

Mountain Island Lake

Watershed Protection Guidelines



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Mountain Island Lake Work Group

Prepared for:

Mountain Island Lake Memorandum of Understanding Partners

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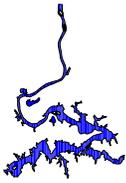
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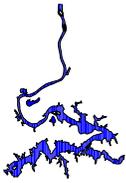
Section 1: Introduction

1.1 Importance of Mountain Island Lake to our Region

Mountain Island Lake is an irreplaceable natural resource that is essential for sustaining livable communities in our region. The lake serves as the raw drinking water supply for over 800,000 residents in both Gaston and Mecklenburg Counties, including the Cities of Charlotte, Gastonia and Mount Holly as well as the Towns of Dallas, Ranlo, McAdenville, Cramerton, Lowell and Stanley in North Carolina and Clover in South Carolina. An average of 103 million gallons of water a day (mgd) is pumped from three (3) intake structures located on the lake operated by the Cities of Charlotte, Gastonia and Mount Holly. Plans are to increase the rate of water withdrawal from Mountain Island Lake in the future as the population of Gaston and Mecklenburg Counties continues to increase. In addition to its vital importance as a drinking water supply reservoir, Mountain Island Lake also serves as a major recreational area for our region and provides habitat for a variety of unique and even endangered species of flora and fauna.

Currently Mountain Island Lake has excellent water quality; however, as the area around the lake continues to develop the sources of water pollution will increase as will the potential for negative water quality impacts. Currently, 24% of the lake's 69 square mile watershed has been developed and 13.4% of the land is publicly owned and will not be developed, which leaves 62.6% or approximately 43 square miles of watershed area currently open to development in Lincoln, Gaston and Mecklenburg Counties. The manner in which this land is developed and the effectiveness of future efforts to control pollution sources will determine whether excellent water quality conditions can be maintained, which is essential for the continued use of the lake as a drinking water supply and important recreational and wildlife area.

On January 14, 2004, Gaston and Mecklenburg Counties held the Mountain Island Lake Workshop to provide information to elected officials and area residents regarding the extreme importance of Mountain Island Lake to our growing region and the need to protect the lake from future threats to water quality and usability. The workshop also highlighted efforts that have proven successful to date at protecting water quality in the lake, as well as explored opportunities and strategies to prevent future degradation of this high quality drinking water source. The workshop was a big success with over 100 persons in attendance, including numerous elected officials. As a result of the workshop, it was decided that the jurisdictions around the lake should enter into a Memorandum of Understanding (MOU) for the purpose of establishing a framework for coordination of efforts to protect water quality conditions in Mountain Island Lake. It was also decided that each jurisdiction would appoint a representative to serve on a Work Group to develop a handbook that could be used as a guide by the different jurisdictions as they strive for better ways to protect water quality. The MOU was developed and signed by all the jurisdictions around the lake by August 2004 (see Appendix A). The Work Group was also established and the document contained herein was developed as the Mountain Island Lake Watershed Protection Guidelines.



1.2 Purpose of Handbook

The purpose of this handbook is to provide the jurisdictions around Mountain Island Lake with watershed protection strategies and guidelines for use at their discretion in the protection of water quality conditions in the lake. As the watershed area around Mountain Island Lake continues to develop, jurisdictions will be challenged to find more effective measures for protecting water quality. This handbook provides some of the water quality protection measures that have proven effective in other jurisdictions in this region. This handbook will be updated annually as necessary as new measures are made available.

Section 2: General Information Regarding Mountain Island Lake

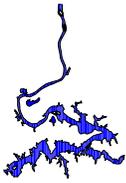
2.1 Location and Size

Mountain Island Lake is the sixth out of eleven lakes that comprise the Catawba River System that stretches 225 miles from Old Ford in the Blue Ridge Mountains of N.C. to Lake Wateree located east of Camden, S.C. The lake is bordered by Lake Norman to the north, Mecklenburg County to the east, Lake Wylie to the south and Gaston and Lincoln Counties to the west (see map in Appendix B). The lake was created in 1924 by the construction of Mountain Island Dam by Duke Power for hydroelectric power generation. Cowans Ford Dam that forms Lake Norman to the north is located at the headwaters of Mountain Island Lake. The lake was named for the “Mountain Island” located just upstream of the dam (shown in cover photo). The surface elevation of the lake is 647.5 feet above mean sea level. The lake covers 2,788 acres and has a total volume of 57,300 acre-feet. The average retention time of the lake is 11 days, with an average river flow of 1,745 million gallons per day at Mountain Island Dam. Mountain Island Lake has a maximum depth at the dam of 58.4 feet and an average depth of 17.7 feet. The length of the main channel of the lake is 14.7 miles. The shoreline has a length of 61 miles with 37 miles in Mecklenburg County, 3 in Lincoln County and 21 in Gaston County. The area of land draining immediately to Mountain Island Lake includes 69 square miles with 50 square miles in Mecklenburg County, 10 in Lincoln County and 9 in Gaston County. The entire area draining to Mountain Island Lake which includes the five (5) lakes located upstream includes 1,860 square miles. There are three (3) creeks that drain to Mountain Island Lake, including McDowell and Gar Creeks in Mecklenburg County and Johnson Creek in Gaston and Lincoln Counties.

2.2 Uses of the Lake

The highest and best use of Mountain Island Lake is as a raw drinking water supply as previously described. A total of three (3) drinking water intake structures are located on the lake as follows:

- Charlotte-Mecklenburg Utilities withdrawing an average of 85 mgd to provide drinking water for approximately 700,000 residents of the City of Charlotte and the Towns of Davidson, Cornelius, Huntersville, Matthews, Mint Hill and Pineville in Mecklenburg County.



- Mount Holly withdrawing an average of 2 mgd to provide drinking water for approximately 12,600 residents of the City of Mount Holly and the Town of Stanley in Gaston County.
- Gastonia withdrawing an average of 16 mgd to provide drinking water for approximately 94,000 residents of the City of Gastonia and the Towns of Dallas, Ranlo, McAdenville, Cramerton, Lowell in N.C. and Clover in S.C.

Shoreline use around Mountain Island Lake is as follows:

- Residential and Commercial = 9.3%
- Recreational = 0.4%
- Undeveloped = 76.8%
- Other = 13.5%

Land use within the 69 square mile area that comprises the watershed flowing directly into Mountain Island Lake is as follows:

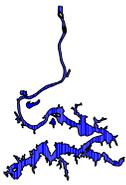
- Urban = 3.3%
- Cultivated = 26.8%
- Forested = 69.5%
- Other = 0.1%

The population in the watershed area draining immediately to the lake is 11,825 (1990 census). In Gaston County the predominant land development is rural residential and agricultural. The same holds true for Lincoln County with the exception that a large portion of land is owned by Duke Power or is in a conservation easement with not much land available for development. Mecklenburg County by far has the most intensive land development in the Mountain Island Lake watershed with heavy commercial and residential development in the McDowell Creek basin in the Towns of Huntersville and Cornelius in the areas of Exits 23, 25 and 28 on I-77. The City of Charlotte has developed in the Mountain Island Lake watershed off Hwy. 16 and Mount Holly Huntersville Road with commercial and residential development.

Mountain Island Lake is also used by Duke Power for power generation at both the Mountain Island Lake Hydro Plant and Riverbend Steam Station, which provide 60 and 188 megawatts of electric capacity, respectively.

Mountain Island Lake also serves as an important recreational resource for the region. A recreational use/needs study performed by Duke Power estimates that during 1999 there were 99,135 visits to the three (3) Duke owned recreational facilities on Mountain Island Lake. If private access areas are included, Duke estimates that 125,750 recreational visits were made to the lake in 1999, which does not include visits to Mecklenburg County's Latta Plantation Park (use estimates not available).

The watershed area around Mountain Island Lake also serves as an important wildlife area containing widely diverse natural communities, including upland and bottomland hardwood forests, open fields, streams, and a piedmont prairie restoration site. These natural communities are home to a variety of unique flora and fauna, including the federally endangered Schweinitz's



sunflower and Michaux's sumac, a diversity of wintering waterfowl, migratory songbirds, bald eagle, wild turkey, red fox, gray fox, mink, and red-spotted newt.

2.3 Aquatic Weeds

Plants are important components of the aquatic environment. They form the basis of the food chain, directly or indirectly feeding all of the animals in the system. Plants provide breeding and nesting sites and cover for fishes, waterfowl, and mammals. Plants also supply oxygen through photosynthesis, stabilize the lake bottom, and prevent shoreline erosion. Most aquatic habitats that contain no vegetation are incapable of sustaining an animal population. Consequently, some vegetation is desirable in most streams, lakes, and ponds. Excessive plant growth, however, can cause problems, making a weed management program necessary.

The amount of nutrients and sediment in water and the availability of sunlight for photosynthesis regulate the growth of vegetation in any aquatic habitat. High input of nutrients, particularly phosphorus and nitrogen, combined with large areas of clear, shallow water inevitably lead to excessive growth of algae or other aquatic plants. Once weedy growths become established, they can invade areas of deeper water and may entirely overrun a pond or shallow lake.

Algae and other aquatic weeds:

- Clog water intakes and distribution systems used for irrigation, public water supplies, and hydroelectric generating plants;
- Increase sedimentation in flood control reservoirs;
- Harbor the vectors of human and animal diseases;
- Interfere with aquaculture;
- Impede boating access and navigation;
- Make recreational activities such as swimming, boating, skiing, and sport fishing difficult and dangerous, if not entirely impossible.



Figure 1: Mat of Hydrilla on Mountain Island Lake.

Mountain Island Lake contains a variety of aquatic weeds that are important for maintaining the lake's healthy ecosystem. However, the lake also contains some nonnative species of aquatic weeds that have become highly invasive leading to the degradation of the lake's aquatic system and associated fisheries. The most problematic of these invasive, nonnative aquatic species is Hydrilla (*Hydrilla verticillata*), a submersed aquatic plant that grows into a nearly impenetrable mat of stems and leaves at the surface of the water (see Figure 1). The weed was first discovered on Mountain Island Lake in 2000. By 2002 it was estimated that over 1,200 acres of the lake



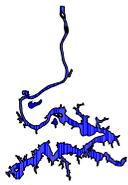
were covered with hydrilla. This highly invasive plant acts to crowd out beneficial native vegetation, interferes with public water supplies, damages fisheries, and interferes with recreational activities. Hydrilla is a native to central Africa but now is found in temperate and tropical regions of the world. It apparently entered the United States as an aquarium plant. Hydrilla spreads rapidly and is a difficult plant to control; however, various physical, mechanical, biological and chemical control techniques are available. The control method chosen for Mountain Island Lake is the stocking of sterile grass carp (*Ctenopharyngodon illella*). These grass carp eat hydrilla in preference to many other submersed plant species and their long life span of up to 10 years makes them an effective mechanism for controlling the plant. Between 2000 and 2003 a total of 34,631 grass carp were stocked in Mountain Island Lake for the control of hydrilla. It is estimated that approximately 20 fish are needed for each acre for a total of 24,000 fish needed for the 1,200 acres of Mountain Island Lake covered by hydrilla. The attrition rate for grass carp is about 25% of the population annually; therefore, grass carp will need to be continually stocked to maintain aquatic weed control in the lake. Chemical controls for hydrilla are not used in Mountain Island Lake due to concerns over impacts to drinking water intakes. Physical and mechanical controls have proven far less effective than the grass carp.

2.4 Existing Regulations for Protection of Water Quality

All surface waters in N.C. are assigned a primary classification. Classifications are designations applied to surface water bodies that define the best uses to be protected within these waters, as required by the Clean Water Act. The most common primary classification within N.C. is Class C, which protects waters for the propagation of aquatic life and for secondary recreation. Waters protected for primary recreation (swimming) are Class B. As previously discussed, the highest and best use for Mountain Island Lake is as a drinking water supply. All drinking water supplies in N.C. have a WS classification ranging from WS-I to WS-V. WS-I is the most protected and WS-V is the least protected of the water supply classifications. Mountain Island Lake is a Class IV, which allows land development activities to occur with some restrictions. The jurisdictions with zoning authority within the watershed area of Mountain Island Lake are required to maintain ordinances that require water quality protection measures to be installed with certain land development activities as stipulated by N.C. Administrative Code 15A NCAC 02B .0216(3)(b)(i)(B). Table 1 below provides a summary of the current water supply watershed protection measures in effect for Mountain Island Lake.

Table 1: Watershed Protection Measures for Mountain Island Lake Jurisdictions.

Jurisdiction	Zone	Built Upon Area(1)	Buffer Width
State	Lake Front	N/A	50 ft
Mt. Holly	Protected Area	≤70% high density ≤24% low density	100 ft 30 ft
Mt. Holly	Critical Area	≤24% low density	100 ft
Gaston County	Protected Area	≤70% high density ≤24% low density	100 ft 30 ft
Gaston County	Critical Area	≤24% low density	50 ft/30 ft on streams
Lincoln County	Protected Area	≤70% high density ≤24% low density	100 ft 30 ft



Jurisdiction	Zone	Built Upon Area(1)	Buffer Width
Lincoln County	Critical Area	≤24% low density	50 ft/30 ft on streams
Charlotte	Protected Area 1	≤70% high density ≤24% low density	100 ft 50 ft
Charlotte	Critical Areas 1 & 4	≤6% to ≤24% low density	100 ft or 100 yr floodplain
Huntersville	Protected Area 1	≤70% high density ≤24% low density	100 ft 50 ft
Huntersville	Protected Area 2	≤70% high density ≤24% low density	100 ft 30 ft
Huntersville	Critical Areas 1, 2, 3 & 4	≤6% to ≤24% low density	100 ft or 100 yr floodplain
Cornelius	Protected Area	≤70% high density ≤24% low density	100 ft 50 ft

(1) All high density development is required to install structural best management practices (BMPs) using State design criteria to achieve 85% total suspended solids removal.

Resources:

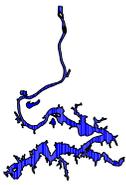
The Catawba, An Update on the Catawba River Basin and the Catawba Reservoirs, Duke Power (www.dukepower.com)

North Carolina Cooperative Extension (www.ces.ncsu.edu)

Section 3: Memorandum of Understanding (MOU)

3.1 Purpose and Scope of the MOU

On January 14, 2004, Gaston and Mecklenburg Counties held the Mountain Island Lake Workshop that was attended by over 100 residents and elected officials from the different jurisdictions around the lake. The purpose of the workshop was to highlight the importance of Mountain Island Lake to our region and to discuss current and possible future efforts for the protection of the quality and usability of this important resource. Elected officials at the workshop agreed that improved coordination between the different jurisdictions around the lake could facilitate improved water quality protection and it was decided that a MOU would be established for this purpose. A Work Group including staff from the different jurisdictions was established to formulate the MOU, which was signed by all parties by August 2004 (see Appendix A). The specific purpose of the MOU is to set forth the general terms and conditions and define the roles and responsibilities of the jurisdictions in the implementation of a cooperative working relationship and establish a framework for coordination of efforts to protect water quality conditions in Mountain Island Lake. The parties that signed the MOU (referred to as Partners) include Gaston, Lincoln and Mecklenburg Counties; Cities of Mount Holly, Gastonia and Charlotte; Towns of Cornelius and Huntersville; the Centralina Council of Governments; and the Mountain Island Lake Marine Commission.



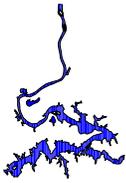
The scope of the MOU includes those activities performed on or around Mountain Island Lake including the watershed area that drains to the lake that have the potential to impact water quality conditions in the Lake, including the following:

1. Changes in zoning and/or subdivision ordinances established following the adoption of this MOU;
2. New or amended post-construction or erosion control ordinances;
3. Public acquisition of lands or establishment of public and private conservation easements;
4. Addition or expansion/modification of NPDES facilities, including wastewater treatment facilities and pumping stations;
5. Addition or expansion of water intakes;
6. Addition or expansion of proposed transportation thoroughfares;
7. New or amended lake use/management regulations;
8. New or amended land use plans;
9. Local legislation affecting the Mountain Island Lake watershed;
10. Coordination and sharing of data and information; and
11. Sharing of funding needs and strategies.

3.2 Working with MOU Partners

An MOU Partner involved in any of the action items listed in 1 through 9 in the previous Section will notify the other Partners regarding the item under consideration, and will provide a specific time frame for the submittal of written comments prior to taking action regarding the item. This notification will be performed via the Mountain Island Lake Marine Commission website at <http://www.marinecommission.com/milmc.htm>. Work Group representatives from each jurisdiction described in the previous Section will serve as the responsible party for completing website entries for action items within their jurisdiction. Once an entry has been made to the website, other Work Group members will be notified via email so that appropriate follow up actions can be quickly initiated. All correspondence regarding an action item will be made between Work Group members who will be responsible for ensuring that comments are provided to the appropriate agency sponsoring the action item. All comments received regarding the action items will be carefully considered in good faith, within their legislative discretion, by the Partners during consideration for approval, but failure to follow such comments will not be construed or utilized in any proceeding by any Partner or third party as a violation of the Partners' land use plans or ordinances. The Partners have agreed to provide written notification concerning the approval status to commenting Partners once a final decision has been rendered.

The Work Group will meet twice a year to update the Mountain Island Lake Handbook as necessary and to discuss other matters important to the protection of water quality conditions in Mountain Island Lake. Any of the Partners can call additional meetings of the Work Group as necessary to address water quality related issues in the Lake. The Work Group will engage other organizations/entities as necessary to ensure that issues are properly addressed. The Work Group will also plan, organize and implement future Mountain Island Lake Workshops open to elected officials and the general public. These workshops will provide an overview of general water quality conditions in the Lake as well as summarize activities performed during the calendar year



pertaining to the eleven (11) coordination items listed in the previous Section. The Workshops will also include a discussion of the watershed protection strategies/guidelines developed for protection of water quality.

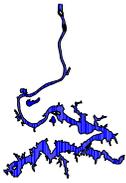
Section 4: General Water Quality Concerns

4.1 Sources of Water Pollution

Water pollution originates from two (2) sources, point and non-point. Point sources of water pollution originate from a fixed point such as a pipe and include illegal discharges, sewer leaks, wastewater plant discharges, etc. The action commonly taken to eliminate point sources of pollution is to identify the specific location of the pollution source, such as a discharge pipe, and enforce State or local regulations to require the owner to eliminate the source and restore all affected areas. A common tool for identifying the location of the pollution source is water quality monitoring.

Non-point sources of pollution originate from storm water runoff and do not come from a fixed point. A common non-point source of pollution is a parking lot, which accumulates numerous pollutants from automobiles such as oils from dripping engines, copper and zinc from brake wear, and iron and other metals from tire wear. When it rains these pollutants are picked up by the storm water runoff flowing across the parking lot and are carried to the storm drainage system, which discharges to a creek or lake. Non-point sources account for over half the pollutants in our surface waters nationwide. Negative water quality impacts from non-point source pollutants increase as the percentage of impervious cover or built upon area increases. In urbanized areas where there is a high percentage of impervious cover such as parking lots, the negative impacts to water quality from non-point sources can be significant. In an undisturbed wooded area, non-point source pollutants are nonexistent. Non-point source pollutants are the primary water quality concern associated with all new developments in the Mountain Island Lake watershed and the implementation of measures to control these pollutants is essential for the protection of our drinking water supply. Measures for the control of non-point source pollutants are called best management practices or BMPs. There are two (2) types of BMPs, non-structural and structural. Information regarding both non-structural and structural BMPs and their use in controlling non-point source pollutants is provided in Section 6.

In Mountain Island Lake the greatest concentration of non-point source pollutants originates from McDowell Creek and Cove in Mecklenburg County, which drains portions of Huntersville and Cornelius and includes the area around Exits 23, 25 and 28 off I-77. This is among the fastest growing areas in Mecklenburg County, which has experienced a significant increase in the amount of impervious area over the past several years. There has also been a significant increase in the discharge of non-point source pollutants into Nance Cove in Mecklenburg County from the recent development occurring at the intersection of Mount Holly Huntersville Road and Highway 16. Negative water quality impacts associated with the increase of non-point source pollutants in both these coves have been measured by the Mecklenburg County Water Quality Program (MCWQP) over the past several years.



There are three (3) permitted point source discharges into Mountain Island Lake as listed below. Other sources of point source pollutants to Mountain Island Lake may include the occasional failing septic system, which is eliminated when detected.

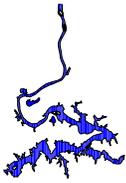
1. McDowell Creek Wastewater Treatment Plant (NPDES #NC0036277) – This facility is owned and operated by Charlotte Mecklenburg Utilities and located at 2074 Neck Road in Mecklenburg County.
2. Riverbend Steam Station (NPDES #NC0004961) – This facility is owned and operated by Duke Energy Corporation and located at the intersection of Hwy. 16 and Horseshoe Bend Road in Gaston County.
3. McGuire Nuclear Station (NPDES #0024392) – This facility is owned and operated by Duke Energy Corporation and located at 13339 Hagers Ferry Road in Mecklenburg County.

4.2 Actions to Measure and Protect Water Quality

When compared by surface area size, Mountain Island Lake is one of the most monitored lakes in the southeastern United States. The following groups currently have routine monitoring programs on Mountain Island Lake: MCWQP, N.C. Division of Water Quality (NCDWQ) and Duke Energy. These agencies and others can be found in Appendix C, Contact List.

MCWQP monitors twelve sites on Mountain Island Lake monthly from May through September and every other month during the rest of the year (January, March and November). Depth profiles of various physical-chemical measurements (temperature, Dissolved Oxygen, pH and Conductivity) are collected at each site using a multi-probe sonde. Water samples are collected at each site and analyzed for the following parameters: total phosphorus, orthophosphorus, kjeldahl nitrogen, nitrate, nitrite, ammonia nitrogen, chlorophyll a, total suspended solids, total solids, turbidity, alkalinity, mineral and toxic metals and fecal coliform bacteria. An additional four sites are monitored monthly for fecal coliform during the summer months. Samples are also collected at selected sites and monitored for Volatile Organic Compounds (VOCs) once per year. Monitoring data is used to assess short and long term water quality trends and to identify sources of water pollution for elimination. All data collected is maintained electronically and Water Quality Index (WQI) maps are produced monthly. MCWQP uses Fusilier's Index with nine key parameters to generate the WQI. The WQI ranks each site from Poor to Excellent in terms of general water quality. Generally water quality conditions in Mountain Island Lake are ranked as Good to Excellent; however, since January 1993 WQI values in the Poor/Fair range have been reported in McDowell Creek Cove of Mountain Island Lake in Mecklenburg County. In August 2004, WQI values dropped to their lowest at Fair in Nance Cove in Mecklenburg County. Both of these coves have experienced significant development activities in the past 5 to 10 years. The other monitoring sites on Mountain Island Lake maintain Good to Excellent WQI values. MCWQP lake data is available at <http://waterquality.charmeck.org>.

MCWQP also responds to numerous citizen requests for service in and around the lake. These requests involve anything from dead fish to discolored water. MCWQP has an Emergency Response Team that is on-call 24 hour a day, seven days a week to respond to any environmental emergency in Mecklenburg County.



NCDWQ conducts monitoring at one site located in the main channel of Mountain Island Lake near Gar Creek. The monitoring is done at the same frequency as Mecklenburg County and tested for the same general parameters. The NCDWQ completes a Basinwide Management Plan every five years for the Catawba River Basin, which summarizes data and discusses management strategies. The NCDWQ also permits, inspects and enforces all NPDES point source dischargers on the lake.

Duke Energy owns and manages the Mountain Island Lake reservoir. Their primary objective is power production but their Environmental Branch conducts routine monitoring on the lake quarterly. They tests for the same general water quality parameters, except they also evaluate phytoplankton. Duke also conducts routine fish population evaluations and tissue analysis. Duke's Lake Management Division is responsible for the actual management of the lake including the classification of the shoreline, permitting of piers, shoreline stabilization and dredging. The Lake Management Division also evaluates the accessibility of the lake.

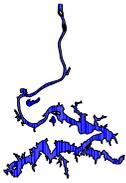
4.3 Swimming Advisories

In unfortunate situations local governments may need to issue swimming advisories for portions of Mountain Island Lake. Historically these advisories have been related to sewage discharges from blocked sewer lines, failing sewage pump stations, wastewater treatment plants and septic systems. Local governments should have policies and procedures to address these issues, should they ever arise within their jurisdiction. The public will most likely look towards their local health department for answers if a health threat should arise. In some cases local governments may elect to defer some issues to the NC Division of Water Quality, but a plan should be in place, which clearly identifies the roles of various agencies so that an adequate evaluation of conditions and clear communication takes place. The issuance of swimming advisories takes careful planning to ensure that the public is properly protected from a pollution source. Planning is also necessary to ensure that adequate supplies are on hand such as "swimming advisory" signs and buoys. Plans should be in place that address press releases and all aspects of media relations. Procedures should include detailed information relating to when an advisory will be issued and at what point it can be released. In Mecklenburg County, a Waterborne Disease Outbreak Prevention Policy has been adopted to address these issues. In addition, an internal procedure for the Water Quality Program has been developed to ensure the proper adherence to the Waterborne Disease Outbreak Prevention Policy. This information can be found in Appendix D.

Section 5: Erosion Control

5.1 Erosion Control Measures to Provide Enhanced Protection of Surface Waters

Sedimentation is the leading polluter of N.C. surface waters. Improperly constructed or poorly maintained erosion control devices are often the cause of sediment entering streams and lakes. When sediment enters surface waters it can destroy the water body by destroying aquatic habitat and lowering dissolved oxygen levels, basically making the stream a desert void of life.



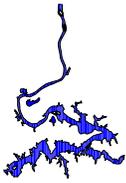
Ensuring proper erosion and sedimentation control on construction sites is one of the most important aspects of protecting our surface waters. In the Mountain Island Lake watershed area, Gaston and Mecklenburg Counties as well as the City of Charlotte maintain local sediment and erosion control programs. In Lincoln County there is not a local program and all sediment and erosion control permitting and regulatory action is taken by the N.C. Land Quality Section operating out of the Mooresville Regional Office.

There are five basic steps toward the proper development and implementation of an effective erosion and sedimentation control plan for any land disturbing activity as described below.

Step One: Planning. Sound planning means planning the construction and development to fit around the site features (not planning the features to fit around the development). The following features should be carefully evaluated: topography, drainage ways, soils, and natural vegetation. The topography of a site should be carefully evaluated and mapped. Areas with a high erosion hazard should be avoided. Drainage ways should also be considered carefully prior to development. Natural drainage patterns should be identified on the site and used if possible, avoiding artificial drainage systems. These streams and drainage ways should be protected with undisturbed buffers. All soils should be evaluated to determine their potential to erode. Areas with soils of high potential to erode should be avoided or plans put in place to effectively control erosion. Natural ground cover should always be left in place wherever possible. Stabilization of the soil through ground cover is the most effective means to prevent erosion and sedimentation. As an enhancement of this step, the permitting agency could limit the amount of cut/fill and require natural drainage ways be left undisturbed with protective buffers in place. High hazard areas should be left undisturbed and all slopes and soils should be evaluated and mapped. In situations where neighboring properties are at risk for being impacted by off site sedimentation, these properties should be evaluated prior to any construction in order to obtain background conditions. For example, a down stream pond should be evaluated for background sediment levels prior to construction in order to later determine if the pond has been impacted. This type of background evaluation should also be conducted on streams.

Step Two: Scheduling of Operations. Simply phasing construction activities will go a long way towards preventing erosion and sedimentation. Exposing the smallest amount of land for the shortest period of time will greatly reduce the risk of erosion and sedimentation. All disturbed land in Phase One should be stabilized prior to disturbing Phase Two of a project. In order to enhance protection measures under this step the amount of land left disturbed (unvegetated) at any one time should be limited to the maximum extent practicable. The permitting agency could phase grading permits and only issue a new permit for a new phase if the previous phase has been stabilized.

Step Three: Soil Erosion Control Practices. The first line of defense against off site sedimentation should be soil erosion control at the entire site. This means controlling erosion of soil particles at the source, not trapping sediment at the bottom of the hill. This is often accomplished by stabilization through seeding, mulching or artificial matting. An enhanced soil erosion technique sometimes required is the use of polyacrylamides (PAM). PAM products come in many forms and are used to prevent erosion by binding soil particles together. PAM is



also effective at reducing turbidity levels in water by binding soil particles and allowing them to settle out. The use of PAM products have often significantly prevented erosion and also reduced turbidity in receiving waters. Most erosion control professionals are very familiar with the use of PAM as an enhanced method of erosion control.

Step Four: Sediment Control Practices. The second line of defense against off site sedimentation is the application of sediment control devices. These devices include things such as silt fence, sediment traps, basins and berms. Devices should be carefully considered and selected based upon slopes, runoff velocities and drainage area sizes. It is critical that these devices be installed properly, as designed. Enhanced sediment control devices include measures such as double silt fencing, baffle devices in basins and over sizing of sediment basins to provide extra storage beyond the typical design. Placing baffles in sediment basins and sometimes even the use of PAM can significantly enhance sediment control capabilities.

Step Five: Inspection and Maintenance. Steps One through Four will not be successful without proper inspection and maintenance. All disturbed areas and sediment control devices should be inspected at least weekly and after every precipitation event. Maintenance should occur routinely in order to prevent off site sedimentation. All activities conducted involving inspection and maintenance should be documented in a log book. Enhanced activities include daily inspections regardless of weather, and extra maintenance such as routine street sweeping. In most cases the employment of an independent erosion control contractor and/or inspector to concentrate only on erosion/sediment control issues is the best way to enhance performance under this step.

Resources:

North Carolina Department of Environment and Natural Resources, Division of Land Quality
Mooresville Regional Office – 704-663-1699 (www.dlr.enr.state.nc.us)

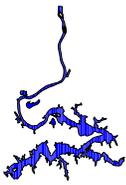
International Erosion Control Association (IECA) (www.ieca.org)

North Carolina Cooperative Extension (www.ces.ncsu.edu/Environment)

Section 6: Best Management Practices (BMPs)

6.1 Non-Structural BMPs

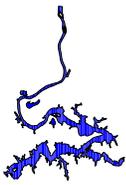
Non-point source pollutants, which originate in storm water runoff from impervious areas such as parking lots, are the greatest threat to water quality conditions in Mountain Island Lake. Devices for the control of these pollutants are referred to as best management practices (BMPs), which fall into two (2) categories including non-structural and structural (see Section 4 for a more detailed discussion of pollution sources). Non-structural BMPs are generally simpler and more effective than structural BMPs and lack expensive long-term maintenance costs. What sometimes complicates the use of non-structural BMPs is that they must be implemented before



land development activities begin and they require the placement of certain restrictions on how a piece of property can be developed. For example, one of the most effective non-structural BMPs is the placement of limits on the percentage of impervious cover allowed within a development and/or requiring that a certain percentage of open, undeveloped land be maintained. For example, in the Mountain Island Lake watershed an imperviousness cap is set at 70% built upon area, which is considered a non-structural BMP. In some jurisdictions, an additional requirement calls for 25% open space within new developments. This further limits the amount of impervious cover and subsequently the quantity of non-point source pollution that will enter Mountain Island Lake. The benefit of open space to water quality is significantly enhanced if the open space is located around headwater streams, wetlands and other critical water quality protection areas. For better control of non-point source pollutants and soil erosion, this open space should be left undisturbed.

Another non-structural BMP is the water quality buffer, which is an undisturbed, naturally vegetated (preferably wooded) area adjacent to a waterway. Storm drain outfalls end at the edge of the buffer and storm water is allowed to sheet flow across the naturally vegetated area where pollutants are absorbed into the ground or taken up in the root structure of plants. Wider buffers provide greater pollutant removal potential. Steep slopes and less permeable soils such as clay reduce the pollutant removal effectiveness of buffers. Effective buffers around Mountain Island Lake are a minimum of 100 feet in width. Along the streams draining to the lake, buffers should be a minimum of 50 feet in width if the stream is intermittent and 100 feet in width if perennial or the entire floodplain, whichever is greater. Buffers are capable of removing all types of pollutants from the storm water runoff that flows across them, including sediment, phosphorus, nitrate and metals. Sediment and phosphorus are trapped when surface flow slows down as it passes through the buffer. Nitrate is converted to nitrogen gas by microbes found in underlying media by the same processes used in wetlands. Metals are taken up in the buffer plants or bound to the soil as storm water passes through the buffer. Water quality buffers are probably the simplest and most effective means of removing non-point source pollutants from storm water runoff; however, they can be easily short-circuited by ditches or pipes passing through the buffer carrying storm water laden with pollutants directly to the creek or lake. This short-circuiting substantially limits the pollutant removal effectiveness of buffers. To eliminate this problem, ditches and/or pipes carrying storm water flow must end at the edge of the buffer and discharge to level spreaders designed to disperse the flow evenly through the buffer vegetation. Level spreaders can be constructed as shallow rock-lined trenches, which are level from end to end, parallel to the stream. Other level spreaders may be a series of 2-inch-by-6-inch boards that are placed end to end along a similar contour. Special design considerations need to be made when sizing level spreaders. Undersized level spreaders are easily overwhelmed by large flows. In addition, if one part of the level spreader is not level then the entire spreader will be ineffective.

Other non-structural BMPs might include the distribution of educational information to homeowners so that they are aware of the measures that should be undertaken to protect water quality. This has proven to be highly effective in Mecklenburg County. Section 10 contains some important information for use in the development of this educational material. Still other non-structural BMPs would include such practices as requiring soil tests prior to the application



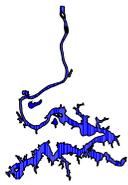
of fertilizers on lawns or golf courses or the use of integrated pest management (IPM) practices to reduce the use of pesticides. For additional information, consult the following website: <http://www.efn.org/~ipmpa/> .

6.2 Structural BMPs

Structural BMPs are manmade devices that collect storm water runoff and remove pollutants before allowing the water to enter the creek or lake. Structural BMPs are required by state law in drinking water supply watershed protection areas when development is categorized as high density. Recently adopted Phase I and II Storm Water Permits require that municipalities adopt a post-construction control ordinance requiring the installation of BMPs to reduce the discharge of pollutants from developed sites exceeding 24% imperviousness or built upon area. Historically, the most commonly used structural BMP has been the wet pond. Wet ponds are usually designed to treat the first inch of rainfall and remove 85% Total Suspended Solids (TSS). Recent research conducted on wet pond performance indicates that most ponds are not removing the required 85% TSS and the more realistic removal efficiency is 65%. Alternative post-construction controls are proving more reliable at removing pollutants and are being encouraged in many jurisdictions to replace wet ponds or are sometimes installed in conjunction with wet ponds. Table 2 provides a summary of the most common BMPs used in North Carolina. Removal efficiencies are provided for TSS, nitrate-nitrogen (form of nutrients) and metals, which are pollutants commonly found in storm water runoff. Following Table 2 is a discussion of low impact development (LID), which is a development technique that minimizes non-point source pollution. Following this discussion, additional information on specific BMPs is provided.

Table 2: Summary of Best Management Practices Commonly Used in North Carolina

BMP	Advantages	Disadvantages	Pollutant Removal
Wet Pond	Commonly used. Can double as recreational facility.	Relatively land intensive. Safety issues with permanent pool of water.	<u>Suspended Particles (TSS):</u> High at 65% to 70% <u>Nitrate-Nitrogen:</u> Moderate at 20% <u>Metals:</u> High at 50%
Storm Water Wetland	Best pollutant removal option. Good educational site.	Most land intensive. Public opinion can be negative (mosquito breeding).	<u>Suspended Particles (TSS):</u> Very High at 80% <u>Nitrate-Nitrogen:</u> High at 40% to 45% <u>Metals</u> – High at 50%
Bio-Retention/ Rain Garden	Aesthetically pleasing. Can double to meet landscape and water quality objectives.	New practice with little data to prove effectiveness. If not properly installed and maintained clogging may occur.	<u>Suspended Particles (TSS):</u> Very High at 80% <u>Nitrate-Nitrogen</u> – High at 40% to 45% <u>Metals</u> – High at 50%



BMP	Advantages	Disadvantages	Pollutant Removal
Grassed Swale	Capable of carrying higher flows than traditional grassed swales with a higher pollutant removal efficiency.	Construction costs higher than traditional swales. Pollutant removal efficiencies are variable.	<u>Suspended Particles (TSS)</u> : Moderate at 40% <u>Nitrate-Nitrogen</u> : Low at 10% to 15% <u>Metals</u> – Moderate at 40%
Sand Filter	Can fit in high land cost situations. Effective at removing pollutants found in parking lots.	Most expensive per square foot. Maintenance can be difficult.	<u>Suspended Particles (TSS)</u> : Very High at 75% to 80% <u>Nitrate-Nitrogen</u> : Negative removal <u>Metals</u> – High at 50%

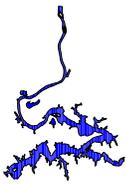
Data Sources: N.C. State University, Urban Storm Water Structural Best Management Practices and Center for Watershed Protection, The Architecture of Urban Stream Buffers.

Low Impact Development (LID): LID is a post-construction control measure that involves innovative, environmentally sensitive techniques for developing property. The goal of LID is to control non-point source pollutants (pollutants carried in storm water runoff) and mimic natural site hydrology through careful site planning and design focused on storing, infiltrating, detaining and retaining storm water runoff. Some of the basic principles of LID include:

- Preserving as many trees as possible.
- Maintaining natural drainage patterns.
- Locating BMPs in soils with the highest permeability.
- Locating impervious areas on less permeable soils.
- Limiting clear cutting and mass grading.

LID combines a hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality. LID devices are oftentimes aesthetically pleasing and blend well into the site. The basis of LID is to model land development activities around the specific characteristics of the land and not model or change the land to fulfill a predetermined development strategy. For this reason, LID requires a very thorough site evaluation prior to beginning any development activities that includes an analysis of the following:

- Topography (2' Contours)
- Natural Drainage Patterns
- Ridges and Valleys
- Vegetation (Meadow, Mature trees)
- Soils (HSG A, B, C, D)
- Hydrology (CN, Tc)
- Groundwater Depth
- Wetlands
- Floodplains
- Steep Slopes (> 15%)
- Access and Connectivity
- Utilities (Sanitary, Water etc.)
- Easements (Duke Power, Sanitary, etc.)
- Zoning (Setbacks, Density, Open Space)



LID works to disconnect, decentralized and distribute storm water flow. LID seeks to micromanage storm water as opposed to the more conventional approach that involves macromanagement of storm water. In other words, LID seeks to disperse and manage storm water in smaller areas closer to the source whereas conventional methods concentrate and manage storm water at the end of the pipe at the bottom of the hill. For example, in the drinking water supply watersheds storm water is concentrated in the storm drainage system and treated in large wet ponds located at the low point in the development. LID would work to disperse storm water close to the source further up hill through the use of a variety of BMPs that remove pollutants and reduce the volume and velocity of storm water runoff.

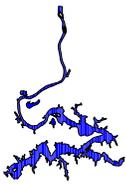
Currently there are two (2) jurisdictions in N.C. that incorporate LID into their post-construction ordinances, which are Chapel Hill and Huntersville. Both ordinances require 85% TSS removal for the post-construction runoff volume from the first inch of rainfall. LID is required to achieve this removal efficiency in the Town of Huntersville but is only recommended in Chapel Hill. In both jurisdictions the storm water runoff volume leaving the site post-construction must not exceed the volume leaving the site pre-construction for the 2-year frequency, 24-hour duration storm event except in the transit corridor in the Town of Huntersville where the 1-year, 24-hour storm applies. Chapel Hill does not have this exception. The Town of Huntersville stipulates that the storm water runoff rate leaving the site during post-construction must not exceed the pre-construction rates for the 2-year, and 10-year 24-hour storm events. Chapel Hill has the same requirement except for the 1-year, 2-year, and 25-year 24-hour storm events. Huntersville is unique in its requirement that no LID BMP treat more than 5 acres.



Figure 2: Wet Pond

A wet pond is considered a traditional BMP because it is among the first put into practice in North Carolina. A typical wet pond is shown in Figure 2. The wet pond functions by collecting storm water and detaining it for a period of time allowing pollutants to settle out. The wet pond can be enhanced through the creation of a littoral shelf with wetland plants for increased nutrient removal. Unlike wet ponds, most innovative BMP designs encourage infiltration, allowing storm water to soak back into the ground replenishing the ground water table and providing enhanced filtration

capabilities for non-point source pollutants. In addition, micro-managing storm water closer to its source using multiple BMPs installed in series is a far more effective means of pollutant removal than the traditional method of macro-managing storm water by collecting and treating it at the bottom of the hill in a single BMP.



Wet Pond: Storm water enters the wet pond through a forebay where sediments and pollutants attached to the sediments are allowed to settle out. The forebay is designed so that it can be easily accessed by excavation equipment and routinely cleaned out. From the forebay, storm water flows into the main body of the wet pond and enters a micropool that is between 4 to 8 feet deep. This micropool slows the flow of the water and holds it for an extended period of time allowing additional pollutants to settle out. Along the sides of the wet pond is an aquatic bench or littoral shelf. This bench area is shallow and gently sloping, such as a 1:6 rise to run. A minimum bench width of 12 feet is used for safety purposes. This bench is usually planted with a variety of wetland plants that provide nutrient uptake and improve pollutant removal. Storm water exits the wet pond through a series of outlets including risers and weirs. These outlets are designed so that water will not flow over the length of the dam. The size of the wet pond varies with the watershed that it is serving. In North Carolina, wet ponds must be as large as 1 to 2 percent of the area draining to it. For example, a 100 acre watershed would require a 1 to 2 acre wet pond. Other factors influencing the size of the wet pond include the depth of storage and the amount of impervious surfaces in the watershed. Deeper ponds would require less surface area and a watershed with a high percentage of impervious area would require a larger pond. The primary costs associated with wet pond construction are associated with excavation and land costs. Other costs include designing and constructing the dam and associated outlets, regular maintenance on the forebay and outlets, and liability. In some highly urbanized areas where land costs are extremely high and where excavated soil would have to be hauled long distances, wet ponds may be cost prohibitive and other BMPs may have to be utilized that are more conducive to these circumstances such as sand filters, rain gardens or manufactured BMPs. Wet ponds are effective at removing approximately 65% to 70% suspended solids, 20% nitrate-nitrogen and 50% metals.



Figure 3: Storm water wetland

Storm Water Wetland: Storm water wetlands are designed to temporarily store storm water in shallow pools that create suitable growing conditions for emergent and riparian wetland plants. These wetlands can be artificially created in areas where they did not previously exist. There are two basic types of storm water wetlands, extended wetlands and pocket wetlands. Extended wetlands are basically designed like a wet pond except the permanent ponding depth is less than three (3) feet. The majority of the wetland is typically zero to one foot in depth. The pocket wetland is designed to treat a smaller area and is usually used in

conjunction with filter strips and grassed swales. All storm water wetlands are designed to maximize the flow path, which increases detention time and prevents water from short circuiting



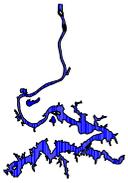
the wetland. Storm water wetlands typically consist of a forebay where solids initially settle. As with the wet pond, the forebay is typically designed for easy access for frequent cleaning. The main body of the wetland consists of high and low areas, which encourage a variety of vegetation types. Water typically exits a wetland through a shallow weir. A wetland uses multiple mechanisms to treat storm water runoff and remove pollutants. Similar to wet ponds, wetlands slow the flow of water and allow for the settling of solids as one pollutant removal mechanism. Studies show that on average, wetlands are capable of removing 80% suspended solids, which is considered a very high removal efficiency. Wetland plants serve as effective mechanisms for nutrient removal and provide an average 40% to 45% removal efficiency for nitrate-nitrogen, which is considered very good. Removal of metals in a wetland averages approximately 50%. The primary cost associated with a wetland is the land cost. A wetland typically requires more land than a wet pond but the wetland excavation costs are less. Design and construction costs for the wetland outlet structure are less than that of a wet pond; however, the plant costs associated with a wetland are higher. Typically wetland costs are higher than wet ponds; however, since the wetland has a higher pollutant removal efficiency, the cost per pound of pollutant removed is less. Since wetlands are not as deep as wet ponds, the danger of drowning is less, but wetlands suffer from “it’s a swamp mentality.” However, a properly constructed wetland will attract mosquito predators such as dragon flies and mosquito breeding should not be a problem. A typical storm water wetland is shown in Figure 3. Because of their effectiveness at removing nutrients, wetlands are preferred over wet ponds in the Mountain Island Lake watershed where excessive plant growth from elevated nutrient levels is a primary concern.



Figure 4: Rain garden in a parking lot.

Bioretention System (Rain Garden): A bioretention system collects storm water in a depression filled with a minimum of 2 feet of conditioned soil, which is covered by mulch and plants and contains an underdrain. A typical bioretention system or rain garden is shown in Figure 4. Storm water is collected and held by the bioretention system for 2 to 4 days allowing some pollutants to be taken up by plants and a portion of the storm water volume to be lost to evapotranspiration. In addition, hydrocarbons contained in the storm water are absorbed by the mulch and many of the pollutants are filtered by the conditioned soil

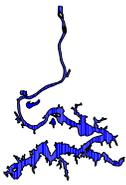
media that includes 80% sand and 20% organic material. This soil also contains micro-organisms that consume many of the organic pollutants. The bioretention system also serves as a detention structure by holding rainwater for several days before it is filtered into the underlying



soil material or allowed to discharge through the underdrain. Rain gardens work very well in areas where space is limited and the percentage of impervious cover is high such as parking lots and commercial sites. They are also very effective in residential developments with lower percentages of impervious cover. Bioretention areas can also be very aesthetically pleasing. They typically remove up to 80% suspended solids along with approximately 40% to 45% nutrients and 50% heavy metals. Economic considerations for the construction of rain gardens or bioretention systems include the cost of excavation, availability and cost of conditioned soil and mulch, plant materials and land needed.

Grassed Swale: Grassed swales are channels lined with grass designed not only to carry storm water but also to slow velocities and allow for infiltration of water into the soil. Swales are used primarily in residential developments along roadways and in highway medians. Swales are usually planted in high fescue or other dense grasses. Suspended sediment becomes trapped in the grasses as the water velocities are decreased. Enhanced swales often contain rock check dams along the channel to allow for ponding and settling. In some cases swales may be enhanced with sandy soil media placed along the bottom to ensure adequate infiltration. Grassed swales typically remove only 45% suspended particles but if used in series with other BMPs they could reach 85% removal.

Sand Filter: Many urban storm water practices have been borrowed from the treatment of wastewater and drinking water. One of these is the sand filter. The use of sand filters for treatment of storm water runoff was pioneered in Delaware and Maryland over a decade ago. Extensive work on new design features is ongoing in Virginia and Texas, as well. Sand filters are a two-tiered treatment system made of concrete (either pre-fabricated or poured on site). Storm water runoff first enters a sedimentation chamber where debris from the drainage area settles out. The water then flows to a sand chamber where it passes through a column of sand. It is here that most of the storm water treatment occurs. The sand used in sand filters is most often ordinary concrete sand. Since sand filters can clog easily, they are primarily used to treat runoff from highly impervious areas, such as parking lots. In fact the best-designed sand filter will treat runoff from only impervious areas. Sand filters can be very expensive; however, material costs can be lowered if the sand filters are constructed outside traffic-bearing areas. Another cost consideration of sand filters is their high need for maintenance. In Delaware, sand filters are serviced from every three years to every six months, depending upon the parking lot usage. Maintenance of sand filters usually includes removing the top 1 to 3 inch layer of sand once the filter is clogged. But sand filters do have a “competitive advantage” in that they do not require as much surface area as ponds or wetlands. In highly urban areas where land cost is substantial, sand filters may be the best alternative. Sand filters also do not have as high a liability concern as their counterparts. Sand filters are very effective at removing non-soluble pollutants, including TSS and sediment-adsorbed pollutants. Removal rates are around 80% for suspended particles and up to 60% for phosphorus and 50% for metals in some studies. Sand filters, however, are nitrate creators due to their nature. They trap other forms of nitrogen, such as organic nitrogen, which under an aerobic environment can become nitrate. So, while total nitrogen removal rates are positive, nitrate-nitrogen levels increase through the use of sand filters. Researchers are currently experimenting with different media and sand filter designs to try to find ways to remove nitrate-nitrogen.



Manufactured BMP: A manufactured BMP system is a structural measure that is specifically designed and sized by the manufacturer to intercept storm water runoff and prevent the transfer of pollutants downstream. In most cases, manufactured BMPs are constructed in a factory and delivered to a project site for subsurface installation. They are used solely for water quality enhancement in urban and ultra-urban areas where surface BMPs are not feasible due to land constraints. Manufactured BMPs generally provide effective spill containment for material handling and transfer areas such as automobile fuel and service areas and other urban hot-spots, such as municipal maintenance facilities. Careful analysis of the proposed development project and intended uses are essential in the proper selection of a manufactured BMP. The two most common manufactured BMP systems are the hydrodynamic and filtering structures.

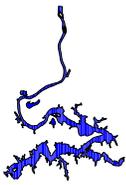
Hydrodynamic structures are systems that rely on settling or separation of pollutants from storm water runoff and are generally categorized as chambered separation structures or swirl concentration structures. Filtering structures rely on screens and other filter mechanisms to remove pollutants.



Figure 5: Installation of a manufactured BMP.

Chambered separation structures rely on settling of particles and, to a lesser degree, centrifugal forces to remove pollutants from storm water. These structures contain an upper bypass chamber and a lower storage/separation chamber. Flow enters the structure in the upper bypass chamber and is channeled through a down-pipe into the lower storage/separation or treatment chamber. The down-pipe is configured such that when the rate of inflow into the structure exceeds its operating capacity, the flow simply “jumps” over the down-pipe, bypassing the lower treatment chamber. The outlet configuration of the down-pipe forces the water to enter the lower

treatment chamber in one direction, which encourages circular flow. This circular flow, as well as gravitational settling, traps the sediments and other particulate pollutants (as well as any pollutants that adsorb to the particulates) at the bottom of the chamber. The water leaves the treatment chamber through a return or riser pipe. The return or riser pipe extends below the water surface within the lower treatment chamber in order to prevent trapped floatables from exiting the structure. The hydraulic gradient of the structure prevents the inflow and the discharge from creating turbulent conditions within the lower treatment chamber. This feature helps prevent the re-suspension of previously trapped particulate pollutants during high flow or “bypass” storm events. An example of a chambered separation structure is the StormceptorTM as shown in Figure 5.



Swirl concentration structures are characterized by an internal component that creates a swirling motion. This is typically accomplished by a tangential inflow location within a cylindrical chamber. The “swirl” technology is similar, if not identical to, the technology used in treating combined sewer overflows. The solids settle to the bottom and are trapped by the swirling flow path. Additional compartments or chambers act to trap oil and other floatables. There is no bypass for larger flows prior to the treatment or swirl chamber. The larger flows simply pass through the structure untreated. However, due to the swirling motion within the structure, larger flows do not re-suspend previously trapped particulates.

Filtering structures are characterized by a sedimentation chamber and filtering chamber. Filtering structures contain a primary settling chamber to remove heavy solids, floatables, oil, etc. The system then directs the water through a series of screens and geotextile filters, and then into a containerized wetland system with soil and aquatic plants. Filtration removes suspended sediment and attached contaminants by retaining the particulates as water passes through a filtering media. The removal of soluble pollutants is achieved through the use of the biological and chemical stabilization caused by plants, algae, and other aquatic organisms. Typically, the filtering structures have much higher pollutant removal efficiencies than the hydrodynamic structures.

Several manufactured BMPs are available for purchase from a number of vendors including: Stormceptor™, StormTreat™ System, Vortechs™ Treatment System, Downstream Defender™, StormFilter™, BaySaver™, AbTech Ultra-Urban Filter™, Hydro-Kleen™ Filtration System, Dandy Bag™, AquaShield™ Filtration System, and DrainPac™ Storm Drain Filtration System. An Internet search on any of the above patented names is the best method for obtaining additional information regarding any of the systems or for obtaining a list of vendors. These systems can be very expensive and careful consideration should be given to the treatment area and the pollutants to be removed prior to purchase. These manufactured systems can be very effective in highly impervious areas with limited space.

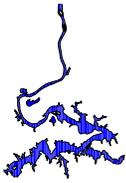
6.3 BMP Maintenance

With both non-structural and structural BMPs, measures must be taken to ensure that the control methods remain effective in perpetuity. For non-structural BMPs this is usually achieved by conservation easements on open spaces or requiring that such spaces be owned and maintained by a homeowners' association. With buffers, strict enforcement of regulations to prevent disturbance and recording of the buffer on plats are effective. For structural BMPs, an effective maintenance plan must be developed, recorded with the property and implemented throughout the life of the development. This can be expensive and difficult but is nonetheless essential for ensuring the effective long-term operation of any BMP and the protection of water quality.

References

The Center for Watershed Protection (www.cwp.org)

North Carolina Division of Water Quality (<http://dem.ehn.state.nc.us/>)



Georgia Storm Water Manual (<http://www.georgiastormwater.com/>)

Town of Huntersville (www.huntersville.org)

Mecklenburg County Water Quality Program (<http://waterquality.charmeck.org>)

Virginia Storm Water Management Program (www.dcr.state.va.us/sw/stormwat.htm#pubs)

Low Impact Development Center (www.lowimpactdevelopment.org)

N.C. State University, Urban Storm Water Structural Best Management Practices
(www.bae.ncsu.edu/people/faculty/hunt)

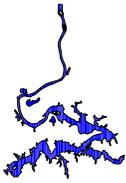
Section 7: Spill Prevention, Response & Control

7.1 Spill Prevention Guidelines

A spill is a discharge of any petroleum product or other hazardous substance into the environment. The vast majority of spills are typically small in quantity. The cumulative effect of these seemingly insignificant small spills can be more damaging to the aquatic environment than a large spill. In too many cases, hazardous materials are poured down the household drain, into the storm drain or thrown into the garbage, with no thought to the possible contamination of water, soil or the danger of burning or explosions. Oil and hazardous material spills can create dangerous health and environmental conditions. Exposure to a spill at a minimum may pose as an irritant to human health, but also may pose more serious conditions such as being flammable, explosive, reactive, corrosive, etiological or toxic.

Many of the products we use every day for housework, gardening, home improvements, or car maintenance contain hazardous materials that are a potential danger to public health and the environment. It is extremely important that these materials be used as directed and disposed of safely and properly, to prevent them from ending up in the water system, soil or air, causing injury, poisoning, and pollution. Most products contain proper handling and disposal measures on the container.

Household hazardous waste – items such as cleansers, pesticides and fertilizers, furniture strippers, paints and paint thinners, etc., that you frequently keep under the sink or on a shelf in the garage – can sometimes be recycled by donating them to another organization that can use them. If you need to dispose of these items, however, they should be managed properly by taking them to a household hazardous waste collection event or facility. If you are a Mecklenburg County resident, you can dispose of household hazardous waste free of charge at Heritage Environmental. For directions to Heritage Environmental and questions about household waste, call (704) 391-9662.



For more information regarding household hazardous wastes please see the Mecklenburg County Land Use and Environmental Services Solid Waste Management website:
<http://www.charmeck.org/Departments/LUESA/Solid+Waste/Home.htm>

The following US Environmental Protection Agency (US EPA) and NC Department of Environment and Natural Resources (NCDENR) websites provide ample information on spill prevention:

EPA Oil Pollution Prevention Regulation Overview
<http://www.epa.gov/oilspill/opprover.htm>

EPA Oil Program
<http://www.epa.gov/oilspill/index.htm>

EPA Wastes A to Z Subject Index
<http://www.epa.gov/epaoswer/osw/topics.htm>

NCDENR Pollution Prevention and Environmental Assistance
<http://www.p2pays.org/>

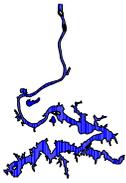
7.2 How to Recognize a Spill

Indicators in and around streams and lakes of spills that either directly or indirectly make contact with surface waters may include:

- A rainbow colored sheen on the water surface;
- Distressed or dead fish and other aquatic wildlife;
- Unusual abundance of nuisance species such as rats and mosquitoes;
- Discolored water appearance;
- Accumulation of trash and other manmade debris;
- Suds on the water surface;
- Unusual odor from the water;
- Staining on the bank and bank vegetation.

7.3 Actions to Take to Ensure Proper Clean Up

Streams and lakes that exhibit spill indicators such as those listed above, are experiencing degraded water quality and may pose a harmful human health condition. These observed areas should be reported to local authorities to ensure both proper clean up and steps to prevent the spill from occurring again. In Mecklenburg County, all spills/discharges should be immediately reported to the Mecklenburg County Water Quality Program (MCWQP) at 704-336-5500 (contact 911 during non-working hours). In the other counties around Mountain Island Lake, all spills should be reported to the North Carolina Department of Environment and Natural Resources, Mooresville Regional Office (MRO) at 704-663-1699. Refer to Appendix C for additional contact information. Under NC state law the spiller of oil or other hazardous substances is responsible for cleaning up the spill and restoring the affected site back to



conditions as closely as possible to those existing prior to the spill (G.S. § 143-215.84). The spiller is also responsible for ensuring that the spill is reported as specified above.

Emergency Contact Phone Numbers and Websites:

North Carolina Department of Environment & Natural Resources, Mooresville Regional Office (MRO):

Some of the program activities performed by the Mooresville Regional Office include: spill response, wastewater treatment plants & sewage collection systems, animal operations, 401 water quality certifications, surface water monitoring, land application of wastewater treatment & spray irrigation of wastewaters, surface oil spills & sewer overflows, and fish kills.

704-663-1699 <http://www.enr.state.nc.us/regionaloffices/offices/mooresville.html>

Mecklenburg County Water Quality Program (MCWQP):

MCWQP is a local water quality program serving Mecklenburg County. The goal of the program is to maintain and restore the quality and usability of the surface resources in Mecklenburg County, including Lake Norman, Mountain Island Lake and Lake Wylie. Some of the program activities performed by MCWQP include: spill response, NPDES Storm Water Permit compliance, monitoring water quality conditions in lakes and streams, identifying water quality problems and concerns, initiating follow-up actions to ensure that these problems are corrected and water quality restored, inspecting permitted wastewater treatment plants through a cooperative working agreement with the State, responding to complaints received from citizens concerning water quality problems, responding to emergency situations such as chemical spills, etc, coordinating numerous water quality initiatives involving the private sector in efforts to cleanup Mecklenburg County waterways (ie. Adopt-A-Stream, storm drain stenciling, Big Sweep, etc.), educating the public concerning water quality problems and concerns in Mecklenburg County and ways they can become involved, enforcing local and state water quality regulations, water quality modeling and the development of watershed management strategies, development and implementation of TMDLs for 303(d) listed streams in Mecklenburg County, numerous efforts associated with Mecklenburg County's newest initiative referred to as S.W.I.M. (Surface Water Improvement and Management). 704-336-5500

<http://waterquality.charmeck.org>

Chemical Transportation Emergency Center (CHEMTREC):

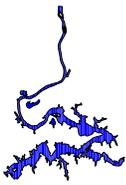
CHEMTREC was established in 1971 by the chemical industry as a public service hotline for fire fighters, law enforcement, and other emergency responders to obtain information and assistance for emergency incidents involving chemicals and hazardous materials.

1-800-424-9300 <http://www.chemtrec.org/>

National Response Center:

The primary function of the National Response Center is to serve as the sole national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the environment anywhere in the United States and its territories. 1-800-424-8802

<http://www.nrc.uscg.mil/nrchp.html>



Section 8: Land Acquisition Around the Lake

8.1 Public Owned Properties and Conservation Easements

A total of 5,918.5 acres of land around Mountain Island Lake are publicly owned and/or controlled, which comprises 13.4% of the watershed and 74% of the lake shoreline. In Mecklenburg County this includes 4009 acres, acquired between 1981 and 2002 as follows (see Appendix E):

- Since 1991, Mecklenburg County Land & Park Bonds totaling \$28,966,929 were used to acquire 2,539.75 acres
- Since 1991, City of Charlotte Funds totaling \$2,409,500 were used to acquire 485.88 acres
- In 1981, 765 acres were acquired by Mecklenburg County for Latta Plantation Park.
- 218.42 acres were donated to Mecklenburg County.

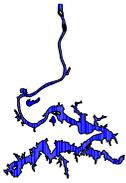
These lands are set aside for parks, conservation easements and nature preserves. In Gaston and Lincoln Counties on the west bank of Mountain Island Lake a total of 1,909 acres of land are set aside as conservation areas as follows:

- In 1998, a N.C. Clean Water Management Trust Fund Grant of \$6,100,000 led to the acquisition of 1,231 acres as part of the Mountain Island Educational State Forest.
- In 1999, a City of Gastonia Revenue Bond provided \$6,400,000 toward the acquisition of the 425 acre Water's Edge tract.
- In December 2000, a conservation easement was donated to the Catawba Lands Conservancy for the 107 acre Bynum-Killian Farm.
- In May 2003, a Conservation easement was acquired for \$300,000 by the Catawba Lands Conservancy at the 146 acre Killian Forest.

8.2 Recommended Actions for Purchase of Additional Properties

The highest priority for the purchase of lands around Mountain Island Lake is the shoreline, which if developed has the greatest potential for causing negative water quality impacts. Currently approximately 74% of the shoreline of the lake is publicly owned, which equates to approximately 45 miles out of the total shoreline length of 61 miles. However, 16 miles remain in private ownership and are available for development. A majority of the shoreline remaining in private ownership in Mecklenburg County has already been developed but there remain several miles of shoreline in Gaston and Lincoln Counties currently available for development. The purchase of additional public lands around Mountain Island Lake should focus on these privately owned shoreline miles.

The secondary priority for land purchases by the jurisdictions around the lake should focus on properties along Johnson Creek in Gaston and Lincoln Counties and McDowell and Gar Creeks in Mecklenburg County. These are the three (3) main creeks that flow directly to Mountain Island Lake, which after the shoreline area have the greatest potential to negatively impact water quality. Land purchases should begin with properties that drain directly to these creeks near the lake shoreline. Land purchase priority should be lowered for properties located further from the



creeks and/or lake shoreline. Properties that include wetlands should be given a higher priority as well as properties that include a lot of stream or lake frontage.

It is recommended that each jurisdiction identify lands for purchase based on the above described prioritization scheme. Once identified the jurisdictions should communicate with one another through regular MOU Work Group meetings so that efforts for securing the necessary funds can be coordinated. It is strongly recommended that all future land purchases around Mountain Island Lake be conducted as part of this MOU partnership, which should increase the likelihood of obtaining grant funds.

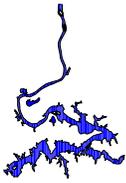
Section 9: Wastewater Systems

9.1 Sanitary Sewer Collection Systems

Properly designed, operated, and maintained sanitary sewer collection systems are meant to collect and transport all of the sewage that flows into them to a permitted wastewater treatment facility where the wastewater is treated and pollutants removed prior to discharge back to surface waters. However, occasional unintentional discharges of raw sewage from sanitary sewer collection systems occur in almost every system. These types of discharges are called sanitary sewer overflows (SSOs). SSOs have a variety of causes, including but not limited to severe weather, improper system operation and maintenance, and vandalism. The U.S. Environmental Protection Agency (EPA) estimates that there are at least 40,000 SSOs each year. The untreated sewage from these overflows can contaminate surface waters and cause significant water quality degradation and even threaten public health. Because SSOs contain raw sewage they can carry bacteria, viruses, protozoa (parasitic organisms), helminths (intestinal worms), and borroughs (inhaled molds and fungi). The diseases they may cause range in severity from mild gastroenteritis (causing stomach cramps and diarrhea) to life-threatening ailments such as cholera, dysentery, infections hepatitis, and severe gastroenteritis. When SSOs occur in a drinking water supply reservoir like Mountain Island Lake, they are of particular concern because of the potential to negatively impact drinking water quality and threaten public health. Therefore, municipalities with sanitary sewer collection systems in the Mountain Island Lake watershed should take the actions necessary to prevent SSOs to the maximum extent practicable.

The primary causes of SSOs are as follows:

- **Infiltration and Inflow (I&I):** Rainfall infiltrating through the ground into leaky sanitary sewers causing the capacity of the system to be exceeded and overflows to occur.
- **Undersized Systems:** Sewers and pumps that are too small to carry sewage from newly-developed subdivisions or commercial areas.
- **Pipe Failures:** Blocked, broken or cracked pipes. Tree roots growing into the sewer pipe and accumulations of grease causing blockages. Sections of pipe settling or shifting so that pipe joints no longer match. Sediment and other material building up in pipes.
- **Equipment Failures:** Pumps failing and power outages.
- **Sewer Service Connections:** Discharges occurring at improperly installed sewer service connections to houses and other buildings.



- Deteriorating Sewer System: Improper installation and/or maintenance.

SSOs can be reduced or eliminated by:

- Reducing infiltration and inflow through system rehabilitation and repairing broken or leaking service lines. The sewer collection system serving the Mountain Island Lake watershed should be rehabilitated/replaced on a more frequent schedule than the system serving the remainder of the jurisdiction.
- Enlarging or upgrading sewer, pump station, or sewage treatment plant capacity and/or reliability. During system design, particular attention should be paid toward ensuring that the system is properly sized, and potentially even oversized in the Mountain Island Lake watershed to prevent future problems with capacity and overflows.
- Increasing sewer system inspection, cleaning and maintenance. The sanitary sewer collection system serving the Mountain Island Lake watershed should be inspected at least annually and cleaned and repaired as necessary to prevent leaks. These inspections should include an examination of all sewer lines, manholes and pump stations.
- Establishing a program for reducing grease in the system, the biggest cause of blockages.
- Construction of wet weather storage and treatment facilities for excess flows. This is particularly important at pump stations.
- Ensuring the proper inspection of sewer system installations.
- Ensuring the proper inspection of all sewer service connections.

9.2 Pump Stations

Most discharges of raw sewage to the lakes along the Catawba River have resulted from malfunctioning pump stations. Some malfunctions can be avoided through enhanced pump station design and installation as described below:

- Install an on-site generator as a component of the pump station including a weekly automatic exerciser.
- Include audible and visible alarms as well as a high water auto dialer.
- Install power surge and lightning protection.
- Provide a minimum of 24-hour storage capacity for sewage discharged from the pump station as a result of system failure.

These pump station enhancements significantly exceed minimum State requirements and provide increased protection of drinking water supplies. They are highly recommended for pump stations installed in the Mountain Island Lake watershed. In addition, it is very important that the 24 hour contact name and phone number for spills be clearly posted at all pump stations in the watershed.

Pump station maintenance is extremely important for preventing malfunctions that could result in discharges of sewage. Table 3 provides a list of recommended maintenance practices for float controlled submersible pump stations. By following these recommendations, jurisdictions could reduce the number of spills from pump stations. In addition, it is recommended that a copy of this list be provided to all private pump station operators.

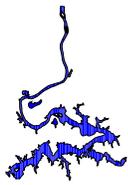


Table 3: Minimum Recommended Guidelines for Sewage Pump Station Maintenance.

Maintenance Activities	Weekly	Monthly	Twice/ Yr.	Yearly
Turn all pumps on and verify they are in working order.	X			
Inspect all visible piping & valves.	X			
Record the Elapsed Time Meter Readings for all pumps & calculate pump run times for week to ensure pumps are running equal hours.	X			
Inspect wet well condition, checking for grease build up.	X			
Inspect all hatches, ladders, & grating for integrity.	X			
Check all visual/audible alarms & auto dialers to verify proper operation & programming.	X			
Verify security of wet wells & control panels. Insure that 24 hour emergency numbers are posted.	X			
Check for proper house keeping in and around station.	X			
Start back-up generators and check for proper operation.		X		
Inspect alternator, level controller, contacts, relays, time delays, transformers, capacitors, & float settings. Tighten all electrical connections and record voltage, amperage, & resistance readings.			X	
Exercise all valves and clean check valves.			X	
Verify pump operating conditions (pressure readings & capacity test).			X	
Pull pumps, inspect oil, impeller and wear rings / cutters.				X
Inspect entire sewer collection system.				X

In addition to the above recommended maintenance practices, the following general pump station operation guidance is also strongly encouraged:

- A maintenance log should be maintained and kept on site at all times.
- A written operation and maintenance plan should be developed and implemented.
- Insure that the facility is locked and secured at all times.
- Insure that 24-hour emergency contact names and numbers are clearly posted at the facility.
- A map of the entire sewer system should be maintained at all times.

North Carolina Administrative Code (NCAC) 15A 2B .0506 (a)(2) requires that any failure of a sanitary sewer collection system, pump station or treatment facility resulting in the discharge of greater than 1,000 gallons of untreated sewage onto the ground that does not reach surface waters or the release of any quantity of sewage that reaches surface waters shall be reported to the N.C. Department of Environment and Natural Resources central office or appropriate regional office as soon as possible but no later than 24 hours from the time the spill is first detected. For the counties surrounding Mountain Island Lake the appropriate regional office is located in Mooresville at 704-663-1699. Spills occurring after hours or on the weekends or holidays should be reported by calling the N.C. Division of Emergency Management at 919-733-3300. A



written report shall also be provided within five (5) days of the time of the incident. The report is to contain a description of the incident and its cause; period of time over which the incident occurred, including exact dates and times and if the bypass has not been corrected, the anticipated time it is expected to continue; and the steps taken (or planned) to reduce, eliminate and prevent recurrence of similar events. In addition, downstream water intakes should be notified of all spills in excess of 5,000 gallons that reach Mountain Island Lake. The contact numbers for the water intakes are as follows: Mount Holly at 704-822-2928; Gastonia at 704-866-6828; and Charlotte-Mecklenburg at 704-399-2331.

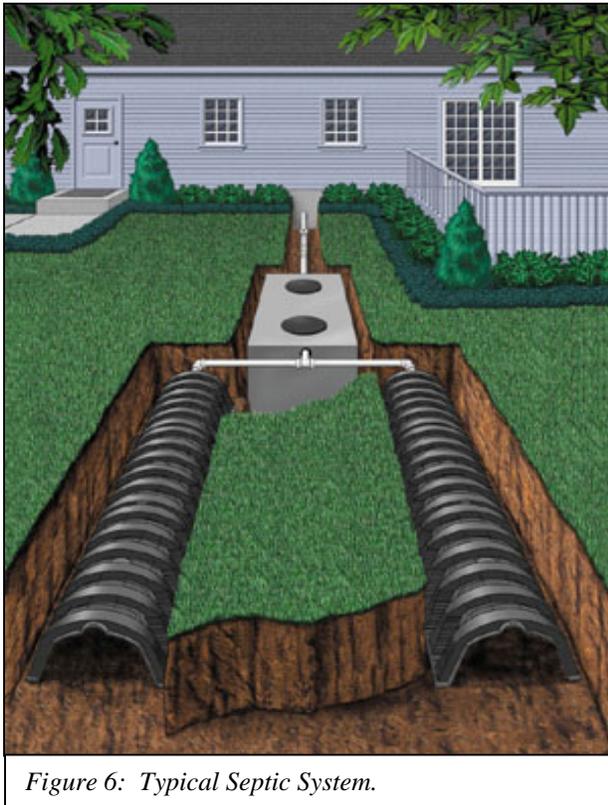


Figure 6: Typical Septic System.

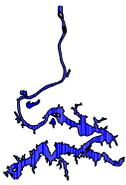
9.3 Septic Systems

Septic systems provide the primary method for sewage disposal around Mountain Island Lake. In a typical septic system, wastewater flows from the house into a septic tank where settling occurs. The heavier solids (e.g., organic waste) sink to the bottom of the tank to form a sludge layer, while the lighter solids (e.g., grease, soapsuds) float to the top to form a scum layer. The clearish liquid in the middle layer is the effluent. After settling out for 24 or more hours, the effluent flows out of the septic tank to a leachfield, where it is discharged into the soil for final treatment and disposal (see Figure 6). If properly installed and maintained, septic systems will provide effective treatment of household sewage. However, when septic system failures occur they can result in discharges of sewage to the surface of the ground or surface waters. Failures of septic systems around Mountain Island Lake could lead to discharges of sewage into recreational

areas and the drinking water supply; therefore, proper septic system installation and maintenance is particularly critical around the lake. The following information is provided for dissemination to residents in the various jurisdictions around the lake either through printed literature or over a website in hopes that it may encourage proper septic system maintenance.

Septic System Installations:

All septic system installations must be performed in strict compliance with State requirements as approved by the local Health Department. In addition, septic systems including their drain fields should be installed as far as possible from surface waters and in no case should they be installed within 50 feet of the water or inside the watershed buffer, whichever is greater (see Table 1).



Septic System Maintenance:

Water conservation is the single most beneficial action for protecting a septic system. Keeping household water usage below the septic system's "daily designed flows" is a simple but powerful way to promote the system's smooth functioning. Consistently exceeding these flows impacts both the volume and quality of wastewater that enters the system's leachfield--the latter because higher flows disrupt the solids settling process and "push out" under-treated wastewater into the leachfield. This spells drainfield failure, and in fact water overuse is one of the leading causes of premature septic system failure. The following are specific water conservation measures that can be easily implemented in the home:

- Fix leaky faucets and toilets. A leaky toilet can burden septic systems with hundreds of wasted gallons of water per day. Compare this to the acceptable daily water usage per person of 50-75 gallons.
- Take sensible steps to curtail water usage. Limit showers to 5 minutes, fill bathtubs half-full and do not let the faucet run when shaving, brushing teeth or washing dishes, vegetables, hands, etc.
- Retrofit showerheads with a water-saving (low-flow) device.
- Retrofit faucets with water-saving faucet aerators.
- Retrofit toilet with a water-saving device, or, better yet, replace toilets with an ultra low-flush system (i.e., one that uses 1.6 gallons or less per flush).
- Do laundry only when there is a full load, and try to spread laundry over the week rather than doing all household laundry at once. When buying a new machine remember that the front-loading model uses less water than the more prevalent top-loading one.
- Run the dishwasher only when it's full.
- Avoid using an automatic (self-regenerating) water filter.

Another important tip for maintaining a properly operating septic system is to minimize the amount of solids deposited to the system, which is designed to handle human waste, toilet paper and water from basic household appliances. Overburdening a septic system with solids will, at best, necessitate more frequent pumping of the tank. At worst, such overloading will cause the carry-over of particulate solids into the leachfield, leading to premature leachfield failure. The following tips address the most serious (and common) offenses when it comes to solids disposal and a septic system:

- Avoid using a garbage disposal. Garbage disposals significantly increase the amount of solids entering the system, making the septic tank's sludge and scum layers accumulate more rapidly. This means that more frequent pumping will be needed (typically, garbage disposal usage shortens the time between pumpings by 1-2 years). Instead of relying on a garbage disposal to get rid of food scraps, consider creating a compost heap.
- Never dispose of cooking oils or grease down the drain. Rather, pour them into containers, let the oil/grease harden and throw them away in the trash.
- Don't use the toilet as a wastebasket. Never flush diapers, paper towels, facial tissues, feminine hygiene products, cigarette butts or other non-biodegradable items down the toilet.
- Coffee grounds, egg shells, large amounts of hair and kitty litter are other common household solids that should be thrown away in the trash, not into the septic system.



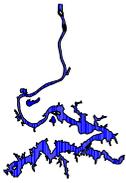
It is also extremely important to the health of a septic system not to put chemicals down the drain. A septic system is its own ecosystem whose inhabitants (bacteria) are in tune with their chemical environment. Adding chemicals (everything from household cleaners to toxic substances like paint, solvents and pesticides) disrupts this ecosystem, killing off the bacteria whose life activities purify the wastewater. Chemicals can also clog the leachfield and damage soil structure. Moreover, because chemicals pass right through the system, they can contaminate groundwater and the nearby lake.

The following chemical usage tips will help you preserve the septic tank, leachfield and the surrounding environment:

- Limit the use of household cleaners such as bleach and detergents. While most septic systems can accommodate moderate amounts of such cleaners, large doses will destroy helpful bacteria populations in the septic tank and will pollute the environment. “Septic friendly” household cleaners can be purchased instead. A better solution is use natural cleaning substances such as lemon, vinegar and baking soda where you can as substitutes for potentially system-damaging commercial cleaners.
- If you have a clogged drain, use boiling water or a drain snake rather than caustic drain cleaners.
- Use low-phosphate detergents to avoid environmental damage. Releasing phosphates into the environment can cause destructive algal blooms in the lake.
- Avoid anti-bacterial soaps and bathroom cleaners. Used in excess, these can destroy bacterial populations in the septic tank.
- Don't flush medicines (over-the-counter and prescription) down the drain. Such substances have an adverse effect on the system's bacteria, and can contaminate groundwater.
- Don't discharge water softener backwash into the septic system. Not only will this increase the water load but chlorides and salts in the discharge can harm the tank's bacteria.
- Don't use septic system “additives.” These additives can destroy the bacteria in the tank and can cause leachfield clogging, damage to leachfield soil and, over time, groundwater contamination.
- ***Never*** dispose of toxic chemicals in a septic system. These include (but are not limited to): solvents; paint, paint thinners and paint strippers; pesticides/herbicides; fertilizers; motor oil; gasoline; antifreeze; break fluid; other automotive fluids; wood preservatives; and photographic chemicals

It is also important to keep surface water away the leachfield to protect the operation of the septic system. Surface water should not collect on or near the leachfield. The excess water will saturate the leachfield's soil, lessening its ability to absorb and treat wastewater. Ponding surface water on the leachfield is a health and environmental hazard and signals leachfield under-performance. Observe the surface water guidelines below:

- Don't let water from sump pumps or roof drains discharge into or near the septic tank or leachfield. If a sump pump or roof drains is draining into a leachfield, consult with a plumber to have the drain water redirected.
- Don't store stockpiles of snow over the leachfield.



- If you notice water (e.g., after a normal rainfall) ponding on the leachfield, call a septic inspector to have the situation checked out. Ponding may be an indication of poor leachfield design (in which case you should consider methods of surface water diversion) or an indication of leachfield clogging and incipient failure--a serious problem that demands immediate attention from a septic contractor.

Water-loving trees and shrubs with deep root systems can cause major problems with a leachfield. If these types of trees or shrubs exist near a leachfield, they should be (carefully) removed (No leachfield should be sited in a spot that already had trees and shrubs growing abundantly). As the tips below suggest, leachfield problems caused by root systems can be significantly minimized (e.g., roots cracking, growing into and otherwise interfering with the leachfield's chambers or pipes) by making wise leachfield plant choices.

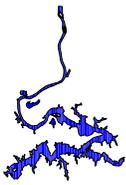
- Avoid planting trees and shrubs with deep root systems that can cause serious (and expensive) damage to the drainfield. Deep-rooted and water-loving trees such as willows, cottonwoods, red and silver maples and poplars are particularly risky choices for planting on or near a leachfield. On the other hand, certain species of trees and shrubs such as dogwoods, holly, and boxwoods have less aggressive root systems and are better choices. Plant trees at a distance from the leachfield that is greater than the typical root spread of a mature tree of a given species. Shrubs should be planted between leachfield trenches.
- Choose shallow-rooted herbaceous (non-woody) plants that are not overly water-loving for planting on or near a leachfield. These include many common perennial flowering plants. Such plants can actually be beneficial to a leachfield, absorbing moisture and nutrients and thus helping the leachfield to treat wastewater (see Table 4).
- Seeding a leachfield with a dense cover of grass is the safest bet for avoiding problems related to root interference.

Ensuring that the leachfield is undisturbed by vehicular traffic, machinery, blacktop or any other compacting, crushing or damaging forces is essential. Two critical things are at risk: the leachfield's absorption capacity and the integrity of the underground chambers or pipes that distribute effluent across the leachfield. Avoid these risks by following the guidelines below:

- Dig carefully with a spade when planting on or near the leachfield. Never use shovels, backhoes or any other earth-moving machinery in the vicinity of the leachfield.
- Don't park or drive vehicles over the leachfield. This could compact the soil and reduce its effectiveness in treating wastewater or damage the leachfield's chambers/pipes.
- Don't store any machinery, soil or construction materials on the leachfield.
- Don't install patios, basketball courts or any other impermeable surfaces over or within 10 feet of the leachfield.

Septic System Pumping:

All septic tanks need to be pumped out on a regular basis. Pumping is essential to maintaining a well-functioning system and preventing premature system failure. Even well maintained septic systems will over time build up solids or sludge. This sludge must be pumped from the septic tank before it accumulates to the point where it could discharge from the tank into the leachfield. Sludge that is allowed to enter the leachfield will clog the chambers or pipes as well as the



underlying soil resulting in complete system failure. Regular pumping is the most important septic system maintenance practice but unfortunately it is oftentimes neglected by homeowners causing it to be one of the leading causes of septic system failure in Gaston, Lincoln and Mecklenburg Counties. Table 4 offers some guidelines for pumping frequencies.

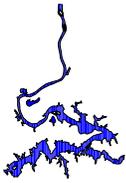
Table 4: Recommended Septic Tank Pumping Frequencies.

Tank Size (gallons)	Household size (number of people)								
	1	2	3	4	5	6	7	8	9+
	Duration (in years) Between Pumpings and/or Inspections								
500	5.8	2.6	1.5	1.0	0.7	0.4	0.3	0.2	0.1
750	9.1	4.2	2.6	1.8	1.3	1.0	0.7	0.6	0.4
900	11.0	5.2	3.3	2.3	1.7	1.3	1.0	0.8	0.7
1000	12.4	5.9	3.7	2.6	2.0	1.5	1.2	1.0	0.8
1250	15.6	7.5	4.8	3.4	2.6	2.0	1.7	1.4	1.2
1500	18.9	9.1	5.9	4.2	3.3	2.6	2.1	1.8	1.5
1750	22.1	10.7	6.9	5.0	3.9	3.1	2.6	2.2	1.9
2000	25.4	12.4	8.1	5.9	4.5	3.7	3.1	2.6	2.2
2250	28.6	14.0	9.1	6.7	5.2	4.2	3.5	3.0	2.6
2500	31.9	15.6	10.2	7.5	5.9	4.8	4.0	3.5	3.0

Section 10: Public Education

One of the best sources of information including publications, handouts and other literature regarding lake management is the North American Lake Management Society or NALMS (see the following website <http://www.nalms.org>). Membership to this organization is available through the website. NALMS also holds annual conferences that are very informative. There is a North Carolina chapter of the organization, which also holds annual conferences (see the following website <http://www.nalms.org/chapters/chapters.htm#NC>). For local information regarding lake management, Mecklenburg County has produced a publication called “Protecting Our Lake Watershed” that is provided in Appendix F. It is also available at the following website <http://waterquality.charmeck.org> (select Lakes – Watershed Protection and click on Lake Watershed Booklet at bottom of page). The booklet can be obtained in Word format by contacting the Mecklenburg County Water Quality Program at (704) 336-5500. This is a good publication to place on your website.

Another very good source of information regarding the management of aquatic plants is available through N.C. State University’s Fisheries and Pond Management Extension at the following website <http://www.ces.ncsu.edu/nreos/wild/fisheries/index.html>.



Appendix A

Mountain Island Lake Memorandum of Agreement

STATE OF NORTH CAROLINA

MEMORANDUM OF UNDERSTANDING

THIS MEMORANDUM OF UNDERSTANDING (hereinafter "MOU"), is made this ____ day of _____, 2004, among **Gaston County, Lincoln County and Mecklenburg County**, political subdivisions of the State of North Carolina; **City of Mount Holly, City of Gastonia, City of Charlotte, Town of Cornelius and Town of Huntersville**, North Carolina municipal corporations; the **Centralina Council of Governments**, State designated lead regional organization for the area; and the **Mountain Island Lake Marine Commission**, established through a joint resolution by Gaston, Lincoln and Mecklenburg Counties, herein referred to individually as a "Partner" and collectively as "Partners." The term Partner and Partners as used herein shall include said parties and their successors and assigns.

WITNESSETH:

WHEREAS, the Partners wish to promote health, economic development and water quality/quantity benefits by proactively addressing issues affecting the Mountain Island Lake watershed;

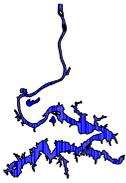
WHEREAS, the Partners wish to enter into a cooperative working agreement through this MOU for the purpose of protecting water quality conditions in Mountain Island Lake;

WHEREAS, the Partners recognize that the protection of water quality conditions in Mountain Island Lake is important for maintaining the quality of drinking water supplies, protecting recreational uses and preserving natural habitats;

WHEREAS, the Partners recognize that the protection of water quality conditions in Mountain Island Lake is best achieved through a coordination of efforts between the Partners; and

WHEREAS, the Partners wish to establish a framework for the establishment of coordinated efforts.

NOW, THEREFORE, in consideration of the mutual covenants, terms and conditions hereinafter set forth, the Partners hereto agree as follows:



I. PURPOSE

The purpose of this MOU is to set forth the general terms and conditions and define the roles and responsibilities of the Partners in the implementation of this MOU and establish a framework for coordination of efforts to protect water quality conditions in Mountain Island Lake.

II. SCOPE

This MOU shall pertain to those activities performed on or around Mountain Island Lake including the watershed area that drains to the Lake (see Exhibit A) that have the potential to impact water quality conditions in the Lake.

The following items are identified as needing coordination among the Partners through this MOU for the protection of Mountain Island Lake water quality conditions:

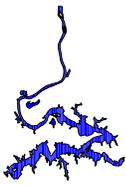
1. Changes in zoning and/or subdivision ordinances established following the adoption of this MOU;
2. New or amended post-construction or erosion control ordinances;
3. Public acquisition of lands or establishment of public and private conservation easements;
4. Addition or expansion/modification of NPDES facilities, including wastewater treatment facilities and pumping stations;
5. Addition or expansion of water intakes;
6. Addition or expansion of proposed transportation thoroughfares;
7. New or amended lake use/management regulations;
8. New or amended land use plans;
9. Local legislation affecting the Mountain Island Lake watershed;
10. Coordination and sharing of data and information; and
11. Sharing of funding needs and strategies.

III. DEVELOPMENT OF WATERSHED PROTECTION STRATEGIES/GUIDELINES

The Partners shall each identify representatives to serve on a Mountain Island Lake Work Group. This Work Group will meet beginning in July 2004 for the purpose of developing watershed protection strategies/guidelines for Mountain Island Lake. These guidelines will be distributed in written format to each of the Partners by September 30, 2004 for use upon adoption in their legislative discretion as part of their land use plan if deemed necessary by the Partner, as guidance in the protection of water quality conditions in Mountain Island Lake when executing the eleven (11) items listed in Section II above.

IV. COMMUNICATION PROTOCOL

In situations where any of the action items 1 through 9 identified for coordination in Section II above are under consideration by one or more of the Partners, said Partners agree to provide written notification to the other Partners regarding the item under consideration and



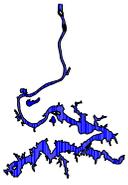
agree to provide a specific time frame for the submittal of written comments prior to taking action (including adoption in their legislative discretion of any necessary amendments to their applicable ordinances) (items 10 and 11 in Section II do not require notification by Partners). Work Group representatives from each jurisdiction identified in Section III above will serve as the point of contact for such notifications. All comments received regarding the coordination items are to be carefully considered in good faith, within their legislative discretion, by the Partners during consideration for approval, but failure to follow such comments shall not be construed or utilized in any proceeding by any Partner or third party as a violation of the Partners' land use plans or ordinances. The Partners agree to provide written notification concerning the approval status to commenting Partners once a final decision has been rendered.

The Work Group shall meet twice a year to update the watershed protection strategies/guidelines as necessary and to discuss other matters important to the protection of water quality conditions in Mountain Island Lake. Any of the Partners can call additional meetings of the Work Group as necessary to address water quality related issues in the Lake. The Work Group will engage other organizations/entities as necessary to ensure that issues are properly addressed. The Work Group will also plan, organize and implement future Mountain Island Lake Workshops open to elected officials and the general public. These workshops will provide an overview of general water quality conditions in the Lake as well as summarize activities performed during the calendar year pertaining to the eleven (11) coordination items listed in Section II. The Workshops will also include a discussion of the watershed protection strategies/guidelines developed for protection of water quality.

It is the intent of the Partners to provide effective notification regarding items 1 through 9 identified for coordination in Section II above. Nevertheless, the failure of a Partner to give the specified notice to the other Partners shall not affect any action taken by the notifying Partner.

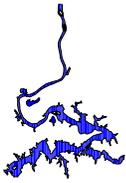
V. MISCELLANEOUS

This MOU sets forth the entire understanding of the Partners with respect to this matter and supersedes all prior discussions, negotiations, understandings or agreements. The Partners shall have the authority to negotiate and execute amendments to this MOU as deemed necessary to ensure the proper execution of measures for the protection of water quality conditions in Mountain Island Lake. If any provision to this MOU is found to be invalid, the remainder of the provisions of this MOU and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby. No Partner shall have a cause of action against another Partner with respect to this MOU or in connection with matters arising out of this MOU, including but not limited to a cause of action for failing to give notices or failing to follow the recommendation of a Partner. There are no third party beneficiaries to this MOU. Thus, no one, including a Partner, shall have a cause of action against a Partner with respect to this MOU or in connection with matters arising out of this MOU, including but not limited to a cause of action related to actions taken or not taken by a Partner related to this MOU.



VI. TERMINATION

Any Partner shall have the right to withdraw its participation in this MOU upon 90 days' written notice to all other Partners. Termination by a Partner shall not cause termination of the MOU and it shall continue in force as long as there are at least two Partners in the MOU.



IN WITNESS WHEREOF, each Partner has caused this instrument to be executed in its name by its duly authorized officials.

GASTON COUNTY

Jan Winters
County Manager on behalf of the
Board of County Commissioners
of Gaston County

Clerk to the Board
(SEAL)

LINCOLN COUNTY

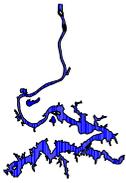
Stan Kiser
County Manager on behalf of the
Board of County Commissioners
of Lincoln County

Clerk to the Board
(SEAL)

MECKLENBURG COUNTY

Harry L. Jones, Sr.
County Manager on behalf of the
Board of County Commissioners
of Mecklenburg County

Clerk to the Board
(SEAL)



CITY OF MOUNT HOLLY

David Kraus
City Manager on behalf of the
Mount Holly City Council

City Clerk
(SEAL)

CITY OF GASTONIA

Edward C. Munn
City Manager on behalf of the
Gastonia City Council

City Clerk
(SEAL)

CITY OF CHARLOTTE

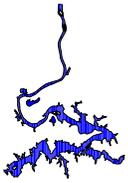
Pam Syfert
City Manager on behalf of the
Charlotte City Council

City Clerk
(SEAL)

TOWN OF CORNELIUS

Anthony Roberts
Town Manager on behalf of the
Cornelius Board of Commissioners

Clerk to the Board of Commissioners
(SEAL)



TOWN OF HUNTERSVILLE

Jerry Cox
Town Manager on behalf of the
Huntersville Board of Commissioners

Clerk to the Board of Commissioners
(SEAL)

**MOUNTAIN ISLAND LAKE MARINE
COMMISSION**

Edna Chirico
Chairman

**CENTRALINA COUNCIL OF
GOVERNMENTS**

Al Sharp
Executive Director

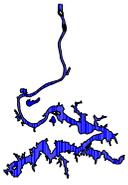


Exhibit A (of MOU)

Mountain Island Lake & Watershed Area

See Appendix B
Map of Mountain Island Lake
on page 45

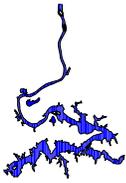


Exhibit B (of MOU) Definitions of Terms

CHANGES IN ZONING: Gaston County, Lincoln County, City of Mount Holly, City of Charlotte, Town of Cornelius and Town of Huntersville have Zoning and/or Subdivision Ordinances that apply to the watershed area draining to Mountain Island Lake. Changes in existing zoning and/ or subdivision ordinances can affect development activities in the watershed area of the Lake and subsequently impact surface water quality conditions through an increase in pollutants discharged in storm water runoff. One of the purposes of this MOU is to provide guidance when making changes in existing zoning and to allow the Partners the opportunity to comment prior to the approval of such changes.

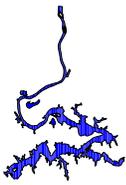
NEW OR AMENDED ORDINANCES: Gaston County, Lincoln County, City of Mount Holly, City of Charlotte, Town of Cornelius and Town of Huntersville have post-construction ordinances that apply to the watershed area draining to Mountain Island Lake as required by North Carolina General Statute 143-214.5, Water Supply Watershed Protection. In addition, all the Partners except Lincoln County have local erosion control ordinances. Changes in these existing ordinances can impact surface water quality conditions in the Lake. One of the purposes of this MOU is to provide guidance for new or amended ordinances and to allow the Partners the opportunity to comment prior to approval.

PUBLIC ACQUISITION OF LANDS OR ESTABLISHMENT OF CONSERVATION EASEMENTS: Certain lands have been acquired by the Partners for the protection of surface water quality conditions in Mountain Island Lake. The Partners recognize the benefits of cooperatively pursuing the acquisition of additional lands. The purpose of this MOU is to provide guidance for land acquisitions and establishment of conservation easements and to allow the Partners the opportunity to comment prior to approval. It is recognized that in some situations the acquisition of properties is subject to closed meeting negotiations by the Partners. It is not the intent of this MOU to require disclosure of such negotiations.

ADDITION OR EXPANSION OF NPDES FACILITIES: National Pollutant Discharge Elimination System or NPDES Permits are issued for all facilities that discharge to surface waters. Currently there are three (3) NPDES discharge facilities located in the Mountain Island Lake watershed including:

1. McDowell Creek Wastewater Treatment Plant (NPDES #NC0036277) – This facility is owned and operated by Charlotte Mecklenburg Utilities and located at 2074 Neck Road in Mecklenburg County.
2. Riverbend Steam Station (NPDES #NC0004961) – This facility is owned and operated by Duke Energy Corporation and located at the intersection of Hwy. 16 and Horseshoe Bend Road in Gaston County.
3. McGuire Nuclear Station (NPDES #0024392) – This facility is owned and operated by Duke Energy Corporation and located at 13339 Hagers Ferry Road in Mecklenburg County.

In addition, the City of Mount Holly in Gaston County and Charlotte Mecklenburg Utilities have pumping stations in the Mountain Island Lake watershed. One of the purposes of this MOU is to



provide guidance for the addition or expansion of NPDES facilities and to allow the Partners the opportunity to comment prior to approval.

ADDITION OR EXPANSION OF WATER INTAKES: Charlotte Mecklenburg Utilities and the cities of Mount Holly and Gastonia currently own and operate water intakes on Mountain Island Lake that have permitted withdrawal rates at 330 million gallons per day (MGD), 3.2 MGD and 75 MGD, respectively. Increases in the permitted withdrawal rates at these facilities or the addition of intake structures on the Lake could affect efforts to protect water quality conditions around the intakes. One of the purposes of this MOU is to provide guidance for the addition or expansion of water intakes and to allow the Partners the opportunity to comment prior to approval.

ADDITION OR EXPANSION OF PROPOSED TRANSPORTATION

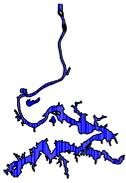
THOROUGHFARES: Transportation thoroughfares, including highways, bridges, railways, etc., are a source of water pollution. In addition, the expansion or addition of transportation thoroughfares can result in increased development activities in a watershed that has the secondary affect of increasing the discharge of pollutants in storm water runoff thus impacting surface water quality conditions. One of the purposes of this MOU is to provide guidance for the addition or expansion of proposed transportation thoroughfares and to allow the Partners the opportunity to comment prior to approval.

NEW OR AMENDED LAKE USE REGULATIONS: Lake use regulations currently exist for Mountain Island Lake as well as the other waterways in North Carolina as adopted by the N.C. Wildlife Resources Commission (NCWRC). The Mountain Island Lake Marine Commission has also adopted boating regulations to supplement the NCWRC regulations on Mountain Island Lake and to further promote safe boating on the Lake. Boating activities have the potential to affect surface water quality conditions in Mountain Island Lake due to the discharge of petroleum products and also due to the wave actions of boats causing increased turbidity levels. The Mountain Island Lake Marine Commission also tracks and coordinates with area jurisdictions, Duke Power, and NC Wildlife in responding to invasive species such as hydrilla. One of the purposes of this MOU is to provide guidance for new or amended Lake use regulations and to allow the Partners the opportunity to comment prior to approval.

NEW OR AMENDED LAND USE PLANS: Gaston County, Lincoln County, City of Mount Holly, City of Charlotte, Town of Cornelius and Town of Huntersville currently have land use plans pertaining to the areas within their jurisdictions that drain to Mountain Island Lake. Land use in these areas has the potential to affect water quality conditions in Mountain Island Lake by either increasing or decreasing the discharge of pollutants contained in surface water runoff. One of the purposes of this MOU is to provide guidance for new or amended land use plans and to allow the Partners the opportunity to comment prior to approval.

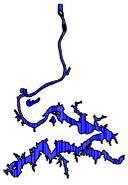
LOCAL LEGISLATION REGARDING THE MOUNTAIN ISLAND LAKE

WATERSHED: The Partners may elect to adopt various legislation having the potential to impact water quality conditions in Mountain Island Lake. The MOU will allow the Partners the opportunity to comment on this proposed legislation prior to consideration for adoption.



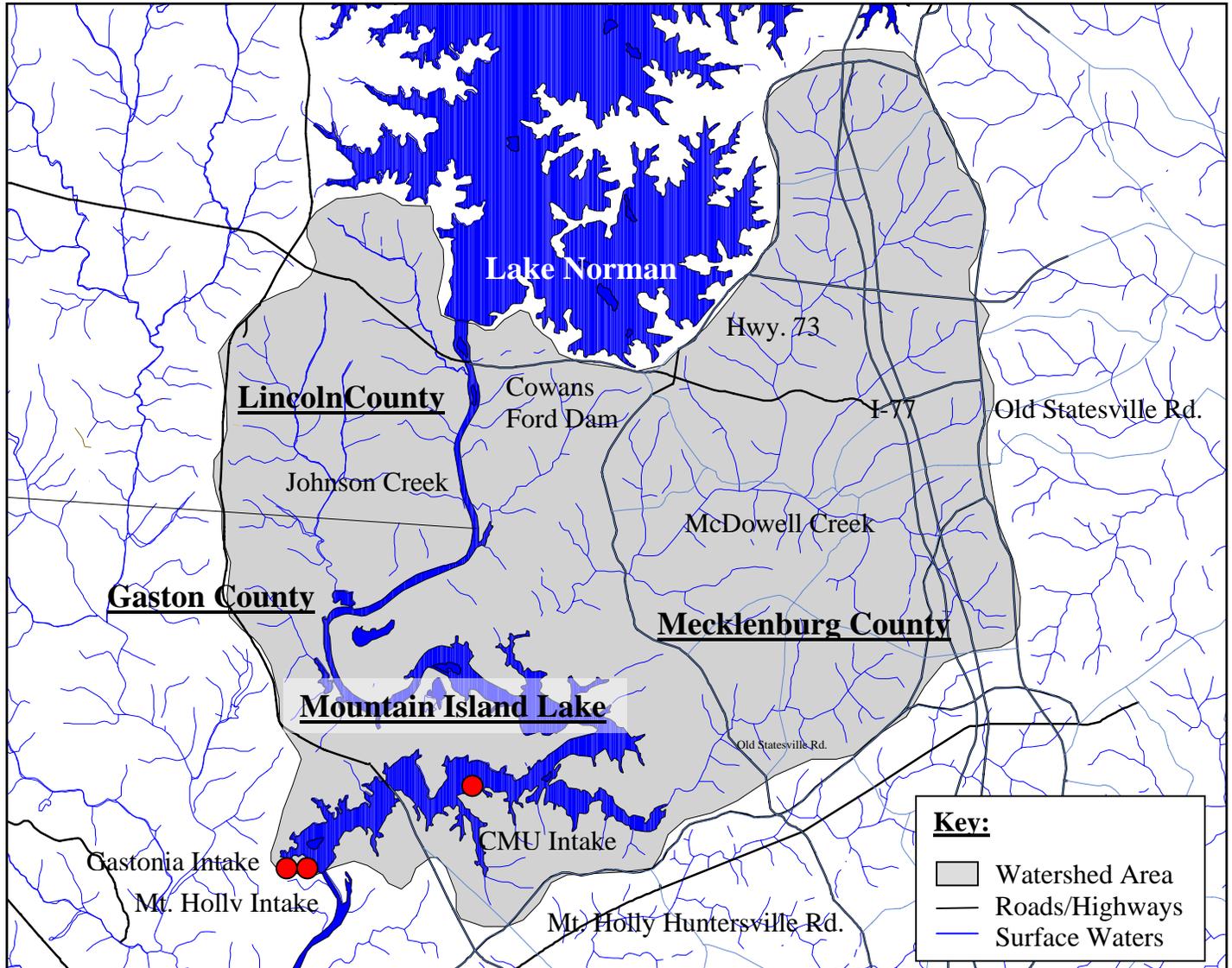
COORDINATION AND SHARING OF DATA AND INFORMATION: Data and information regarding Mountain Island Lake exists from a variety of sources. Assimilating this data and sharing it among the Partners is a goal of this MOU.

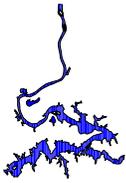
SHARING OF FUNDING NEEDS AND STRATEGIES: The Partners may have needs for funds to implement various actions important to the protection of water quality conditions in Mountain Island Lake. This MOU will allow the Partners the opportunity to share these needs with one another and work together on strategies to secure the needed financing.



Appendix B

Map of Mountain Island Lake





Appendix C: Contact List

Federal Government

U.S. Environmental Protection Agency (EPA), Region 4, Atlanta GA

Sam Nunn Atlanta Federal Center

61 Forsyth Street, SW

Atlanta, GA 30303-3104

Telephone: (404) 562-9900; Toll Free: 1-800-241-1754; Fax: (404) 562-8174

<http://www.epa.gov/region4/>

The EPA is responsible for the country's adherence to the Clean Water Act. EPA typically has little involvement with local issues since most water quality regulations are delegated down to the state level (NCDWQ).

Federal Energy Regulatory Commission (FERC)

701 Pennsylvania Avenue, N.W.

Washington, D.C. 20004-2696

(202) 508-5000

http://www.eei.org/industry_issues/electricity_policy/Federal_Energy_Regulatory_Commission

FERC is responsible for all permitting issues related to the management of the Catawba River.

All of Duke Energys activities such as power production, alteration of the river and permitted of any kind must be approved by FERC.

US Army Corp of Engineers (USACE) Asheville NC Field Office

151 Patton Avenue, Room 208

Asheville, North Carolina 28801-5006

General Number: (828) 271-7980; Fax Number: (828) 281-8120

<http://www.saw.usace.army.mil/wetlands/where/ashville.htm>

The USACE has ultimate authority over wetlands. Any construction that would alter or disturb wetlands, including streams and lakes could require permitting through the USACE.

US Geological Survey (USGS) Charlotte NC Field Office

810 Tyvola Road, Ste 108

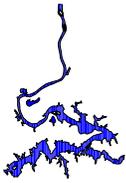
Charlotte, NC 28217

(704) 344-6272 / 6791

(704) 344-6363 (fax)

<http://nc.water.usgs.gov/>

The USGS maintains numerous stream and river flow gauges throughout the region. They also have an extremely extensive rain gauge network that covers the region. The USGS has historically partnered with local governments in the area, providing various water quality and quantity information.



State Government

North Carolina Division of Water Quality (NCDWQ) Mooresville Regional Office

919 North Main Street
Mooresville, NC 28115
voice: (704) 663-1699; fax: (704) 663-6040
<http://www.mro.enr.state.nc.us/wq/>

The NCDWQ has delegated authority from EPA to enforce water quality regulations. They are responsible for ensuring the states compliance with the Clean Water Act, parts of the Oil Pollution Control Act, and others. This includes items such as National Pollution Discharge Elimination System (NPDES), water quality standards, Total Maximum Daily Loads (TMDL), water supply watershed protection and others.

North Carolina Division of Land Resources, Mooresville Regional Office

919 North Main Street
Mooresville, NC 28115
Phone: 704-663-1699; Fax 704-663-6040
<http://www.dlr.enr.state.nc.us/>

The Division Land Resources is responsible for the states compliance with the Sedimentation Pollution Control Act. Land Resources staff review erosion control plans and inspect construction sites as needed to ensure compliance. This division is extremely understaffed in relation to the amount of construction activity in this region. Local governments may elect to start their own sedimentation control programs, in which case they would need to acquire delegated authority from the state. Currently, Charlotte, Mecklenburg County, and Gaston Counties have their own erosion control programs. The state, however, must inspect all public projects, ie. schools, municipal utility projects, etc.

North Carolina Wildlife Resources Commission

<http://www.ncwildlife.com/>

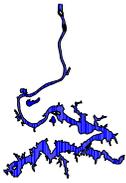
The North Carolina Wildlife Resources Commission is responsible for wildlife and fisheries regulations in North Carolina. This includes the protection of threatened and endangered species and the preservation of fish and wildlife habitat. The enforcement branch of the commission enforces game and fish regulations.

Local Government

Mecklenburg County Water Quality Program (MCWQP)

700 North Tryon St. Charlotte, NC 28202, 704-336-5500
<http://waterquality.charmeck.org>

MCWQP has delegated authority from NCDWQ to enforce some components of state laws within Mecklenburg County. Staff respond to spills, buffer violations and inspect waste water treatment plants. They also have delegated authority from the NC Land Resources Division to enforce sediment control regulations in Mecklenburg County (excluding Charlotte). MCWQP has an extensive monitoring program throughout the county, including the lakes.



Gaston County Planning Department

212 W. Main Street, Gastonia

Phone: 704-866-3195; Fax: 704-866-3908

<http://www.co.gaston.nc.us/PlanningBoard/index.htm>

Responsible for all land use planning and local ordinance / zoning development and enforcement.

**Gaston County Soil and Water Conservation District
Natural Resources Department**

1303 Cherryville Hwy.

Dallas, NC 28034

704-922-4181

www.co.gaston.nc.us/SoilAndWaterConservation/index.htm

Provides technical assistance to the public regarding natural resource conservation including water quality.

**North Carolina Cooperative Extension Service (Gaston County)
Quality of Natural Resources Commission (QNRC)**

PO Box 1578

Gastonia, NC 28053

704-922-2119

www.ces.ncsu.edu/gaston/Volunteers/QNRC.html

A board of representatives from various businesses, environmental organizations and industry with a mission to educate, evaluate and communicate environmental issues to the public and elected officials.

Gaston County Environmental Health Department

991 West Hudson Boulevard

Gastonia, NC 28052

704-853-5000

Fax 704-853-5252

<http://www.co.gaston.nc.us/HealthDept/EnvironmentalHealth.HTM>

Responsible for the permitting and inspection of individual water and waste water systems such as wells and septic systems.

Lincoln County Environmental Health Department

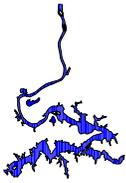
302 N Academy St

Lincolnton, North Carolina 28092

(704) 736-8426

<http://www.lincolncounty.org/County/departme.htm#E>

Responsible for the permitting and inspection of individual water and waste water systems such as wells and septic systems.



City of Charlotte Engineering and Property Management, Land Development Division

600 East 4th St.

Charlotte, NC 28202

704-336-6692

<http://www.charmeck.nc.us/Departments/City+Engineering/home.htm>

The Charlotte Land Development Division has delegated authority from the state to enforce sediment control regulations within Charlotte.

Town of Cornelius Planning Department

21445 Catawba Avenue

PO Box 399

Cornelius, North Carolina 28031

Phone: (704) 896-2461; Fax: (704) 896-2462

<http://other.cornelius.org/planning/>

Responsible for all land use planning and local ordinance / zoning development and enforcement.

Town of Huntersville Planning Department

101 Huntersville-Concord Road

Post Office Box 664

Huntersville, North Carolina 28070

Telephone: (704) 875-6541; Fax: (704) 875-6546

<http://www.huntersville.org/>

Responsible for all land use planning and local ordinance / zoning development and enforcement.

City of Mt. Holly Planning Department

131 South Main Street

Post Office Box 406

Mount Holly, North Carolina 28120

704.827.3931 phone

704.822.2933 fax

<http://www.mtholly.us/planning.htm>

Responsible for all land use planning and local ordinance / zoning development and enforcement.

City of Gastonia Planning Department

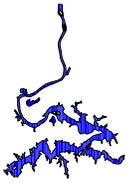
P. O. Box 1748

Gastonia, NC 28052

704.866.6747 (phone); 704.864.9732 (fax)

<http://www.cityofgastonia.com/citydepts/planning/planning.htm>

Responsible for all land use planning and local ordinance / zoning development and enforcement.



Mountain Island Lake Marine Commission

1300 Baxter Street Suite 450

P.O. Box 35008

Charlotte, NC 28235

(Phone) 704 348-2705

(Fax) 704 347-4710

www.marinecommission.com/milmc.htm

The Mountain Island Lake Marine Commission was formed in 1997 through a joint resolution between Gaston, Lincoln and Mecklenburg Counties. Members of the commission are appointed by County Commissioners. The purpose of the Commission is to manage and protect the lake's many uses. The commission's jurisdiction includes the entire lake and 1000 ft. above full pond level.

Utilities

Duke Energy

526 South Church St.

Charlotte, NC 28202-1904

(704) 594-6200 800) USE-DUKE

(800) 873-3853

<http://www.duke-energy.com/>

Local power company that owns and manages the lake for power production. Duke Energy is permitted and regulated by the Federal Energy Regulatory Commission (FERC).

Charlotte Mecklenburg Utilities

5100 Brookshire Blvd. Charlotte, NC 28216

704-399-2221

<http://www.charmeck.org/Departments/Utilities/Home.htm>

Responsible for local water and sewer planning and operations.

Mt. Holly Utility Department

131 South Main Street

PO Box 406

Mount Holly, NC 28120

(704) 827-3931

http://www.ci.mount-holly.nc.us/w_water.htm

Responsible for local water and sewer planning and operations.

City of Gastonia Utility Department

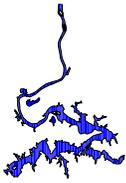
P. O. Box 1748

Gastonia, NC 28053

704.854.6694 (phone); 704.867.0120 (fax)

<http://www.cityofgastonia.com/citydepts/pwu/pwu.htm>

Responsible for local water and sewer planning and operations.



Non Profit Agencies

Catawba River Foundation

926 Elizabeth Ave #301

Charlotte, NC 28204-2204

Phone: 704. 373.1916 Fax: 704.373.1665

<http://www.catawbariverkeeper.org/>

Advocate for the protection of the Catawba River through various programs, including the funding of the Catawba Riverkeeper Program, a citizen watch initiative.

The Trust for Public Land

<http://www.tpl.org/index.cfm>

National nonprofit group working to secure, protect and conserve lands for the future.

Catawba Lands Conservancy

105 West Morehead Street, Suite B

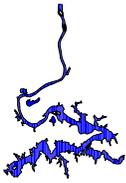
Charlotte, NC 28202

Telephone: (704) 342-3330

Fax: (704) 342-3340

<http://www.catawbalands.org/>

Catawba Lands Conservancy is a nonprofit land trust that protects the land, water and wildlife resources of the Southern Piedmont and Lower Catawba River Basin of North Carolina.



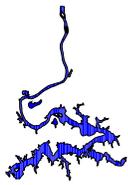
Appendix D

Mecklenburg County

Waterborne Disease Outbreak Prevention Policy

Purpose: One of the primary functions of our lake monitoring program is to protect the citizens of Mecklenburg County from exposure to elevated bacteria levels in Lake Norman, Mountain Island Lake and Lake Wylie and to prevent the outbreak of waterborne diseases. Mecklenburg County's "Waterborne Disease Outbreak Prevention Policy" pages 19 and 20 clearly specifies the actions necessary to ensure that the Mecklenburg County Water Quality Program (MCWQP) adequately fulfills this extremely important function (see attached). The purpose of the procedures provided below is to ensure that MCWQP fulfills this Policy to the letter.

1. Review all fecal coliform data collected from lake monitoring activities immediately upon receipt from the lab and always within 5 working days of collection. If bacterial contamination is suspected in an area, notify the lab to **RUSH** the sample analyses and to contact you immediately when results are available which should be within 24 hours of delivery to the lab. If you don't hear from the lab in 24 hours, call them.
2. Notify your supervisor immediately (or Program Manager if the Supervisor is not available) if one or more of the following conditions is observed. If the observation is made in the field, contact should be made immediately by cell phone or radio.
 - a. Any unusual observations are made during lake monitoring activities (i.e. fish kill, odors, unusual colors).
 - b. A sewer discharge to the lake is confirmed.
 - c. Sampling results indicate fecal coliform bacteria concentrations greater than or equal to 200 colonies/100 millimeters for any one or more samples collected.
 - d. Sampling results indicate an exceedance of **any** of the established Action Levels for the lakes.
3. The Supervisor is to immediately notify the Program Manager of staff notifications as described in 2 above. The Program Manager will immediately notify the Health Director of any sampling results indicating greater than 200 colonies/100 millimeters for any one or more samples collected as specified in "c" above. Conditions reported in "a, b or d" will be relayed to the Health Director as is deemed necessary by the Program Manager. Through consultation with the Health Director, the Program Manager will determine if a "**SWIMMING ADVISORY**" will be issued and for what area(s).
4. Upon approval from the Supervisor and/or Program Manager, immediately post "**SWIMMING ADVISORY**" signs along the shore to adequately mark the affected area and place a buoy in the cove to warn boaters. If you are going into the field to investigate a possible pollution problem (i.e. reported sewer overflow, etc.), be sure to take the "**SWIMMING ADVISORY**" signs with you and notify the Supervisor if one or more of the conditions in 2 above are confirmed. Following approval from the Program Manager, signs can be posted prior to leaving the site.

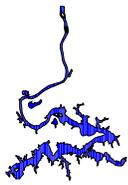


5. Carefully document all activities on your Service Request of Activity Report. This documentation should include a complete description of all observations and lab results. The report must also contain the date and time when the “**SWIMMING ADVISORY**” was issued and the area posted. You must also document all follow up activities and monitoring results and indicate the date and time when the advisory was lifted. Get copies of all “Media Releases” and attach to your report.
6. The Program Manager will immediately notify all interested parties by way of email. A sample email message is provided below.

On July 27, 2000, the Mecklenburg County Water Quality Program (MCWQP) received notification from Ms. Hickle, President of the Spinnaker Point Condominiums Homeowners’ Association, that a sewage spill at a malfunctioning lift station serving the Spinnaker Point Condominiums in Davidson, N. C. had resulted in the discharge of an unknown quantity of raw sewage to Lake Davidson. An investigation by MCDEP on July 27 confirmed that the sewage had entered Lake Davidson. Repairs were completed to the lift station and the discharge stopped in the evening on July 27. Bacteriological samples were collected by MCWQP to determine the impacts to nearby swimming areas. On July 29, 2000, the bacteriological results were reported to MCWQP by the Health Department lab indicating concentrations of fecal coliform bacteria at 400 colonies/100ml of sample. Normal counts of fecal coliform bacteria in lakes, which indicate the suitability of an area for swimming should not exceed 200 colonies/100 ml. MCWQP immediately contacted Health Department officials and a joint decision was made to issue a “**SWIMMING ADVISORY**” for all affected areas on Lake Davidson. This advisory was placed on the cove at the Spinnaker Point Condominiums in Davidson Lake effective at 6:30 p.m. on July 29, 2000. Signs have been posted in the affected area and a media release issued. Ms. Hickle was also informed and she indicated that she would notify residents within the condominium complex around the affected area. MCWQP will sample the affected area daily until bacteria levels fall below 200 colonies/100 ml at which time the “**SWIMMING ADVISORY**” will be lifted and the signs removed. A press release will also be issued concerning the lifting of the advisory. Areas of Lake Davidson outside the cove at the Spinnaker Point Condominiums are unaffected by the sewage spill and should be safe for swimming. If you have any questions, please contact David Caldwell or Rusty Rozzelle of MCWQP at 704-336-5500. You will be informed of the results of future sampling and the lifting of the “**SWIMMING ADVISORY.**” Thank you.

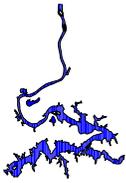
The mailing list for issuance of this advisory is provided below. This mailing list is saved as a group titled “swimadv” I Rusty Rozzelle’s GroupWise.

- Bobby Cobb (Meck. Co. Env. Health Dept.): in GroupWise
- Boyce Hunt (Gaston Co. Env. Health): bhunt@gastongov.org
- Carmel Clements (Meck. Co. Health Dept.): in GroupWise
- David Caldwell (MCWQP): in GroupWise
- Donna Lisenby (Catawba RiverKeeper): <http://www.catawbariverkeeper.org/>
- Gary Black (Meck Co. Health Dept.): gblack@carolinas.org



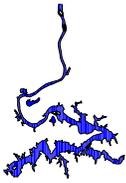
- Joe Faris (District Eng. Catawba Env. Quality Control): farisjs@incstr30.dhec.state.sc.us
 - Joe Hall (Duke Power Lake Management): jshall@duke-energy.com
 - Joe Travis (Trapper) (Meck. CO. Media Contact): trapper704@aol.com
 - John McGillicuddy (Director of Meck. Co. PSI): in GroupWise
 - John M. Barry (MCDEP): in GroupWise
 - Kelly Sheeks (Iredell Co. Env. Health): ksheeks@co.iredell.nc.us
 - Kyle Vickery (DHEC Env. Health): vickermk@rockhl60.dhec.state.sc.us
 - Mike McLaurin (Mountain Island and Lake Wylie Marine Commissions): mmclaurin@centralina.org
 - Pam Beck (aid to RiverKeeper): pambeck@dellnet.com
 - Peter E. Safir (Meck. Co. Health Dept.): in GroupWise
 - Richard Bridgeman (Mooresville Regional Office)
 - Rusty Rozzelle (MCDEP): in GroupWise
 - Susan Long-Marin (Meck Co. Health Dept.): slong-marin@carloina.org
 - Scott Sneed (Lincoln Co. Env. Health): ssneed@lincoln.org
 - Stephen R. Keener (Meck. Co. Health Dept.): in GroupWise
 - Sylvia D. Daniel (Meck C. Env. Health Dept.): in GroupWise
 - Thomas Spurling (Catawba Co. Env. Health): toms@mail.co.catawba.nc.us
7. The Program Manager will immediately notify Alex Barnett (LUESA Media Relations) of the elevated bacteria levels for issuance of a “Media Release”.
8. Within 24 hours of receiving lab results, resampling must be performed in the area where elevated fecal coliform levels were detected (or other Action Level Exceedances) under direction from the Supervisor and Program Manager. The sampling area will be expanded to determine the full extent of contamination and all potential sources. For all resampling, notify the lab to **RUSH** the sample analyses and to contact you immediately when results are available which should be within 24 hours of delivery to the lab. If you don’t hear from the lab in 24 hours, call them. This resampling will continue at 24 hours intervals until results fall below the Action Level and the Program Manager has lifted the **“SWIMMING ADVISORY.”**
9. Immediately upon receipt of results, notify the Supervisor and Program Manager who will make the determination after consulting with the Health Department as to whether the **“SWIMMING ADVISORY”** should be lifted at which time the signs will be removed and a media release issued by Alex Barnett. The program Manager will also send an email containing all resampling results and the status of the swimming advisory to the above listed contacts. A sample email is provided below.

On Wednesday, August 2, the Mecklenburg County Water Quality Program (MCWQP) in cooperation with the Mecklenburg County Health Department lifted the swimming advisories, which had been previously issued for coves located at Half Moon Bay Condos on Lake Norman and Spinnaker Point Condos on Lake Davidson. Both advisories were



issued due to elevated bacteria levels detected by MCWQP from water sampling performed following sewer leaks from private lift stations located adjacent to the lakes at the condos. The advisory for Half Moon Condos was issued on July 17 due to bacteria counts at 17,000 colonies/100ml, which was significantly above safe levels at less than 200 colonies. The advisory for Spinnaker Point Condos was issued on July 29 with counts at 400 colonies. Resampling performed at both locations on July 31 revealed that bacteria levels had dropped well below 100 colonies, which is within the safe range for human contact. MCWQP performed sampling every day in the effected areas throughout the advisory period and “NO SWIMMING ADVISORY” signs were posted around the lakefront to warn swimmers. Media releases for the advisories were also issued. Due to the initial high concentrations at Half Moon Condos, it took 2 weeks for levels to come down. With the lifting of the swimming advisories all signs have been removed and a media release issued.

10. REMEMBER, if you are going to make a mistake always strive to error on the side of caution, never complacency.



Mecklenburg County Waterborne Disease Outbreak Prevention Policy

1. Recreational Water

The following is a summary of surface water monitoring performed by the Mecklenburg County Water Quality Program (MCWQP):

a. Surface Waters

1. Bacteriological Monitoring (MCWQP)

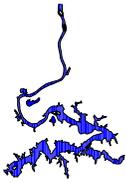
Thirty-six sites at Lake Norman, Mountain Island Lake, and Lake Wylie are monitored for coliform bacteria between May and September. Monitoring sites are located in areas subject to activities involving frequent human body contact (see Appendix B).

Fecal coliform results will be received and reviewed by MCWQP within five working days of collection. According to state standard, fecal coliforms are not to exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any thirty day period; nor exceed 400/100ml in more than twenty percent of the samples examined during such period. Violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution. Any exceedance of 200 colonies of fecal coliform bacteria per 100 milliliters (“Action Level”) will automatically trigger a resample for confirmation and identification of pollution source(s). The “Action Level” was set using empirical data and is set at a relatively low threshold. The Health Director will be notified of all such resampling activities.

During the performance of resampling activities, a sample will be collected for further analysis of contaminants. All resampling results will be made available to the Health Director.

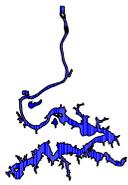
2. Chemical Monitoring (MCWQP)

Seventeen sites at Lake Norman, Mountain Island Lake, and Lake Wylie are monitored year-round for general water quality. Sixteen parameters are monitored: alkalinity; total phosphorus (TP); orthophosphorus; total kjeldahl nitrogen (TKN); ammonia nitrogen; nitrate; nitrite; total solids; turbidity; chlorophyll a; fecal coliform bacteria; pH; dissolved oxygen (DO); temperature; conductivity; and secchi disk depth. Monitoring sites are located in areas subject to activities involving frequent human body

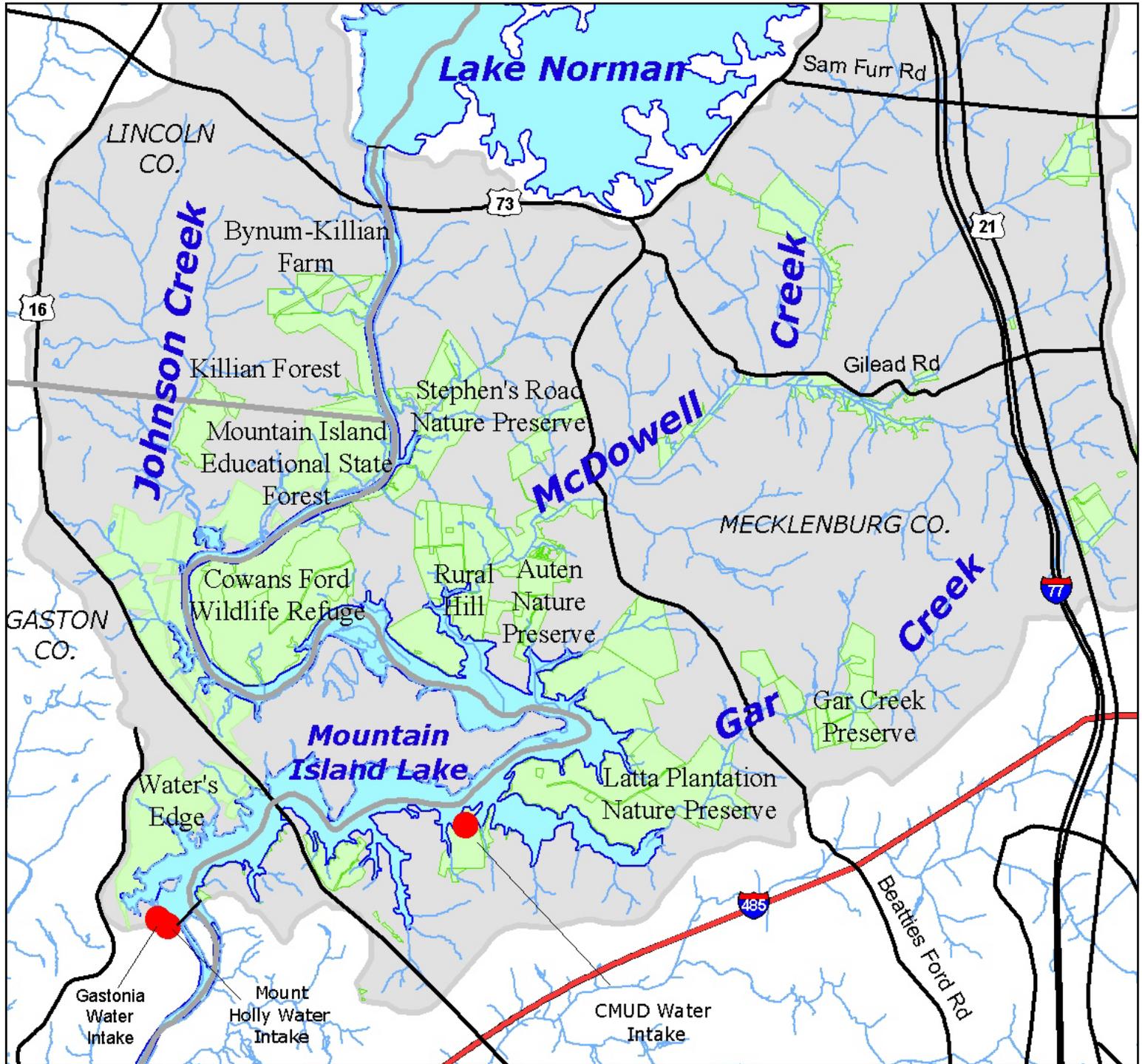


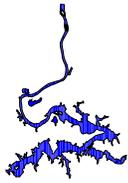
contact or in areas where there is a high probability of chemical contamination (see Appendices C and D).

Monitoring results are reviewed when received from the laboratory (usually within 30 days of collection). Some parameters have established standard levels of acceptance. Other parameters have no established standard; therefore, acceptance levels are based on historical data. Any exceedance of established levels for each parameter will trigger a resample of confirmation and identification of pollution source(s). The Health Director will be notified of all resampling for parameters which indicate possible human health impacts including fecal coliform bacteria, pH, temperature and conductivity. Resampling results for these parameters will be made available to the Health director.



Appendix E Public Owned Properties in Gaston, Lincoln and Mecklenburg Counties





Appendix F

Protecting Our Lake Watersheds

Mecklenburg County, North Carolina

A Practical Guide To Lake Watershed Protection
2005

Prepared by:

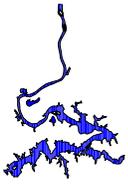
Mecklenburg County Water Quality Program
Land Use and Environmental Services Agency
700 N. Tryon Street, Suite 205
Charlotte, NC 28202

Phone: 704-336-5500

Fax: 704-336-4391

<http://waterquality.charmeck.org>

January 2005



“Treat the earth well. It was not given to you by your parents.
It was loaned to you by your children.” Kenyan Proverb

Lakes have a special allure that draw people to their shores. They provide beautiful scenery and wonderful recreational opportunities like boating, fishing and swimming. In the past decade, Mecklenburg County has experienced an escalated demand for property near and along our lakes. As people have relocated to the area, businesses have flourished and infrastructure has been built to support the development boom. All of this growth has led to increased pressure on the quality of water in our lakes and their connecting creeks. Proximity to our precious waters gives lake residents a special opportunity, if not responsibility, to have a positive impact on water quality. Accepting this responsibility helps protect the water and adjacent land for your enjoyment as well as that of other residents and future generations.

This booklet is intended for residents who own property and/or live within a lake watershed in Mecklenburg County. It provides valuable information about laws and regulations pertinent to lake-area living. In addition, it gives advice on how to maintain a lifestyle that has a low impact on the water and the environment in general. Take the time to read through this booklet and you may find the answers to some of your questions and perhaps learn something you did not know.

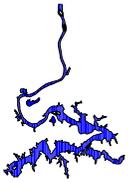


Figure 7: Canoeing at Latta Plantation Nature Preserve is a favorite recreational activity enjoyed on Mountain Island Lake.

Protecting Water Quality ... What's In It For You?

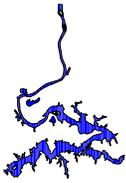
Consider some of the important reasons to help protect the quality of our lakes and creeks in Mecklenburg County:

Your Health

- With Lake Norman and Mountain Island Lake being the sources for our drinking water, we do not want to ever run the risk of producing more contamination than the water treatment technology can handle.
- High bacteria levels put swimmers and other lake recreationists at risk of eye and ear infections. Children and elderly are especially susceptible to bacterial infections.

Your Quality Of Life

- An attractive lake offering an assortment of recreational activities improves our quality of life. Without clean, healthy waters, lake residents and visitors alike cannot enjoy these activities to the fullest. Protecting our lakes maintains our quality of life.



Economics

- Let's face it: poor water quality affects your wallet (or purse). People are drawn to live near beautiful, clean lakes and creeks - not unsightly, dirty waters. For obvious reasons, property values are higher in areas in high demand. Polluted waters can quickly ruin an area's appeal.
- Polluted water is more expensive to treat and may result in an increased water bill.
- Recreational water opportunities attract visitors and residents to lake amenities, contributing to the local economy.

Fish And Wildlife

- Given that fish and other aquatic wildlife spend all (or most) of their time in the water, pollution has a great impact on their health. Most organisms are adapted to a particular habitat and water quality level, so even small amounts of pollution or changes in the surrounding environment can have a negative effect.

We're All Downstream

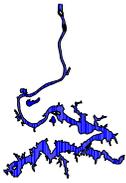
Lake Norman, Mountain Island Lake and Lake Wylie, are all part of the Catawba River system. As with any waterway, what happens upstream in the system impacts the water and people downstream. The Catawba River system is mainly comprised of 11 hydropower reservoirs, starting with Lake James at the foot of the Blue Ridge Mountains and leading down to Lake Wateree in central South Carolina. Smaller rivers and creeks also flow into the river's main stem.

Altogether, the Catawba River basin covers over 4,750 square miles and has nearly 3,100 miles of free-flowing rivers and creeks. With over 1.5 million residents living within this basin, it is one of the most densely populated river basins in North Carolina. Just as those who live upstream of Mecklenburg County impact the water quality flowing into our area, we impact the water quality flowing out of our area. This is the same water that downstream residents rely on for drinking, swimming, fishing, and a variety of other uses.

Quite naturally, families and businesses located directly along the Catawba River lakes and creeks have the greatest potential for impacting the water supply given their proximity. For this reason, lakeshore and creekside residents must be especially mindful of how they can affect the water nearby...and downstream.

Watershed Management

Past efforts to reduce pollution have focused more on factories than subdivisions. After all, it is easier to regulate an industrial site than to track down the neighbor whose excessively applied fertilizer washed off into the lake. That is why for years, regulations were directed more at "point source" pollution, meaning the pollutant discharges into the water by a direct route from an identifiable source, like industrial plants and wastewater treatment facilities. Yet we now know subdivisions account for a great deal of water pollution, too. Studies indicate 50 percent of water quality degradation nationwide is due to "nonpoint source" pollution such as chemicals used around the house, in the yard and with a car. Today's focus includes nonpoint source pollution through a concept called watershed management. Basically, this involves implementing measures to manage and prevent water pollution within a defined watershed.



For a particular body of water, a watershed (or drainage basin) is the surrounding land area that drains into that body of water. For a lake, water may first drain to a stream within a watershed that then flows into the lake. On its way, water travels across farm fields, forested land, suburban lawns, parking lots and city streets and picks up pollutants. Pollution emanating from these landscapes includes sediment, oil, grease, bacteria and fertilizer that either seeps into the soil and travels as groundwater or is picked up in storm water runoff. Reducing the contaminants found in runoff by addressing individual behaviors that impact the environment is a vital aspect of watershed management. Later in this booklet, you will find tips on what you can do to help.

Mecklenburg County Lake Watersheds

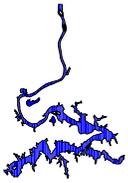
Lake Norman Watershed

- Lake Norman is located along the northwestern border of Mecklenburg County
- Largest man-made lake in the Carolinas
Drinking water source for Mooresville, Huntersville, Davidson, Cornelius and Lincoln



Figure 8: Lake Norman is the largest man-made lake in the Carolinas.

- Supports a wide variety of aquatic life, including large fish populations
- Total surface area of 32,510 acres
- Individual watershed encompasses 340 square miles
- Total drainage area including all lake and river watersheds upstream is 1,790 square miles.



- 520 miles of shoreline, with an estimated 90 miles in Mecklenburg County

Currently, Lake Norman has the best water quality of the three lakes in Mecklenburg County. In the past, the watershed had a fairly low population density and a large percentage of wooded and open space, which are significant factors contributing toward its good quality. However, this has changed. Growth pressures within Lake Norman's watershed continue to threaten the water quality and the lake's main uses such as drinking water and recreation.

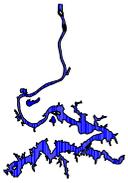
Mountain Island Lake Watershed

- Smallest of the three lakes
- Primary drinking water source for Mecklenburg County, Gastonia and Mount Holly
- Approximately 100 million gallons of water are withdrawn daily to serve Charlotte-Mecklenburg residents.



Figure 9: Charlotte-Mecklenburg Utilities drinking water intake on Mountain Island Lake.

- Mecklenburg County's McDowell, Torrence and Gar Creeks flow into Mountain Island Lake
- Total surface area of 2,788 acres
- Individual watershed encompasses 70 square miles



- Total watershed drains 1,860 square miles
- Approximately 61 miles of shoreline, with an estimated 37 miles in Mecklenburg County

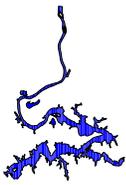
Currently, Mountain Island Lake has good to excellent water quality. However, streams, which flow into the lake, are declining in terms of water quality, particularly McDowell Creek that winds through the Town of Huntersville. McDowell Creek Cove has experienced a significant decline in water quality conditions due to increased land development in the watershed. Its water quality has become one of the poorest in Mecklenburg County due to increased sediment and nutrient levels.

Lake Wylie Watershed

- Very long lake with a surface area of 12,139 acres
- Largest individual watershed along the Catawba River, encompassing 1,160 square miles
- Total drainage area is 3,020 square miles
- Drinking water source for Belmont and Rock Hill



Figure 10: Lake Wylie Dam in South Carolina.



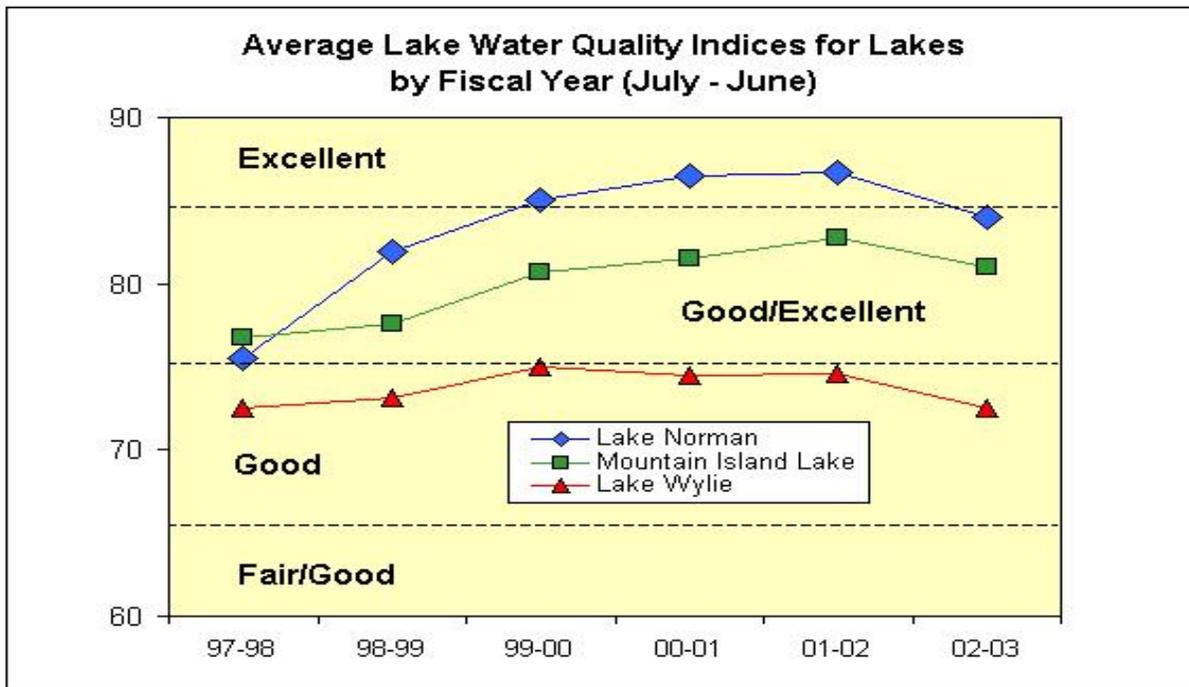
- Long and Paw Creeks flow into this watershed
- 327 miles of shoreline, with an estimated 67 miles located in Mecklenburg County

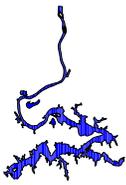
Overall, Lake Wylie has good water quality. However, its uses are currently threatened. Numerous point and nonpoint pollution sources have contributed to water quality degradation in its embayments and tributary arms. High nutrient levels have been linked to algae blooms and fish kills in warmer months. The primary sources of pollution are urban runoff and wastewater treatment plant discharges. Over 100 plants are located along tributaries to Lake Wylie in Gaston and Lincoln counties. Urban runoff and wastewater treatment discharges from Mecklenburg County and agricultural runoff from Gaston and Lincoln counties are also significant problems.

In addition, Lake Wylie is becoming more developed. In 1995, the population density within Mecklenburg County’s portion of the Lake Wylie watershed was 134 persons per square mile, which is low compared to the Mecklenburg County average of 876 persons per square mile. The percentage of open space was also the highest in the county. However, the population is increasing and the open space is decreasing, as there is a greater desire to live along Lake Wylie’s shores.

Water Quality Conditions In Mecklenburg County Lakes

The following graph provides an average for the water quality conditions in Lake Norman, Lake Wylie, and Mountain Island Lake from July 1997 to June 2003. The data is provided in a Water Quality Index, which is a mathematical means of transforming large quantities of water quality data into a single number. The water quality index is comprised of nine water quality parameters including Chlorophyll *a*, pH, Dissolved Oxygen, Secchi Disk Depth, Specific Conductivity, Temperature, Total Alkalinity, Nitrate and Total Phosphorus.





Buffers and Their Importance

What Is A Buffer And How Does It Function?

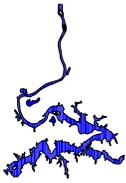
Buffers are natural, forested areas adjacent to lakes and creeks. These buffers serve to filter pollutants from storm water, absorb runoff and reduce the volume of runoff, thereby reducing erosion and pollutants.

In order to effectively provide their natural filtering function, buffers must be of sufficient width. In North Carolina, the recently adopted Catawba Buffer Rules require a 50-foot minimum buffer width for new development along the Catawba River. Wider buffers may be necessary for steeper slopes, areas downstream of intense development, or for extra protection of highly valued uses such as drinking water.

A well-established buffer is generally self-perpetuating and requires little maintenance. Native trees and shrubs are recommended for their hardiness, effective canopy and root structure. Buffer canopies intercept rainfall, thereby minimizing soil disturbance. They also improve water quality by providing shade, which lowers water temperature. Cool water carries more dissolved oxygen than warmer water and is essential to the survival of fish and other aquatic wildlife species that are sensitive to changes in temperature. Buffers also provide woody debris for fish habitat.



Figure 11. A natural forested area adjacent to surface water body is called a buffer.



Buffer Regulations

In 1992, North Carolina passed a law requiring local governments to develop watershed regulations aimed at protecting water quality in lakes classified as drinking water supplies. Minimum standards were established by the state, and local governments were required to pass regulations for their jurisdictions. Most jurisdictions in Mecklenburg County adopted more stringent watershed regulations and incorporated them into subdivision, land development, and/or zoning ordinances. A majority of these regulations address the following three issues: (1) development density (amount of built-upon or impervious area), (2) buffer widths and (3) land use. Those who live within a lake watershed should be most familiar with buffer requirements in their area. A pullout map is provided to help determine which rules apply to where you live. The attached document entitled *Watershed Buffer Guidelines for Mecklenburg County, NC* summarizes general buffer requirements and guidelines for all lake watersheds. Other pertinent information, such as suggested tree plantings for buffer areas and guidelines for stepping stone pathways, can be found in the attachment as well.

Buffer Requirements

Undisturbed buffers required along the shoreline of all Mecklenburg County lakes are measured from the full pond elevation:

- Lake Norman - 760 feet
- Mountain Island Lake - 648 feet
- Lake Wylie - 569.4 feet

Along all perennial streams, undisturbed buffers are measured from the top of the bank on each side of the stream. Critical Areas (CA) are generally located in close proximity to surface waters. Such areas are protected by higher standards because of the greater risk of water quality degradation from pollution. Protected Areas (PA) are located beyond the CA in the watershed. They are subject to fewer restrictions because the risk of water quality degradation from pollution is less. Development density is typically addressed by either a low-density option, (single-family detached dwellings) or a high-density option, (multi-family dwellings or commercial development). There are separate watershed regulations and buffer requirements for each of the three lakes. Refer to the attachment for more information about specific buffer and watershed requirements.

Buffer Violations And Restoration

Where a buffer area has been found to be disturbed, a Notice Of Violation (NOV) may be issued to the property owner by the local zoning department or their designee. The violation requires that the property owner restore the buffer to a condition acceptable under the attached *Watershed Buffer Guidelines for Mecklenburg County, NC*. Monetary penalties may also be assessed. Restoration involves replanting trees and shrubs to a certain density in the buffer, which is given in the guidelines. A restoration plan must be submitted and approved by Mecklenburg County Water Quality Program (MCWQP).



An appeal of the violation may be submitted to the Zoning Department. If the violation is not corrected or no appeal is made within 60 days of the date of the NOV, the Zoning Department may (1) revoke the certification of occupancy, making continued occupancy unlawful; (2) issue a citation and, if unpaid, a judgment could become a lien on the property; (3) seek an injunction; or (4) issue a criminal summons.

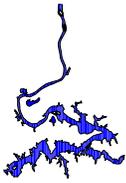
Special Permits

A permit is required when conducting certain activities near a lakeshore in Mecklenburg County. Duke Power's Lake Management Division has the following six permitting programs: (1) commercial facilities, (boat slips at condominiums, campgrounds, marinas, etc.), (2) private single-family, (boat docks or piers at a single-family residence), (3) conveyance, (water intakes, bridges, and road crossings), (4) shoreline stabilization, (rip-rapping and seawall construction), (5) excavation or dredging and (6) miscellaneous uses for activities such as installing heat coils or withdrawing greater than one million gallons of water per day. Withdrawal of less than this amount for domestic purposes does not require a permit, but does require a letter of intent to the Duke Power Lake Management Office. Contact their office at 1-800-443-5193 if you think you might need a permit.

Any activity that could potentially disturb the buffer requires the submittal of an Application for Temporary Buffer Disturbance to the MCWQP. Disturbed areas would include all areas of the buffer where the natural ground cover has been graded, removed or altered. For your convenience, an Application For Temporary Buffer Disturbance has been included in the attachment.



Figure 12: Building boat slips and stabilizing shorelines on lakes in requires a special permit.



Impervious Surfaces Limitations

One component of the watershed protection regulations is Built Upon Area (BUA) or impervious area. Limitations on the amount of BUA within a drinking water supply watershed are critical to protecting water quality. Research has shown that there is a direct correlation between the amount of impervious surfaces in a watershed and that watershed's water quality conditions. Generally, the more impervious surface coverage, the more polluted the water body. Impervious surfaces have many negative effects on water quality:

- Reduce the amount of pervious ground cover, which prevents storm water from infiltrating into the ground and replenishing the groundwater.
- Act as a direct conduit for pollutants to wash into nearby water bodies, carrying pollutants from rooftops, parking lots and roads.
- Promote runoff and often cause excessive erosion in buffers and streambeds.
- Linked to thermal pollution in water bodies, which can deplete oxygen levels and stress aquatic life.
- Increase downstream flooding due to the loss of permeable areas for soaking up storm water.

BUA limitations for each watershed protection district within Mecklenburg County are provided in the chart on pages 4-6 of the attachment. Every development within a drinking water supply watershed must show that it is in compliance with the BUA limitations during the design phase. The developer of a project must allocate a maximum amount of BUA to each lot within a development to ensure that the development as a whole does not exceed the maximum allowed. Single-family residents will often find this allocated amount on their deed and/or plat. BUA is tracked for every property in Mecklenburg County by the Zoning Department. Homeowners and potential homebuyers in the watershed protection area should be aware of these restrictions and research their individual BUA limitations. These restrictions may prohibit a home addition, sidewalk, out building or driveway expansion.

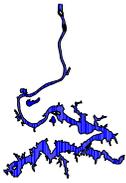
The watershed regulations define BUA as "impervious or partially impervious material." BUA includes but is not limited to asphalt, concrete, stone, brick, terrazzo, roofing, ceramic, buildings, pavement, recreational facilities, gravel areas, metal, wood, plastic, rubber, pervious asphalt, pervious pavers, and outdoor turf/carpet. Pervious surfaces include grass, sand, soil, pine straw, mulch, wooden slated decks, surface water and the water area of a swimming pool.

OTHER WAYS TO PROTECT WATER QUALITY

Boating

Fueling

Petroleum contains toxic compounds, which are harmful to fish, and shellfish. Under federal law, it is illegal to discharge oil or oily waste into U.S. waters. Violators are subject to substantial civil penalties and/or criminal sanctions, including fines of up to \$5,000 per violation and imprisonment.



What you can do to help:

- Avoid “topping off” your gas tank when refueling
- Install a fuel/air separator to prevent accidental overflows from the tank vent line
- Ask your fuel dock to install automatic cutoff nozzles or alarms
- Report spills to the MCWQP at (704) 336-5500
- Do not apply soap or detergents to the water when a spill occurs. Doing so causes the petroleum to sink into the water column instead of staying on the surface where it can be contained and removed

Sewage

Sewage contains disease-causing pathogens that are harmful to humans and aquatic life. It also contains large amounts of nutrients that can stimulate algae growth and deplete oxygen in the water. Discharging sewage into waters of the U.S. is illegal and subject to civil penalties and/or criminal sanctions.

What you can do to help:

- Install a Type III Marine Sanitation Device (MSD) such as a holding tank on your boat. These can be emptied at an onshore pump-out station. Please be aware that MSDs designed to treat and discharge waste into the lake are illegal on all three lakes.
- Encourage your marina to install a pump-out station. Federal funds for pump out stations are available under the Clean Vessel Act. The following marinas currently have public pump-outs:

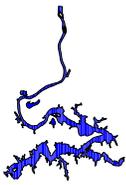
Lake Norman

Boat Rack Marina
Holiday Harbor Marina
Inland Sea Marina
Kings Point Marina
Lake Norman Marina
Midtown Sundries Restaurant
Harborside Marina
North Bridge Marina
Westport Marina

Lake Wylie

Harbortowne Marina
River Hills Marina
Tega Cay Marina

- To minimize the need to pump out your system, use onshore rest room facilities when possible.
- Keep your MSD properly maintained.



Litter

Plastic and litter not only ruin the natural beauty of the water, they can also injure aquatic life, clog water intakes and damage boat propellers. Dumping garbage into the water is illegal and subject to civil penalties and/or criminal sanctions.

What you can do to help:

- Do not throw any litter overboard. If the wind causes something to blow overboard, go back and pick it up.
- Install a garbage can on your boat.
- If you see litter in the water, pick it up and bring it back to shore for proper disposal.

Exotic Species

Exotic species are plants or animals living in an area, which is not their native territory. Aquatic exotic species are spread from one water body to another mainly by boats and humans. Exotics often flourish and out-compete native species because there are no natural predators or diseases to control the population. Exotic plants can especially become a nuisance to boaters and swimmers when they flourish in coves. Hydrilla is one type of exotic plant that has been found in area lakes. The plant has become a nuisance in Mountain Island Lake and Lake Norman. Hydrilla forms nearly impenetrable mats of stems and leaves at the surface of the water. A few of the problems it may cause are crowding of beneficial native vegetation, interference with public water supplies, and blocking of docks, marinas and boat launching sites. Asiatic clams and zebra mussels are two exotic animals that have caused extensive damage to aquatic ecosystems. Asiatic clams have been found in area lakes, while zebra mussels have not yet made it into the Catawba River.



Figure 13: Hydrilla has two highly reproductive structures at the end of its stems and roots (highlighted to left).

What you can do to help:

- Remove all plant material from boats, trailers and vehicles. Plants can survive two to three days out of water and as long as two weeks in a bilge.
- Drain your livewells, bilge water and transom wells before leaving the boat landing.
- Do not dump aquatic plants from your aquarium or garden ponds into a lake or stream.
- Do not remove Grass Carp from the lakes. Grass Carp are often released into lakes by state and local agencies to feed on Hydrilla.

Fertilizers and Pesticides

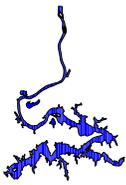


Figure 14: Grass Carp used to control Hydrilla

Fertilizers

Fertilizers contain large amounts of nutrients like nitrogen and phosphorus, which stimulate plant growth. When improperly or excessively applied, fertilizer can be transported by storm water runoff and deposited into our lakes and creeks. In the water, fertilizer stimulates algae growth. Excessive algae growth or “algae blooms” often occur in the summer. These blooms can cause fish kills by depleting the water of its oxygen supply.

Pesticides/Herbicides

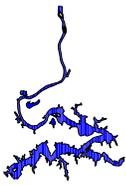
Many pesticides and herbicides contain a variety of toxic compounds and heavy

metals, which are harmful to the environment. When applied improperly or in excess, they can enter our lakes and creeks where they can kill fish and other aquatic life and contaminate drinking water supplies.

Making good decisions and following a few easy guidelines can minimize the adverse effects fertilizers, pesticides, and herbicides have on our environment.

What you can do to help:

- Always follow label directions. Make sure the product is appropriate for your intended use.
- Never apply when heavy rain is expected within 12 hours.
- Do not apply within 50 feet of lakes, creeks or near storm drains and ditches.
- Test your soil to determine what, if any, nutrients your lawn needs. Contact Mecklenburg County’s Cooperative Extension Service for a free test kit and assistance at (704) 336-2561.
- Use alternatives that are less harmful to the environment. These are often available at your local hardware or lawn and garden store.
- Spot spray pest and weed problems whenever possible.
- Store fertilizers, pesticides and herbicides in a locked, dry place safe from flooding and accidental spillage.
- Use native trees and shrubs for landscaping. They typically have fewer pest problems and require less water.
- Utilize natural areas for landscaping instead of planting turf grass. This will reduce the need for fertilizers.



More Environmentally-Friendly Ideas For The Homeowner

Vehicle Maintenance

Have you ever looked at the parking lot at your favorite mall? Virtually every space is stained with drippings from cars. When it rains, this accumulated oil, antifreeze and other harmful fluids enter nearby storm drains and eventually end up in local surface waters. All storm drains in Charlotte-Mecklenburg drain directly into creeks and lakes.

Proper vehicle maintenance can not only prevent such contamination, but also can increase gas mileage and reduce airborne pollutants. If you wash your car at home, wash it on the grass to prevent harmful soaps and detergents from running off into nearby storm drains. In addition, use biodegradable antifreeze and recycle used antifreeze and motor oil.

Yard Waste

Dumping yard waste such as grass clippings, leaves and branches into creeks or lakes can block the natural flow of water and consume the water's precious oxygen needed by fish and other aquatic life.

Leave grass clippings on the lawn to serve as a natural fertilizer or utilize them as mulch around trees and shrubs. Leaves can be easily composted and used in gardens, flowerbeds and plant pots. If you are served by the City of Charlotte's Solid Waste Services, you can have yard waste collected. Place leaves and grass clippings in separate clear plastic bags and place at the curbside with your regular trash.

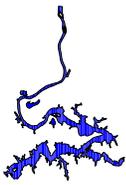


Figure 15: Dumping yard waste can block the natural flow of water and consume the water's oxygen.

Recycling

There is more to recycling than just throwing your bottles and cans in a recycling bin. Many other products could be recycled but often end up being thrown away or dumped where they have a potential to contaminate our water. Mecklenburg County's full service recycling centers accept all types of leftover products such as used motor oil & filters, antifreeze, paint, and tires. For directions and a list of what each site accepts go to www.wipeoutwaste.com. The following are full service recycling centers.

- Foxhole Recycling Center
17131 Lancaster Highway
(704) 341-4962
- Hickory Grove Recycling Center
8007 Pence Road
(704) 535-3781



- North Mecklenburg Recycling Center
12300 North Statesville Road
(704) 875-1563
- West Mecklenburg Recycling Center
8440 Byrum Drive
(704) 357-1473

Common Water Quality Problems

Sewage

One of the most common water quality problems in Mecklenburg County is sewage. Many of the sanitary sewer lines run along creeks, so when lines break or overflows from man-holes occur, the sewage immediately flows into surface waters. Sewage is often grey in color, but the impacted surface waters may also appear white, black or a variety of other colors following a sewer spill. A strong sewage odor is another indication of a problem.

Sewage pump stations and wastewater treatment plants have malfunctioned in the past and caused sewage discharges to surface waters. When impacts to swimmable waters occur, swimming advisories are posted until safe conditions are met.

Illicit Discharges

Storm water drains and pipes carry precipitation to creeks, ponds and lakes. The sanitary sewer system, on the other hand, carries polluted waste water to wastewater treatment plants where

pollutants are removed and the water is eventually discharged into surface waters. Sometimes people and businesses illegally dispose of polluted waste by having pipes discharge straight into the storm drain system when the waste should be going into the sanitary sewer system. Illicit discharges carried by pipes into creeks and lakes are a common problem. Steady flow through a storm water pipe during or shortly after a rain event is natural. However, dry-weather flow is unnatural, and may indicate an illegal hookup from a residence or business.



Figure 16: A turbid McDowell Creek flows into Mountain Island Lake after a rainstorm.

Sedimentation

Another large pollution problem that many people overlook is sedimentation resulting from soil



erosion upstream. According to a study conducted by the North Carolina Department of Environment and Natural Resources, sediment is the most widespread cause of stream and river impairment. In Mecklenburg County, development activities cause significant amounts of erosion and sedimentation problems.

Agriculture is cited as another source, especially in heavily farmed areas of North Carolina. Tree roots bind soil particles together and their leaves provide a protective barrier from heavy rains. When trees are removed, soil is left exposed to precipitation that can carry the sediment in suspended form. Without proper runoff control structures at construction sites, this sediment flows into creeks and lakes where it clogs fish gills and destroys habitat essential to aquatic life survival.

Algae Blooms

Excessive algae are a good indicator of a pollution problem. Algae growth, especially in the summer, is natural to a certain degree and forms the base of the aquatic food chain. The combination of sunlight, water, nutrients and warmer temperatures produces growth. However, when nutrients such as phosphorus and nitrogen are present in large amounts, dense algae blooms can form. These algae blooms can deplete the supply of oxygen available to aquatic life, resulting in a fish kill. Common sources of excessive nutrient runoff are over application of fertilizers, raw sewage discharges and wastewater treatment plant effluent.



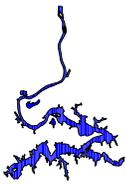
Figure 17
· *An algae bloom observed on a private pond*

Dumping

Illegal dumping is a significant pollution source in our surface waters. Dumping activities range from a neighbor pouring used oil onto the ground to a carpet cleaning business emptying waste into a storm drain. Dumping any potential pollutant is illegal. Some people dump things into storm water drains (located on the sides of roads and in parking lots) not realizing that these drains flow directly to creeks or lakes.

WHAT'S ALREADY BEING DONE TO PROTECT LAKE WATER QUALITY?

Lakes and creeks have played a vital role in attracting people to our area. Protecting these waters is important to sustaining a healthy local economy and environment. The MCWQP conducts numerous activities for the purpose of lake water quality protection.



Monitoring

Mecklenburg County has 31 monitoring sites on the lakes and 47 sites along the creeks. The goal of the monitoring program is to identify and eliminate sources of water pollution and restore water quality conditions. The monitoring sites were selected to provide an overall representation of water quality conditions throughout Mecklenburg County. The data collected gives a sense of the overall water quality conditions, helps track water quality trends and helps pinpoint specific water pollution problems. Monitoring on the 25 sites on Lake Norman, Mountain Island Lake and Lake Wylie are conducted monthly during the summer when there is increased recreation and bimonthly from October to April. Monitoring of Lake Davidson and Lake Cornelius are performed twice a year. Monitoring activities include collecting and analyzing samples for pollution indicators such as fecal coliform bacteria, phosphorus, nitrogen, chlorophyll *a*, turbidity and solids. Field tests are also conducted for temperature, pH, conductivity, dissolved oxygen and other parameters.

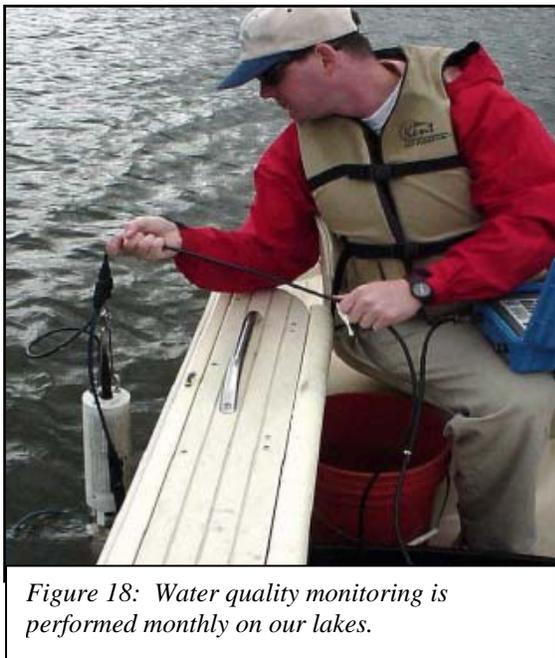


Figure 18: Water quality monitoring is performed monthly on our lakes.

Plan Review

Plans for development within Mecklenburg County lake watersheds are reviewed by the MCWQP to ensure that all regulations regarding buffers are being followed. Additional concerns and recommendations regarding water quality protection are also addressed.

Service Requests

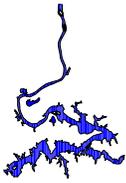
Citizens call in over 900 requests each year concerning possible threats to water quality. When citizens report discolored creeks, possible sewage spills or someone dumping a substance in a creek or storm drain, MCWQP investigates the possible pollution problem. If you suspect a potential water pollution problem call and report it at 704-336-5500.

Public and Private Land Acquisition

Purchase of lands adjacent to lakes is another method both public and private entities have used to protect lake water quality. Currently in Mecklenburg County, public land is owned along all three lakes. Some of this land is managed as parks and wildlife refuges, while the rest is preserved as nature preserves.

Public Education And Awareness

The MCWQP works to educate the public about the surface waters of Mecklenburg County. Storm Drain Marking and Adopt-A-Stream are a couple of programs that are in place to get citizens involved in water quality protection. Presentations are given by staff to homeowner's associations, homebuilders and other public groups and organizations to help educate the public.



A great deal of literature is also available for public distribution. Contact staff with questions or concerns Monday-Friday at (704) 336-5500.

Frequently Asked Questions

Is it legal to withdraw water for irrigation from a lake or stream without a permit? Yes, according to riparian ownership rights, the use of waters for domestic purposes, such as watering a garden, is legal without a permit. A riparian owner is a waterfront property owner. Duke Power Lake Management must be notified in writing, however, if any amount of water will be withdrawn from any of the lakes. Withdrawal of greater than one million gallons per day from a lake for commercial or industrial purposes must be permitted.

Is it safe to eat the fish from Mecklenburg County lakes? Currently there are no fish consumption advisories on any of our lakes. If you catch a fish that appears sick, do not eat it. Fish can get sick just as humans do.

As a waterfront property owner, what is the one thing I can do that will benefit water quality the most? Leaving your property as natural as possible will benefit water quality the most by providing a buffer area between your activities and the water.

Who owns the lakes and creeks of Mecklenburg County? Naturally occurring inland water bodies are held in trust by the State for public use. Property owners on rivers and creeks (dammed rivers excluded) generally own the bed of the waterway to its center. Federal, state, and local laws, however, restricts activities on the water.

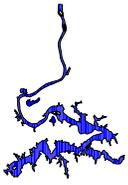
What's the biggest threat to our lakes? Nonpoint source pollution is the biggest threat overall. This is pollution that is picked up by storm water as it flows over streets, lawns, and the general landscape. This type of pollution increases as population and impervious surfaces expand.

How do I know when and where it's safe to swim? The MCWQP increases monitoring efforts in lakes during summer months due to increased recreation. If high levels of pollutants are observed and it is determined that lake areas are unsafe for swimming, a "No Swimming" sign will be posted. It's recommended that you not swim in any of Mecklenburg County's streams.

Where can I get information on boat safety, rules, and regulations? Contact the Lake Wylie, Mountain Island Lake or Lake Norman Marine Commissions. They offer classes on boat safety and have information about rules and regulations for distribution. Refer to page 15 for a list of phone numbers.

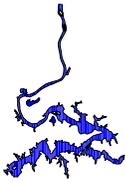
Who do I contact about shoreline stabilization, dredging, or building a pier? Contact Duke Power Lake Management at 1-800-443-5193. You will be asked to complete a permit which will be reviewed by Duke Power and the MCWQP.

How should I remove dead or diseased trees from the buffer? Do I need to call someone first?



Dead or diseased trees may be removed from the buffer, however, it is always a good idea to call the MCWQP at (704) 336-5500 before disturbing any vegetation in the buffer.

Can I have a fence in the buffer? Fences may be installed if no trees, roots or vegetation is disturbed in the buffer. Call the MCWQP at (704) 336-5500 before starting any projects in the buffer.



GLOSSARY

100-year floodplain - lowland area bordering a stream which is impacted by flood waters associated with a 100-year flood event

algae bloom - excessive algae growth in a water body caused by an overload of nutrients; may cause oxygen depletion

best management practice - measures developed to improve storm water quality through pollutant removal

biological oxygen demand - a measure of the amount of oxygen consumed during biological and chemical processes that break down organic matter in water

built-upon area - includes the portion of a development project covered by impervious or partially impervious cover (e.g. pavement, gravel, buildings, etc.)

chlorophyll *a* - pigment present in all algae types; concentration increases with higher algae biomass

critical area - land with the highest degree of development restrictions due to its proximity to a protected water source and the greater risk of water quality degradation from pollution

dissolved oxygen - measure of the amount of oxygen present in a water body; important for survival of aquatic life

erosion - wearing away of soil particles from the land surface by water, wind, ice, gravity, or other force

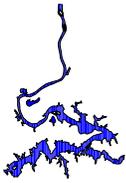
fecal coliform - bacteria present in fecal matter; high levels in surface water sometimes indicate a discharge of sewage

groundwater - water below the land surface which is held up in soil layers and rock formations

impervious surface - surface area which does not allow infiltration of water (e.g. pavement, rooftops, gravel, etc.)

high-density development - development with a high density of structures and built-upon areas within a particular land area (e.g. condominiums, apartments, etc.)

macroinvertebrates - small aquatic animals that live mostly on stream and lake bottoms or attached to substrate material; their diversity and abundance indicate water quality conditions



low-density option - development with a low density of structures within a particular land area (e.g. one structure per acre)

normal pool elevation - the average land elevation above sea level reached by a body of water

nutrients - substances necessary for growth and reproduction of organisms; in water, mainly nitrates and phosphates

perennial stream - a stream that maintains water in its channel throughout the year

phytoplankton - microscopic free-floating aquatic plants

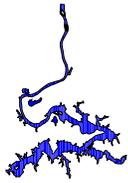
protected area - land area subject to development restrictions which are not as stringent as in the critical area due to their further distance from the water body

runoff - rainfall that flows over the land surface into adjacent water bodies, picking up pollutants along the way; also known as storm water

storm drain system - system of drains, pipes, and outfalls that allows storm water, surface drainage, street wash, and other wash waters to be transported quickly from the land surface to nearby water bodies

turbidity - measure of a water body's clarity; caused by suspended matter such as clay, silt, organic and inorganic matter, and/or microscopic organisms such as phytoplankton

zooplankton - microscopic and macroscopic animals existing as free-swimming or suspended in the water



CONTACT DIRECTORY

Audubon Society of Mecklenburg County
(704) 537-8181
www.meckbirds.org

Catawba Lands Conservancy
(704) 342-3330
www.catawbalands.org

Catawba River Foundation/River Keeper
(704) 373-1916
www.catawbariverkeeper.org

Ducks Unlimited of North Carolina
(919) 847-0116
www.ncdu.org

Duke Power Lake Management
1-800-443-5193
www.dukepower.com

Katawba Valley Land Trust
(803) 285-9455
www.kvlt.org

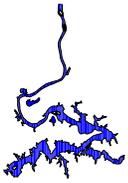
Lake Norman, Lake Wylie, & Mountain Island Lake Marine Commission
(704) 372-2416
www.marinecommission.com

Mecklenburg County Park & Recreation Department
(704) 336-3854
www.parkandrec.com

Mecklenburg County Soil & Water Conservation
(704) 336-2455
www.mecklenburgconservation.com

Mecklenburg County Solid Waste
(704) 336-4304
www.wipeoutwste.com

Mecklenburg County Water Quality Program
(704) 336-5500
<http://waterquality.charmeck.org>



Mecklenburg County Zoning Department

(704) 336-3569

<http://www.charmeck.org/Departments/home.asp> (click on Zoning)

North American Lake Management Society/SE

(828) 254-5644

www.nalms.org

N.C. Department of Environment & Natural Resources

Mooresville Regional Office

(704) 663-1699

www.mro.ehnr.state.nc.us

North Carolina Wildlife Federation

(704) 377-4696

www.ncwf.org

N.C. Wildlife Resources Commission

(704) 986-6109

www.ncwildlife.org

Open Space Institute of the Carolinas

(704) 687-2767

www.uncc.edu/urbinst/land_use_and_environmental_planning.asp

Sierra Club - Central Piedmont Group

(704) 527-5035

www.sierraclub.org

South Carolina Dept. of Health and Environmental Control

(803) 898-3609

www.scdhec.net

The Trust for Public Land

(704) 376-1839

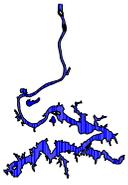
www.tpl.org

Neighboring Governments:

Lincoln County

(704) 736-8432

www.co.lincoln.nc.us



Iredell County
(704) 878-3050
www.co.iredell.nc.us

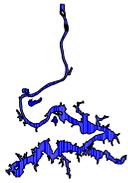
Gaston County
(704) 866-3100
www.co.gaston.nc.us

York County
(803) 684-8511
www.yorkcountygov.com

Town of Cornelius
(704) 892-6031
www.cornelius.org

Town of Davidson
(704) 892-7591
www.ci.davidson.nc.us

Town of Huntersville
(704) 875-6541
www.huntersville.org

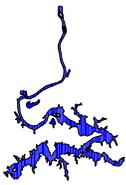


WATERSHED BUFFER GUIDELINES
for
MECKLENBURG COUNTY, NC



Mecklenburg County Land Use & Environmental Services Agency
Water Quality Program
700 North Tryon Street, Suite 205
Charlotte, North Carolina 28202-2236
704/336-5500
704/336-4391 (fax)
<http://waterquality.charmeck.org>

Revised 1/05



I. Background

In 1992, the State of North Carolina adopted the Water Supply Watershed Protection Rules, which outlined minimum requirements for protecting water supplies. The rules also required all local governments having land use jurisdiction within water supply watersheds to adopt and implement water supply watershed protection ordinances that met or exceeded the State minimum rules. As a result of this rule, Mecklenburg County, the City of Charlotte, and the Towns of Davidson, Cornelius and Huntersville adopted and implemented watershed protection rules within their jurisdictions. The rules apply to properties that are within drinking water supply watersheds and generally become more restrictive as you get closer to raw drinking water intakes. Currently, Water Supply Watershed Protection Rules apply to all areas of Mecklenburg County that drain to Lake Norman, Mountain Island Lake, and Lake Wylie, all of which have drinking water intakes. The rules limit the type of development, the Built-Up Area (BUA) of development, and also require buffers along lakes and perennial streams. BUA is defined as impervious or partially impervious material. Local ordinance adoption dates are as follows:

Lake Norman

Mecklenburg County	June 20, 1994
Davidson	October 1, 1993
Cornelius	September 20, 1993

Mountain Island Lake

Mecklenburg County	March 8, 1993
Charlotte	June 21, 1993
Cornelius	September 20, 1993
Huntersville	October 1, 1993

Upper Lake Wylie

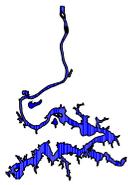
Mecklenburg County	June 20, 1994
Charlotte	June 21, 1993

Lower Lake Wylie

Mecklenburg County	July 10, 2001
Charlotte	September 17, 2001

II. Purpose

The purpose of these guidelines is to provide further guidance and clarification relating to the watershed protection buffer requirements in Mecklenburg County and the City of Charlotte, as well as the Towns of Davidson, Cornelius and Huntersville Zoning Ordinances. Although these Guidelines are referenced in many of the above Zoning Ordinances, the Watershed Administrator or their designee for each jurisdiction has the final authority regarding regulations found in the Zoning Ordinances. Any interpretation of the watershed protection regulations or variance granted by local government bodies must at least adhere to the minimum North



Carolina regulations, which can be found in North Carolina Administrative Code section 15A NCAC 02B.0216.

III. Buffer Function

Undisturbed buffers along lakes and streams provide seven basic functions:

- 1) Provides an area for storm water to filter through, decreasing velocities and removing pollutants prior to discharge into a waterbody.
- 2) Provides stability to lake and stream banks by preserving trees and vegetation, thereby reducing erosion and bank failure.
- 3) Provides shading to waterbodies, thereby reducing water temperatures and improving aquatic habitats.
- 4) Provides woody debris in waterbodies, thereby increasing aquatic habitat.
- 5) Provides wooded corridors and wildlife habitat.
- 6) Provides open space for recreation, wildlife habitat, general aesthetics, and an improved quality of life.
- 7) Preserves floodplains, which are critical to reducing downstream flooding.

IV. General Requirements and Prohibitions

Buffer Widths

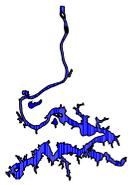
Watershed Protection Buffers apply to all three lakes within Mecklenburg County; Lake Norman, Mountain Island Lake and Lake Wylie. The buffers also apply to all perennial streams within the designated watershed protection areas. The ordinances define perennial streams as ones designated on a current United States Geological Survey (USGS) topographic map or by local government studies. The buffer widths are defined in the following table:

Lake Norman Watershed

Zone	Zoning Jurisdiction	Allowable Built Upon Area	Lake/Stream Buffer
Critical Area (CA)	Davidson	≤ 24% - Low Density ≤ 50% - High Density	40 Feet 100 Feet
Critical Area (CA)	Cornelius	≤ 24% - Low Density ≤ 50% - High Density	50 Feet 100 Feet
Critical Area (CA)	Huntersville	≤ 24% - Low Density ≤ 50% - High Density	50 Feet 100 Feet

Mountain Island Lake Watershed

Zone	Zoning Jurisdiction	Allowable Built Upon Area	Lake/Stream Buffer
Protected Area (PA)	Cornelius	≤ 24% - Low Density ≤ 70% - High Density	50 Feet 100 Feet



Protected Area 1 (PA1)	Huntersville	≤ 24% - Low Density ≤ 70% - High Density	50 Feet 100 Feet
Protected Area 1 (PA1)	Charlotte/Mecklenburg	≤ 24% - Low Density ≤ 50% - High Density	50 Feet 100 Feet
Protected Area 2 (PA2)	Huntersville	≤ 24% - Low Density ≤ 70% - High Density	30 Feet 100 Feet
Critical Area 1 (CA1)	Huntersville	≤ 6% - Low Density	100 Feet or 100 yr. Floodplain (whichever is greater)
Critical Area 1 (CA1)	Charlotte/Mecklenburg	≤ 6% - Low Density	100 Feet or 100 yr. Floodplain (whichever is greater)
Critical Area 2 (CA2)	Huntersville	≤ 12% - Low Density	100 Feet or 100 yr. Floodplain (whichever is greater)
Critical Area 3 (CA3)	Huntersville	≤ 12% - Low Density	100 Feet or 100 yr. Floodplain (whichever is greater)
Critical Area 4 (CA4)	Huntersville	≤ 24% - Low Density	100 Feet
Critical Area 4 (CA4)	Charlotte/Mecklenburg	≤ 24% - Low Density	100 Feet or 100 yr. Floodplain (whichever is greater)

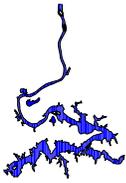
Upper Lake Wylie Watershed

Zone	Zoning Jurisdiction	Allowable Built Upon Area	Lake/Stream Buffer
Protected Area (PA)	Charlotte/Mecklenburg	≤ 24% - Low Density ≤ 70% - High Density	40 Feet 100 Feet
Critical Area (CA)	Charlotte/Mecklenburg	≤ 24% - Low Density ≤ 50% - High Density	100 Feet 100 Feet

Lower Lake Wylie Watershed

Zone	Zoning Jurisdiction	Allowable Built Upon Area	Lake/Stream Buffer
Protected Area (PA)	Charlotte/Mecklenburg	≤ 24% - Low Density ≤ 70% - High Density	40 Feet 100 Feet
Critical Area (CA)	Charlotte/Mecklenburg	≤ 20% - Low Density ≤ 50% - High Density	50 Feet 100 Feet*

- *For Lower Lake Wylie Watershed only, buffer width is increased 50% for lots with an average slope greater than or equal to 50%. This applies only to new development proposed along the lake shore, and using the high density option.*



- *Structural water quality best management practices are required for all developments exceeding the low density option.*
-

Measuring Buffers

Stream buffers are measured horizontally from the top of the stream bank on a line perpendicular to the surface water. Lake buffers are measured horizontally from the full pond elevation of each lake, as follows: Lake Norman – 760 feet above sea level, Mountain Island Lake – 648 feet above sea level, Lake Wylie – 569.4 feet above sea level. The buffer line follows the contour line and is not influenced by property lines. The buffer should be recorded on all development plats and individual deeds.

Additional Buffer Regulations in Mecklenburg County

Since the adoption of the Drinking Water Supply Watershed Protection Buffers, several additional buffer regulations have been passed. When other buffer regulations apply, the more restrictive regulation will always apply.

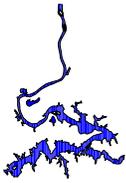
S.W.I.M., Surface Water Improvement & Management™ Buffers - All jurisdictions within Mecklenburg County have adopted S.W.I.M. buffers. These buffers apply only to streams and are often more restrictive than the drinking water supply buffers. For more information on these regulations, go to <http://waterquality.charmeck.org> or call (704) 336-5500.

North Carolina Catawba River Basin Riparian Buffers – These regulations were adopted by the State of North Carolina and apply to the entire main stem of the Catawba River from Lake James to the South Carolina border. This includes the entire shoreline of Lake Norman, Mountain Island Lake and Lake Wylie. Generally, the locally adopted Drinking Water Supply Watershed Protection Buffers in Mecklenburg County are more restrictive than these rules. The regulations are found in the North Carolina Administrative Code Section 15A NCAC 02B.0243. For more information on these regulations, go to www.dem.ehnr.state.nc.us or call (704) 663-1699.

General Buffer Prohibitions

The Drinking Water Supply Watershed Protection Buffers are generally undisturbed buffers and should be minimally disturbed in order to protect their water quality function. The following are general prohibitions within the buffer:

- No permanent structures, built upon areas, septic tank systems or any other disturbance of existing vegetation is allowed. This also refers to sidewalks, patios, gazebos, brick or



concrete walls and out buildings. Pervious asphalt, concrete, any type of gravel and pavers are also considered “built-upon area” and cannot be placed in the buffer.

- No trees larger than 2 inch caliper (measured six inches above the ground) may be removed or damaged.
- No grading, clearing or filling is allowed in the buffer.
- No ponds or structural Best Management Practices (BMPs) are allowed in the buffer.
- No burial of roof drains or other drainage of any type is allowed. All storm water pipes must stop prior to the buffer and discharge as sheet flow.
- No new turf grass can be planted in the buffer (Grass existing prior to the adoption of the ordinance may be maintained).

General Buffer Allowances

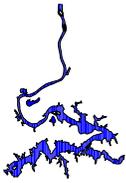
The following activities are allowed within the buffer:

- Minimal hand clearing of small undergrowth and removal of trees two inches in caliper or smaller (measured six inches above the ground) as approved by the Mecklenburg County Water Quality Program (MCWQP).
- Stream bank or shoreline stabilization and dredging is allowed if approved by MCWQP and Duke Power (for lakes). Note: An application with a buffer restoration plan is required to be submitted and approved prior to beginning work (see Attachment 3).
- The removal of dead or diseased trees, as approved by MCWQP.
- The limbing of trees, up to half the distance of their height.
- Pathways that adhere to the Pathway Guidelines (Attachment 1) and are approved by MCWQP.
- Irrigation systems that adhere to the Irrigation Installation Guidelines (Attachment 2).
- Piers may encroach in the buffer provided no trees greater than 2-inch caliper (measured six inches above the ground) are removed or damaged, slatted decking is used to allow rainwater to pass through, and no roofed structures are placed within the buffer.
- Fences, provided that no trees greater than 2-inch caliper are removed or damaged and are constructed with chain link, split rail or wood slat. No brick or concrete walls are allowed.
- The addition of new trees / shrubs.
- Temporary disturbances of the buffer may be allowed with prior approval from MCWQP and shall be evaluated on a case-by-case basis.

Buffer Plans

Site-specific Buffer Plans must be submitted to MCWQP for review and approval in the following situations, to include but not limited to:

- 1) When stream bank or shoreline stabilization is proposed (this plan must be submitted and approved before MCWQP will grant approval, see Attachment 3 for Application for Temporary Buffer Disturbance);
- 2) When removal of any trees greater than 2-inch caliper (measured 6 inches above the ground) is proposed;



- 3) During new development or the expansion of existing development if the buffer requires enhancement;
- 4) When any disturbances of existing vegetation is proposed within the buffer;
- 5) When any land disturbance is proposed or has occurred within the buffer (i.e. grading, cutting, filling, building, soil tilling, etc.). Plan approval will be based on the direct application of these Guidelines as appropriate and on the ability of the buffer to protect water quality.
- 6) New subdivision plans, which include a watershed buffer must include specific notes relating to the buffer, as specified in Attachment 5.

V. Maintenance of Existing Buffer Vegetation

Groundcover

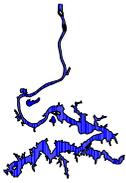
Existing, trees, shrubs, ground covers, natural grasses or perennials should be left in place. Where there is not enough vegetation to control runoff and erosion, a mulch cover of 2-inch minimum depth should be maintained over the entire buffer area. This should be, whenever possible, made up of natural leaf litter as is typically found in an undisturbed wooded area. Where this natural litter is not present at a sufficient depth, it should be supplemented with natural organic mulch such as leaves, leaf mold, wood chips, tree bark or pine needles. Removal of natural leaf fall from within the buffer is prohibited as natural leaf litter provides beneficial results such as enriching the soil, protecting tree roots and absorbing water runoff. Perennial ground cover as specified in Attachment 6 can be used in place of mulch as approved by MCWQP.

Existing Tree Cover

The minimum desired existing tree cover should be retained at a minimum density of at least 10 healthy trees of a minimum 6-inch caliper per 1000 square feet of buffer area. This minimum tree density should be more or less uniformly distributed over the entire buffer area. Pruning of trees within the buffer is limited to the removal of only lateral limbs from no more than the lower 50 percent of the tree's total height. Topping is not allowed. The Ordinances state, "No trees larger than 2 inch caliper are to be removed except for dead or diseased trees." Combinations of larger and smaller trees can also provide an effective buffer. For example, where an adequate density of natural tree cover exists, but there are too few trees of the minimum 6 inch diameter size class, then two trees of at least a 1 1/2 inch caliper may be counted for each deficiency of a larger tree. As an example, if a buffer contained 2500 square feet, the normal standard would be a minimum of 25 six-inch trees. If the buffer had only 10 trees over six inches and the rest were smaller, then the standard would be met with the 10 six-inch trees and 30 (2x15) trees above 1 1/2 inches in caliper.

Land Clearing

The removal of selective native vines, shrubs, ground covers and small trees (<2 inch diameter) to facilitate a better view or a more aesthetically pleasing natural landscape may be allowed. This thinning operation should be done with hand tools and/or minimal use of herbicides. No grubbing of tree stumps is allowed; however, stump removal with a stump-grinding machine,



which causes minimal soil disturbance, is allowed. Natural leaf litter, humus and soil should remain. Additional tree thinning may be permissible with prior approval where thick cover exists and it is desirable to promote a healthy tree cover and produce the most effective buffer. With prior approval from MCWQP, the minimum desired tree density standard might be reduced in order to reduce crowding to below 10 trees per 1000 square feet, if the buffer contains a majority of large diameter trees. For every three trees that have a diameter at chest height of over 12 inches, the total number of trees desired within the buffer is reduced by one tree. As an example, if a buffer is 2500 square feet, it should contain a minimum of 25 healthy trees of a minimum six-inch diameter. Should 15 of these trees be 12 inches in diameter or above, then the minimum desired standard would drop to 20 trees with the lower density being found in the area where the larger trees were predominant.

VI. Buffer Restoration / Planting New Vegetation in Buffer

New Tree Cover

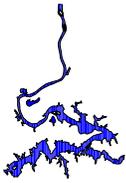
In the event that a buffer must be restored or planted with new vegetation due to a violation, shoreline stabilization project, dredging, site mitigation, or other disturbance, the required tree density shall be 10 trees per 1000 square feet and all trees shall have a minimum caliper of 1 1/4 inches measured at 6 inches above the root ball. Larger trees may be required depending on the site conditions. Equivalent combinations of tree, shrub and groundcover may be substituted following MCWQP's approval of a site-specific buffer plan (see Attachment 4). All vegetation must be on the approved plant list (Attachment 6).

New Shrubs and Groundcovers

Planting of additional shrubs, ground covers and perennials is desired if done so with minimal disturbance to root systems of existing trees. Addition of nutrients (fertilizers) into these buffer areas is discouraged except at planting time when mixing nutrients and soil amendments with the backfill soil is acceptable. In the event of buffer restoration or mitigation, the buffer plan should illustrate acceptable ground cover such as two (2) inches of mulch or other approved material.

VII. Approved Plants for Watershed Buffers

A list of approved trees and shrubs has been provided in Attachment 6. This list is not comprehensive, but includes species that are native to the Piedmont and tolerate dry to wet conditions. Prior to developing a planting plan, care should be taken in selecting species appropriate for the soil, moisture and light conditions of your specific site. MCWQP encourages the planting of native species, however variations from this list may be permitted with prior approval from the MCWQP. *(The use of invasive, exotic species will not be considered for buffer restoration projects.)*



Attachment 1

PATHWAY GUIDELINES FOR WATERSHED BUFFERS

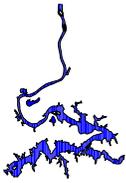
Pathways made of concrete, asphalt, pavers, rock or gravel are not allowed in buffers. Pathways made of materials other than topsoil, mulch, or approved pervious material must meet the following stipulations and must be pre-approved by the MCWQP. Pathways for handicap access are evaluated on a case-by-case basis.

Boardwalk:

- Wooden boardwalks are allowed but spaces must be at least 1/4 inch apart between boards. The ground beneath the boardwalk must be comprised of pervious material.
- No trees can be cut or damaged during installation.
- The total impervious area of property may not exceed the amount required by the watershed ordinance. (Boardwalks are not considered impervious areas.)

Stepping Stones:

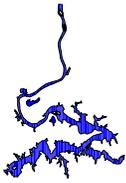
- The pathway may be no more than 3 ft. wide at any location.
- The rock sections may be no larger than 225 square inches.
- Spaces between all rock sections must be a minimum of 2 inches. Only soil, sand, mulch or vegetation may be installed between or around the rock sections (no gravel).
- The base material must be composed of only soil, sand, mulch or vegetation.
- The pathway should meander through the buffer around trees and should be sloped in a manner as to divert water away from the lake. No trees may be removed or damaged in order to install pathway.
- The total impervious area of property may not exceed the amount required by the appropriate watershed ordinance. (Stepping stones are considered impervious areas.)



Attachment 2

IRRIGATION SYSTEM GUIDELINES

1. Homeowners shall notify the Mecklenburg County Water Quality Program (MCWQP) in writing of their intent to install an irrigation system through a buffer. Their name, address, telephone number, and proposed installation date should be included.
2. No trees larger than 2 inches in diameter may be cut from the buffer.
3. No heavy mechanical equipment such as trenchers may be used in the buffer. Only hand clearing and hand digging tools are allowed.
4. No fuel powered pumps are allowed in the buffer. Small electrical pumps are permitted.
5. No impervious pads (concrete, asphalt, etc.) are permitted in the buffer. Wooden frames may be placed around pumps for support.
6. All irrigation lines must be installed in such a way as to prevent the back flow of water to the lake. The use of back flow prevention and foot valves is recommended.
7. Irrigation lines, which are installed through the buffer, should disturb as little area as possible.
8. Erosion control devices such as silt screening should be installed and maintained if the ground is disturbed longer than 24 hours, or if rain is predicted at any time during construction.
9. After installation the disturbed area should be covered with mulch or pine straw.



Attachment 3

APPLICATION FOR TEMPORARY BUFFER DISTURBANCE

Please complete the following application and submit with the buffer restoration plan

I. Applicant / Property Owner Information

Name_____

Mailing Address_____

Telephone_____

II. Location of Proposed Buffer Disturbance

Address_____

Subdivision Name_____ Lot # _____

III. Reason for Proposed Buffer Disturbance

a. Shoreline / stream stabilization

b. Dredging

c. Other, explain_____

IV. Proposed Work Schedule

Estimated Project Start Date_____

Estimated Project Completion Date (including buffer restoration)_____

V. Contractor Information *(please list all parties involved in proposed disturbance and restoration activities)*

Name_____

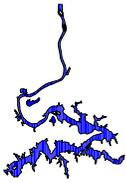
Address_____

Telephone_____

Name_____

Address_____

Telephone_____



Application for Temporary Buffer Disturbance (continued)

VI. Buffer Disturbance and Restoration Plan

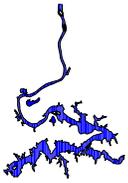
(see Attachment 4 of the Watershed Buffer Guidelines for Mecklenburg County for a sample buffer plan).

Please attach a plan which illustrates the following:

- Scaled map of lot showing buffer delineation (copy of survey is usually acceptable)
- Map or sketch of buffer area showing proposed disturbed area (should also show equipment access route)
- Square footage of proposed disturbed area in buffer
**Note: Disturbed area would include all areas of the buffer where the natural ground cover or vegetation has been graded, removed or altered.*
- Proposed number of trees greater than 2 inches in diameter that will be removed from the buffer
- Proposed location, number, and species of all trees to be planted in disturbed area
**Note: Buffer restoration must occur at a density of 10 trees per 1000 square feet of disturbed area. New trees must be a minimum caliper of 1 1/4 inches measured at 6 inches above the root ball. See Attachment 6 of the Watershed Buffer Guidelines for Mecklenburg County for a list of approved tree species.*
- Type of ground cover to be placed in disturbed area (i.e. mulch, pine straw, etc.)
- Proposed planting schedule and deadline for completion of restoration activities

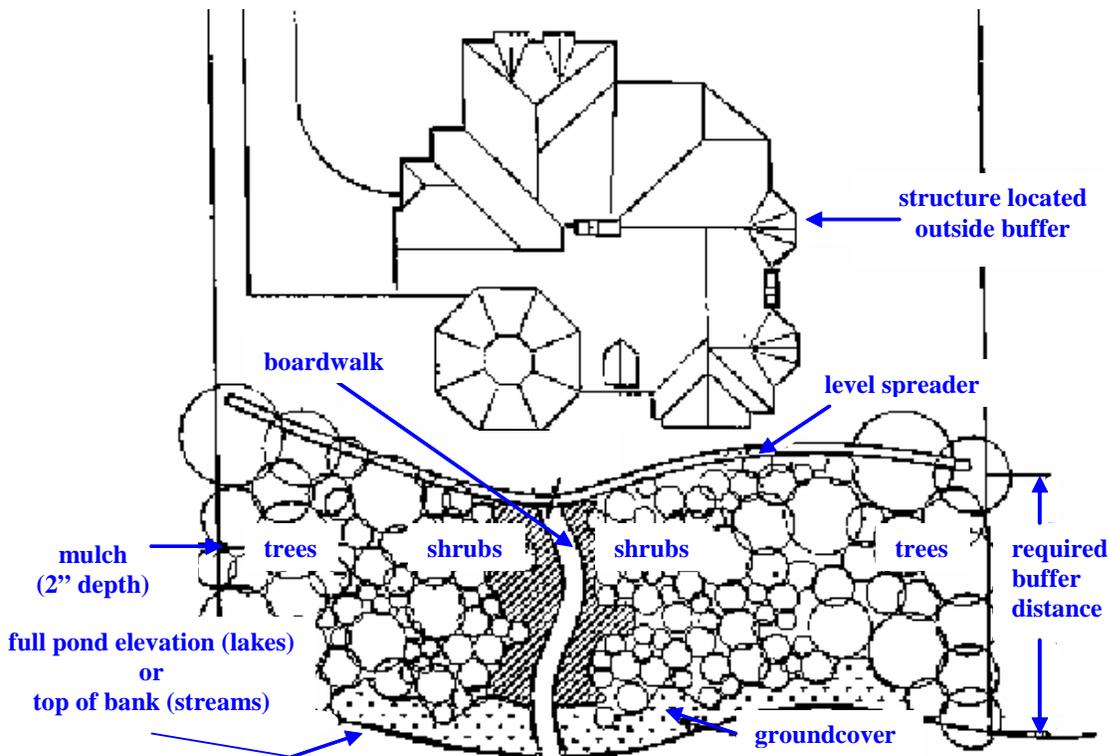
Mail or Fax Application and Plan to:

Mecklenburg County Water Quality Section
Land Use & Environmental Services Agency
700 North Tryon Street, Suite 205
Charlotte, NC 28202
(704) 336-5500
Fax (704) 336-4391



Attachment 4

SAMPLE BUFFER RESTORATION PLAN

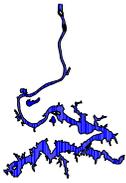


Specifications Which Must Be Included In The Buffer Plan:

- All plant species to be placed in the buffer must be identified.
- The distances between the different plantings must be specified.
- Unless otherwise specified by MCWQP, all plantings must comply with the density and size requirements specified in Section VI Buffer Restoration / Planting New Vegetation in Buffer.
- All plantings should be of a variety specified in Attachment 6 entitled Plant List.
- Mulch should be specified at a minimum depth of 2 inches.

If the plan is being submitted for shoreline stabilization or dredging, it should illustrate the following:

- Equipment access and staging area and the restoration plans for these areas.
- Existing trees to be removed.
- Width and length of total buffer disturbance, including rip rap or seawall location.



Attachment 5

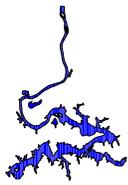
SUBDIVISION PLAN REQUIREMENTS FOR WATERSHED BUFFERS

A Buffer Plan must be included in the Subdivision Plan package. Components of this Plan may be included on a separate plan sheet or it may be included as part of the grading and drainage plan sheets. The Buffer Plan must contain the following:

1. The entire buffer area clearly marked or shaded.
2. The point from which the buffer was measured.
3. Any activity or disturbance in the buffer should be identified and “magnified” on the Buffer Plan. Specific details should be given on pathways, boardwalks, shoreline stabilization, etc.
4. If a disturbance is proposed in the buffer, a restoration plan showing replantings should be included as part of the Buffer Plan. The restoration should follow the guidelines stated in Section VI Buffer Restoration / Planting New Vegetation in Buffer. Specifics should be stated such as tree/ bush types and planting densities.

The Buffer Plan MUST CLEARLY STATE the following:

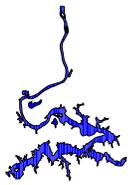
1. No disturbance whatsoever is allowed in the buffer.
2. No sediment basins, open channels, or piped storm water is allowed in or through the buffer. Drainage areas should be designed to allow water to sheet flow across the buffer to filter out pollutants. Plunge pools, level spreaders, diversion devices or wetland flow should be used to provide this sheet flow.
3. No heavy equipment is allowed in the buffer.
4. The buffer will be clearly marked by flagging or fencing prior to any construction at the site.
5. Any activity in the buffer will comply with the Watershed Buffer Guidelines for Mecklenburg County, NC.
6. The MCWQP will be notified of any changes to the approved Buffer Plan.
7. The buffer will be permanently marked on each individual lot using iron stakes in concrete.
8. Buffer restrictions will be placed on each individual deed.
9. Educational materials concerning the buffer will be distributed to each homeowner and builder prior to construction or occupancy.
10. All sub-contractors will be notified of the buffer regulations prior to development.



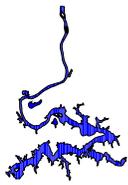
Attachment 6

APPROVED TREE/SHRUBS FOR WATERSHED BUFFERS

Group	Common Name	Botanical Name	Light Conditions	Soil Conditions	Height / Diameter
Coniferous Trees	Shortleaf Pine	<i>Pinus echinata</i>	sun/partial shade	dry	70-100 ft./2-3 ft.
	Virginia Pine	<i>Pinus virginiana</i>	sun	dry	40-70 ft./1-2 ft.
	Eastern Red Cedar	<i>Juniperus virginiana</i>	sun	dry/moist	40-60 ft./1-2 ft.
Deciduous Trees	Ash, Green	<i>Fraxinus pennsylvanica</i>	sun	moist	60-100 ft./1.5 ft.
	Basswood (Linden)	<i>Tilia heterophylla</i>	sun	moist	60-100 ft./ 2-3 ft.
	Beech, American	<i>Fagus grandifolia</i>	sun	moist	80-100 ft./3 ft.
	Bigleaf Snowbell	<i>Styrax grandifolius</i>	partial shade	moist	20 ft.
	Birch, River (Red Birch)	<i>Betula nigra</i>	sun/partial shade	wet	60-80 ft./1-2 ft.
	Blackhaw	<i>Viburnum prunifolium</i>	partial shade	moist	20-25 ft.
	Buckeye, Painted	<i>Aesculus sylvatica</i>	partial shade	moist/dry	20-25 ft.
	Carolina Silverbell	<i>Halesia carolina</i>	sun/partial shade	moist	50-60 ft.
	Cherry, Black	<i>Prunus serotina</i>	sun	moist	80 ft./2 ft.
	Cottonwood, Eastern (Carolina Poplar)	<i>Populus deltoides</i>	sun/partial shade	wet	100 ft./5 ft.
	Dogwood, Flowering	<i>Cornus florida</i>	sun/partial shade	moist/dry	30-40 ft./12-18 ft.
	Dogwood, Silky	<i>Cornus amomum</i>	sun/partial shade	wet/moist	12 ft.
	Elm, Slippery (Red Elm)	<i>Ulmus rubra</i>	sun	moist	70-80 ft./2-3 in.
	Fringe Tree	<i>Chionanthus virginicus</i>	sun/partial shade	moist/dry	30 ft.
	Hickory, Bitternut	<i>Carya cordiformis</i>	sun	moist	60-80 ft./1-2 ft.
	Holly, American	<i>Ilex opaca</i>	partial shade	moist	15-30 ft.
	Hornbeam, American (Blue Beech, Ironwood)	<i>Carpinus caroliniana</i>	sun/partial shade	moist	35 ft./1 ft.
	Hornbeam, Hop	<i>Ostrya virginiana</i>	partial shade	dry/moist	35 ft.
	Maple, Ash-	<i>Acer negundo</i>	sun/partial	moist/wet	30-60 ft./2.5 ft.



Group	Common Name	Botanical Name	Light Conditions	Soil Conditions	Height / Diameter
	leaved (Boxelder)		shade		
	Maple, Red	<i>Acer rubrum</i>	sun	moist/dry	60-90 ft./3 ft.
	Mulberry, Red	<i>Morus rubra</i>	sun	moist	60 ft./2 ft.
	Oak, Southern Red	<i>Quercus falcate</i>	sun	dry	80-100 ft.
	Oak, Scarlet	<i>Quercus coccinea</i>	sun	dry	70-80 ft.
	Oak, Swamp Chestnut	<i>Quercus michauxii</i>	sun	moist	60-80 ft./2-3 ft.
	Oak, Water	<i>Quercus nigra</i>	sun	moist/wet	60-100 ft./2.5 ft.
	Oak, White	<i>Quercus alba</i>	sun/partial shade	dry/moist	80-100 ft./3-4 ft.
	Oak, Willow	<i>Quercus phellos</i>	sun	moist	90-100 ft./1-2 ft.
	Paw Paw	<i>Asimina triloba</i>	sun/partial shade	moist	25 ft./1-2 ft.
	Persimmon	<i>Diospyros virginiana</i>	sun/partial shade	moist/dry	20-70 ft./ 1-2 ft.
	Redbud (Judas Tree)	<i>Cercis canadensis</i>	sun	moist	40 ft./8 in.
	Silverbell, Carolina	<i>Halesia carolina</i>	partial shade	moist	30-50 ft./1 ft.
	Sourwood	<i>Oxydendrum arboreum</i>	sun/partial shade	moist/dry	20-30ft./10-12in.
	Sycamore (Planetree)	<i>Platanus occidentalis</i>	sun	wet	60-100 ft./3-5 ft.
	Tulip Poplar (Yellow Poplar)	<i>Liriodendron tulipifera</i>	sun	moist	80-120 ft./3-4 ft.
	Tupelo, Black (Blackgum)	<i>Nyssa sylvatica</i>	sun	moist	50-100 ft./2-3 ft.
	Viburnum, Possumhaw	<i>Viburnum nudum</i>	partial shade	moist	15-20 ft.
	Willow, Black (Swamp Willow)	<i>Salix nigra</i>	sun/partial shade	wet	80-100 ft./2.5 ft.
Shrubs	Alder, Tag	<i>Alnus serrulata</i>	sun/partial shade	wet/moist	3-6ft.
	Azalea-Pinxter	<i>Rhododendron nudiflorum</i>	partial shade	moist	4-10 ft.
	Beautyberry, American	<i>Callicarpa americana</i>	sun/partial shade	moist/dry	5-10 ft.
	Buckeye, Bottlebrush *	<i>Aesculus parviflora</i>	sun/partial shade	moist	15-20 ft.



Group	Common Name	Botanical Name	Light Conditions	Soil Conditions	Height / Diameter
	Buttonbush	<i>Cephalanthus occidentalis</i>	sun/partial shade	wet/moist	3-6 ft.
	Mountain Laurel	<i>Kalmia latifolia</i>	partial shade	moist/dry	20-25 ft./8-10 in.
	Possum haw (Deciduous holly)	<i>Ilex deciduas</i>	sun/partial shade	dry/moist	20 ft.
	Red Chokeberry	<i>Sorbus arbutifolia</i>	sun/partial shade	wet/moist	6-9 ft.
	Rosebay Rhododendron	<i>Rhododendron maximum</i>	partial shade	moist	30 ft./8-10 in.
	Sparkleberry, Huckleberry	<i>Vaccinium arboreum</i>	sun/partial shade	moist/dry	6-10 ft.
	Spicebush	<i>Lindera benzoin</i>	shade	wet/moist	6-12 ft.
	St. John's Wort	<i>Hypericum hypericoides</i>	sun/partial shade	moist/dry	1-3 ft.
	Strawberry Bush	<i>Euonymus americanus</i>	shade	dry/moist	3-5 ft/
	Sweet Shrub	<i>Calycanthus floridus</i>	sun/partial shade	moist	6-10 ft.
	Waxmyrtle * (Southern Bayberry)	<i>Myrica cerifera</i>	sun/partial shade	dry/wet	30 ft.
	Willow, Virginia *	<i>Itea virginica</i>	sun/partial shade	dry/moist	6 ft.
	Witch-hazel	<i>Hamamelis virginiana</i>	partial shade	moist	30-35 ft.
Ground covers	Christmas fern	<i>Polystichium acrostichoides</i>	shade	moist	
	Cinnamon fern	<i>Osmunda cinnamomea</i>	shade/partial shade	moist/wet	
	Southern Lady Fern	<i>Athyrium asplenoides</i>	shade	moist/wet	
	Dog Hobble	<i>Leucothoe editorum</i>	sun/partial shade	dry/moist	
	Black-eyed Susan (coneflower)	<i>Rubekia sp.</i>	sun	dry/moist	2-2.5 ft.
	St. John's wort	<i>Hypericum sp.</i>	sun/partial shade	dry/moist	.5-4 ft.

* Native, but not necessarily to the Piedmont region of North Carolina. References: Brown and Kirkman "Trees of Georgia and Adjacent States", Radford, Ashe, Bell "Manual of the Vascular Flora of the Carolinas."