-mail:

1. Target Plant:_____
2. Removal method of (pulling, cutting, raking): _____
3. Estimated area of removal (include map or drawing): _____
4. Proposed Date of Removal (list specific date/s or indicate ongoing if actions will continue throughout the growing season):_____
5. Disposal Method:_____
6. Contractor Information (if applicable)
   Company Name:_____ Phone #:_____

Approved by:

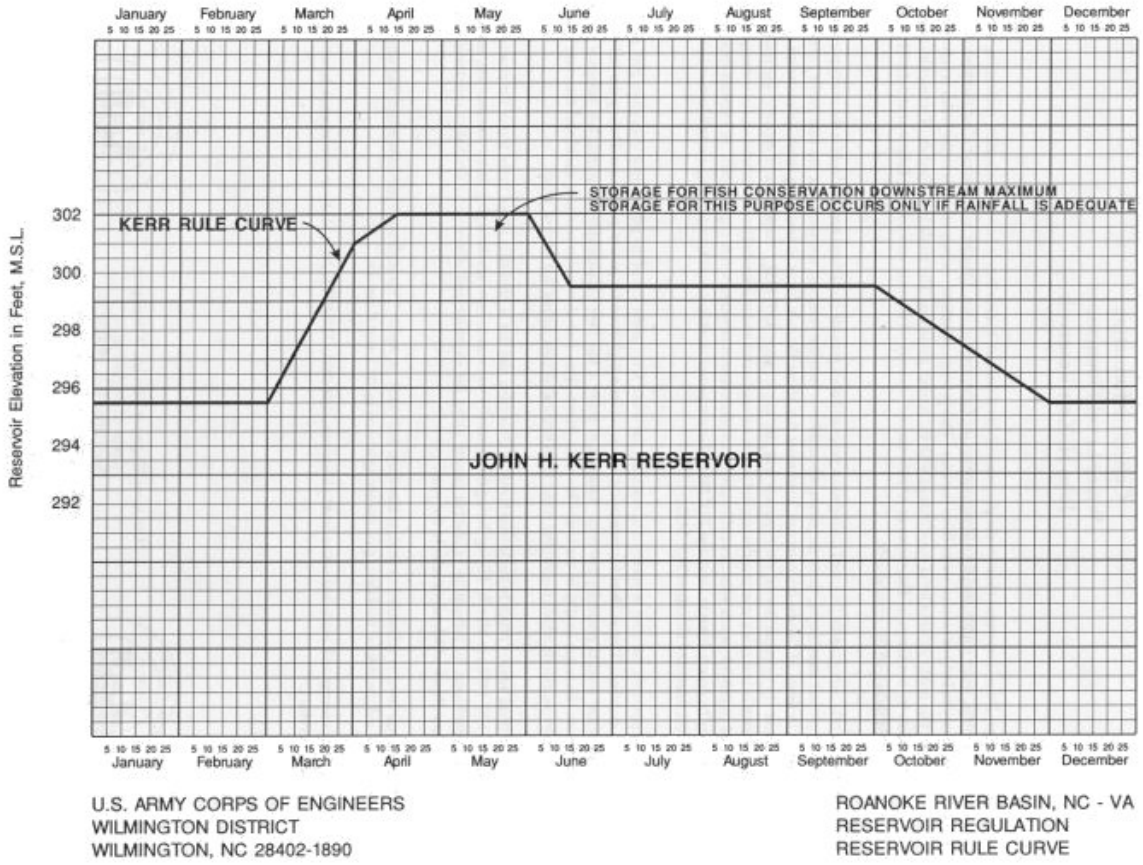
Signature **Print Name** ***Date**

USACE John H Kerr Dam and Reservoir – Authorized Representative ***Permit expires at end of the calendar year**

Permit Conditions:
1. Applicant must not initiate plant removal until permit is approved. A site visit may be necessary prior to determination being made.
2. Plants targeted for removal may be removed by hand (pulling) or with hand tools (rakes and blades).
3. Pulled plants and plant cuttings must be removed from the water and disposed of properly.
4. Floating mats of vegetation may be pulled up and stranded on the shore in an area where the plants will not reenter the lake.
5. This permit does not authorized excavation of plants, use of power equipment, or access by vehicles or equipment onto government property.
6. At the end of the calendar year the Permittee must provide the USACE a written summary of plant hand removal actions including date/s of removal, tools used, estimate of area kept clear, and if re-growth occurred the time taken for re-grow and the amount of re-growth. Include before and after photos if available.
7. The Permittee is responsible for compliance with all applicable laws and regulations, including restrictions on transportation and disposal of noxious weeds.

Appendix II - Figures

Figure1. Kerr Reservoir Elevation Rule Curve (Guide Curve). Figure copied from the Kerr Reservoir Water Control Manual



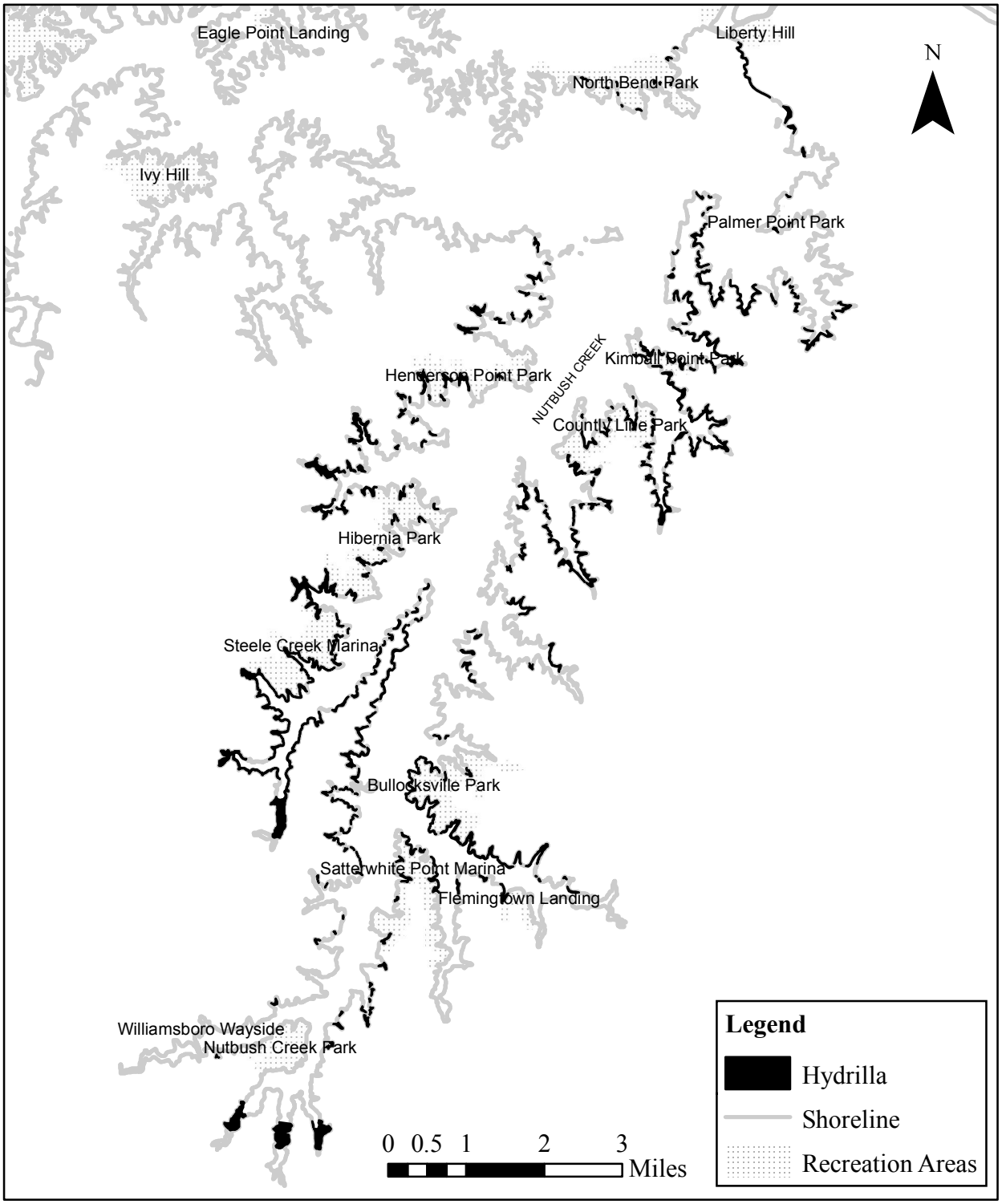


Figure 2: Nutbush Arm 2011 Aquatic Vegetation Survey Hydrilla Locations

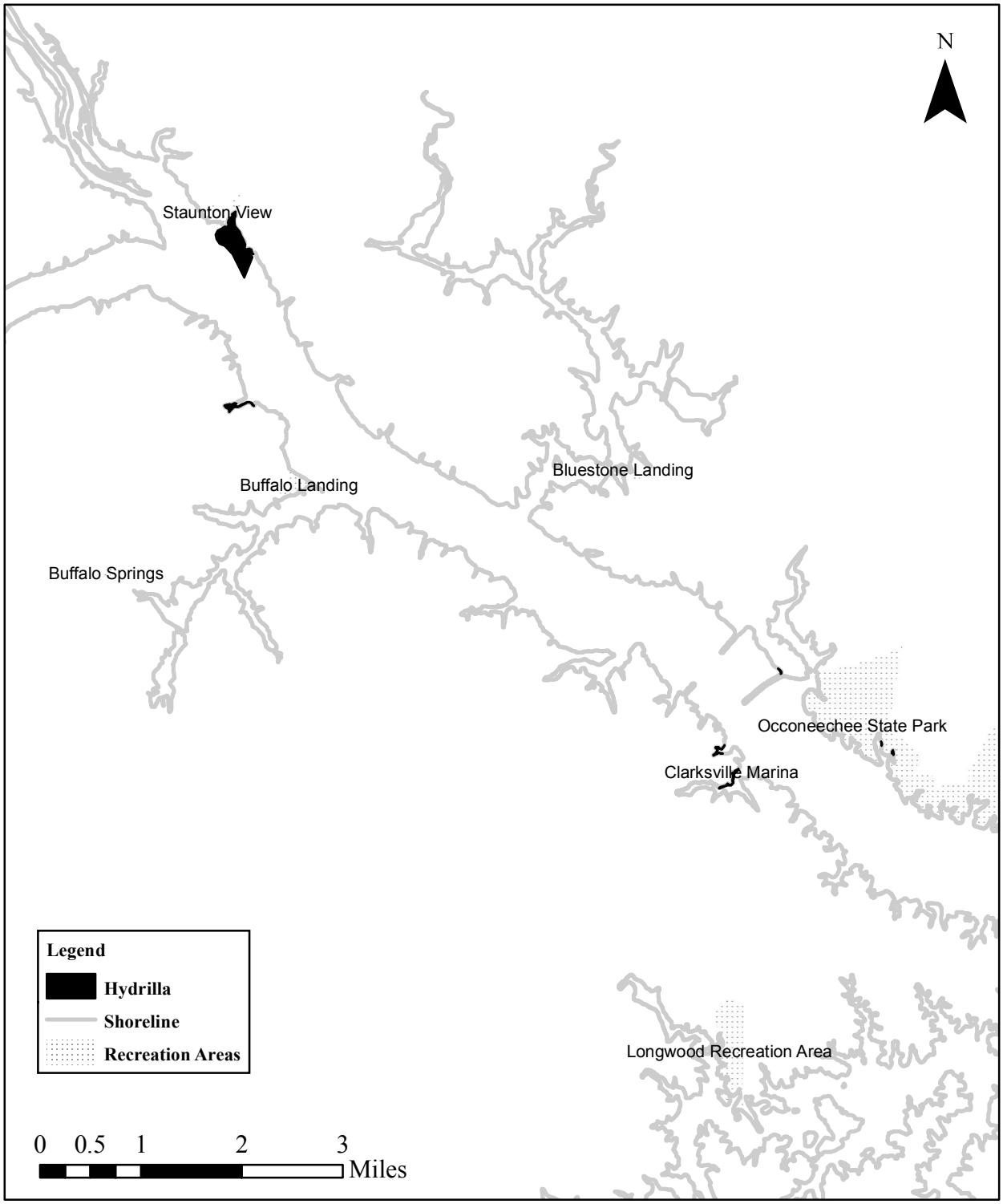


Figure 3: Clarksville Area 2011 Aquatic Vegetation Survey Hydrilla Locations

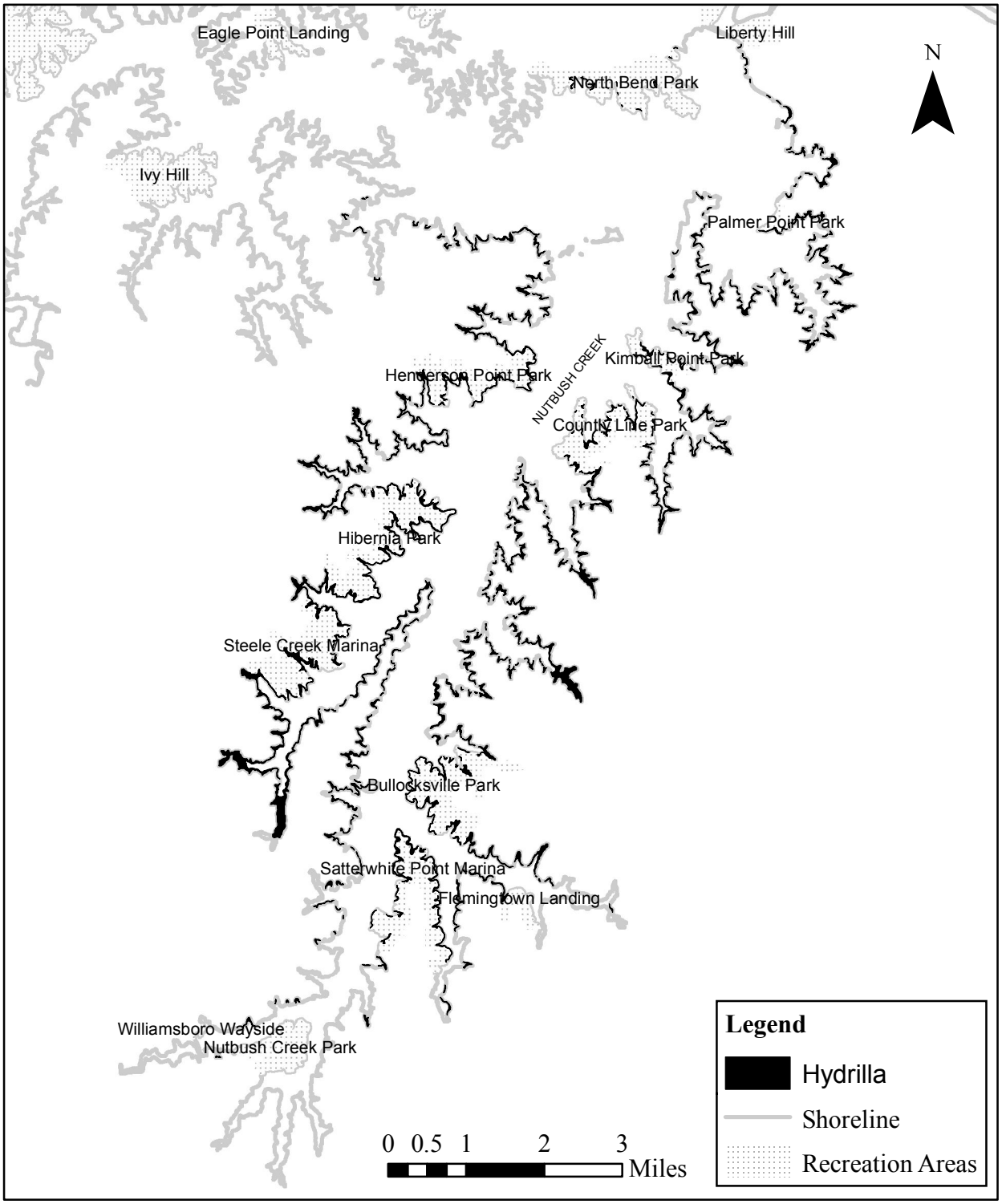


Figure 4: Nutbush Creek Arm 2012 Aquatic Vegetation Survey Hydrilla Locations

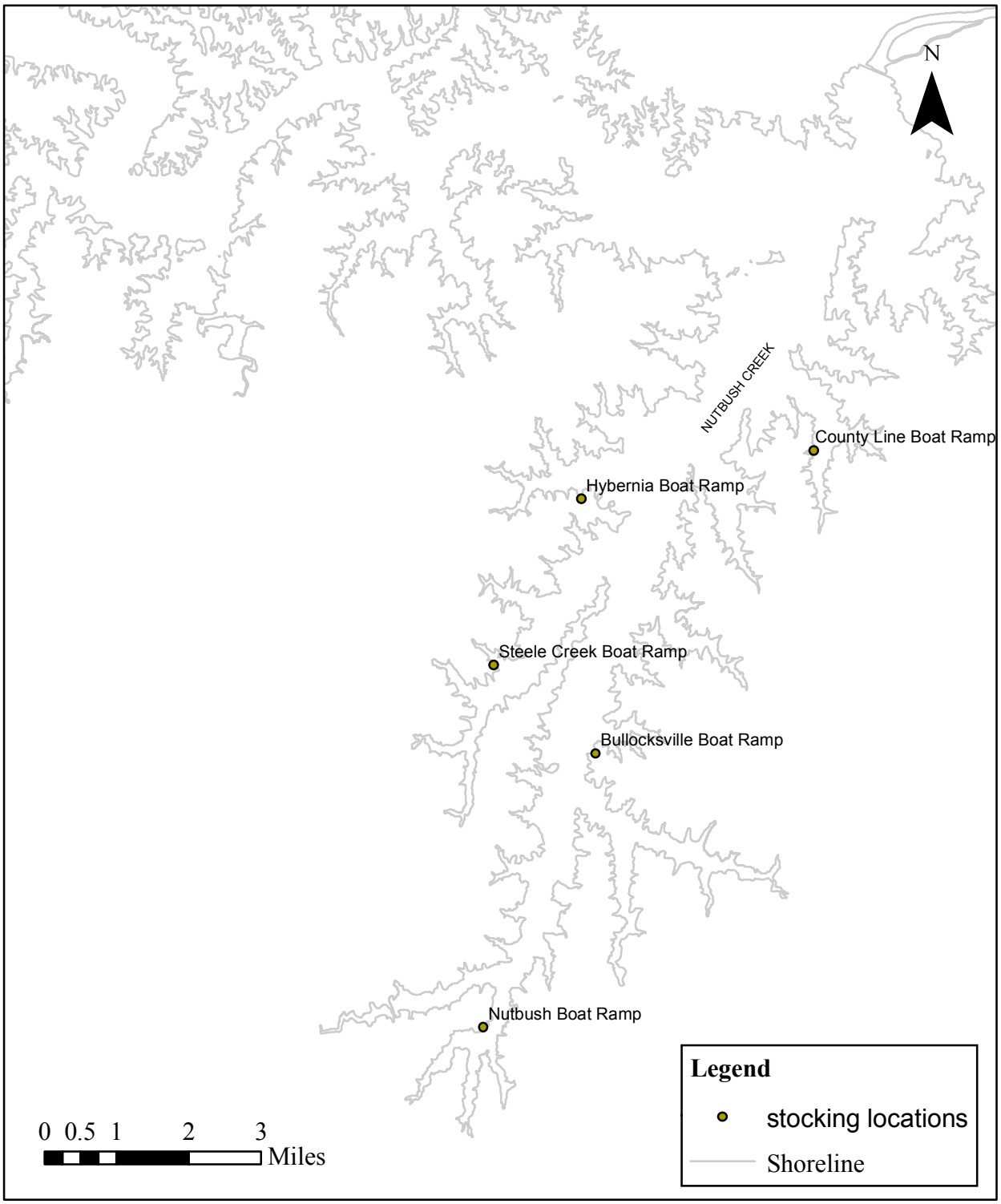


Figure 5: Proposed Initial Stocking Locations

Appendix III

2011 Kerr Lake Aquatic Vegetation Surveys

Kerr Lake Vegetation Survey

October – November 2011

Report submitted by NC State University

Background

Hydrilla (Hydrilla verticillata) is a non-native invasive submersed aquatic plant. This plant was first documented in Wake County, North Carolina in 1980. Initial infestations were confined to small ponds and lakes, however, by 1988 it had spread into Lake Gaston. The plant continued to spread across North Carolina and increased acreage in both the North Carolina and Virginia portions of Lake Gaston into the 1990's.

In the fall of 1992, hydrilla was documented in the North Bend Park portions of Kerr Lake. The first reports were of small patches in the back of one cove near a boat ramp location. Because of the location (near the dam, and adjacent to Lake Gaston) it was thought that boats traveling between the two lakes had been the primary method of dispersion. Following surveys in this area, addition small patches (approximately 8 acres total) were discovered in 1993. Other portions of Kerr Lake were not surveyed, however, some boat ramps in the NC portion of the lake were examined and no Hydrilla found. Treatments of the known locations of Hydrilla were started in 1993, using a contact herbicide Aquathol-K (endothall) plus a sinking agent Nalquatic. Based on information from NCDNR Aquatic Weed Control Program records the treatments were successful and only conducted in 1993 and 1994. In July 1996 after reports of weed problems in the Satterwhite Point area, a survey of that area was conducted. Several locations were found to contain Chara and Brittle Naiad (*Najas minor*). No additional information on surveys or treatments was found.

In the summer of 2009, there were reports of Hydrilla problems in the North Carolina portions of Kerr Lake. Additional reports in 2010 gave indication of an increasing problem in these areas. Paul McKenzie, (Vance County, NC Cooperative Extension Agent) sent several samples to NC State University for positive identification and organized a survey of the North Carolina portions of Kerr Lake mainly in the areas of Nutbush and Little Nutbush Creeks. A group of local volunteers and representatives of various Governmental Agencies participated and found Hydrilla in many of the areas surveyed. Reports from others indicated that the Hydrilla may be more widespread and actual locations and acreages were unknown.

After meeting with representatives of the USACE, NC and Va Fish and Wildlife officials and others it was decided that a thorough survey of Kerr Lake was needed and NC State University was contracted to conduct the survey.

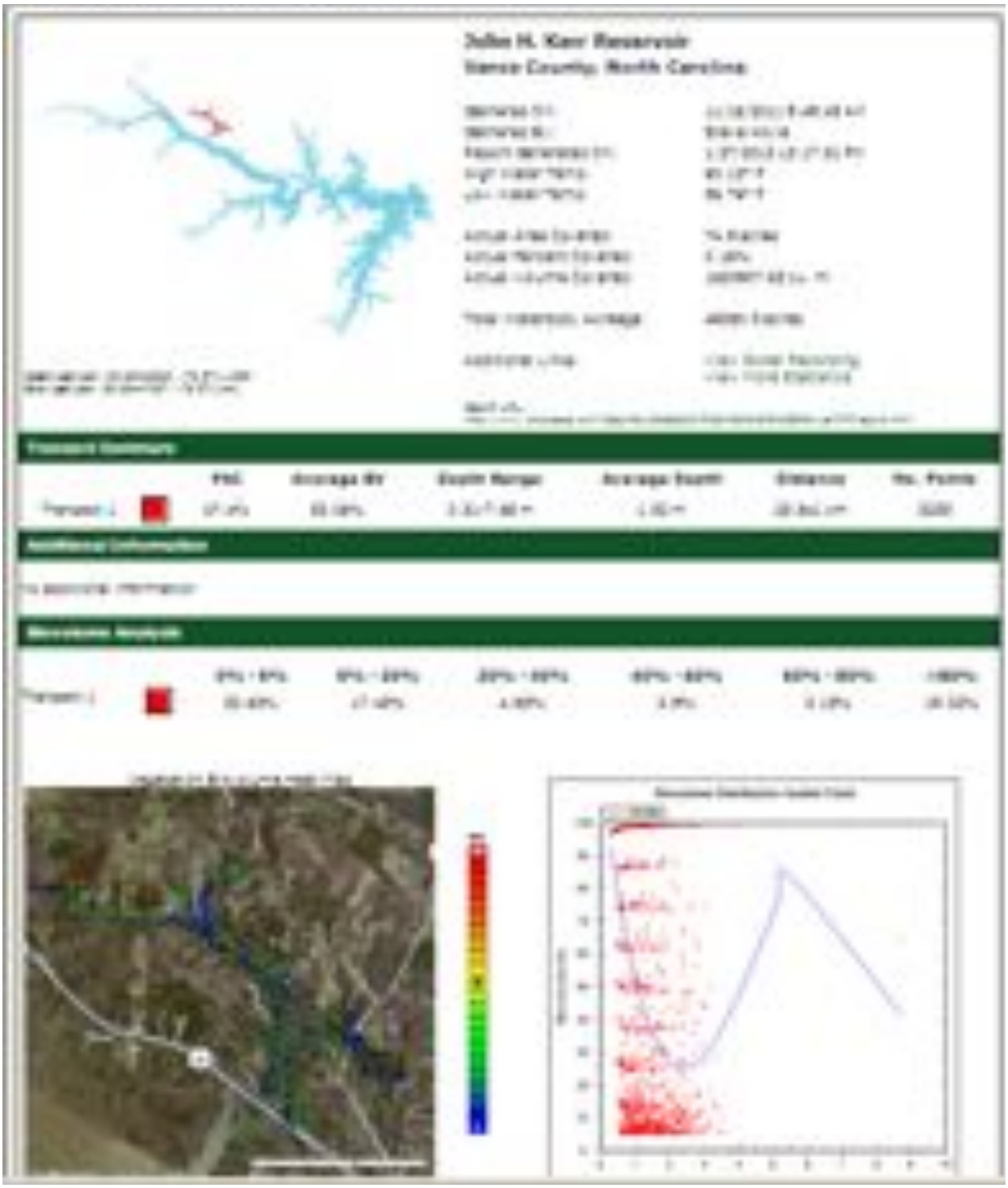
Methods

Dr. Michal Netherland USACE, University of Florida, and Dr. Robert Richardson, NC State University discussed survey methods and decided that using a new high resolution SONAR technique would provide the information needed for this survey. The data collected was transmitted to a private company (Contour Innovations) to process the information and provide maps of all surveyed areas. The sonar unit recorded information on water depth, plant presence and plant height as well as location data. However SONAR methods cannot determine exact species, only vegetation presence or absence. In addition to SONAR, staff members from NC State University recorded the locations of Hydrilla and additional plants. Rake collections of plants were done to aid in species identification.

The survey began October 12, 2011 and was completed on November 16, 2011. A total of approximately 650 miles of shoreline were surveyed. During the survey timeframe, the lake elevation ranged between approximately 296 and 298 feet msl.

Shoreline use and lake map digital information was provided by USACE to be used in completing this survey.

Sonar unit used in Kerr Lake Surveys



Example of reports generated by Contour Innovations

Results

Over a 30+ day period, Hydrilla was observed as low growing, small clusters of plants as well as topped out surface mats in various locations throughout the survey. Hydrilla was the most frequent plant observed in areas where dense plant beds were present. Several other plant species were found in significant quantities in many locations throughout the lake. Native submersed plants included ***Chara sp./Nitella* sp.** (macroalgae), ***Potamogeton diversifolius*** (variable leaf pondweed), ***Potamogeton pectinatus*** *(sago pondweed)*, ***Najas guadalupensis*** (southern naiad). Several locations also had ***Najas minor*** (brittle naiad) a non-native invasive species. Little Nutbush Creek contained large mats of the filamentous algae, ***Spirogyra***. Although not a direct part of the project, several small populations of floating leaf plants were observed including ***Nuphar sp.*** and ***Brasenia sp.*** Also, large sections of the shoreline contained a variety of ***Polygonum sp.*** (smartweeds) and to a lesser extent ***Justicia americana*** (water willow), and other emergent plants.

Because the SONAR unit defined areas of submersed plants without species identification, hand drawn maps were used to determine areas of Hydrilla infestations. The information was transferred from the maps into ArcGIS software and this information was converted to shapefliles and used to determine acreage. The information was then compared to the processed data from Contour Innovations and slight corrections made based on both sources. *A CD of the shapefile information is included*.

During the survey process it was noted that most of the Hydrilla infestations occurred in areas of high human use including State Parks, boat ramps, commercial marinas, and in areas of higher populations of people based on number of docks. As the survey work continued large areas of undeveloped shoreline were found to contain almost no Hydrilla.

There seem to be four main areas of high occurrences of Hydrilla:

1. Little Nutbush Creek had the largest continuous areas of shoreline containing Hydrilla; the back of numerous coves had extensive populations.
2. Nutbush Creek has several large populations of Hydrilla, but also large areas with Chara/Nitella and Naiads (esp. *Najas minor*).
3. North Bend Park the site of the original infestations has several small populations in the same general areas as 1993.
4. Clarksville Va. areas include Staunton View ramp area, Occoneechee State Park ramp area, Clarksville Marina, dock at convenience store, and scattered locations mainly along the south shore, west of Clarksville bridges

Based on the information obtained during the survey, our estimated total acreage of Hydrilla in Kerr Lake is 698 acres, located mainly in the areas listed above.

The sections of the main lake and between Clarksville and Nutbush Creek (Longrass Point) including Mill Creek, Butcher Creek, Beaver and Grassy Creeks contain numerous areas with native vegetation, but little to no hydrilla (small patch noted in back of Beaver Creek).

No Hydrilla was observed at any of the boat ramps in these areas.

Recommendations

Additional whole lake surveys should be conducted to determine spread and document impacts on public use areas and native plant populations. Frequency of these whole lake surveys could be based on random point surveys conducted annually. Point survey efforts should focus on high use areas and boat ramps/marinas.

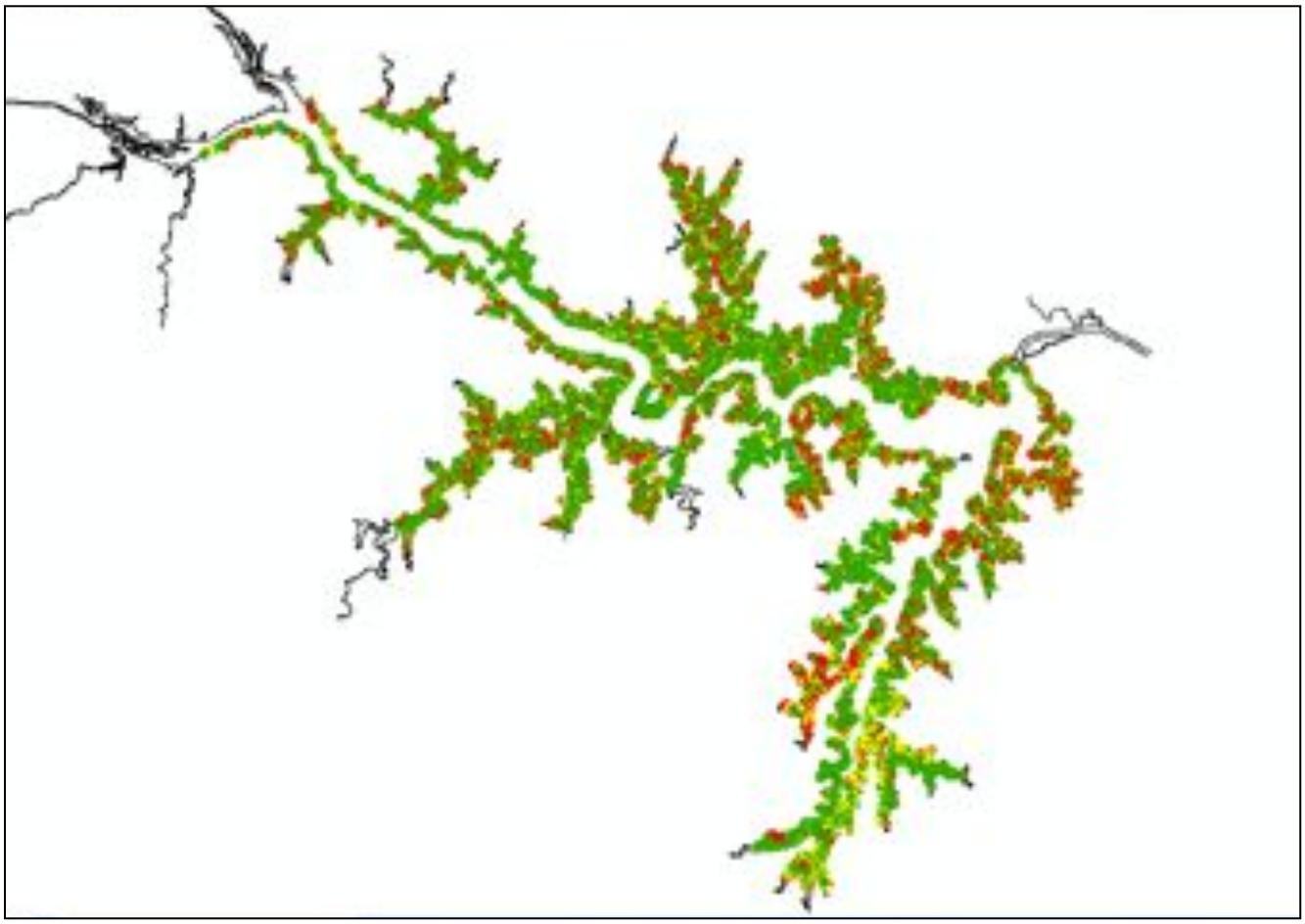
Grass carp (*Ctenopharyngodon idella*) would be the cheapest management option for full lake hydrilla control. Normal stocking rates would be 15 fish / vegetated acre. However, submersed native plants may also be controlled.

Contact herbicides applied by USACE approved applicators may be the best option for control in many areas. Some sections of the currently infested North Carolina portion of the lake may be suitable for systemic herbicides, but water flow will limit their use. Any herbicide applications should be made by these approved applicators and reports containing acres treated, herbicides used and rates, some evaluation of biomass reduction, and other information should be made to the USACE for future determinations of treatments.

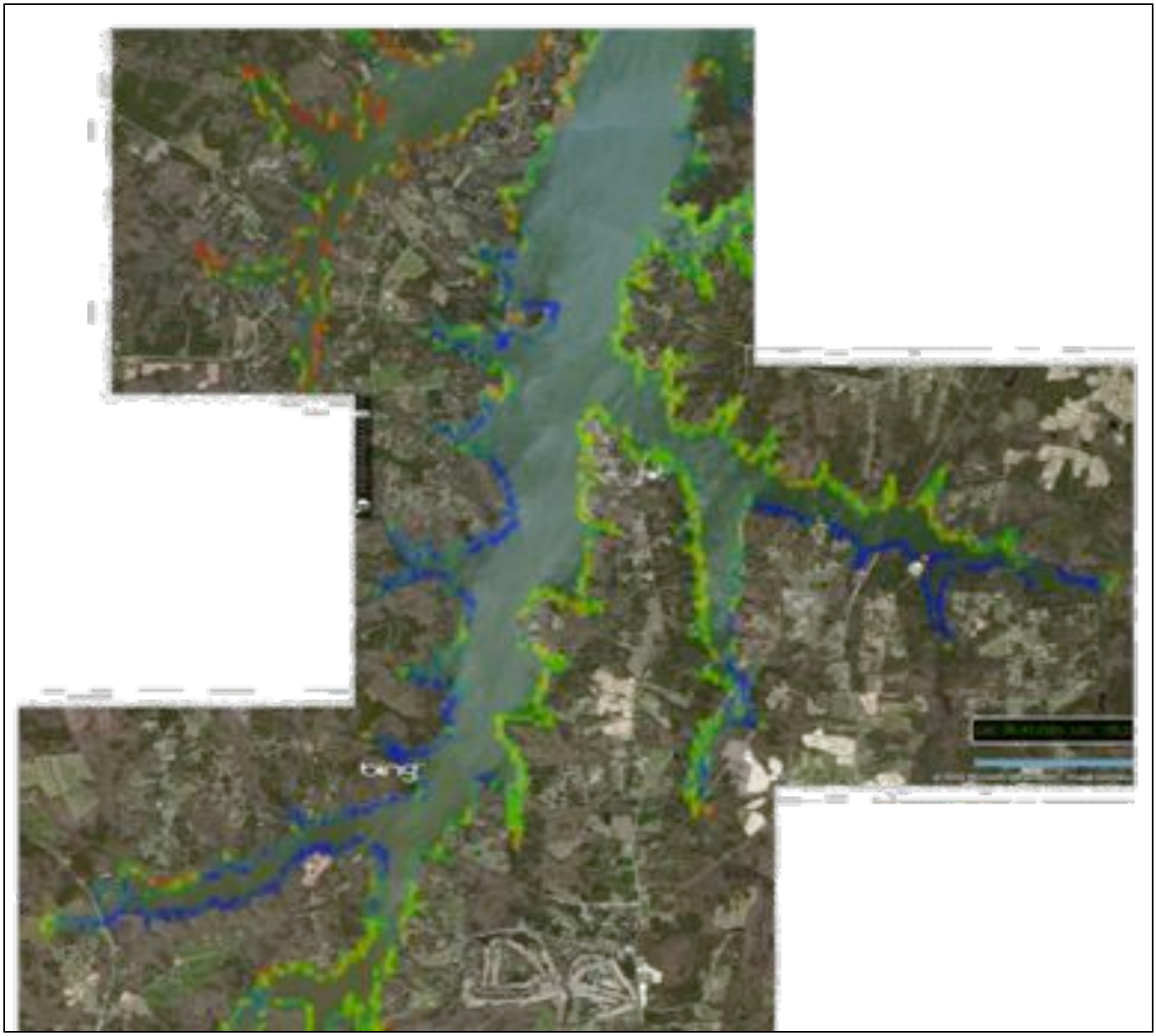
Signs should be placed at all boat ramp/marina locations to help limit unintentional spread in Kerr and to other water bodies.

Information should also be provided to private individuals with “lake front” property, and/or docks. This information could provide instructions for chemical treatments and proper identification of native and non-native plant species. In addition, a reporting system to track new infestations should be implemented. These individuals should be encouraged to rake out or otherwise remove floating mats in the fall to slow spread

Public funds (unknown sources) should be used to treat in areas around public facilities including swimming areas and boat ramps. Repeat applications may be needed and applicators should be required to follow-up in order to reduce tuber formation.



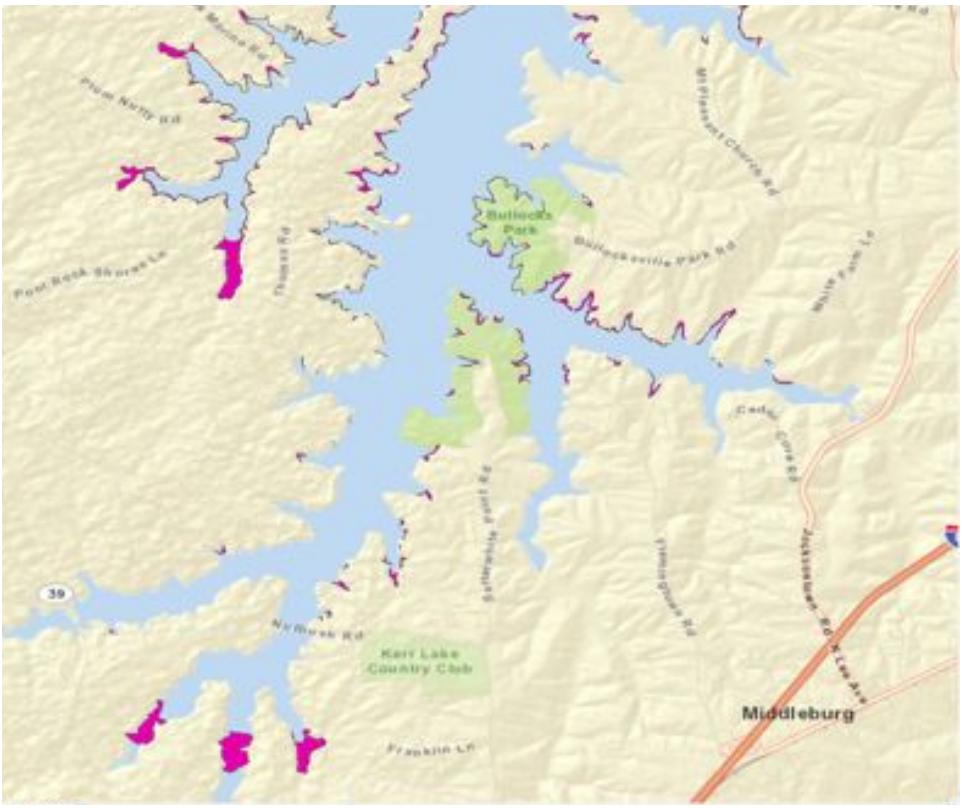
Total Area Surveyed With Relative Plant Density Mapped



Contour Innovations map of plant density

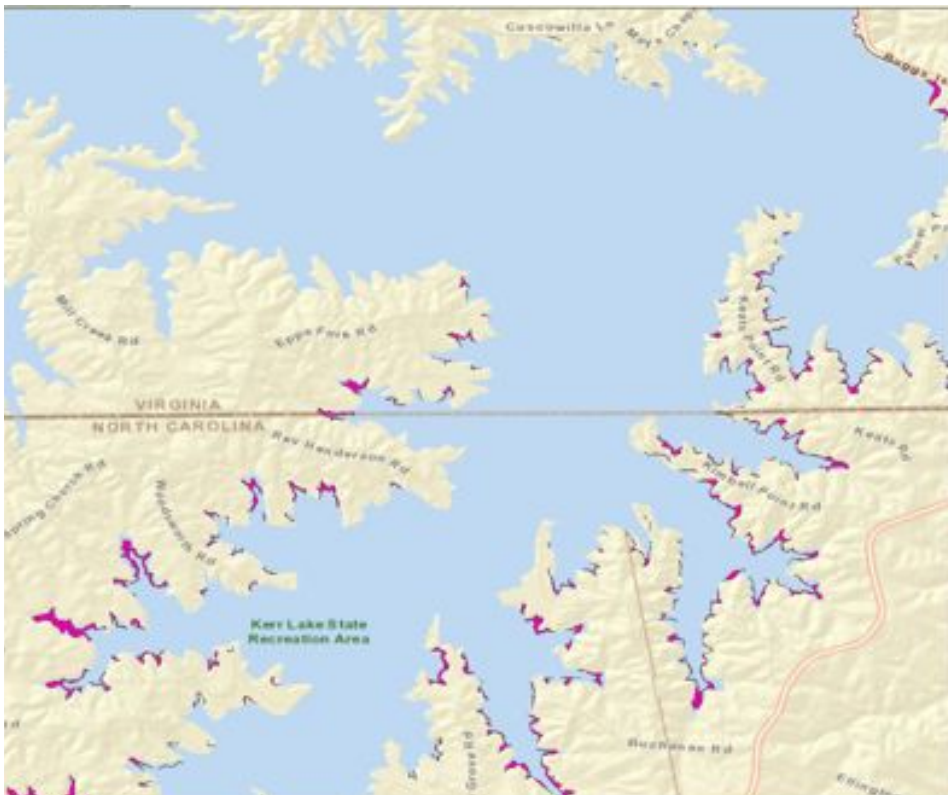
Nutbush and Little Nutbush Creeks

Red high density, Blue low density



Nutbush Creek Mapped Hydrilla Locations

Hydrilla



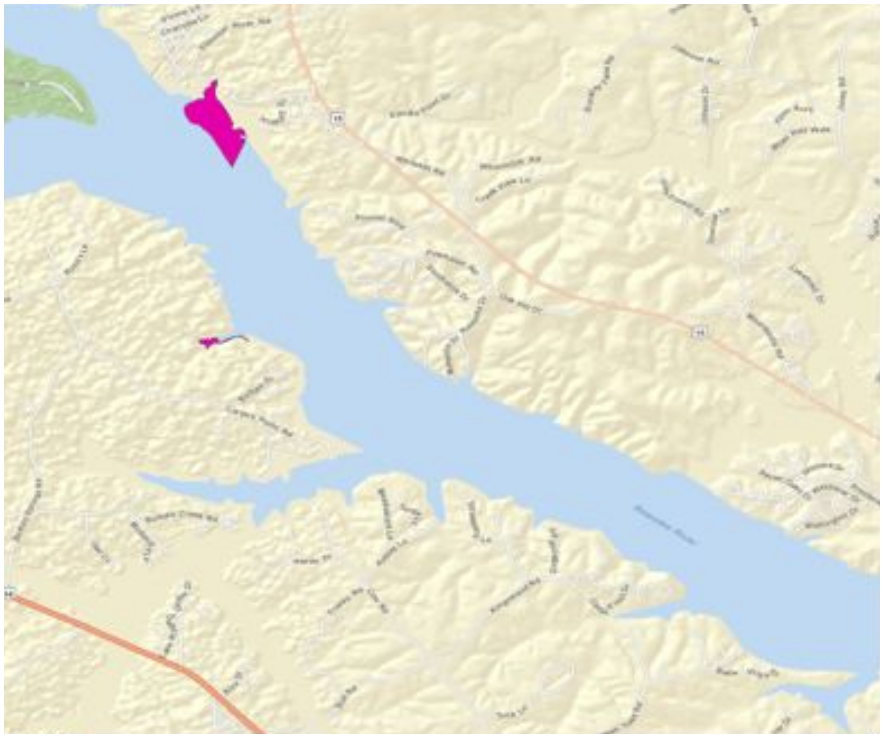
North Section of Nutbush Creek Mapped Hydrilla Locations

Little Nutbush Creek Mapped Hydrilla Locations

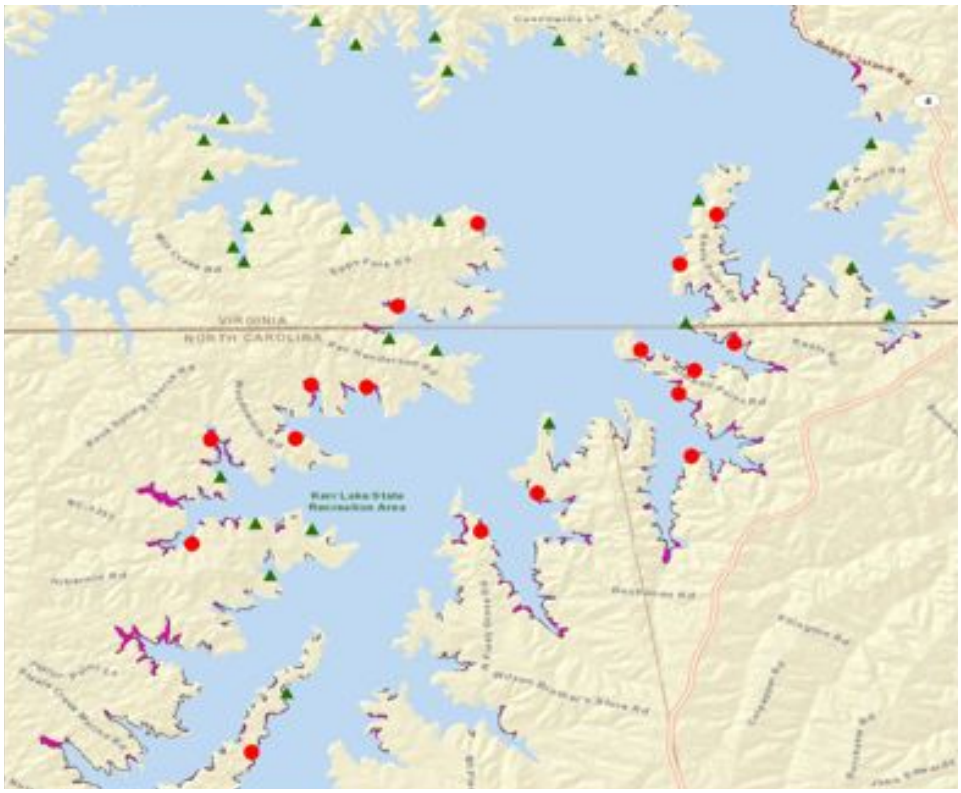
Large Hydrilla site, from boat location to back of Little Nutbush Creek

North Bend Park Mapped Hydrilla Locations

Clarksville Marina and State Park Mapped Hydrilla Locations



Areas West of Clarksville Mapped Hydrilla Locations



Point Survey Locations

Green – No Hydrilla

Red - Hydrilla

Appendix IV

2012 Kerr Lake Aquatic Vegetation Surveys

Kerr Lake Vegetation Survey

October – November 2012

Report submitted by NC State University

Background

Hydrilla (*Hydrilla verticillata*) is a non-native invasive submersed aquatic plant. This plant was first documented in Wake County, North Carolina in 1980. Initial infestations were confined to small ponds and lakes, however, by 1988 it had spread into Lake Gaston. The plant continued to spread across North Carolina and increased acreage in both the North Carolina and Virginia portions of Lake Gaston into the 1990's.

In the fall of 1992, hydrilla was documented in the North Bend Park portions of Kerr Lake. The first reports were of small patches in the back of one cove near a boat ramp. Because of the location (near the dam, and adjacent to Lake Gaston) it was thought that boats traveling between the two lakes had been the primary method of dispersion. Following surveys in this area, additional small patches (approximately 8 acres total) were discovered in 1993. Other portions of Kerr Lake were not surveyed, however, some boat ramps in the NC portion of the lake were examined and no Hydrilla found. Treatments of the known locations of Hydrilla were started in 1993, using a contact herbicide Aquathol-K (endothall) plus a sinking agent Nalquatic. Based on information from NCDNR Aquatic Weed Control Program records the treatments were successful and only conducted in 1993 and 1994. In July 1996 after reports of weed problems in the Satterwhite Point area, a survey of that area was conducted. Several locations were found to contain Chara and Brittle Naiad (*Najas minor*). No additional information on surveys or treatments was found.

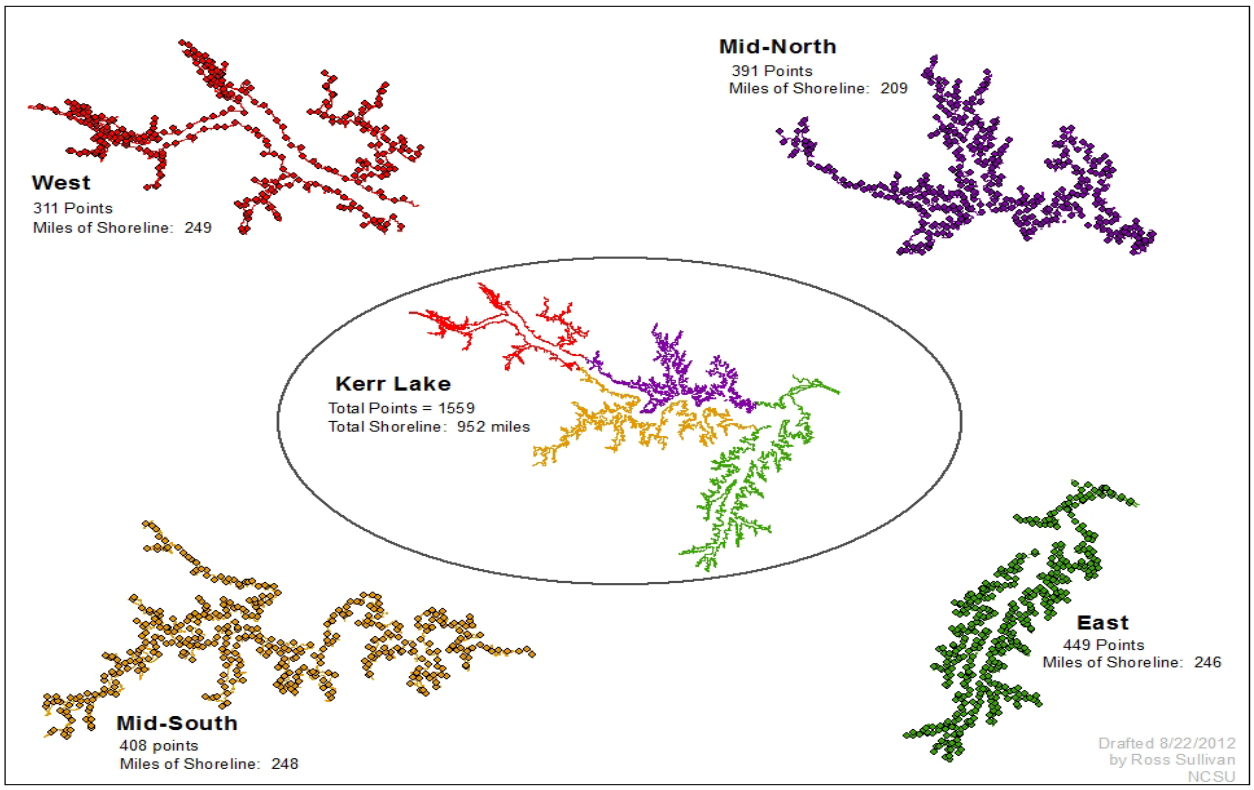
In the summer of 2009, there were reports of problematic Hydrilla infestations in the North Carolina portions of Kerr Lake. Additional reports in 2010 gave indication of an increasing problem in these areas. Paul McKenzie, (Vance County, NC Cooperative Extension Agent) sent several samples to NC State University for positive identification and organized a survey of the North Carolina portions of Kerr Lake mainly in the areas of Nutbush and Little Nutbush Creeks. A group of local volunteers and representatives of various Governmental Agencies participated and found Hydrilla in many of the areas surveyed. Reports from others indicated that the Hydrilla may be more widespread and actual locations and acreages were unknown. A full lake survey was conducted in the fall of 2011 indicating 698 acres of Hydrilla.

After meeting with representatives of the USACE, NC and Va Fish and Wildlife officials and others it was decided that a thorough survey of Kerr Lake was needed and NC State University was contracted to conduct the survey.

Methods

The survey began September 20, 2012 and was completed on November 3, 2012. During the survey timeframe, the lake elevation ranged between approximately 293.88 and 295.39 feet msl. Shoreline use and lake digital map information was provided by USACE to be used in completing this survey.

In 2012, a point intercept method was used to more accurately determine species presence/absence and assist in determining Hydrilla spread. A total of 1559 points were placed at an approximately 0.5 mile interval around the shoreline based on USACE shoreline shape file. Some of these points occurred in areas that were not accessible for various reasons including low water, behind culverts, below dam structure. Of the predetermined points, 1245 were actually sampled for vegetation. The sample method included visual observation of area and 2 rake tosses at each point (or as close as possible to actual point). In addition, Sonar (same method as 2011) was used in areas where Hydrilla was found, along with hand drawn maps and notes. In addition, rake samples were taken at two points around all boat ramps.



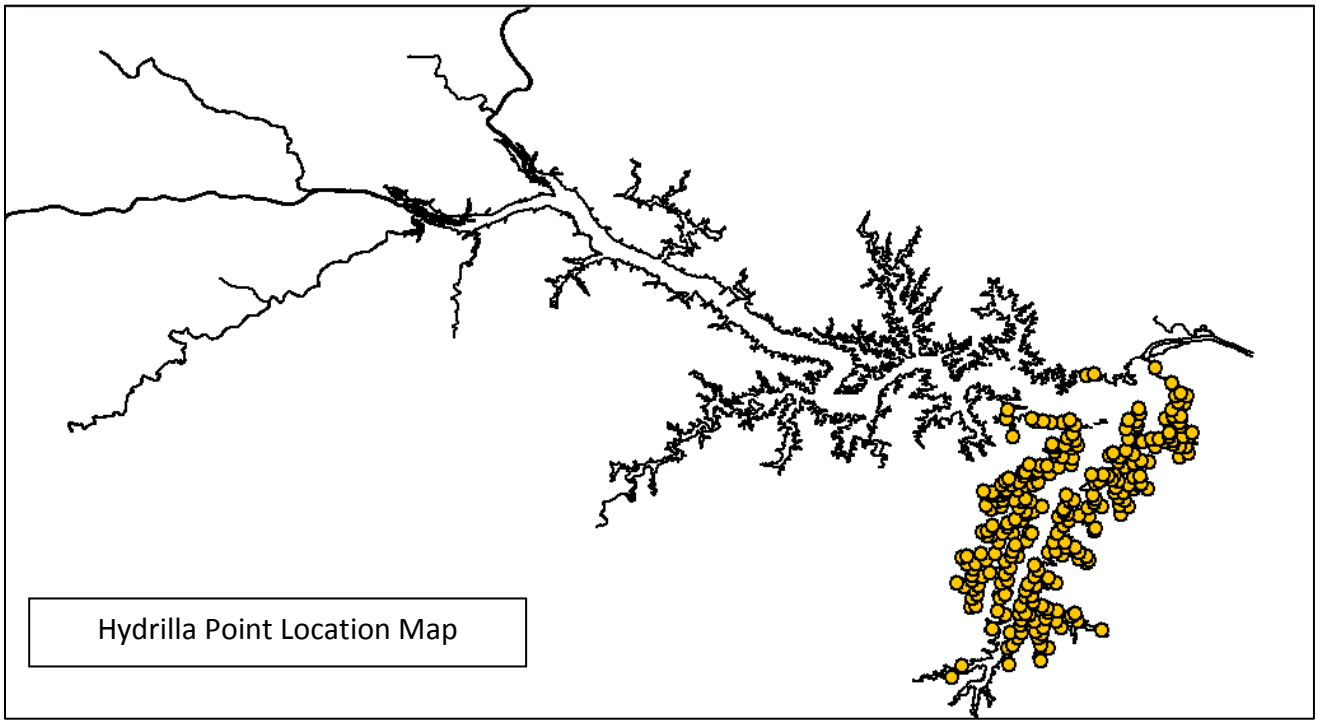
Results

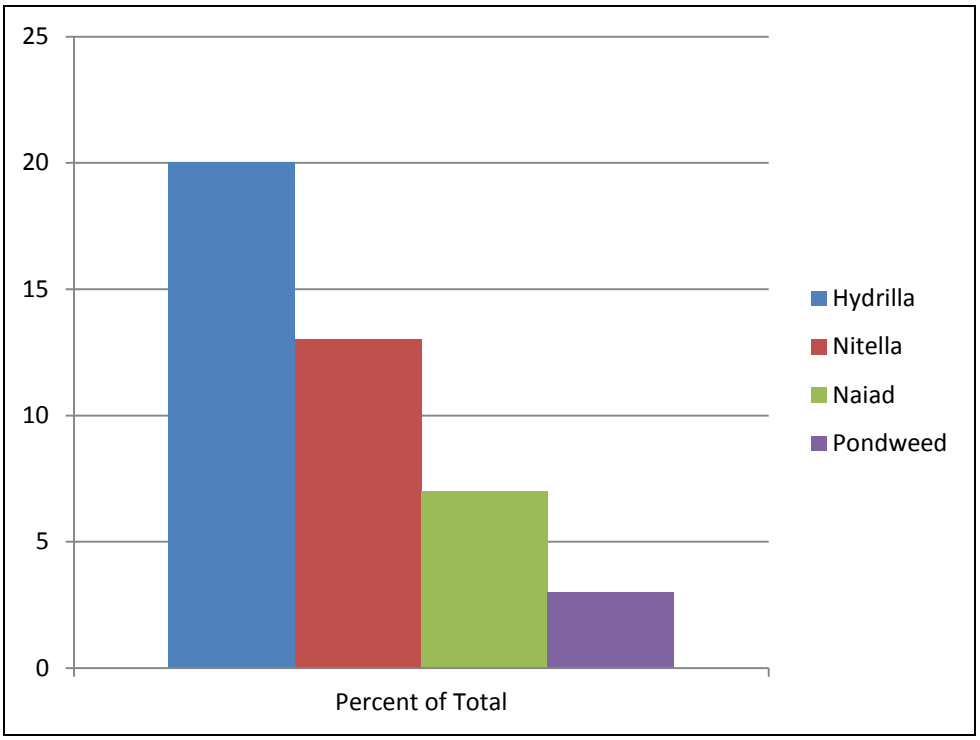
Over a 30+ day period, Hydrilla was observed as low growing, small clusters of plants as well as topped out surface mats in various locations throughout the survey. Hydrilla was the most frequent plant observed in areas where dense plant beds were present. Several other plant species were found in significant quantities in many locations throughout the lake. Native submersed plants included ***Chara sp./Nitella* sp.** (macroalgae), ***Potamogeton diversifolius*** (variable leaf pondweed), ***Potamogeton pectinatus*** (sago pondweed), ***Najas guadalupensis*** (southern naiad). Several locations also had ***Najas minor*** (brittle naiad) a non-native invasive species.

Because the SONAR unit defined areas of submersed plants without species identification, hand drawn maps were used to determine areas of Hydrilla infestations. The information was transferred from the maps into ArcGIS software and this information was converted to shapefiles and used to determine acreage. The information was then compared to the processed data from Contour Innovations and slight corrections made based on both sources.

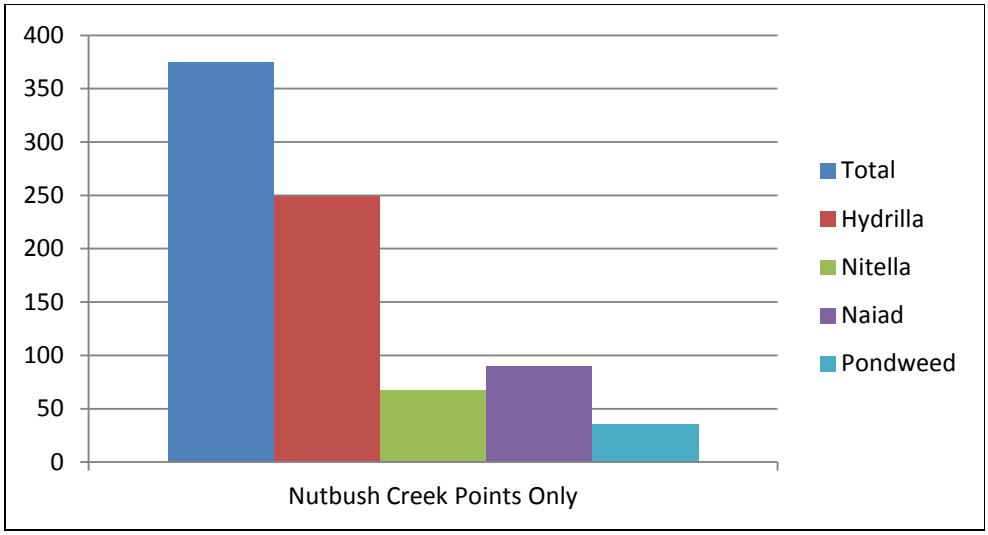
A CD of the shapefile information is included.

During the survey process it was noted that most of the Hydrilla infestations occurred in areas of high human use including State Parks, boat ramps, commercial marinas, and in areas of higher populations of people based on number of docks. As in 2011 large areas of undeveloped shoreline west of Nutbush Creek were found to contain almost no Hydrilla.

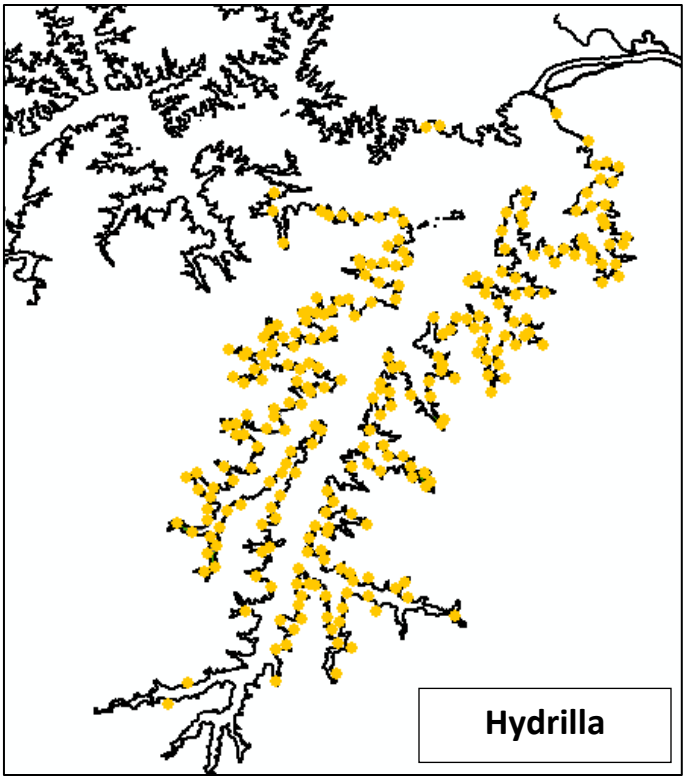


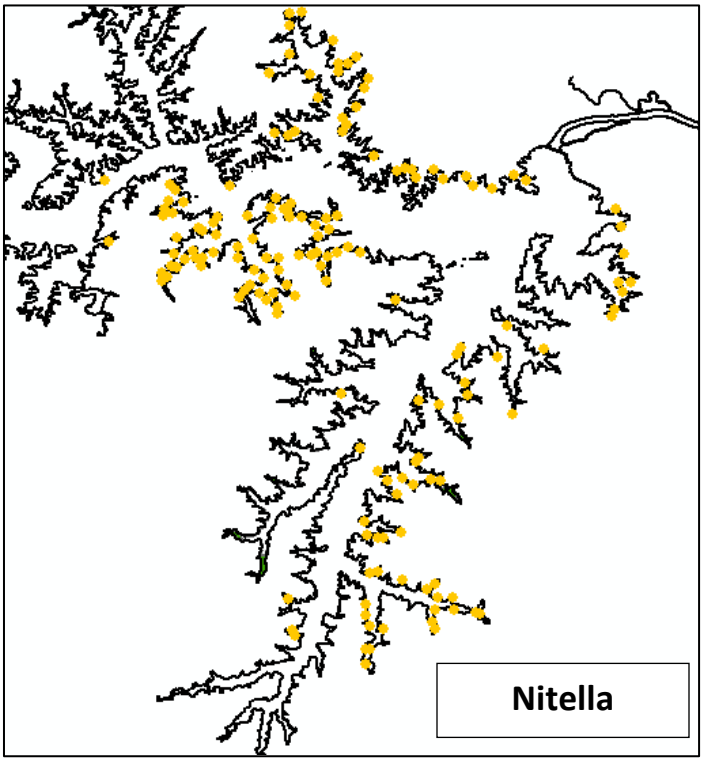


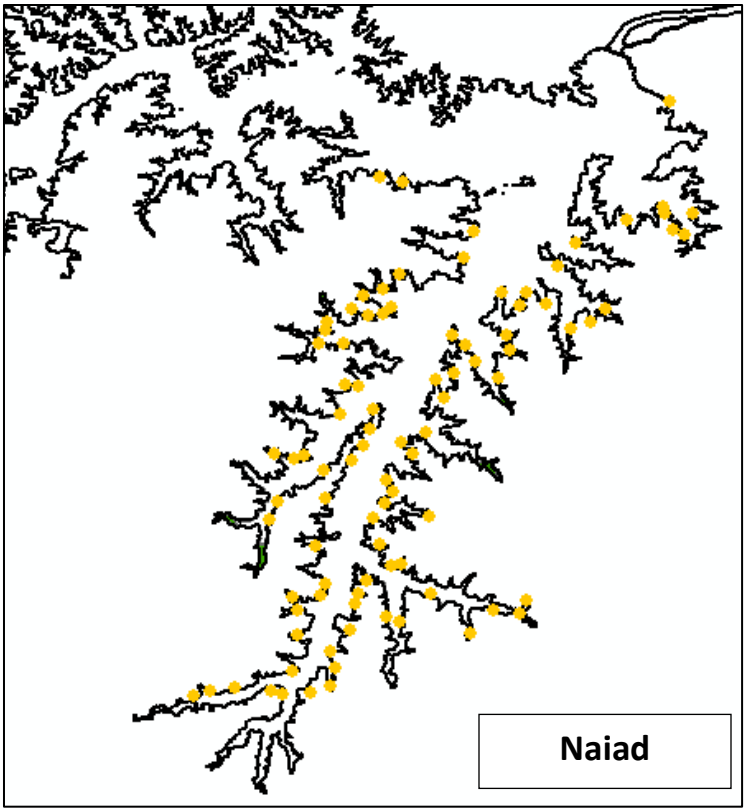
Percent Plant Abundance by Species (whole lake and based on 1245 sample points)

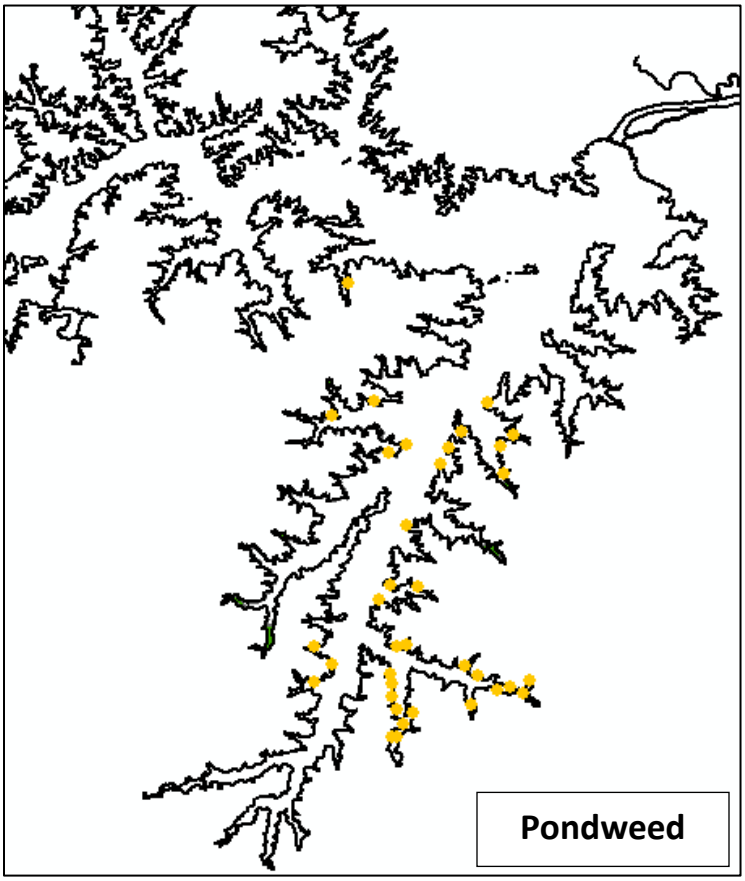


Number of Points Each Species Was Found in Nutbush Creek


Hydrilla


Nitella


Naiad


Pondweed

Hydrilla was observed growing in the area of several boat ramps growing on the concrete "mattress" paved areas.

Concrete Mattress Structure Exposed

Hydrilla Growing on Mattress

Several areas also contained small populations of Hydrilla in spots around the shore.
Most of these areas were adjacent to State Parks or undeveloped shorelines where it is possible boats were pulled to shore and hydrilla fragments fell off.

Hydrilla Infestations in 2012:

1. Little Nutbush Creek continues to have the largest continuous areas of shoreline containing Hydrilla; the back of numerous coves had extensive populations as well as many small scattered populations.
2. Nutbush Creek has several large populations of Hydrilla, but also large areas with Chara/Nitella and Naiads (esp. *Najas minor*).
3. North Bend Park the site of the original infestations has several small populations although some sites with Hydrilla in 2011 had none in 2012.
4. Several areas where Hydrilla was documented in 2011 including: Staunton View ramp area, Occoneechee State Park ramp area, Clarksville Marina, dock at convenience store, and scattered locations along the south shore west of Clarksville bridges, had none in 2012. Low water levels during the survey may account for this.

Based on the information obtained during the survey, our estimated total acreage of Hydrilla in Kerr Lake is 887.8 acres, located mainly in Nutbush Creek and Little Nutbush Creek. Additional areas from 2011 may account for 75 to 80 additional acres to this total.

Recommendations

Additional whole lake surveys should be conducted to determine spread and document impacts on public use areas and native plant populations. Frequency of these whole lake surveys could be based on random point surveys conducted annually. Point survey efforts should focus on high use areas and boat ramps/marinas.

Grass carp (*Ctenopharyngodon idella*) would be the cheapest management option for full lake hydrilla control. Normal stocking rates would be 15 fish / hydrilla vegetated acre. However, submersed native plants may also be controlled.

Contact herbicides applied by USACE approved applicators may be the best option for control in some areas. Certain sections of the currently infested North Carolina portion of the lake may be suitable for systemic herbicides, but water flow will limit their use. Any herbicide applications should be made by these approved applicators and reports containing acres treated, herbicides used and rates, evaluation of biomass reduction (treatment effectiveness), and other information should be made to the USACE for future determinations of treatments.

Signs should be placed at all boat ramp/marina locations to help limit unintentional spread in Kerr and to other water bodies. Information should also be provided to State Park visitors and others to aid in public awareness of invasive species.

Information should also be provided to private individuals with “lake front” property, and/or docks. This information could provide instructions for chemical treatments and proper identification of native and non-native plant species. In addition, a reporting system to track new infestations should be implemented. These individuals should be encouraged to rake out or otherwise remove floating mats in the fall to slow spread

Public funds (unknown sources) should be used to treat in areas around public facilities including swimming areas and boat ramps. Repeat applications may be needed and applicators should be required to follow-up in order to reduce tuber formation.