Environmental Assessment for Controlling the Growth and Spread of a Noxious Aquatic Weed, *Hydrilla verticillata*, in the Eno River Watershed.

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Above photo: Hydrilla infesting the Eno River at the Pleasant Green access, Eno River State Park, Orange County, NC. Photo taken by Erik Nygard, 2011.

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A. Proposed Project Description

1. History

The Eno River is a relatively shallow, swift flowing, Piedmont stream originating in northwest Orange County. It forms at the confluence of the West Fork Eno River and the East Fork Eno River and flows eastward through Durham County where it joins the Flat River to form the headwaters of the Falls Lake Reservoir. From its origin to Falls Lake the Eno flows approximately 28 miles and encompasses an approximately 150 square mile watershed area. The Eno River is fed by approximately 12 named creeks and dozens of additional unnamed tributaries. It is one of only four rivers completely encompassed within the boundaries of the state. The Eno River includes two drinking water reservoirs upstream of its confluence with the Flat River.

The Eno River is regionally and nationally important for its ecological, recreational, and historical resources. Along its course the rugged river valley encompasses rural forest and agricultural lands, low density development, city, state, and private conservation lands, and two eastern Piedmont municipalities. Sixteen aquatic animal species associated with the Eno River are classified as special status including: one crustacean, eight mussels, one gastropod, two insects, one amphibian, and three fishes (See Table 1). Numerous communities and plant species classified as special status are also found throughout the watershed. Recreational opportunities such as hiking, camping, paddling, picnicking, fishing, and nature study exist in the varied natural setting just outside of the municipal and developed areas. The Eno River also holds relevant historical importance for the area with ties to the southeastern Siouan Native American tribes, European colonial development, the American Revolution, the Civil War, and many additional periods through present day.

In 2005 Eno River State Park staff detected hydrilla [*Hydrilla verticillata* (L.F Royle)] in the Eno River. Park staff determined that a 3/4 mile long section within the state park, at a minimum, was infested with this noxious aquatic weed. During the following year additional survey work documented hydrilla throughout the riverine corridor within the park from the Dumont Road Access to Guess Road, and additionally downstream at the City of Durham's West Point on the Eno city park. Following the initial detection, NC Division of Parks and Recreation (DPR) contacted the NC Aquatic Weed Program (NCAWP) requesting assistance. Broadening the survey work in 2008, in effort to delimit the infestation, hydrilla was discovered in Corporation Lake, west of Hillsborough. Also in 2008, the Town of Hillsborough contacted the NCAWP and reported hydrilla in the West Fork Eno Reservoir. By this time the need for an Eno River watershed hydrilla management partnership that would include State and local agencies, as well as other stakeholders became apparent. This was the beginning of what eventually developed into the Eno River Hydrilla Management Task Force (ERHM Task Force). Hydrilla monitoring continued from 2009-2012. A technical advisory component of the ERHM Task Force designed and coordinated a survey in the fall of 2013 which included nearly the entire length of the Eno. This survey identified roughly 25 miles of the river containing hydrilla with varying densities and

the most infested part of the river was located between the Highway 70 bridge on the east side of Hillsborough, near Riverside Drive, and Guess Road in Durham. As part of this coordinated effort the City of Durham conducted a survey from Cole Mill Road to Old Oxford Road and found hydrilla at varying densities throughout that section.

Prior to the discovery of hydrilla in these sites (i.e., Eno River, Corporation Lake, and West Fork Eno Reservoir) hydrilla was known to be present in the Eno River watershed only in Lake Orange, which is located on the East Fork Eno River. The first documented infestation on Lake Orange was in 1992. At Lake Orange a fish barrier was installed and triploid grass carp were stocked in 1994 and 1998 to help control the growth and spread of hydrilla. Hydrilla was thought to be completely removed from this site circa 2005, but in 2010 a local resident observed actively growing hydrilla in the headwaters of Lake Orange and reported this information to the NCAWP; this incident may have been a re-introduction or possibly a rebound from the original infestation. The latter being a possibility since hydrilla forms propagative structures in the hydro-soil that can lay dormant for several years. Either way, NCAWP staff conducted a whole lake survey in the autumn of 2014 and found between 2-3 acres of hydrilla within Lake Orange. That 2014 survey of the area also found a well-established infestation of hydrilla in Arrowhead Lake, which is located approximately one-quarter mile east of Lake Orange. No historical records of hydrilla at this lake were found.

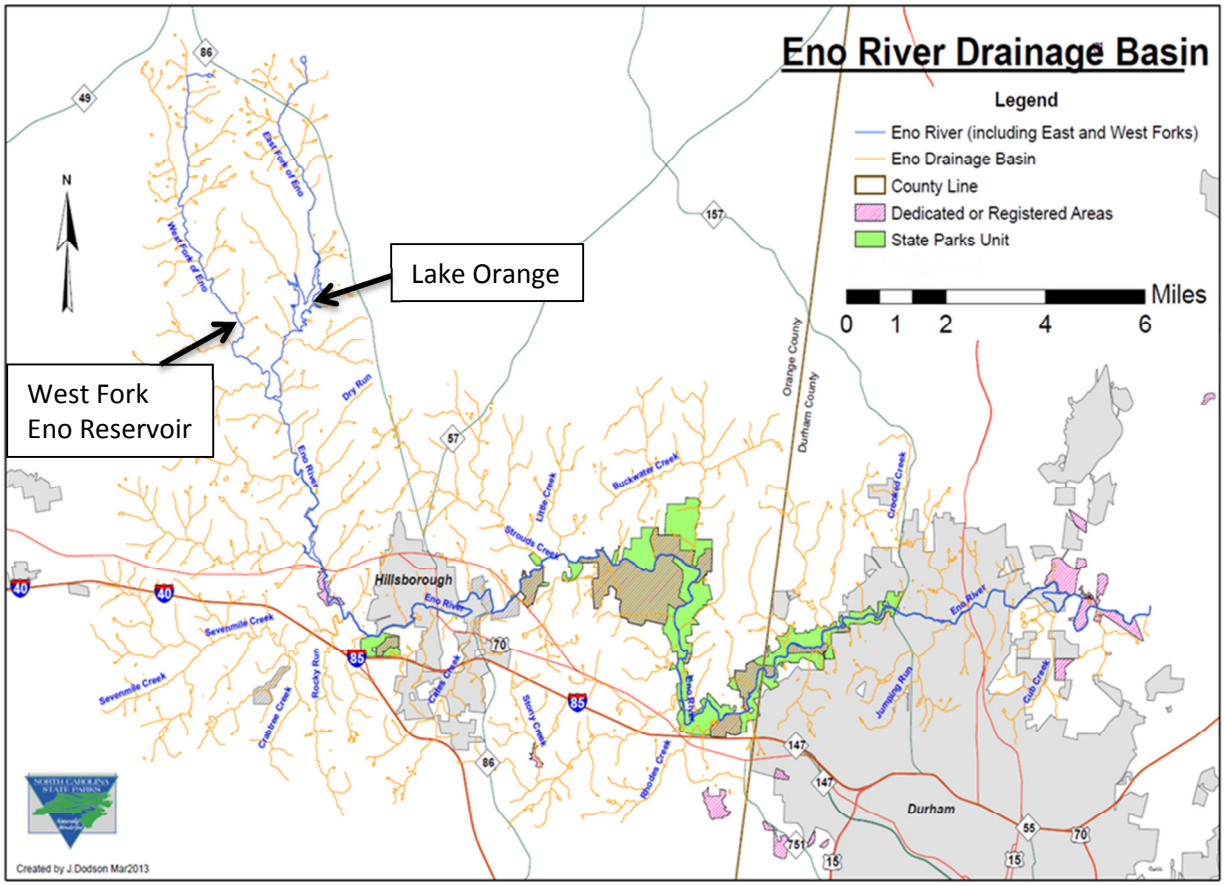
Hydrilla is a federally listed and state listed noxious weed. It is considered by many to be the perfect aquatic invasive weed because of its ability to grow in most soil types, thrive in low light conditions, colonize shallow or deep water (down to approximately 30 feet in clear water) and because it can utilize multiple reproductive mechanisms (Langeland, K.A. 1996). Hydrilla can form extremely dense stands, filling the water column from the bottom to the surface, crowding and outcompeting native vegetation, as well as reducing habitat quantity and quality for native freshwater aquatic animals. The density of hydrilla mats can readily inhibit recreation activities, especially swimming, boating, and fishing, as well as clog water intakes for municipal and private entities. Hydrilla has infested few riverine systems in North Carolina. Historically, ponds, lakes, and reservoirs are typical the bodies of water that become infested with hydrilla. Management techniques in impounded areas have relied heavily on herbicides and the use of triploid grass carp. Controlling hydrilla in the Eno River presents additional challenges due to the complications associated with a flowing water system. Additionally, selective vegetation management is needed to target hydrilla while causing minimal impact to native submerged aquatic vegetation and the special status species present in the Eno River.

From 2007 to 2014, the ERHM Task Force examined and discussed the myriad of challenges associated with the hydrilla infestation in the Eno River. Recommendations from the task force lead to various actions including research, survey work, and demonstration activity. The North Carolina State University (NCSU) Weed Science program, under the direction of Dr. Rob Richardson, conducted various herbicide trials to determine native submersed plant sensitivity to the herbicides that are typically used to control hydrilla. Eno River State Park organized volunteers to determine the feasibility of hand-removal. NCAWP, in cooperation with NCSU, performed preliminary spot treatment herbicide applications to determine their effectiveness

under the flowing water conditions of the Eno River. NCSU, under the direction of Dr. Greg Cope, performed toxicity tests on glochidia (larval) and juvenile stages of aquatic mussel species and the Panhandle Pebblesnail (*Somatogyrus virginicus*), using the herbicides that are being considered for management of the hydrilla in the Eno River.

Hydrilla management at West Fork Eno Reservoir (WFER), Corporation Lake, and Lake Orange has been conducted by the NCAWP in conjunction with the Town of Hillsborough, Orange-Alamance Water Systems, and Lake Orange, Inc., respectively. These treatments have included the use of triploid grass carp in Lake Orange and WFER, as well as the use of Environmental Protection Agency (EPA) approved aquatic use herbicides in both of these impoundments.

Map 1: Eno River Basin. This map predates the construction of the West Fork Eno Reservoir, however the location is noted.



2. Proposed Action

West Fork Eno Reservoir, Lake Orange and Arrowhead Lake

Hydrilla management at West Fork Eno Reservoir has been accomplished to date primarily by stocking triploid grass carp and to a lesser extent through herbicide applications. This approach is proposed to continue. With the more recent findings of hydrilla in Arrowhead Lake and the reoccurrence in Lake Orange herbicide applications are proposed for these impoundments and will be supplemented with the stocking of triploid grass carp. Only herbicides that are approved by the EPA for aquatic use will be used. There are several herbicides that are 1) effective on hydrilla, 2) currently marketed and 3) labeled for use at these sites. Herbicide products with the following active ingredients are typically used by the NCAWP to manage hydrilla: copper-based, diquat, endothall, and fluridone. Products with these active ingredients may be used solely during an application or combined, following label allowances. The NCAWP personnel will determine which herbicides to use based on site assessments and surveys. This document will not review the details on the use or potential environmental impacts of grass carp since an Environmental Assessment and Finding of No Significant Impact for the statewide use of grass carp exists within controlled hydrologic systems. The use of grass carp is regulated by the NC Wildlife Resources Commission (NCWRC). Permit applications for the use of grass carp will be submitted to the NCWRC and will be handled as individual sites. No grass carp stockings at these sites will occur without permits.

Eno River

The feasibility of several management options, including harvesting, biological control methods, and herbicide treatment have been discussed and weighed by the ERHM Task Force and particularly by the technical advisory component of this group. The ERHM Task Force is composed of local, state, and federal government agencies, academia, and public interest groups (See Appendix A for a complete list of participants). This group has determined that the best option for hydrilla management in the Eno River will be the use of herbicide. There are several EPA-approved aquatic-use herbicide products that are commonly used to control hydrilla. The ERHM Task Force considered all herbicide options and a thorough review process reduced the list of possible herbicides to endothall and fluridone. These are the only two herbicides that are currently being proposed for use in the Eno River. Factors weighed when determining which herbicides to employ included toxicity to non-target organisms, water-use restrictions and cost.

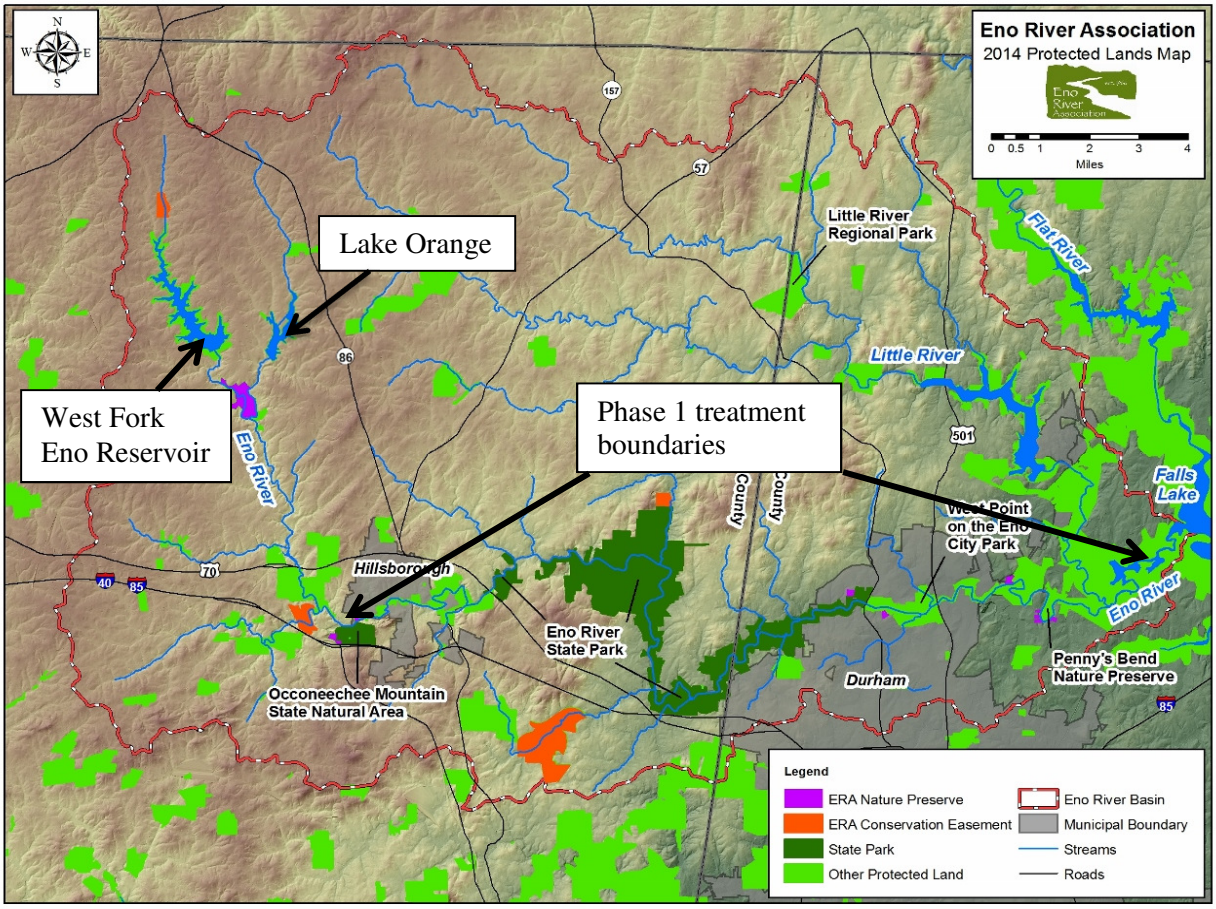
Herbicides have been used to manage hydrilla at many sites across the State, for example: Lake Gaston, Tar River Reservoir, Badin Lake, Lake Tillery and Lake Waccamaw. These examples all have important recreation value and/or are used as municipal water sources and/or are inhabited by special concern species. However, there has been no hydrilla management project in North Carolina in a system like the Eno River. Herbicide treatments in river systems are much more difficult because the effectiveness of herbicides (efficacy) is based largely on contact time. In static waters like lakes and ponds it is relatively easy to attain a target herbicide concentration in the water and maintain it for a long enough period of time to be efficacious, but in a flowing system herbicide can be moved from the treatment area before it has time to affect the target

plant. To complicate the situation further, the flow in the Eno River is highly variable due to the significant percentage of impervious surface within the drainage basin. To effectively treat the hydrilla a metering device will be used to apply the herbicide at a regulated rate, and periodically adjusted as needed, over the duration of the treatment period.

This project proposes two phases. Phase I, which can be considered as a case study, will include a limited section of the river. The section of river included in Phase I of this project is defined as follows: beginning downstream of the Lake Ben Johnston Dam and ending at the confluence with the Flat River, which creates the headwaters of Falls Lake (See Map 2). A portion, or portions, of the Phase I section of river will be treated annually for at least two years to ascertain the effectiveness of this method of treatment. To successfully manage hydrilla an additional five consecutive years of treatment may be required, based on research conducted by NCSU which looked at tuber persistence at other NC sites that were treated annually with herbicides (Personal Communication, Justin Nawrocki). This stretch of the river was selected for Phase I of the project because it possesses great ecological significance and surveys identified this section as being the most heavily infested with hydrilla.

Phase I will be evaluated on an on-going basis by the ERHM Task Force annually for the duration of the case study. If the overall evaluation is positive and there is support for project continuation the next phase will then be initiated. Phase II will expand the treatment area to include the Eno River upstream of the Lake Ben Johnston dam and other areas within the Eno River watershed as needed. Additional field surveys need to be conducted to further determine hydrilla presence and densities throughout the watershed. The ERHM Task Force will evaluate survey results and prioritize treatment areas. Prior to initiating Phase II a supplement to this Environmental Assessment will be prepared for review. The supplemental document will propose specific hydrilla management activities beyond Phase I and address concerns that may be associated with the expanded treatment area.

Map 2: Proposed Treatment Area Boundaries.



3. Methods

The use of herbicide is an excellent option for aquatic weed control, particularly when a primary goal is to reduce the biomass of the target plant species and mechanical removal is not practical. An evaluation of specific site characteristics as well as water use and flow rates determines which herbicide(s) to employ. Aquatic herbicides can be used as "spot treatments" where only part of the water body is treated, or they can be applied to treat the entire body of water. For this project, since hydrilla is a submersed plant, herbicides will be applied directly to the water.

West Fork Eno Reservoir, Lake Orange and Arrowhead Lake

The herbicide products listed above in "Proposed Action" are available in liquid and granular formulations. Granular formulations will be applied by hand or with spreaders depending on the size and flow dynamics of the selected site(s). Spreaders are typically manufactured and marketed for agriculture or landscape purposes, have a 12V DC motor, and are relatively simple devices to use. Liquid formulations will be applied directly into the water. Subsurface injection is the technical term for this application method. Subsurface injection is well documented and

has become a standard practice in the aquatic weed control industry when the target species is a submersed plant. Motorized boats, outfitted with application equipment will be used to transport herbicide products and adjuvants from shore-side to the treatment sites and aid in the applications.

Successful management of hydrilla is dependent on accurate field data and the inclusion of personnel that are experienced in making management decisions. Unlike managing terrestrial weeds and emerged aquatic vegetation, submersed aquatic vegetation is much more difficult to detect and treat. Detection of submersed aquatic vegetation (SAV) can be done by visual reconnaissance if water level and clarity allows. Another common method used to detect and sample SAV is the use of a rake, grapple, or similar weighted tool that will harvest SAV from the bottom. An efficient method to detect the presence and amount of SAV in water bodies that are greater than a few feet deep is a recording fathometer (a.k.a. SONAR) device to provide data regarding SAV bio-volume and location. These devices can be used in conjunction with a sampling tool to confirm species identification.

Eno River

The treatment area will be evaluated to consider factors such as flow rate and water volume. Data generated by USGS gauges along the river will be crucial in the development of the treatment design and implementation. Controlling the growth of SAV requires an appropriate concentration of herbicide in the water surrounding the target vegetation and a minimum exposure time. This is known as Concentration-Exposure Time (CET). The required CET varies depending upon the aquatic-use herbicide product and target species. It is likely that this project will utilize a drip infusion system(s) that will deliver herbicide at a regulated rate and will be operated by State-licensed pesticide applicator(s). An alternative method would be the application of slow-release pellets over a course of the treatment area. An integrated application may be utilized for special or unforeseen circumstances that arise during the treatment period, such as extremely low flow conditions that can lead to pooling throughout the river. Regardless of the specific delivery method(s), downstream water sampling sites will be established and water samples will be routinely collected and analyzed for herbicide concentration. The results of these measurements will provide insight to realized concentration levels and guide fine-tune adjustments of the application to attain/maintain target concentrations of herbicide throughout the treatment period. Water analyses will also be used to verify that herbicide levels are below allowances set by the EPA for drinking water and recreational use.

The timing of herbicide applications is important. The biological activity of herbicide compounds has a half-life and there are windows of opportunity when applications must occur so that herbicidal activity corresponds with plant growth. Initial herbicide application will coincide with initial hydrilla seasonal growth. The hydrilla tubers in the Eno River are expected to begin sprouting between late April and mid-June. Herbicide application is projected to begin in mid-May and continue through September. Mid-treatment adjustments will occur as needed to maintain target concentrations.

Surveying of hydrilla density within the treatment areas will occur annually at a minimum. Surveys will determine effectiveness of herbicide treatments and guide decisions on the continuation and/or adjustments to management. Hydrilla surveys outside of the treatment areas will also occur annually since that data will be critical to mapping and monitoring hydrilla. The ERHM Task Force and/or NCAWP staff will also inspect other parts of the watershed for the presence of hydrilla.

B. Purpose and Need for Proposed Project

The purpose of this project is to develop a management plan to control the growth and spread of hydrilla throughout the Eno River watershed. This management plan will also serve to reduce the risk that hydrilla colonizes areas downstream of the current infestation (i.e. Falls Lake).

1. Hydrilla Introduction

Hydrilla is an aquatic perennial plant indigenous to Asia. The plant exists as two bio-types, dioecious and monoecious. The dioecious form was introduced to Florida in the 1960's and has since spread throughout the Southeastern U.S. Dioecious hydrilla has male and female flowers on different plants. The monoecious form has both male and female flowers on the same plant. The monoecious form occurs from North Carolina northward to Maine. It is likely that hydrilla was first introduced to North Carolina in the mid-1970's, approximately the same time as this species was introduced near the Potomac River.

Monoecious hydrilla was first documented in North Carolina in 1980 at William B. Umstead State Park, near Raleigh. State officials, responding to this occurrence, inspected all surrounding lakes and found several other locations within Wake County (Neuse River Basin) that were infested. Management efforts commenced at all sites identified during this initial survey and hydrilla was successfully extirpated from nearly all sites. Despite the rapid response of authorities and good management hydrilla still found its way into other major river basins (Roanoke and Catawba), yet remained generally limited to Piedmont waterways during the 1980's and 1990's. However, over the last decade this noxious weed has also spread into the Coastal Plain and Mountain regions of the state. Currently, the largest infestation is at Lake Gaston where it has invaded 3,000 acres of the 20,000 acre lake (with a potential for infesting 8,000 total acres). Hydrilla continues to colonize new habitats and now infests areas with flowing water including the Cheoah River in Graham County, Chowan River in Chowan County and Contentnea Creek in Wilson County. In 2010, it was also observed in the western reach of the Albemarle Sound. Additionally, in 2014 a well-established hydrilla infestation was discovered in the Cape Fear River basin upstream of Lillington, NC (Dodson, Richardson, Hoyle, Nawrocki, personal communications).

Hydrilla has the ability to reproduce through a variety of methods including vegetative fragments, tubers (formed at the end of rhizomes), turions (formed at the leaf axils) and seed. Tubers can remain viable in the hydrosoil for seven years or longer (Richardson, personal communication). Reproduction from seed is of minor importance compared to reproduction by vegetative methods, but seed may be an important mechanism for long-distance transport via the gut of waterfowl (Langeland, K.A. 1996).

The 2005 detection of hydrilla in the Eno River was the first documented occurrence in a true, free-flowing riverine system within the state of NC. The Eno River has long been classified as one of the most important rivers in the state, and has at least 16 documented special status aquatic species within its watershed reach (see Table 1). It is not known where the infestation originated, and given that hydrilla can reproduce by vegetative means, the introduction could have occurred many years prior to 2005 via numerous means and locations, but Lake Orange (East Fork drainage) seems the most likely location for the introduction of hydrilla to the Eno because this is where the initial hydrilla infestation in the drainage basin was discovered.

2. Invasive and Noxious Status

Hydrilla is a Federal Noxious Weed and by reference, therefore, also considered a Class A Noxious Weed in NC and is regulated by the NC Department of Agriculture and Consumer Services (NCDA). Sale of hydrilla is prohibited and movement within the state is also prohibited without a permit. In addition, the NC Department of Environment and Natural Resources recognizes hydrilla as a Noxious Aquatic Weed, thereby qualifying it for consideration for State cost-share funding for its control.

Hydrilla infestations impede water use and alter aquatic habitat. Major concerns include:

- The disruption of recreational activities (wading, swimming, boating, etc.) leading to economic loss
- The disruption of water withdrawal due to clogging of intakes
- Public health & safety
- Habitat alteration and/or loss
- Competition with native SAV
- Stratification leading to anaerobic conditions
- Alteration of fish community dynamics
- The disruption of water flow leading to flooding events

Hydrilla can harbor mosquitoes and impose public health issues due to the threat of mosquito-borne diseases. West Nile Virus and arboviral encephalitides are potential concerns with hydrilla infestations, as are Dengue fever and malaria (North Shore Mosquito Abatement District, 2005 Annual Report).

Hydrilla has been strongly linked to Avian Vacuolar Myelinopathy (AVM), a lethal disease that affects American coots, mallards, geese and other plant eating waterfowl. AVM also affects raptors that prey on affected individuals which are weak and dying. There have been over 100 documented cases where bald eagles (*Haliaeetus leucocephalus*) have perished as a result of AVM. Studies have identified hydrilla, among other invasive submersed aquatic vegetation, as primary supporting substrates for a toxin-producing cyanobacterium (*Aetokthonos hydrillicola*). This cyanobacterium is not commonly associated with native SAV. The consumption of aquatic vegetation harboring the cyanobacterium and/or affected waterfowl causes AVM. The putative cyanotoxin also affects the nervous system of herbivorous fish, such as triploid grass carp, and herbivorous turtles (Mercurio et al 2014). There is a strong correlation between AVM cases and hydrilla infestations (Dr. Susan Wilde, personal communication). While there have been no documented public health effects associated with AVM and *Aetokthonos hydrillicola* to date, there are well documented effects associated with various other cyanobacteria and cyanotoxins (WHO 1). The potential for the AVM-*Aetokthonos* association has yet to be fully determined. (Wilde et al 2014 and Haynie et al 2013)

Due to these serious risks that hydrilla can impose on human health, natural communities and economic interests it is imperative that a management plan is put into action to reduce these impacts.

3. Benefits from the Project

- Remove/mitigate the threat that hydrilla imposes on the wellbeing and progression of the native flora and fauna communities, including special status aquatic plants and animals that are known to exist in the Eno River watershed.
- Reduce/eliminate the opportunities hydrilla has to spread (or be moved) from the Eno River watershed to Falls Reservoir, or additional locations beyond the watershed.
- Ensure/restore recreational activities associated with the Eno River.
- Protect public and private economic interests associated with the Eno River watershed.
- Explore the potential to protect the High Quality Water designates of the headwater stretches located upstream of Sevenmile Creek (Orange County near Hillsborough) and potentially contribute to the improvement of water quality in the downstream stretches of the basin.

C. Alternatives Analysis

1. No Action

A "no action" response will allow uncontrolled spread of hydrilla both within the river, the Falls Lake Reservoir, and the Neuse River Basin. The infestation would continue to be a source of fragments that could be intentionally or unintentionally moved to surrounding watersheds. The formation of a monoculture could severely impact native organisms that occur within the Eno River watershed and throughout the Neuse River Basin including special status species.

Fragmentation is the primary method hydrilla propagates itself and spreads. Fragmentation describes the plants ability to regenerate from single pieces or sections of stem. Broken pieces or fragments of plants drift to new areas, take root, and create new colonies. There is no reliable method at the present time to estimate the rate of downstream spread, as the presence of hydrilla in a riverine system is a relatively unique circumstance. However, in the few occurrences nationally, including the Eno River infestation, downstream spread has been documented. Given the plant's growth and reproductive characteristics, it can be fairly assumed that the problems associated with hydrilla will multiply with uncontrolled spread – loss of recreational use, loss of habitat (impacting fish, wildlife and native plants), additional costs associated with water withdrawal, and depreciation of adjacent real estate values. The presence of hydrilla also jeopardizes watersheds that are adjacent to and surround the Eno River watershed because plant fragments can 'hitchhike' and therefore be moved across watershed boundaries.

A "no action" response will not lead to any of the project benefits identified in section B.3.

2. Biological Control

Biological control of hydrilla can be separated into three different categories: non-selective herbivory, selective herbivory and selective pathogenicity (target weed-specific disease).

Non-selective Herbivory

With respect to generalist herbivory, sterile triploid grass carp (*Ctenopharyngodon idella*) have been shown to be a cost-effective, but non-selective option for hydrilla management (Webb et al. 1994, Hanlon et al. 2000, Bonar 2002). The degree of SAV removal is correlated to the stocking density of the carp. Attaining a stocking density that is sufficient to remove hydrilla without impacting native vegetation is a challenge. Past management efforts indicate grass carp should be used only where removal of non-target submersed (and some emersed) aquatic vegetation is an acceptable outcome of management. The loss of riverweed, a submergent plant, is not acceptable and could negatively impact the panhandle pebblesnail's population. Additionally, there is no feasible fish barrier or other device that could be installed to keep the fish in place. Grass carp would be free to emigrate from the stocked location. The North Carolina Wildlife Resource Commission is currently conducting a preliminary study to evaluate the movement of grass carp stocked in the Eno River. Radio-tagged grass carp were released in 2014 and will be monitored

to determine whether they move upstream, downstream, or if they remain in the vicinity of the original stocking location.

Selective Herbivory

Selective herbivory through use of hydrilla host-specific insects has been a desired bio-control approach for several decades. Out of four efforts since 1987 at insect introductions to attack hydrilla, only one species was successfully established in dioecious hydrilla in Florida (the leaf-mining fly *Hydrellia pakistanae*), and no species of insects have proven to provide effective control of hydrilla populations (Hetrick and Langeland 2012). *Hydrellia pakistanae* was previously released on Lake Gaston, NC, but did not establish. It is currently believed that this species cannot overwinter in North Carolina because monoecious hydrilla shoot biomass dies off each winter. Dioecious hydrilla biomass is persistent in Florida providing an overwinter habitat for the species. There is currently no selective herbivory option available for the Eno.

Host-specific Pathogens

Various efforts have been made to develop host-specific pathogens for hydrilla management. Several efforts over the last three decades have been made to commercialize the fungal pathogen *Mycoleptodiscus terrestris* for use as an inundative bio-herbicide for hydrilla control (example: Shearer et al. 2011). All bio-herbicide development to date has been unsuccessful. There is currently no host-specific pathogen option for this project.

3. Chemical Control

There are currently seven EPA-approved herbicides with some operational use for control of hydrilla: fluridone (Sonar®), endothall (Aquathol®) copper, diquat (Reward ®), penoxsulam (Galleon®), bispyribac (Tradewind®), and flumioxazin (Clipper®). Of the seven EPA-approved herbicides that can be used to control hydrilla only fluridone and endothall are being considered. The Florida Fish and Wildlife Conservation Commission have an excellent web-based information system concerning aquatic plant management in Florida (http://tinyurl.com/kxkqz5d). It synthesizes much of the current understanding of control methods for hydrilla including use of herbicides that generally translates well for consideration for management in NC and can be a good secondary resource in addition to the information provided here.

Fluridone has been successfully used since 1986 for hydrilla control. Fluridone's bleaching mode of action provides gradual control of sensitive target weeds like hydrilla over a 45 – 90 day period depending on plant establishment. Hydrilla is highly sensitive to fluridone at a concentration 3 – 5 ppb. This concentration is sufficient to control the plant with sustained exposure. Fluridone is highly effective on monoecious hydrilla with low-dose applications, particularly when starting treatment as tubers begin sprouting (late spring). This is when the plant's carbohydrate reserves reach their lowest level. In eradication efforts for monoecious hydrilla, immediate injury and growth suppression result from the use of low-dose fluridone on sprouting plants, in addition to preventing the re-establishment of the hydrilla plant in the spring

and eventual maturation of the plant. Similar to contact-type herbicide treatments fluridone will leave some remaining biomass in the form of tubers and root crowns. Maturing hydrilla plants lead to potential fragmentation and spread and eventually the formation of new tubers. Minimal water use restrictions are required with low dose application of fluridone for hydrilla management (lack of restrictions on fishing, swimming, domestic use, and most forms of irrigation).

Endothall, diquat, copper, and flumioxazin are contact herbicides. Although all have different modes of herbicidal action, all are faster acting products than fluridone, with diquat, copper and flumioxazin providing very fast weed control within days while endothall may take several weeks for hydrilla knockdown. Hydrilla control from contact herbicides, like systematic herbicides, generally leaves a portion of the lower part of the plant, typically referred to as the root crown of the plant.

Recent research has indicated that longer exposures (1 – 2 weeks in cooler water) to lower doses of endothall (1 – 2 ppm) at larger scales can provide improved control of dioecious hydrilla in Florida. Endothall is typically the most selective of the contact herbicides if used at lower rates. However, endothall is commonly not as selective as low-dose treatment of fluridone.

The remaining products currently used on hydrilla are newly-registered ALS (acetolactate synthase inhibitor) herbicides. The ALS herbicides penoxsulam and bispyribac shut down hydrilla growth at use rates of 10 – 15 ppb for penoxsulam and 20 – 30 ppb for bispyribac. These herbicides will control hydrilla growth if contact exposure time can be maintained for extended periods (several months). Due to slow activity on established hydrilla biomass, ALS herbicides have been combined with endothall to provide both initial knockdown and extended hydrilla control. Another ALS herbicide, imazamox (Clearcast®), has hydrilla activity but is more commonly used as a selective growth regulator that can provide several months of strong suppression with short exposure (several days). These ALS inhibitors and contact herbicides have limited applicable uses in the flowing waters of riverine systems, but could be options for consideration in the impoundments where the contact time requirements can be more readily attained.

4. Mechanical Control

Mechanical control includes using cultivators, rotovators, drags, dredges, cutters or other similar equipment. Cultivators and rotovators can be used in a manner similar to a garden tiller for controlling aquatic vegetation. This process is intensely disturbing to sediment and would cause great increases in turbidity. Benthic organisms, such as mollusks and macro-invertebrates, would be rotovated indiscriminately from plants.

Drags, such as cables and chains, may be pulled by boats or winches to remove aquatic plants. This process creates large amounts of plant fragments that can spread the infestation and can

significantly disturb sediment. This technique is recommended for small areas and would not be practical or effective for hydrilla management in the Eno River.

Dredging can be a very effective method of removing aquatic plants from certain sites. It can also provide long term control of plants that do not produce seed or vegetative propagules. However, dredging is extremely expensive, with costs as high as $6,000 per acre. It is not selective and will remove all organisms in the dredge path. Dredging is highly disturbing to sediments and will increase turbidity. Dredge spoils would also need to be disposed of away from water so hydrilla does not spread to other water bodies. Because hydrilla does produce tubers in the hydrosoil, it is unlikely that dredging would remove 100% of the hydrilla infestation and hydrilla would rapidly repopulate the system. There is also strong potential for negative impacts to other benthic organisms.

Mechanical cutters use a reciprocating cutting bar to clip off plant biomass underwater (McComas 2003). This process, however, creates enormous amounts of plant fragments which could disperse and spread the infestation.

Mechanical harvesting combines cutting with a mechanical collection of most clipped biomass. Harvesting has some limited utility for clearing hydrilla biomass out of heavy use areas, but more as a maintenance strategy than a control measure: there is no published research to indicate that mechanical harvesting can reduce hydrilla infestations over time. This process is expensive, providing no long-term control and often exacerbating the problem by spreading plant fragments. Harvesting has shown few advances in technology in the last several decades (Haller 1996). Additionally, harvesting is non-selective across flora and fauna and can produce significant mortality of fish and other aquatic animals in the harvested zone (Haller et al. 1980, Haller 1996). Haller et. al (1980) estimated that 32% and 18% of total fish numbers and total fish weight, respectively, were removed as by-catch from each acre mechanically harvested. Harvesting is a slow process, with only 2 to 8 acres completed per day (USACE-ERDC 2013). Disposal sites away from water would also be required for the tons of hydrilla biomass removed.

Weed rollers are small scale devices for installation around objects like docks (McComas 2003). Mechanical rollers travel back and forth over the lake sediment disturbing plants and other organisms in the travel path. Rollers work best on sandy sediments and may not work on mucky bottoms. In summary, there are currently no feasible mechanical control options for this project.

5. Physical Control

Physical control methods, including hand removal, benthic barriers, and water-level drawdowns, have been used to control hydrilla. Hand removal can be effective in very small areas of infestation, such as around intake valves and boat docks. However, this method is not considered cost-effective for large-scale areas of invasive plants. Aquatic plants may be up to 98% water and these plants often reproduce as fast as they are removed from an area. Additionally, the fragments and tubers left behind can actually increase the infested area.

To evaluate the feasibility of controlling hydrilla by hand removal, the Eno River State Park organized physical removal events during the summer of 2011. A section (approximately 100 feet in length) of the Eno River that contained hydrilla was selected. This area falls between Fews Ford and the suspension bridge. During June-August a cumulative time totaling 290 man-hours by volunteers and an additional 20 man-hours from park staff were spent pulling hydrilla from the Eno River. All plant material was bagged and removed from the river. In late September a visual inspection of the site reported no substantial difference in the density of hydrilla biomass within the project area compared to control sites (sections immediately upstream and downstream of project site). Applying the information gathered from this feasibility exercise into a simple extrapolation it would take a total of 16,368 man-hours to physically pull hydrilla from a one mile section of the Eno River. Converting this to a dollar figure by applying the current minimum wage ($7.75/hr.) generates a cost of $126,852 per mile. In order to effectively control hydrilla this effort would need to be implemented at least twice during a given year, bringing the cost to ~$250,000 per mile per year.

Benthic barriers are large mats laid down over an area to prevent light from reaching the bottom. They can prove effective in broad spectrum control of aquatic plants. They provide immediate results and will continue to control growth until removed. The barriers will eventually breakdown and persistence depends on the material and site conditions. Unfortunately, these barriers are only effective on a small scale and can be quite expensive (upwards of $3,000 an acre). This method is non-selective and will likely have severe impacts on non-target organisms, including mussels and spawning fish and for these reasons is not a feasible option for the Eno.

The drawdown of water in a treatment area can have certain advantages. It can be very effective on many species with little-to-no cost per acre and can be used in conjunction with other treatment options. The Eno River, as a headwater riverine system, varies in flow throughout the year based upon numerous influences such as seasonality, rainfall, and water-use obligations of the municipalities and communities scattered along its course. A drawdown of the river would essentially be dropping outflow from West Fork Eno Reservoir and Lake Orange below minimum required release and/or additional damming whereby downstream flow would cease. This action would not be in accordance with the Voluntary Capacity Use Agreement that is in effect for the Upper Eno River and would also not be ecologically sound. In summary, there are currently no feasible physical control options for this project.

6. Regulatory Control

Regulatory control for invasive aquatic plants typically focuses upon education and enforcement policies designed to prevent spread to non-infested areas. Signage and other public communications can educate recreationists and members of the local community and/or re-enforce the negative environmental and economic impacts of aquatic invasive species. Additionally, an effective way to reduce/eliminate the movement of hydrilla within and out of a watershed is to clean vegetation and debris from equipment that has been in affected water prior

to transport. Hydrilla can spread easily by fragmentation, so it is essential to clean all gear potentially exposed to hydrilla before departing infested sites. Yet while each of these efforts contributes various benefits, none will provide any direct control, nor prevent the current infestation from continuing to expand and adversely impact the system. Thus, regulatory control measures can only support any of the other control methods proposed.

Preferred Alternative

Mechanical methods are non-selective, costly and will most likely injure or remove native aquatic species. Biological control options are very limited. Triploid grass carp is currently the only biological control agent that is effective in North Carolina. Grass carp are good options for certain impoundments but their effectiveness and our ability to use them in the Eno River is doubtful. Other means such as physical removal are not appropriate because the infestation is too large. Physical removal would be far too costly and given that hydrilla can propagate by fragmentation would only further the risk that this invasive would establish somewhere else downstream.

After careful consideration of each control option, the ERHM Task Force has decided to pursue the following actions with the goal of managing hydrilla within the Eno River watershed:

- An herbicide treatment program that will be implemented over the course of two phases.
  - The first phase will include the section of the river defined by the Lake Ben Johnston dam (Hillsborough water intake) and its confluence with the Flat River. A two year case study will be conducted to determine treatment efficacy.
  - The second phase will occur after the assessment of Phase I with the potential to broaden the treatment to include other areas within the Eno River watershed.
- The use of triploid grass carp will continue as an integrated control method in the upstream reservoirs (West Fork Eno Reservoir and Lake Orange) for hydrilla.

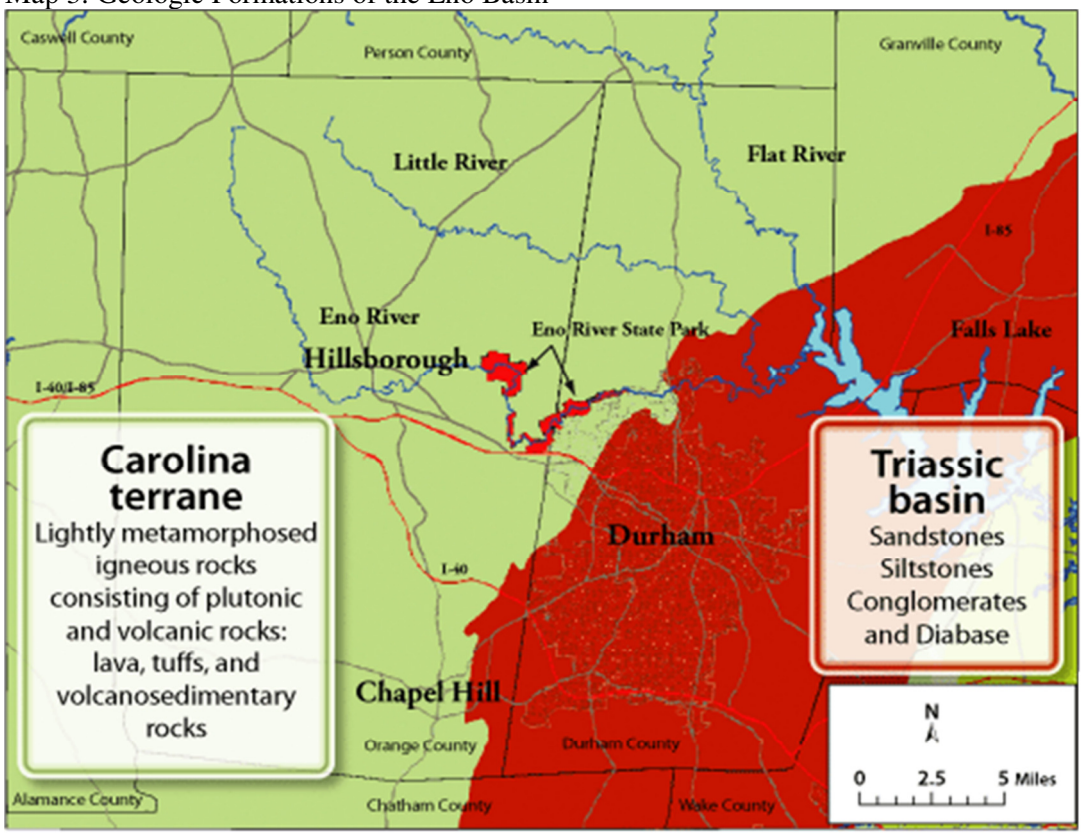
D. Existing Environmental Characteristics of Project Area

1. Topography

The Eno River is one of the two headwater riverine systems that form the Neuse River watershed basin. The Eno itself begins in the upper portion of Orange County along Hwy 86, as the drainages of the East and West Forks. The forks merge at the confluence below Lake Orange and the West Fork Eno Reservoir to form the Eno River proper. From the confluence, the river flows south through Corporation Lake, and then east through the municipality of Hillsborough, NC. Next, the river then passes through Eno River State Park and then into Durham, NC before entering the upper reaches of the Falls Lake Reservoir. The Eno watershed drainage area covers approximately 150 square miles. The river is approximately 28.6 miles in length, measured from the initiation at the headwater origins down to the confluence with the Deep River, at the inlet into Falls Lake Reservoir.

The river originates in the Carolina Terrane geologic formation at an elevation of approximately 740 feet. The river enters the Triassic basin in the municipality of Durham, NC at an approximate elevation of 300 feet before entering the Falls Lake Reservoir near 250 feet in elevation.

Map 3: Geologic Formations of the Eno Basin



(Diagram courtesy of www.ncgeology.com)

2. Soils

Hydrilla is limited to permanent aquatic habitats. The U.S. Department of Agriculture, Natural Resources Conservation Service does not classify permanent water bodies as a soil series.

3. Land Use

Land uses found within the Eno watershed are highly varied, ranging from rural homesteads, farming lands, and conservation lands, to municipal residential and business development. The Upper Neuse River Basin Association projects that by 2025 50,000 acres of the remaining undeveloped land in the watershed will be converted to other uses. This conversion will raise the total developed land to 140,000 acres or 28% of the watershed.

4. Wetlands

The Eno River basin encompasses roughly 150 square miles and it is likely to contain several jurisdictional wetland areas as defined by the U.S. Army Corps of Engineers. These areas are mostly found in association with the tributary streams and main riverine corridor. Given the geologic base of this portion of the Piedmont physiographic region, the majority of these wetlands are relatively small in size.

5. Prime or Unique Agricultural Lands

The Eno basin is generally characterized as a small headwater river compared to the larger scale river basins in the state of North Carolina. This smaller basin still encompasses over 150 square miles along the northwestern side of the Research Triangle area. The Piedmont as a whole has a rich history of agricultural development that dates as far back as the early settlement periods of North Carolina, and the Eno basin is no different. While agricultural uses for much of the land area have shifted in more recent decades to other priorities, the productivity and characterization of high agricultural value remains present provided its present use does not preclude such activities.

The USDA Natural Resource Conservation Service soil survey data provide an approximation and historical interpretation of the agricultural value for the lands within the drainage basin. Not accounting completely for current use condition changes since the soil survey was last updated, greater than 50% of the Eno basin is comprised of soil types classified as “prime” or “state significant” (see Exhibits, Items 3 through 6).

The color scheme on the maps (Items 3 & 5) for farmland classification is as follows:

- Prime Farmlands – forest green
- Prime Farmlands (if flood protected) – light green & gold
- State Significant Farmlands – light blue
- Not Prime Farmlands – any shade of red

Also included in Exhibits are the tabular data (Items 4 & 6) associated with the approximate basin delineation. This data provides a listing of soil types found throughout the basin, an approximate acreage, and the agricultural classification for each type,

6. Public Lands and Scenic, Recreational, & State Natural Areas

While there are many conservation lands located within the Eno basin, the greatest proportion of public, recreational, and state lands are found within Eno River State Park, the Occoneechee Mountain State Natural Area, the Town of Hillsborough and the Orange and Durham County Park systems. There are additional public lands associated with the Falls Lake Reservoir, located just downstream of the Eno basin.

The North Carolina State Park System officially began in 1915 with the establishment of Mount Mitchell State Park in western North Carolina. The system is operated by the DPR, within the North Carolina Department of Environment and Natural Resources (NCDENR). Today, the system consists of sixty-six properties across the state including thirty-eight state parks and twenty-eight state rivers, lakes, trails, and natural areas totaling approximately 212,000 acres. The mission of the state park system is "to conserve & protect examples of natural beauty, ecological features, and recreational resources of statewide significance; to provide outdoor recreational opportunities in a safe & healthy environment; and to provide environmental education opportunities that promote stewardship of the state's natural heritage." (NCDPR #1)

The Eno River State Park is one of the properties of the state park system. Officially opened in 1975, this park now encompasses approximately 4,175 acres along the central riverine corridor within the basin. Additionally, Occoneechee Mountain State Natural Area is also operated by DPR, and totals approximately 190 acres located south-southwest of the town of Hillsborough, NC. Each of these units provide conservation protection of unique ecological areas and function, provide public recreation in the form of trails and direct access to the Eno River, and provide numerous opportunities for environmental education and societal value. A large portion of both properties originated from the efforts of the Eno River Association and other conservation land groups, and funding has been provided by the North Carolina Natural Heritage Trust Fund.

The Town of Hillsborough owns Kings Highway Park, Gold Park and Riverwalk that include lands along the Eno River. Kings Highway Park is an 18-acre natural area located at 1001 Ben Johnston Road in the great bend of the Eno River. The property is bounded on the south and west by Lake Ben Johnston. The park includes trails, picnic tables, and a canoe/kayak launch. Kings Highway Park is just upstream of the town's raw water intake. Gold Park is a 20-acre park located at 415 Dimmocks Mill Road, at the end of South Nash Street. The park includes restroom facilities, seven picnic tables, three picnic shelters, a multi-use field, playground, dog park and extensive natural areas and pedestrian trails. The park includes 0.3 miles of the Riverwalk greenway. Riverwalk is an accessible, asphalt, urban greenway that stretches approximately 1.8 miles along the Eno River between Gold Park in western Hillsborough and trails east of town. It is a popular trail for walking, jogging and cycling and provides a comprehensive pedestrian network for recreation and commuting in town. The greenway's downtown portion is the primary route for the N.C. Mountains-to-Sea Trail.

The Orange County Department of Environment, Agriculture, Parks and Recreation (DEAPR) plays a key role in the management and conservation of the natural resources located within Orange County. They have a variety of natural areas, nature preserves, parks and recreation facilities. The DEAPR Natural and Cultural Resources Division works to promote and conserve

valuable lands of high importance to Orange County. They work with a variety of people including volunteer groups, non-governmental organizations, farmers and local government to help implement their objectives. They oversee four separate parks that offer a variety of outdoor activities including fishing, hiking, mountain biking, bird watching and camping. They also work with farmers and other landowners to promote sustainable and environmentally friendly practices including storm water and erosion control.

The City of Durham Parks and Recreation Department has nearly 1,800 acres of public parks and greater than 20 miles of trails and greenways that it maintains for the community members. They also maintain two lakes, Michie and Little River, for public use including bank fishing, boating, canoeing and other recreational activities as well as serving as their drinking water reservoirs. They are also involved in educating the public and providing them with hands-on activities to learn more about their natural environment. Activities that they offer include weekend programs mainly focused on teaching topics in nature at an introductory level, camps that explore surrounding natural areas, trips that help kids see firsthand North Carolina's abundant natural areas and a "Teens in Nature" program which allows kids ages 14-18 to gain valuable experience working with environmental groups.

The United Army Corp of Engineers in conjunction with the State of North Carolina and multiple local governments helps to manage the over 25,000 acres of undeveloped public lands surrounding Falls Lake. They use a variety of management techniques including prescribed burns, thinning and grassland management to help maintain the natural environment as well as manage for rare or endangered species.

The Department of Agriculture, Plant Conservation Reserve System manages approximately 300 acres of land in the Eno River Basin, mostly in the location known as "Penny's Bend". This area is part of the Eno Diabase Sill, an upheaval in the greater Triassic geologic basin that has resulted in very unique ecological conditions compared to the predominant found throughout the Piedmont physiographic region of North Carolina.

Numerous private and non-profit conservation lands also exist within the river basin. The Eno River Association, Triangle Land Conservancy, Classical American Homes Preservation Trust and Duke University are just a few examples of land owners with properties located along the river corridor. Open public access may be limited on some of these properties, but many are utilized for ecological conservation and educational benefits.

7. Areas of Archaeological or Historical Value

There are numerous archeological and historically significant areas located within the Eno River Basin and along the river course proper. Pre-colonial Native Americans of the Eno tribe and the Ocaneechi of the Saponi tribe have historical ties to various sites throughout the basin. European settlers established homesteads, commerce facilities, and townships in the vicinity of the river, and Hillsborough holds significant weight in the early national history of the United States even boasting ties to the modern NASCAR circuit establishment.

8. Air Quality

Air quality in the Eno River watershed is not significantly different than the rest of Durham and Orange counties.

9. Noise Levels

The Eno River runs through urban and rural areas and for this reason noise levels are variable and dependent on specific location. In the more urban areas engine noise can be heard from roads near the river while in the rural areas noise levels along the river are considerably low.

10. Water Resources

The Eno River is a headwater sub-basin located within the greater Neuse River Basin. The portion of the Eno River that flows through the Eno River State Park is classified as WS-IV, B and NSW. Upstream from the Eno River State Park the Eno is classified as WS-II, WS-V, High Quality Waters (HQW) and Critical Area (CA). The class WS-IV (Water Supply IV) is given to waters where WS-I, II, III classifications are not possible mainly due to the amount of development in the surrounding area. WS-IV waters are often located within areas that are moderately to highly developed. The WS-V classification is given to waters that are generally upstream of WS-IV waters. WS-II classification is given to waters that are used for drinking water, culinary or food processing purposes and are generally located in relatively undeveloped areas. The HQW classification is assigned when waters are designated as excellent based on biological and physical/chemical characteristics. Class B is assigned to waters that are used for primary recreation. Primary recreation is defined as swimming and other similar activities that involve human body contact that occur on a frequent or routine basis. The NSW class, Nutrient Sensitive Waters, is a supplemental classification that is added by the Division of Water Resources to further protect waters with special value or uses. This classification is reserved for waters that are subject to excessive macro or microscopic organisms and provides these waters with additional protection and management.

Surface water classifications are applied to surface water bodies such as streams, rivers and lakes and they help to define what uses should be protected within these waters. These protected uses then have water quality standards that are set to protect those uses and help to determine if the uses are in fact being protected. These rules can protect water quality, fish and wildlife associated with the system or other special characteristics such as ecologically sensitive areas or drinking water sources. The associated regulations can also impose regulations on activities that have the possibility of negatively affecting water quality especially in areas that are classified as drinking water sources. The classifications are based on minimum protection rules that are put in place by state and federal agencies. In North Carolina all waters must at least meet the requirements for Class C, which is water that is used for secondary recreation which includes fishing, boating, fish consumption and agriculture. Secondary recreation is defined as uses that involve human body contact but are not in an infrequent or unorganized manner. Multiple classifications are often given to a certain body of water because there are often multiple uses for that water body or there may be some ecologically important factor that needs to be protected.

The Town of Hillsborough withdraws raw water from the Eno River for treatment and use. The raw water intake is located upstream of Dimmocks Mill Road in Lake Ben Johnson. The town withdraws approximately 1.1 million gallons per day (MGD), but varies throughout the year depending upon demand. Withdrawals are governed by the Eno River Capacity Use Agreement, a binding agreement that helps guarantee minimum flows within the river. The town's waste water plant is permitted to treat and discharge a maximum of 3.0 MGD pursuant to its National Pollutant Discharge Elimination (NPDES) permit. The town also protects water quality within the Eno River through various regulatory tools. The Town of Hillsborough enforces water protection measures through its Unified Development Ordinance (UDO) which includes development

standards for storm water runoff, riparian buffer protection, floodplain protection and watershed protection measures. The town holds an NPDES Phase II storm water permit, and has delegated authority to implement the state's Falls Lake rules, Neuse Buffer rules, and watershed protection rules.

11.Forest Resources

Many forest areas are adjacent to and occupy the Eno River corridor, including privately and government owned properties with said resources. The majority of these forests, along and surrounding the river corridor, are second growth or younger timber given that the Piedmont region of North Carolina was mostly denuded of old growth during the first few hundred years of European settlement.

Forestland communities exhibit differences and gradations based upon elevation, aspect, and inherent moisture availability. There are Piedmont Monadnock Forest and Pine-Oak-Heath natural communities in Occoneechee State Natural area, the highest elevation point in Orange County, transitioning to various dry and mesic pine and hardwood communities down to the banks and wetland interfaces located along the river proper.

As the Eno flows downstream, it crosses the geologic boundaries of the Carolina Terrane into the Durham sub-basin within the Triassic age Deep River Basin from its headwater origin to its confluence with the Flat River. This geology also affects the diversity of natural communities along the river course as it flows downstream. Many natural communities found in the Carolina Terrance upper reach represent some of the eastern-most occurrences of those more typically found in the western Piedmont region of North Carolina. At the same time, the characteristics of the Durham Triassic basin contribute to the occurrences of diabase sill communities, like those in the vicinity of Penny's Bend, farther downstream.

These forested areas provide numerous recreational benefits, storm water run-off and erosion management benefits, and conditions that favor the presence of a diverse array of terrestrial and aquatic species of significant occurrence.

12.Shellfish or Fish and Their Habitats

The Eno River has many unique values, characteristics, and circumstances that have contributed to the presence and retention of numerous state and even globally significant aquatic species. The nature of the river being a headwater sub-basin, coupled with the rural or low density development, and the conservation lands, have reduced the loss of species diversity and water quality degradation issues that have occurred downstream. Because of these factors, the Eno River is known to contain many species of significantly rare fishes and mollusks (see Table 1). See Appendix B for Federal and State Status definitions.

Table 1. Aquatic Species and Natural Communities Tracked by NC Natural Heritage Program Documented from the Eno River.

Taxonomic Group	Scientific Name	Common Name	Status	Federal Status	State Status
Freshwater Bivalve	*Alasmidonta heterdon*	Dwarf Wedgemussel	Current	Endangered	Endangered
	Alasmidonta undulata	Triangle Floater	Current	None	Endangered
	Elliptio roanokensis	Roanoke Slabshell	Current	Species of Concern	Threatened
	Fusconaia masoni	Atlantic Pigtoe	Current	Species of Concern	Endangered
	Lampsilis cariosa	Yellow Lampmussel	Current	Species of Concern	Endangered
	Lampsilis radiata	Eastern Lampmussel	Current	None	Threatened
	Lasmigona subviridis	Green Floater	Current	Species of Concern	Endangered
	Strophitus undulatus	Creeper	Current	None	Threatened
	Villosa constricta	Notched Rainbow	Current	None	Threatened
Freshwater Gastropods	*Somatogyrus virginicus*	Panhandle Pebblesnail	Current	Species of Concern	Significantly Rare
Trichopterans	*Bibusa angata*	a caddis fly	Current	None	Significantly Rare
Odonate	*Gomphus lineatifrons*	Splendid Clubtail	Current	None	Significantly Rare
	Gomphus septima	Septima's Clubtail	Historic	Species of Concern	Significantly Rare
Amphibian	*Necturus lewisi*	Neuse River Waterdog	Current	Species of Concern	Special Concern
Freshwater Fishes	*Ambloplites cavifrons*	Roanoke Bass	Current	Species of Concern	Significantly Rare
	Etheostoma collis	Carolina Darter	Historic	Species of Concern	Special Concern
	Noturus furiosus	Carolina Madtom	Current	Species of Concern	Threatened
	Notropis volucellus	Mimic Shiner	Current	None	Significantly Rare
Natural Communities	*Rocky Bar & Shore*		Current	None	None

There are 44 fish species known to the Eno basin, and of these the Carolina Madtom is state listed as a threatened species, and the Roanoke bass and the Mimic Shiner are listed as state rare. North Carolina Wildlife Resources Commission (NCWRC) regularly conducts surveys of the fishes in the Eno to monitor the health and population levels.

Additionally, there are many other species of significance found within the Eno River. The Dwarf Wedgemussel is the only federally listed species, while it and eight additional mussels found throughout the basin are state listed. The Neuse River Waterdog is the only amphibian with special status. The Panhandle Pebblesnail, the only special status mollusk, is also of particular not because this aquatic snail is highly associated with the presence of riverweed (Podostemum ceratophyllum).

The NCWRC along with over 50 cooperating partners formulates the North Carolina Wildlife Action Plan (WAP); a comprehensive strategic planning tool intended to prioritize conservation efforts for species and habitats in decline or imperiled. A great deal of conservation insight for each of the species listed above can be found in the WAP (NCWRC 1).

There are numerous wetland and aquatic areas found within the watershed, which contain a large number of associated species dependent on these areas to survive. Based on surveys and classifications conducted by the North Carolina Natural Heritage Program and other conservation agencies and organizations, the following aquatic natural communities can be found in close association with the river corridor.

Table 2. List of Natural Communities for the Eno

Rocky bar & shore
Piedmont Swamp Forests
Floodplain pools
Piedmont Semi-permanent Impoundment
Piedmont Alluvial Forests
Upland Pool
Hillside Seepage Bog or Low Elevation Seep

13. Wildlife and Natural Vegetation

Wildlife

A variety of vertebrates and invertebrates inhabit the Eno River and the surrounding lands associated with the river. The assemblage would be considered normal for this geographic location with species including white-tailed deer, raccoons, opossums and a variety of terrestrial bird and waterfowl species.

Eno River State Park provides a very good inventory for many of the species found within the basin, but is not comprehensive by any extent. Numerous additional species exist, some potentially not yet discovered, and some too difficult for people other than highly specialized experts to identify. Nonetheless, the NCDPR Natural Resources Inventory Database currently has over 1600 occurrence records documented on the park for the following taxa:

- Amphibians – 22 species
- Annelids – 8 species
- Arachnids – 47 species
- Birds – 166 species
- Crustaceans – 8 species
- Fishes – 67 species
- Insects – 730 species
- Mammals – 27 species
- Mollusks – 32 species
- Myriapods – 7 species
- Reptiles – 33 species

Within many of these taxa groups are numerous occurrences for species of significance (i.e. endangered, threatened, species of concern, rare, etc.). These higher rarity classifications are determined by the US Fish and Wildlife Service at the federal level, and the Wildlife Resources Commission at the state level (NCWRC 2). There are a number of "watchlist" species as defined by the North Carolina Natural Heritage Program (NCNHP 1) within many of these taxa. And finally, the North Carolina Wildlife Action Plan (NCWRC 1) provides detailed information for many of these taxa requiring special impact consideration. While the Eno basin is relatively small, it is still a complex natural system.

Native Vegetation

The Eno River is home to a variety of native aquatic vegetation. Multiple surveys have been conducted on the river to delimit the extent of the hydrilla infestation. Two common aquatic plants that are known to occur in the river and provide great benefits to the aquatic organisms residing there include water-willow (*Justicia americana*) and riverweed (*Podostemum ceratophyllum*).

Riverweed distribution data was captured during the 2013 presence-absence surveys, but no density estimate protocol was attempted. To date these data have not been fully summarized. It is known that the Panhandle pebblesnail (*Somatogyrus virginicus*) is closely associated to the presence, density, and health of riverweed in the system.

No survey data was gathered for water-willow, but it is known to readily occupy a number of the Eno riverine niche natural communities with the most prominent being Rocky Bar & Shore. Water-willow provides important habitat conditions that support the numerous invertebrate groups and refuge for various fish life stages dependent on water depths and flow rates.

The benefits of these two aquatic plants, along with the diversity of other native plants found in the system, cannot be overstated. Without the native plants in place, the stability of the stream and river channels will degrade, the faunal support & diversity will diminish or potentially collapse and the water quality will likewise decline. All of these adverse factors can occur concurrently and over relatively short timeframes if stressors and threats are not mitigated. Hydrilla stands as one of the major threats to the long-term resilience of the Eno drainage if allowed to continue unchecked.

E. Predicted Environmental Effects of Project

1. Topography

No land disturbance is required for the implementation of hydrilla control efforts in the Eno River basin.

2. Soils

Any herbicide that is used to control the growth of vegetation whether terrestrial or aquatic is going to accumulate within the soil. This is due mainly to herbicide that is not absorbed by the plant or does not come into contact with the plant. Most herbicides are broken down through a variety of processes and are not present for a significant amount of time.

Studies have shown the fluridone residue in natural pond hydrosoil generally declines to non-detectable levels sixteen to fifty-two weeks following an application. Dissipation of fluridone from the hydrosoil occurs gradually into the water column, where it is primarily degraded by the process of photolysis. The resulting by-products of the photo degradation do not persist or accumulate in the hydrosoil regions.

Comparatively, endothall breaks down at varying rates through microbial action dependent on the water temperature. It can persist for up to a week in cool water or for as little as twenty-four hours during the late summer months.

No significant direct, indirect or cumulative impacts to soils are anticipated.

3. Land Use

No permanent change to land use will result from hydrilla control efforts described here.

The irrigation restrictions for fluridone are as follows. For established tree crops seven days must pass before treated water can be used for irrigation and fourteen days must pass for established row crops/turf/plants.

Endothall may be used immediately after treatment to irrigate crops except annual nursery or greenhouse plants or newly seeded turf or sodded areas.

4. Wetlands

Herbicides applied adjacent to or near wetland communities may cause some injury to plants along the river course in the treatment area. Injury to those plants is anticipated to be undetectable or at most minor based on the proposed methods. The proposed action will not place any dredge/fill material in any waters or wetland, therefore a Section 404 or 401 permit will not be required.

No significant direct, indirect, or cumulative impacts are anticipated.

5. Prime or Unique Agricultural Lands

No terrestrial herbicide applications will occur thus no impact is expected.

6. Public Lands and Scenic, Recreational, and State Natural Areas

The chemical treatment of hydrilla within the Eno basin is expected to have no significant negative impacts to the resources, recreation, or additional values of these lands. The project's long-term goal of managing hydrilla from the Eno watershed is consistent with protecting the natural resources, economic and recreational values, and additionally, the public uses such as quality drinking water.

7. Areas of Archaeological or Historical Value

No environmental impacts to these areas based on any of the treatments or implementation locations considered are anticipated.

8. Air Quality

The herbicide products considered for this project will not impact air quality for persons other than the handler (often referred to on pesticide labels as "mixer, loader, and/or applicator"). Endothall and fluridone product labels caution the handler and contain language such as "harmful

if inhaled" or "avoid breathing". Depending on specific products and/or uses handlers may be required to wear a NIOSH-approved respirator with a dust/mist filter. No direct, indirect, or cumulative impact to wildlife is anticipated.

One or more of vehicles/ATVs/small machines powered by internal combustion engines will be employed during the course of this project. Gasoline/Diesel engines release carbon monoxide, carbon dioxide, and other emissions that impact air quality. However, the cumulative uses of these engines operated for this project are not anticipated to significantly affect air quality.

9. Noise Levels

Low level mechanical noise levels will be present, and intermittent, within close proximity to the treatment infusion locations. The application of herbicides will be delivered by mechanical means using a small pump. The pump will be housed in an enclosure. The sound will be barely audible outside of the enclosure. The bulk of noise resulting from this project will be generated by vehicles used to access the site(s) for installation and maintenance of infusion system(s) as well as vehicle traffic to and from the monitoring locations where water samples will be collected. The noise will be of relatively low level and temporary. The noise may be apparent to the public and wildlife, but no impacts are anticipated. Except in the instance that a chainsaw or similar power tool is needed the anticipated noise levels will be low enough that ear protection will not be necessary.

10. Water Resources

Per EPA labeling there are no restrictions on the use of water containing less than 20 ppb fluridone for swimming, fishing, or consumption by domesticated animals or humans. (Durkin, 2008) Application rates exceeding 20 ppb of fluridone cannot be made within ¼ mile of any functioning potable water intake. Similarly, endothall is deemed as a food-safe herbicide, allowing recreational uses (swimming, fishing, etc.) after application. Endothall does however require that potable water intakes be closed when treated water is present at the intake and can only be used when the Maximum Contamination Level is at or below 0.1 ppm (CSI, 2001). No potable water intake operations will be impacted during Phase I of this project. Potential impacts to potable water withdraw associated with Phase II of this project will be addressed in a supplemental document. That document will undergo agency review and will also be posted for public review and comment via the State Clearinghouse process. See Appendix D for herbicide labels.

11. Forest Resources

This project involves only aquatic application of herbicides, and as such, will involve no predicted impacts to forest resources found within the Eno River basin.

12. Shellfish of Fish and Their Habitats

The mollusks, crustaceans, and fishes found within the Eno River basin would be exposed to the herbicide options considered for treatment of the hydrilla infestation. Impacts to these populations are of particular concern given the number considered significant species. Fluridone is one of the herbicides proposed for treatment activities, with a target concentration of 3-5 parts per billion (ppb) in the treatment zone maintained for no less than 4 months (the growing season). At no point in time will herbicide concentrations in the water exceed label limits.

A report submitted to the US Forest Service details the associated ecological risk of using fluridone (Durkin 2008). This report concluded that the use of the maximum target application rate, 150 ppb as either an acute or chronic exposure, did not result in any toxic effects in fishes. The report also concluded that expected concentrations of fluridone in water should not have adverse effects on aquatic invertebrates; the acute and chronic toxicity values for sensitive and tolerant aquatic invertebrates were only slightly greater than those for fishes.

Endothall (Aquathol®), a contact herbicide, is another herbicide that could be utilized in the infestation treatment. Based on a literary review conducted by Compliance Services International (2001), endothall was not found to acutely or chronically affect aquatic biota when applied at the concentrations recommended on the label for the treatment of hydrilla.

North Carolina State University has conducted acute toxicity tests on mollusk species using fluridone and endothall in 2013. Initial tests were conducted as part of the hydrilla treatment project assessment for the Lake Waccamaw infestation. These tests focused on the glochidia (larval stage) and juveniles of *Lampsilis siliquoidea*, a relative freshwater mussel species in the same genus as some found in Lake Waccamaw, and also correspondingly to at least two species found in the Eno River basin. Results from these test indicated that the concentrations of fluridone and endothall used in typical treatment regimens (5 ppb and 3 ppm respectively) were not acutely toxic to the most sensitive life stages of these freshwater mussels. Median lethal fluridone concentrations (LC50s) were 865 ppb for glochidia (24 h) and 511 ppb for juvenile *L. siliquoidea* (96 hour) – more than 100 times greater than the typical application concentrations and well above the maximum label rate of 150 ppb. Moreover, no mortality occurred in a 28-day exposure of adult *L. fullerkati*, where concentrations ranged 0 – 300 ppb. No statistically significant effect of fluridone concentration on the sublethal endpoints, foot protrusion and siphoning behavior were found (both $p > 0.05$; Archambault et al. 2014). The 24-hour LC50 for glochidia exposed to the dipotassium salt of endothall was 31.2 ppm and the 96-hour LC50 for juvenile mussels was 34.4 parts per million (ppm) (Archambault et al. 2014), approximately 10 times higher than a moderate application concentration of endothall.

Subsequently following the Lake Waccamaw mussel assessment, acute toxicity test with fluridone were also conducted on *Somatogyrus virginicus*, commonly called the Panhandle Pebblesnail. Results from this test indicated that herbicide concentrations which would be applied during the planned Eno River treatment would not be acutely toxic to these organisms (juvenile 96-h LC50 = 500 ppb; Archambault et al. 2014). A pilot study was conducted in 2014 to investigate the feasibility of detecting toxicity of herbicides to *Somatogyrus* eggs. Ensuring the safety of all life stages is of particular concern because *S. virginicus* is an annual species, in which most adults die soon after reproducing (Johnson et al. 2013) and developing eggs and hatchlings are likely to be present at the time of herbicide application. Preliminary results indicate that acute (96 h to 7 d) exposure to endothall did not inhibit egg development at typical application concentrations, but statistical analysis is still pending (Personal communication, Jennifer Archambault). Additional toxicological studies with fluridone and endothall are scheduled for 2015, with plans to finish these studies before treatment in the Eno River begins.

When the target vegetation dies after herbicide treatment, there is a risk that decomposition would result in decreased levels of dissolved oxygen in portions of the river corridor. This decrease could pose a threat to some aquatic life. This risk will be minimized by timing the applications to correspond to the timeframe when hydrilla begins to grow in the late Spring. With appropriate timing, there will be less dead and dying biomass to decompose, as well as cooler water

temperatures which support higher dissolved oxygen levels, reducing the potential for hypoxic aquatic fauna mortality.

The herbicides considered in this treatment are not known to be persistent in the environment, nor are they known to bio-accumulate. Bio-accumulation refers to the process by which chemicals or contaminants are taken up by an organism lower in the food chain and then moved through the food chain as you increase in trophic level.

13. Wildlife and Natural Vegetation

In addition to the fish and mollusk issues discussed above, hydrilla management in the Eno River basin should not adversely affect other wildlife species. The management effort will result in hydrilla being unavailable for potential summer-fall use by waterfowl and other species that might utilize the dense surface and subsurface matted biomass typical of the infestation. However, the low concentration treatment options should reduce the presence of hydrilla, thereby promoting the native vegetation in the river. The corresponding change to more historical food sources and cover associated with the promotion of native vegetation may benefit the aquatic wildlife species found in the basin.

In 2013-14, North Carolina State University conducted ad hoc, static system, aquatic herbicide impact tests on riverweed (*Podostemum ceratophyllum*). Both tests for fluridone and endothall produced minimal levels of direct injury, particularly at the proposed treatment concentration levels, and neither resulted in plant mortality (Nawrocki, personal comm.).

14. Introduction of Toxic Substances

Herbicides by nature are toxic to target organisms and potentially toxic to non-target organisms. Professionally licensed applicators (private and State), maintenance, and associated project personnel will insure that all toxic substances (e.g. fuel, oil, lubricants, herbicides, adjuvants, etc.), as well as all containers utilized, will be handled in accordance with all appropriate State and Federal regulations. All herbicides will be used following the guidelines for lowest effective doses and will be below approved maximum concentrations.

No direct, indirect, or cumulative impacts are expected during this project.

F. Mitigation Measures

1. Topography

N/A

2. Soils

N/A

3. Land Use

N/A

4. Wetlands

No modification or destruction of jurisdictional wetland will occur; therefore no mitigating measures are needed regarding that. Please refer to the Wildlife and Natural Vegetation section for monitoring and sampling of vegetation along the Eno River.

5. Prime or Unique Agricultural Lands

There are no documented irrigation withdrawals from the Eno River based on information available to the North Carolina Division of Water Resources. Nonetheless, a public information announcement will be conducted to notify potential stakeholders in the basin.

6. Public Lands and Scenic, Recreational, and State Natural Areas

No detrimental effects are expected for this category of environmental elements. Please see the additional details provided for section F12 and F13.

7. Areas of Archaeological or Historical Value

N/A

8. Air Quality

N/A

9. Noise Levels

N/A

10. Water Resources

The ERHM Task Force is only considering herbicide products which have a wide margin of safety between target concentrations (to effectively control the growth of hydrilla) and label limits. During the treatment, herbicide concentration levels will be monitored throughout the target treatment area. There will be multiple sampling sites located throughout the treatment area. Routine sampling will ensure that proper herbicide levels are maintained and confirm that levels are within label limits. Herbicide applications will be suspended as needed if water analysis detects concentrations that exceed label limits. Once treated water from the Eno River enters Falls Lake the herbicide concentrations will be diluted to levels undetectable by conventional analyses methods.

11. Forest Resources

N/A

12. Shellfish or Fish and Their Habitats

The NCWRC, the North Carolina Division of Parks and Recreation, North Carolina State University and other partners will continue to conduct standardized protocol surveys for priority species of fishes and mollusks found in the Eno River basin.

The NCWRC conducted surveys on fish, crayfish, and mussel communities at five sampling sites along the Eno River in 2013 and 2014. These surveys will be used as pre-treatment base line data. Once treatment begins sampling will continue for another three years to evaluate any changes that occur within these aquatic communities. The sampling site locations from upstream to downstream are: US 70 (west of the town of Hillsborough), US 70 (east of the town of Hillsborough), Few's Ford access (Eno River State Park), Cole Mill access (Eno River State Park), and Guess Road (Eno River State Park). Fish were collected using electrofishing equipment from sites that were approximately 350 m in length and consisted of pool, riffle, and run habitats. Sites are sampled in late spring / early summer to avoid decreased sampling efficiency due to increased presence of hydrilla. Fish were identified, counted, weighed and measured. Crayfish were collected using a semi-quantitative quadrat-seine method from sites that were approximately 100 m in length and composed of primarily riffle and run habitats. Crayfish were identified, counted and measured. Mussels were evaluated by conducting visual, timed surveys (6 person-hrs.) in 2013.

13. Wildlife and Natural Vegetation

There are no predicted detrimental effects to wildlife directly or indirectly resulting from activities proposed for this project. If any effects are observed or reported otherwise, they will be investigated and the herbicide treatment will be re-evaluated.

No detrimental effects to natural vegetation are expected based on manufacturer's herbicidal screening of various aquatic plants plus the specific research conducted by NCSU. Natural vegetation will be monitored to confirm no detrimental effects are occurring. If natural vegetation is found to be significantly affected at any point during the treatment then the project will be re-evaluated.

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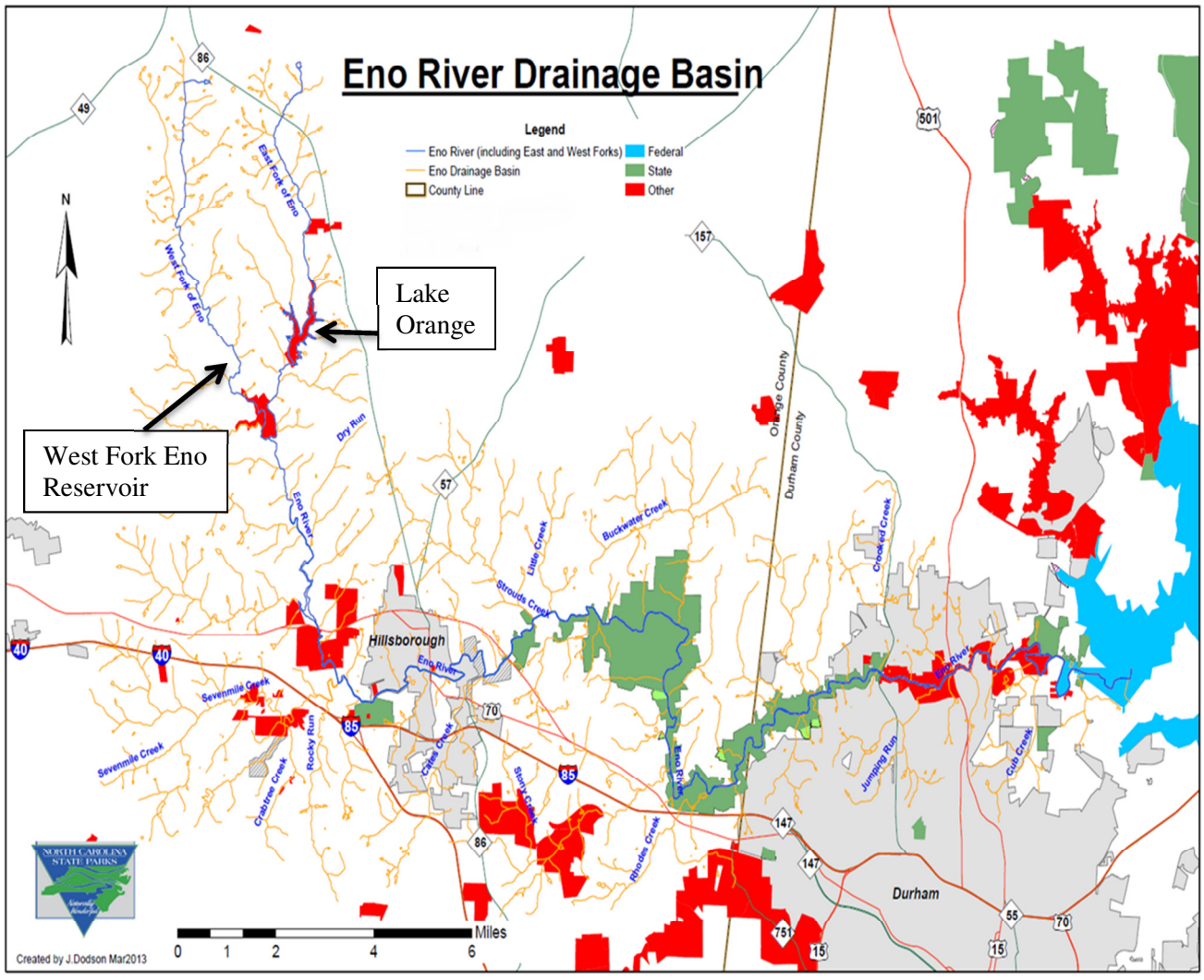
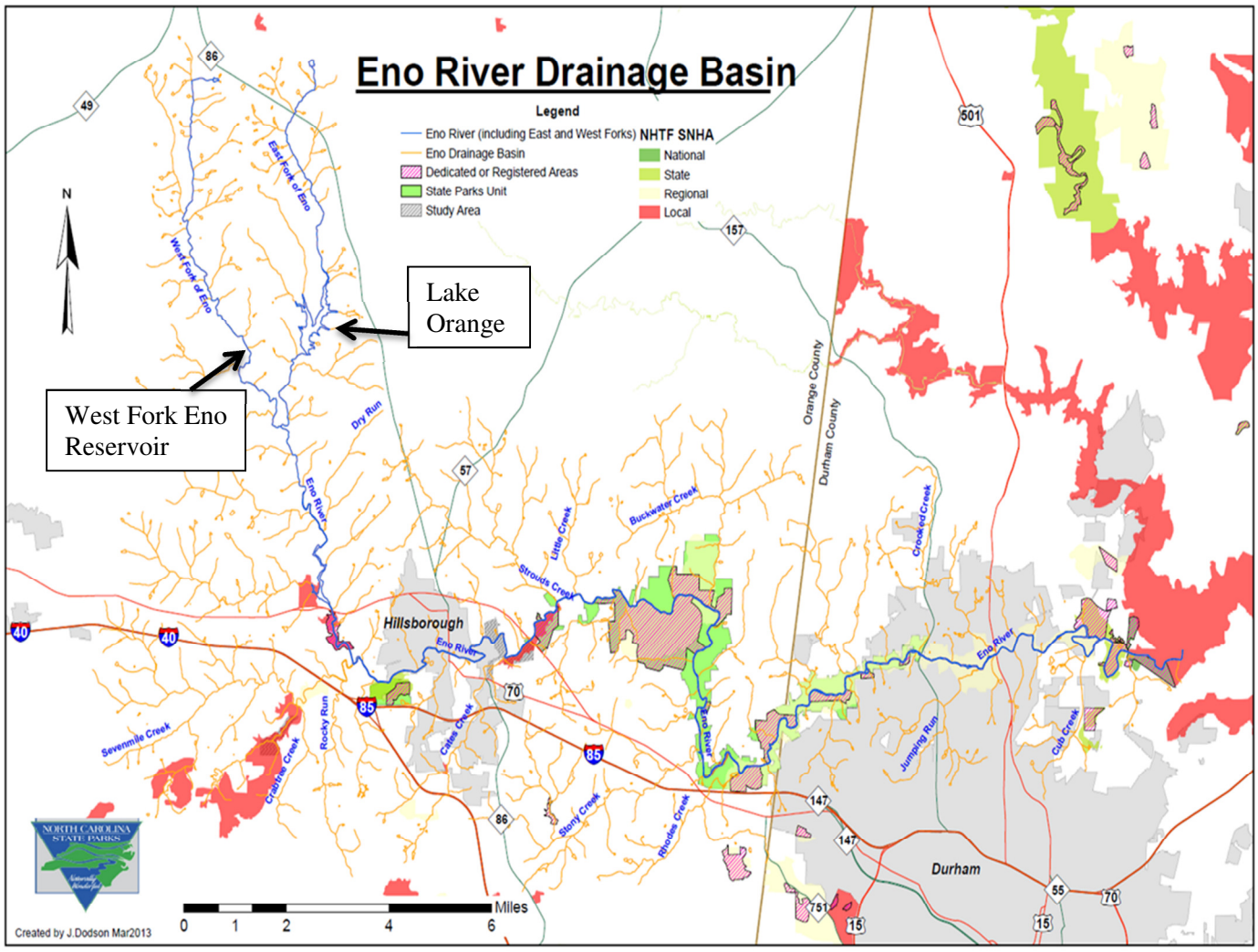
H. Exhibits

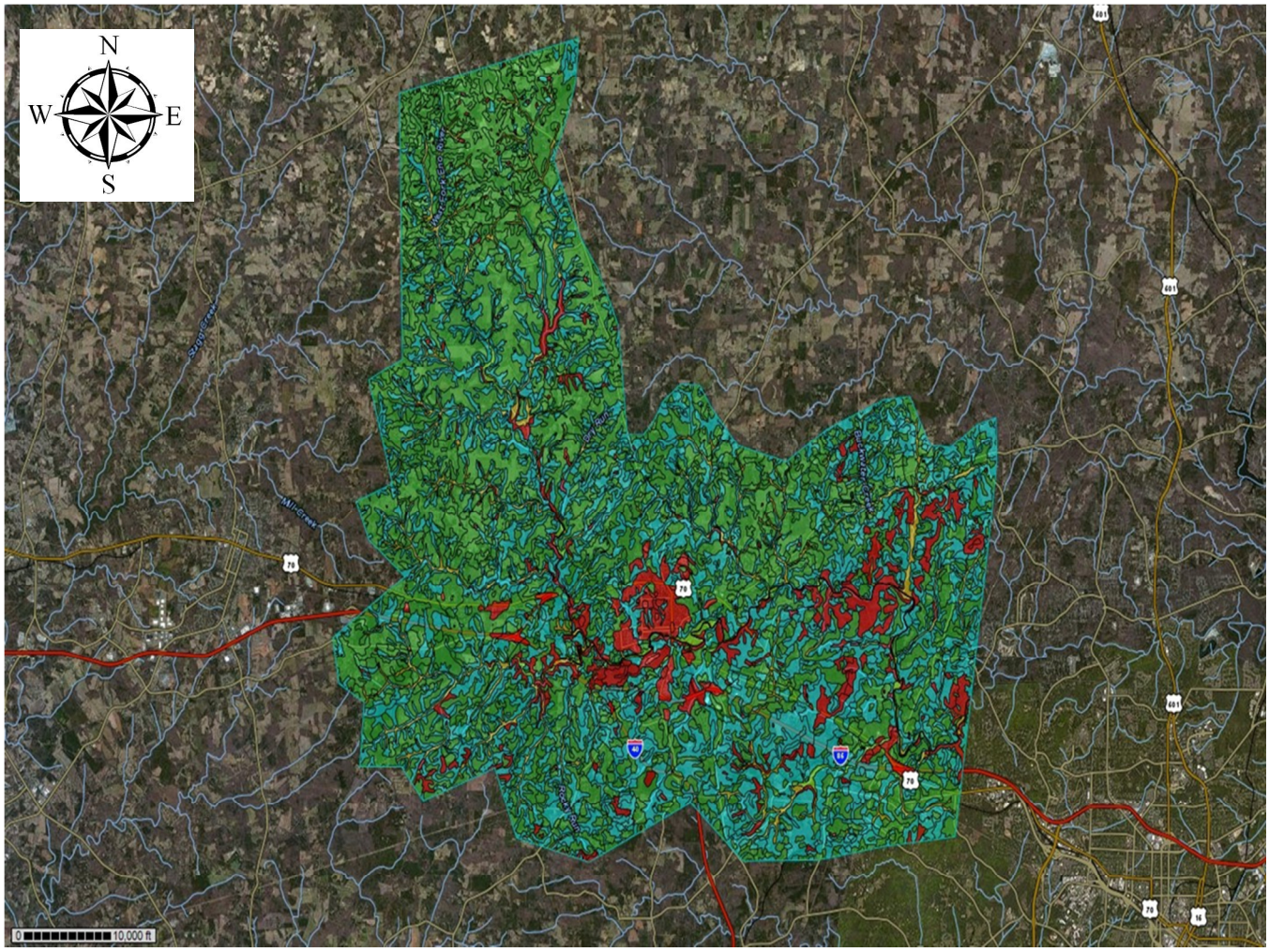
1. Map of Conservation Land Ownership in the Eno River Basin



2. Map of Significant Natural Areas in the Eno River Basin



3. Map of Agricultural Land Classification for Eno Basin in Orange County, NC



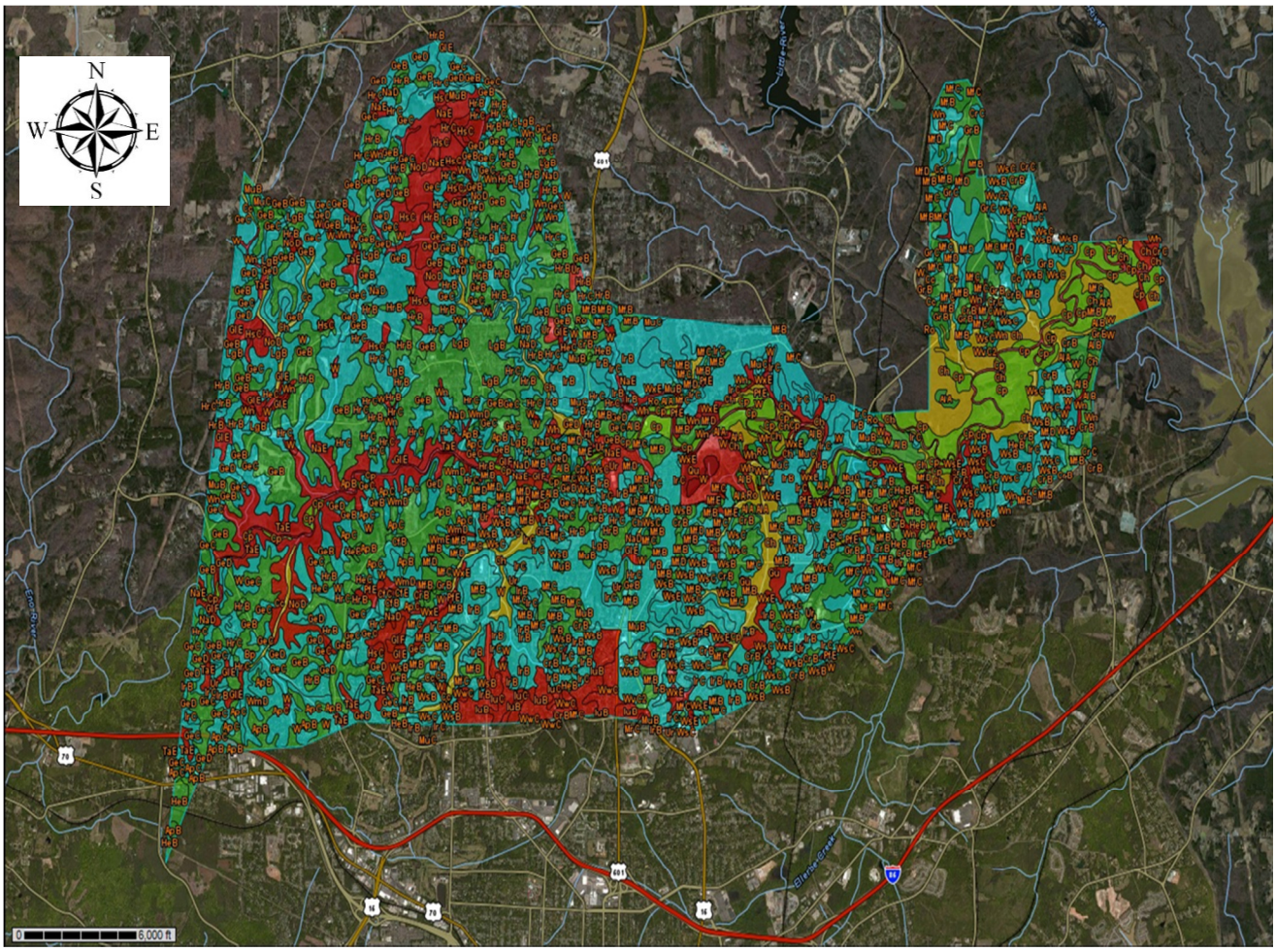
4. Soils and Agriculture Land Classification Data for Orange County, NC

Tables — Farmland Classification — Summary By Map Unit

Summary by Map Unit — Orange County, North Carolina (NC135)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Aa	Altavista fine sandy loam, 0 to 3 percent slopes, occasionally flooded	All areas are prime farmland	161.4	0.2%
ApB	Appling sandy loam, 2 to 6 percent slopes	All areas are prime farmland	3,242.0	4.1%
ApC	Appling sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	1,097.2	1.4%
CfB	Cecil fine sandy loam, 2 to 6 percent slopes	All areas are prime farmland	232.3	0.3%
CfC	Cecil fine sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	130.2	0.2%
Ch	Chewacla loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	3,514.3	4.4%
Cp	Congaree fine sandy loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	535.0	0.7%
EnB	Enon loam, 2 to 6 percent slopes	All areas are prime farmland	3,064.4	3.9%
EnC	Enon loam, 6 to 12 percent slopes	Farmland of statewide importance	1,309.4	1.7%
GeB	Georgeville silt loam, 2 to 6 percent slopes	All areas are prime farmland	17,755.5	22.4%
GeC	Georgeville silt loam, 6 to 10 percent slopes	Farmland of statewide importance	12,942.7	16.3%
GhC	Georgeville-Urban land complex, 2 to 10 percent slopes	Not prime farmland	1,269.4	1.6%
GlD	Goldston channery silt loam, 6 to 15 percent slopes	Not prime farmland	147.5	0.2%
GlF	Goldston channery silt loam, 15 to 45 percent slopes	Not prime farmland	500.1	0.6%
HeB	Helena sandy loam, 2 to 8 percent slopes	All areas are prime farmland	3,329.5	4.2%
HhA	Helena-Sedgefield complex, 0 to 2 percent slopes	All areas are prime farmland	448.9	0.6%
HrB	Herndon silt loam, 2 to 6 percent slopes	All areas are prime farmland	8,842.7	11.1%
HrC	Herndon silt loam, 6 to 10 percent slopes	Farmland of statewide importance	4,455.8	5.6%
HwB	Lloyd clay loam, 2 to 6 percent slopes	All areas are prime farmland	566.2	0.7%
HwC	Lloyd clay loam, 6 to 10 percent slopes	Farmland of statewide importance	209.4	0.3%
IrB	Iredell gravelly loam, 1 to 4 percent slopes	Farmland of statewide importance	443.2	0.6%
IuB	Iredell-Urban land complex, 1 to 8 percent slopes	Not prime farmland	144.9	0.2%
Lg	Lignum silt loam, 0 to 3 percent slopes	Farmland of statewide importance	2,245.9	2.8%
Or	Orange silt loam, 0 to 3 percent slopes	Farmland of statewide importance	1,009.3	1.3%
Pt	Pits, quarry	Not prime farmland	46.1	0.1%
TaD	Tarrus silt loam, 8 to 15 percent slopes	Farmland of statewide importance	6,268.8	7.9%
TaE	Tarrus silt loam, 15 to 25 percent slopes	Not prime farmland	3,325.6	4.2%
Ur	Urban land	Not prime farmland	146.7	0.2%
VaB	Vance sandy loam, 2 to 8 percent slopes	All areas are prime farmland	629.1	0.8%
W	Water	Not prime farmland	770.8	1.0%
WmD	Wedowee sandy loam, 8 to 15 percent slopes	Farmland of statewide importance	196.7	0.2%
WmE	Wedowee sandy loam, 15 to 25 percent slopes	Not prime farmland	36.0	0.0%
WxD	Wilkes gravelly loam, 8 to 15 percent slopes	Not prime farmland	216.9	0.3%
WxF	Wilkes gravelly loam, 15 to 45 percent slopes	Not prime farmland	118.3	0.1%
Totals for Area of Interest			**79,352.3**	**100.0%**

5. Map of Agricultural Land Classifications for Eno Basin in Durham County, NC



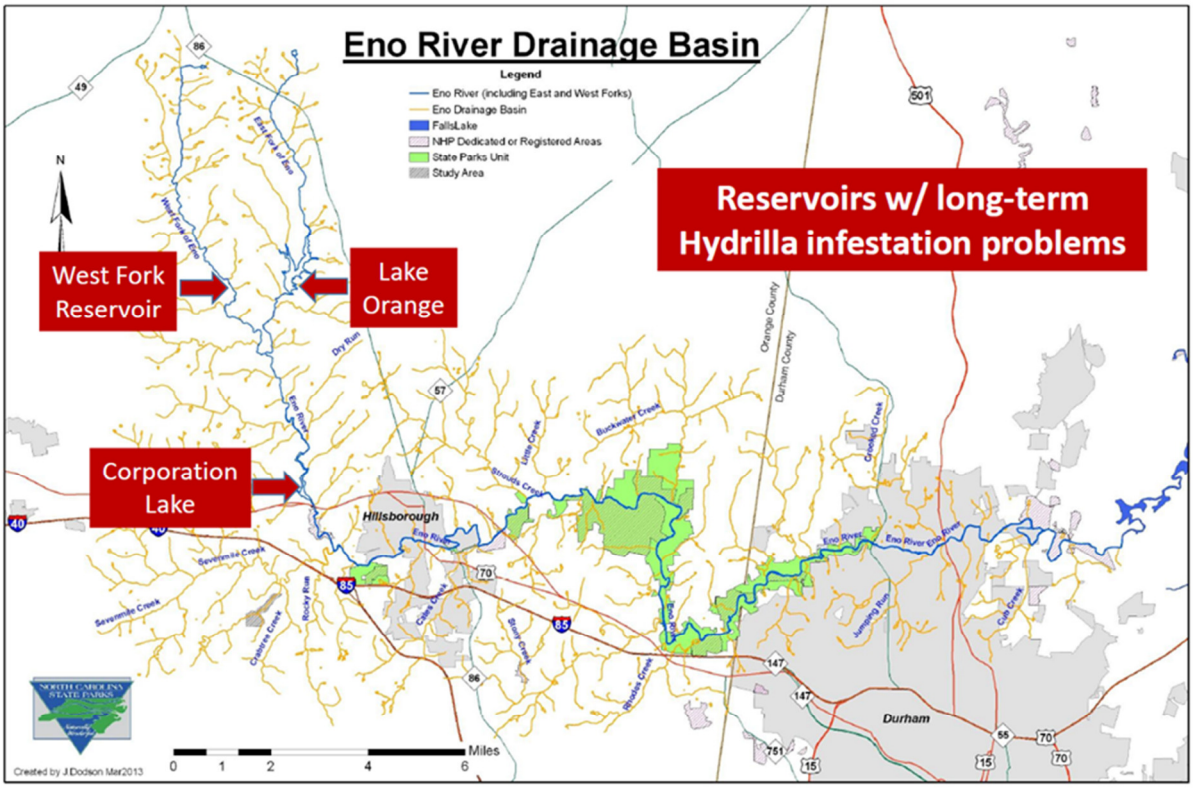
6. Soils and Agriculture Land Classification Data for Durham County, NC

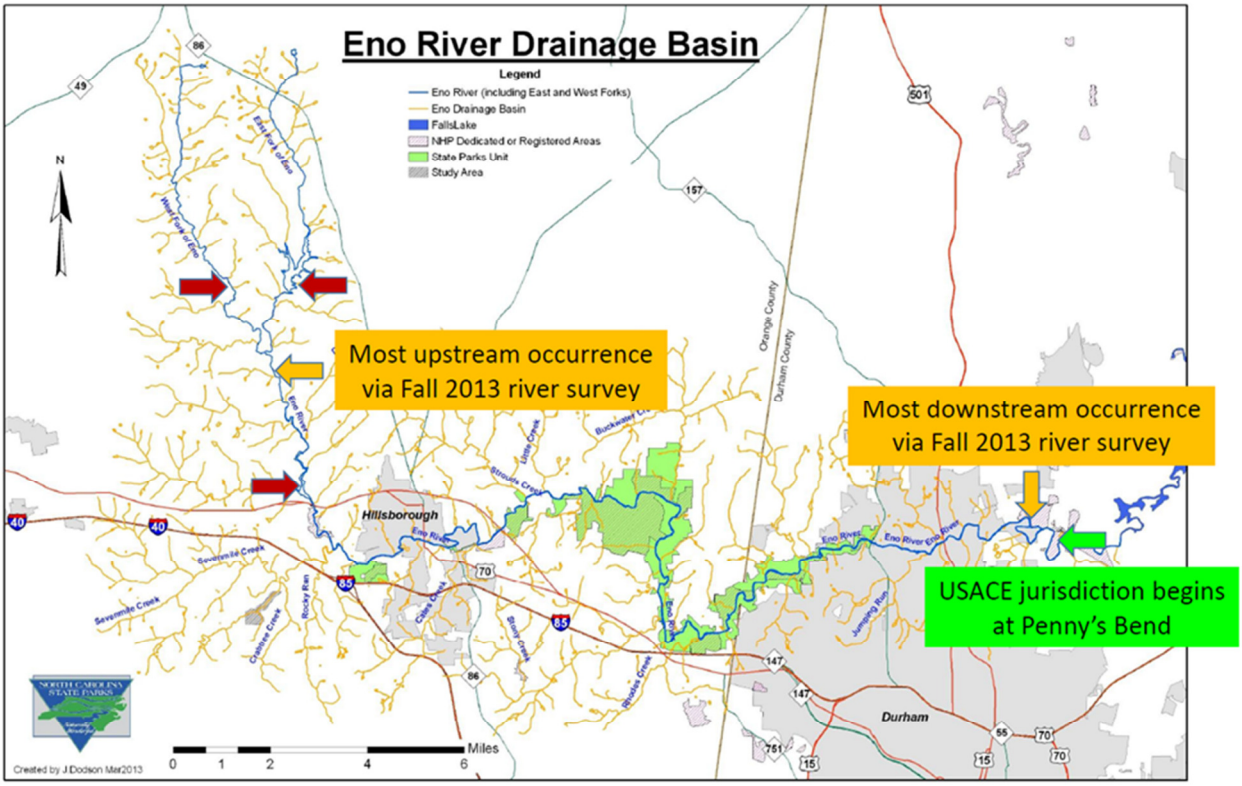
Tables — Farmland Classification — Summary By Map Unit

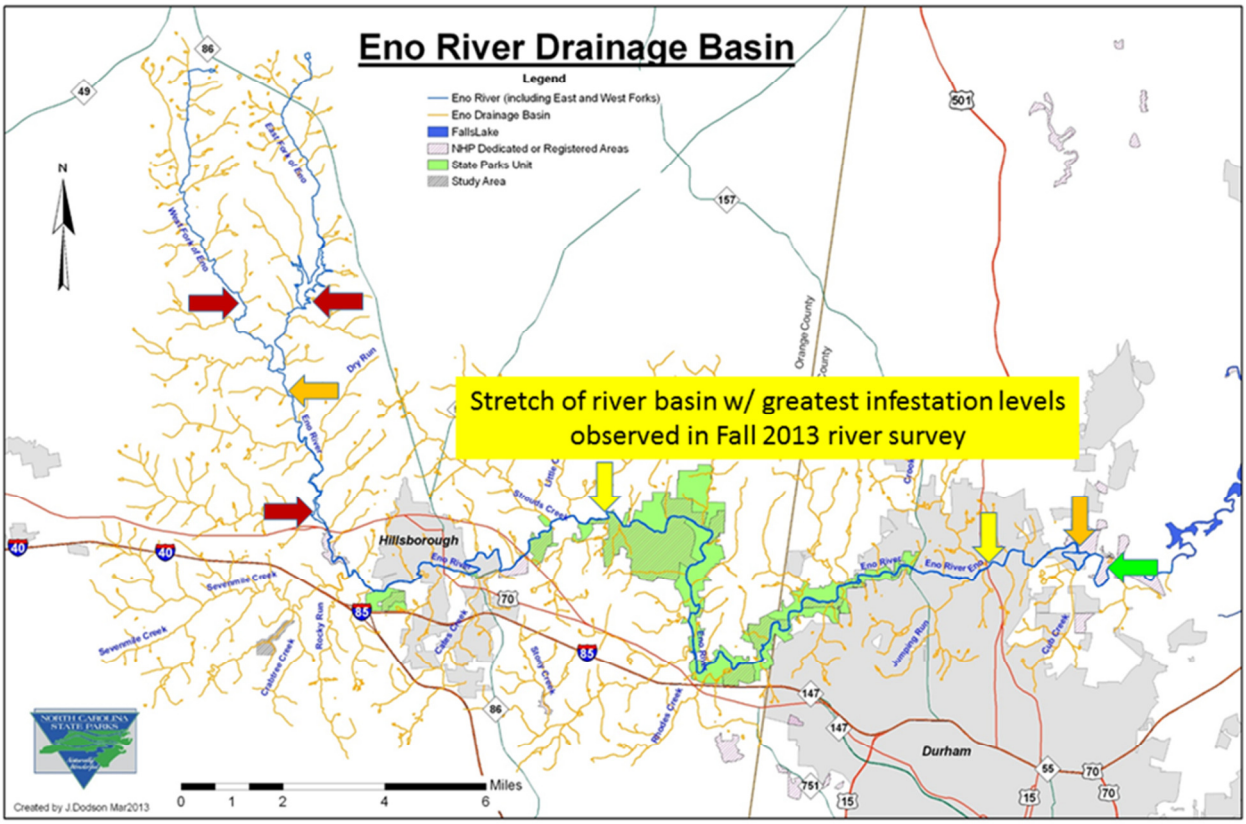
Summary by Map Unit — Durham County, North Carolina (NC063)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AaA	Altavista silt loam, 0 to 2 percent slopes, rarely flooded	All areas are prime farmland	107.7	0.5%
AaB	Altavista silt loam, 2 to 6 percent slopes, rarely flooded	All areas are prime farmland	164.0	0.8%
ApB	Appling sandy loam, 2 to 6 percent slopes	All areas are prime farmland	520.9	2.4%
ApC	Appling sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	448.4	2.1%
Bp	Borrow pits	Not prime farmland	2.5	0.0%
Cc	Cartecay and Chewacla soils, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	129.5	0.6%
CfB	Cecil fine sandy loam, 2 to 6 percent slopes	All areas are prime farmland	23.3	0.1%
CfC	Cecil fine sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	10.7	0.0%
CfE	Pacolet fine sandy loam, 10 to 25 percent slopes	Not prime farmland	12.3	0.1%
Ch	Chewacla and Wehadkee soils, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	1,121.1	5.2%
Cp	Congaree silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	867.3	4.0%
CrB	Creedmoor sandy loam, 2 to 6 percent slopes	All areas are prime farmland	250.5	1.2%
CrC	Creedmoor sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	82.1	0.4%
GeB	Georgeville silt loam, 2 to 6 percent slopes	All areas are prime farmland	1,430.6	6.6%
GeC	Georgeville silt loam, 6 to 10 percent slopes	Farmland of statewide importance	1,611.7	7.4%
GeD	Georgeville silt loam, 10 to 15 percent slopes	Farmland of statewide importance	581.1	2.7%
GlE	Goldston very channery silt loam, 10 to 25 percent slopes	Not prime farmland	240.0	1.1%
GlF	Goldston very channery silt loam, 25 to 45 percent slopes	Not prime farmland	58.6	0.3%
GrB	Granville sandy loam, 2 to 6 percent slopes	All areas are prime farmland	235.9	1.1%
GrC	Granville sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	29.3	0.1%
Gu	Gullied land, clayey materials	Not prime farmland	17.0	0.1%
HeB	Helena sandy loam, 2 to 6 percent slopes	All areas are prime farmland	100.2	0.5%
HeC	Helena sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	46.0	0.2%
HrB	Herndon silt loam, 2 to 6 percent slopes	All areas are prime farmland	1,566.2	7.2%
HrC	Herndon silt loam, 6 to 10 percent slopes	Farmland of statewide importance	1,277.5	5.9%
HsC	Herndon silt loam, 2 to 10 percent slopes, very stony	Not prime farmland	235.8	1.1%
IrB	Iredell loam, 2 to 6 percent slopes	Farmland of statewide importance	1,801.7	8.3%
IrC	Iredell loam, 6 to 10 percent slopes	Farmland of statewide importance	827.5	3.8%
IuB	Iredell-Urban land complex, 0 to 6 percent slopes	Not prime farmland	281.8	1.3%
IuC	Iredell-Urban land complex, 6 to 10 percent slopes	Not prime farmland	69.5	0.3%
LgB	Lignum silt loam, 2 to 6 percent slopes	Farmland of statewide importance	208.5	1.0%
MfB	Mayodan sandy loam, 2 to 6 percent slopes	All areas are prime farmland	1,388.2	6.4%
MfC	Mayodan sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	903.3	4.2%
MfD	Mayodan sandy loam, 10 to 15 percent slopes	Farmland of statewide importance	236.5	1.1%
MfE	Mayodan sandy loam, 15 to 25 percent slopes	Not prime farmland	44.4	0.2%
MrC	Mayodan-Urban land complex, 0 to 10 percent slopes	Not prime farmland	2.5	0.0%
MuB	Mecklenburg loam, 2 to 6 percent slopes	All areas are prime farmland	138.5	0.6%
MuC	Mecklenburg loam, 6 to 10 percent slopes	Farmland of statewide importance	186.4	0.9%
NaD	Nason silt loam, 10 to 15 percent slopes	Farmland of statewide importance	142.2	0.7%
NaE	Nason silt loam, 15 to 25 percent slopes	Not prime farmland	101.1	0.5%
NoD	Nason stony silt loam, 10 to 15 percent slopes, very bouldery	Not prime farmland	332.7	1.5%
PfF	Pinkston fine sandy loam, 10 to 25 percent slopes	Not prime farmland	75.8	0.4%
Qu	Pits, quarry	Not prime farmland	156.6	0.7%
Ro	Roanoke silt loam, 0 to 2 percent slopes, occasionally flooded	Farmland of statewide importance	26.5	0.1%
TaE	Tatum gravelly silt loam, 15 to 25 percent slopes	Not prime farmland	642.3	3.0%
Ur	Urban land	Not prime farmland	171.8	0.8%
W	Water	Not prime farmland	418.0	1.9%
Wh	Hornsboro silt loam, 0 to 2 percent slopes, rarely flooded	Not prime farmland	44.8	0.2%
WmD	Wedowee sandy loam, 10 to 15 percent slopes	Farmland of statewide importance	129.7	0.6%
WmE	Wedowee sandy loam, 15 to 25 percent slopes	Not prime farmland	14.4	0.1%
Wn	Wehadkee silt loam, 0 to 2 percent slopes, frequently flooded	Not prime farmland	227.4	1.1%
WsB	White Store sandy loam, 2 to 6 percent slopes	Farmland of statewide importance	756.4	3.5%
WsC	White Store sandy loam, 6 to 10 percent slopes	Farmland of statewide importance	724.9	3.3%
WsE	White Store sandy loam, 10 to 25 percent slopes	Not prime farmland	101.6	0.5%
WtC2	White Store clay loam, 2 to 10 percent slopes, moderately eroded	Farmland of statewide importance	22.2	0.1%
WwC	White Store-Urban land complex, 0 to 10 percent slopes	Not prime farmland	93.0	0.4%
WxE	Wilkes sandy loam, 10 to 25 percent slopes	Not prime farmland	226.7	1.0%
Totals for Area of Interest			**21,656.7**	**100.0%**

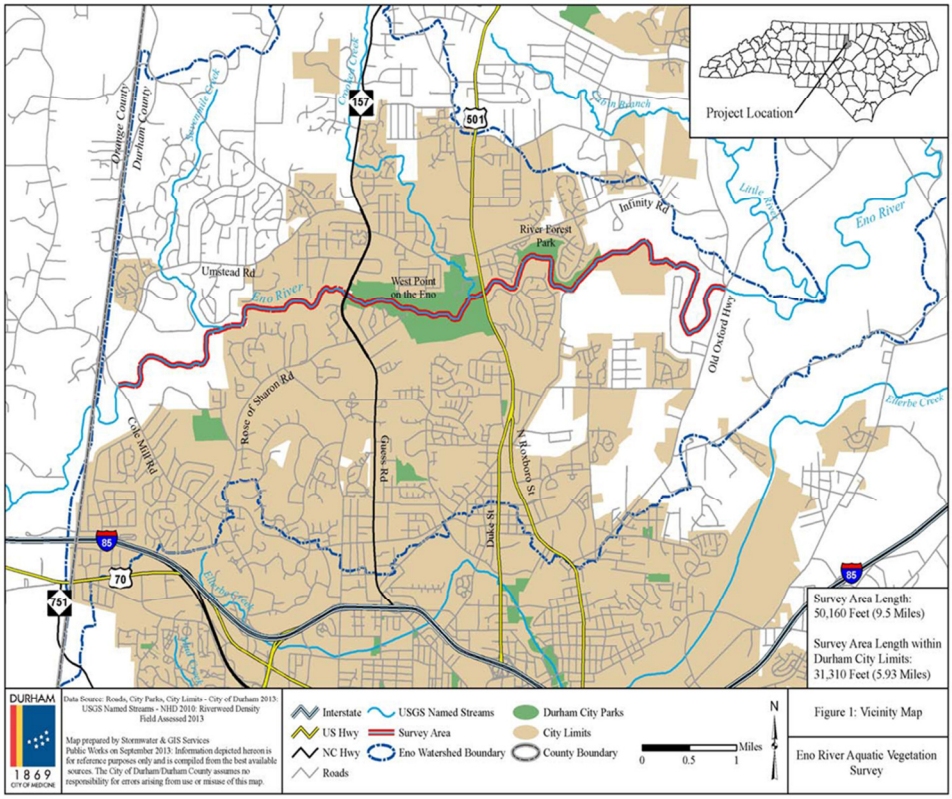
7. 2013 Presence-Absence Survey Maps



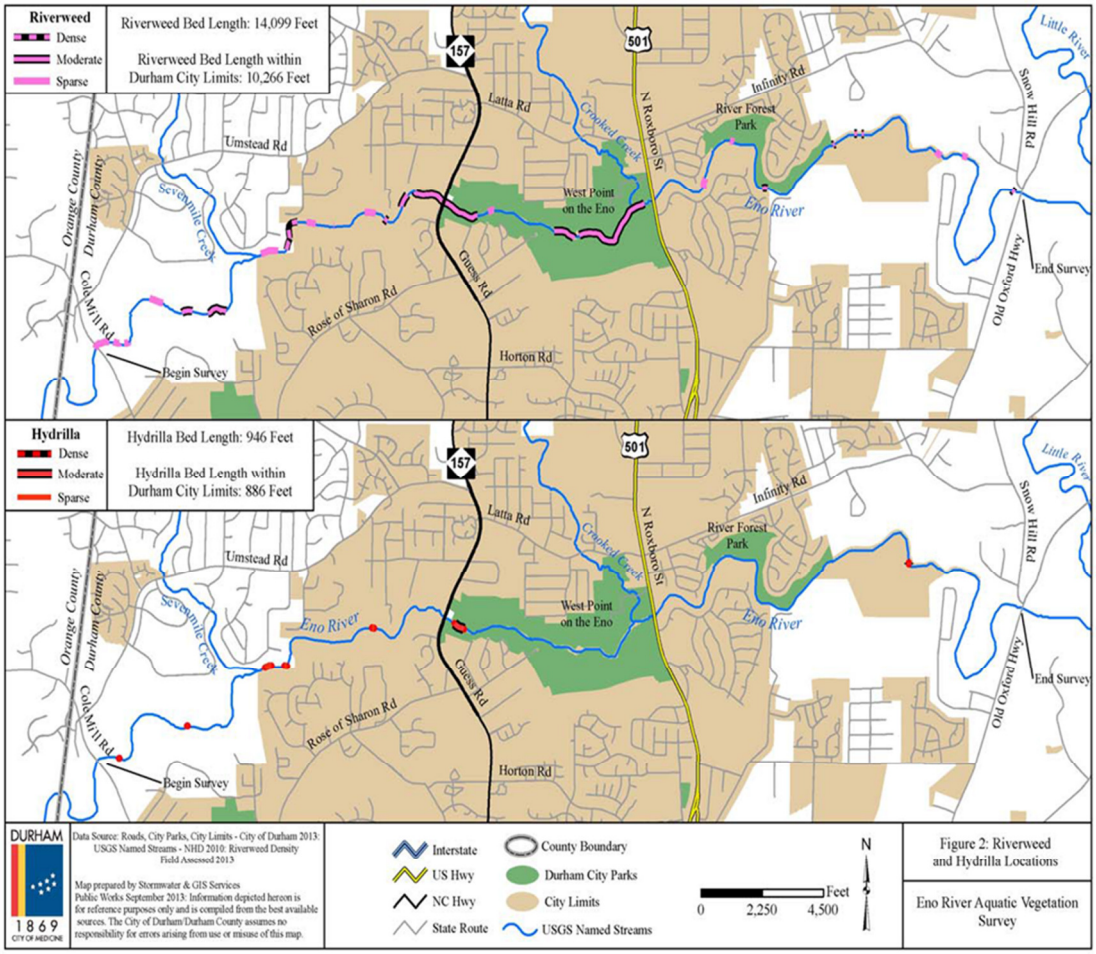

Eno River Drainage Basin
Legend
Eno River (including East and West Forks)
Eno Drainage Basin
FallsLake
NHP Dedicated or Registered Areas
State Parks Unit
Study Area
Most upstream occurrence via Fall 2013 river survey
Most downstream occurrence via Fall 2013 river survey
USACE jurisdiction begins at Penny's Bend
Hillsborough
Durham
Orange County
Durham County
Miles
0 1 2 4 6
Created by J.Dodson Mar2013


Eno River Drainage Basin
Legend
Eno River (including East and West Forks)
Eno Drainage Basin
FallsLake
NHP Dedicated or Registered Areas
State Parks Unit
Study Area
Stretch of river basin w/ greatest infestation levels observed in Fall 2013 river survey
Hillsborough
Durham
Orange County
Miles
0 1 2 4 6
Created by J.Dodson Mar2013

8. Map of City of Durham Hydrilla Survey Boundaries.



9. Map of City of Durham Hydrilla Survey Results.



I. State and Federal Permits Required

1. State of North Carolina, Department of Environment and Natural Resources, Division of Water Quality General Permit NCG50000 to discharge pesticides under the National Pollutant Discharge Elimination System.

2. North Carolina Environmental Policy Act (As Amended).

   The EA has been developed in accordance with the requirements of the State Clearinghouse review process under the North Carolina Environmental Policy Act (NCEPA, G.S. 113A-1), based upon an agreement with the North Carolina Department of Environment and Natural Resources.

3. Endangered Species Act of 1973.

   Coordination with the U.S. Fish and Wildlife Service includes consultation under Section 7 of the Endangered Species Act of 1973, as amended.

J. Appendices

Appendix A: Eno River Hydrilla Management Task Force

James Pflaum	City of Durham
Jeff Forde	City of Durham
Maverick Raber	City of Durham, Stormwater & GIS Services
Ed Buchan	City of Raleigh – Public Utilities Department
Leigh Ann Hammerbacher	City of Raleigh – Public Utilities Department
Jennifer Brooks	Durham County SWCD
Eddie Culberson	Durham County SWCD
Christopher Greiner	Eno River State Park, NCDPR
Keith Nealson	Eno River State Park, NCDPR
Rick Langley	NC Dept. of Health and Human Services
Mort, Sandy	NC Dept. of Health and Human Services
Judith Ratcliffe	NC NHP
Jimmy Dodson	NCDPR
Ed Corey	NCDPR
Jon Blanchard	NCDPR
Dave Cook	NCDPR
Brian Bockhahn	NCDPR
Bridget Lassiter	NCDA&CS
Rob Emens	NCDWR
Rob Richardson	NCSU
Steve Hoyle	NCSU
Shannon Auell	NCSU
Justin Nawrocki	NCSU
Greg Cope	NCSU
Jennifer Archambault	NCSU
Christine Bergeron	NCSU
Mark Fowlkes	NCWRC
Brian McRae	NCWRC
Jessica Baumann	NCWRC
Rob Nichols	NCWRC
Tyler Black	NCWRC
Tom Davis	Orange County
Terry Hackett	Town of Hillsborough
Will Baker	Town of Hillsborough
Montie Mathews	USACE
Rebecca Thomson	USACE – Falls Lake
Sarah McRae	USFWS
Barbara Driscoll	Eno River Association
Kim Livingston	Eno River Association
Catherine Wright	Town of Hillsborough
Charlie Peek	NCDPR
Sarah Young	NCDWR
Russell Wong	NCWRC
Jodie Owens	NCWRC
Carla Banks	Orange County

Appendix B: State and Federal Status Definitions

State of NC Status Definitions (NCNHP #2)

Status	Definition
Endangered	"Any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the Wildlife Resources Commission to be in jeopardy or any species of wild animal determined to be an 'endangered species'' pursuant to the Endangered Species Act." (Article 25 of Chapter 113 of the General Statutes; 1987).
Threatened	"Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the Endangered Species Act." (Article 25 of Chapter 113 of the General Statutes; 1987).
Special Concern	"Any species of wild animal native or once-native to North Carolina which is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulations adopted under the provisions of this Article." (Article 25 of Chapter 113 of the General Statutes; 1987).
Significantly Rare	Any species which has not been listed by the N.C. Wildlife Resources Commission as an Endangered, Threatened, or Special Concern species, but which exists in the state (or recently occurred in the state) in small numbers and has been determined by the N.C. Natural Heritage Program to need monitoring. (This is a N.C. Natural Heritage Program designation.) Significantly Rare species include "peripheral" species, whereby North Carolina lies at the periphery of the species' range (such as Hermit Thrush), as well as species of historical occurrence with some likelihood of re-discovery in the state. Species considered extirpated in the state, with little likelihood of re-discovery, are given no N.C. Status (unless already listed by the N.C. Wildlife Resources Commission as E, T, or SC).

Federal Status Definitions (USFWS #1)

Status	Definition
Endangered	An animal or plant species in danger of extinction throughout all or a significant portion of its range.
Species of Concern	An informal term referring to a species that might be in need of conservation action. This may range from a need for periodic monitoring of populations and threats to the species and its habitat, to the necessity for listing as threatened or endangered. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing. A similar term is "species at risk" which is a general term for listed species as well as unlisted ones that are declining in population.

Appendix C: Acronyms

1. AVM - Avian Vacuolar Myelinopathy
2. NCDA – North Carolina Department of Agriculture and Consumer Services
3. DPR - NC Division of Parks & Recreation
4. SAV - Submersed Aquatic Vegetation
5. NCAWP - NC Aquatic Weed Control Program
6. NCSU- North Carolina State University
7. EPA- U.S. Environmental Protection Agency
8. NCWRC- North Carolina Wildlife Resources Commission
9. CET- Concentration Exposure Time
10. ERHM Task Force- Eno River Hydrilla Management Task Force
11. SWCD- Soil and Water Conservation District
12. USFWS- United States Fish and Wildlife Service
13. NCNHP- Natural Heritage Program
14. USACE- United States Army Corps of Engineers
15. PPM- Parts per Million
16. PPB- Parts per Billion

Appendix D: Herbicide Labels

Sonar Genesis (Fluridone): http://www.sepro.com/documents/Sonar-Genesis_Label.pdf

Aquathol K (Endothall): http://www.cdms.net/LDat/ld195009.pdf