This training module has five parts:

- Water resources
- Surface water quality protection
- Controlling pollution
  Water supply watershed protection
  Wastewater management
  Stormwater management
  Erosion & sedimentation control
  Wetlands
- Groundwater protection
- Floodplain management

Water Resources

• Overview

North Carolina’s extraordinary variety of natural resources, including its water resources, is related to the diversity of its landscapes. North Carolina can be divided into three distinct geographical regions - the Coastal Plain, the Piedmont, and the Mountains. All three regions face the pressures of increased population and competition among potential resource users.

North Carolina’s surface waters generally drain the state northwest to southeast, with some exceptions (a substantial area of western NC drains westward to the Mississippi River through the Tennessee River basin).

Of the 50 inches of rain (on average) that falls in North Carolina every year:

- 33 inches returns to the atmosphere through evaporation and uptake by plants
- 15 inches of the rainfall returns to the oceans through surface waters (i.e. sounds, rivers, lakes, ponds, streams, creeks, wetlands, swamps, etc)
• Only 1 to 2 inches of the rainwater seeps into groundwater aquifers through a process called “groundwater recharge”.

Water for agricultural, domestic or industrial uses is obtained from either ground or surface water sources. Unlike groundwater, surface waters provide man benefits such as energy production (i.e. hydropower) and navigation. Both surface and groundwaters are essential to support wildlife and aquatic species. But more than any other use, plentiful, clean water is valuable to man for drinking, food production, and supporting businesses and industries.

• 55% of North Carolina’s citizens rely on groundwater as their source of drinking water. (19% nationally)
• Many N.C. counties have over 90% of their population using groundwater as their sole sources of potable water (water for drinking)
• 95% of rural residents and 75% of city residents in North Carolina depend on groundwater to supply domestic needs
• 45% of the state’s residents, including most in the larger cities, depend on surface water sources.
• Approximately 8% (2.7 million acres) of North Carolina is under water.
• The state has 17 major river basins or main watersheds.
• As of 1990, a total of 8.5 billion gallons per day of surface water was withdrawn from these 17 river basins in North Carolina, providing potable water for 6.5 million people.
• 80% (2.2 million acres) of the surface water is saline and found primarily in the Albemarle and Pamlico Sounds and estuarine ecosystems.

• Water Shortages

Although NC’s annual precipitation and surface water supplies are relatively high compared with drier parts of the country, water shortages have occurred in N.C. in the last few years. Most notable have been in Cary, Greensboro and some communities in the western mountains. Most of these problems have occurred due to:

- periodic droughts
- high urban growth rates
- increased demands from industry
- limited new surface water sources.

In other areas of the state, additional regional water intakes and distribution systems have been required to replace failing groundwater wells. Often these failures are along the coast and are caused by:

- excessive groundwater pumping
- intrusion of saltwater or other minerals such as iron
- contamination by fecal coliform or nitrate from adjacent large livestock farms or septic tanks.

Water shortages have only recently become a serious issue for North Carolinians. Although the state provides some oversight of water use and assistance to local governments and utilities (as described in the next section), very little state regulation
exists to prevent water shortages from affecting local communities. Local governments will continue to be responsible for adequately planning for and providing their own long-term water needs. As water demand continues to increase, local governments will be faced with three choices to avoid water shortages-develop alternative water sources, require conservation of existing water supplies, or decrease demand through managing or limiting growth.

• Development of Alternative Water Sources

The creation of new ground or surface water sources is a very expensive, complex and time-consuming task. Water sources must first be of suitable quantity and quality to be safe and desirable to drink. Quantity is sometimes a problem, as surface and groundwater sources are limited in their capacity. The only relatively unlimited supply is seawater for coastal communities, which is extremely expensive to treat adequately for public consumption. Safety is usually fairly easy to accomplish, as it is achieved through destroying disease causing microorganisms through the use of chlorine or other inexpensive chemicals. Palatability, however, is sometimes harder to achieve, since the removal of tastes, colors and odors necessary to produce clear water takes greater technology, which leads to more expensive capital and operating expenditures, and is complicated still if the raw water source varies in its quality from day to day. New capacity is provided by one of 3 methods:

- New Reservoirs
- New Intakes on existing water sources
- New Groundwater Wells

Both new intakes and reservoirs are limited options in areas with excessive water pollution. Even with the highest levels of technology currently available, some surface water and groundwater in the state may not be usable by local communities due to the presence of toxic or untreatable pollutants, or to the increased cost or effectiveness of treating polluted waters to meet federal and state drinking water standards.

Protecting water quality is fundamental to preventing water shortages!

• Water Supply Management

There are several common (but false) beliefs about water supply management that local governments should be aware of:

- State agencies will make sure my community has plenty of clean water.
- It is not necessary to coordinate with other local governments and water users in my area to address water and sewer needs.
- Only towns with water shortage emergencies need to worry about water supply planning, water conservation and water quality protection.
- It is not necessary to think about long-term water supply issues when making industrial recruitment or growth decisions.
- Water conservation methods are unpopular and infeasible.
- Comprehensive land use plans do not need to include water supply or water quality protection components.
- It is not necessary to address water and wastewater systems concurrently.
The two factors that all of these myths have in common are:

1) a need for better planning and coordination; and,
2) a need for conservation and protection of water resources at the local level in North Carolina.

• Planning for Future Water Supplies

Whether or not state law mandates that the local government prepare a Local Water Supply Plan, all local governments, regardless of size, should prepare plans for the efficient and economical use of water in their communities. This process should take local land use planning, growth projections, long-range plans and local development and conservation policies into consideration when planning future water system extensions. Water system placement and design should be consistent with long-range plans and land use ordinances to ensure properly planned growth and the provision of adequate water supplies for the future.

Long-range water supply plans should be prepared in conjunction with long-range wastewater master plans for the community, since an increase of water in a system will require upgrades and expansions to the wastewater system. Both water and wastewater management plans should be consistent with existing comprehensive land use and growth management plans for the community.

• Conservation

The time is past when clean, plentiful drinking water was an unlimited resource in North Carolina. Even with long-range planning, many communities are discovering that existing water supplies are inadequate to meet the demands of growth. Even with new water sources and improved technology, many communities are regularly faced with decreasing supply and increasing demand, leading to shortages that force them to use drought management measures including rationing and limiting uses (e.g. prohibiting car washes and restricting lawn watering). Some local governments have even been forced to institute growth moratoria due to a lack of clean water.

The EPA has been advising local governments since the 1970’s that to avoid water shortages they should focus on protecting ground and surface waters:

✓ Protect aquifer recharge areas and water supply watersheds from being built upon or polluted (the more polluted the ground or surface waters, the less clean water available for use, and the more likely the existence of water shortages in the community)
✓ Prevent wastes from entering the water stream so that more water is available for use (this is discussed in full in the next section on surface water quality)
✓ Combine water supply and wastewater management districts since they are part of the same system (an increase in one affects the other)
✓ Encourage businesses and households to conserve water by using an increasing water and sewer rate structure that requires higher payments for more wasteful users
✓ Require clean up of toxic waste sites before ground or surface waters are polluted
• **Price water at the marginal cost of new supplies** – requiring water users to pay the real cost of producing fresh water and treating wastewater
• **Use the water you currently have more efficiently** rather than going after greater supplies

What are specific ways communities can use their water more efficiently? Successful conservation methods being used in North Carolina include:

• **Retrofitting and upgrading existing wastewater treatment plants** to allow reuse and reclamation of treated wastewater. Although reclaimed and reused water is not suitable for drinking (because it may contain trace amounts of fecal bacteria), it can be used in irrigation, manufacturing processes, fire protection and many other public uses.
• **Performing a leak detection survey of the community’s water pipes** to prevent loss of potable water
• **Requiring low volume toilets, low shower heads, and pressure reducing valves** in new single family and multi-family construction
• **Educating homeowners on how to detect water leaks** in home plumbing systems
• **Educating homeowners on using water more efficiently** around the home
• **Adopting policies that require industries and businesses to use water efficient technologies** that reuse or recycle their water
• **Limiting amounts of water industries can use and discharge to the municipal system**
• **Updating local building, plumbing and health codes** and ordinances to allow use of water conservation technologies
• **Limiting new industries in the community to “dry” industries that do not use large amounts of water**
• **Educating homeowners and developers on how to design landscaping that requires less watering and fertilizing**
• **Designing public parks and public areas with plants that require no irrigation and limited additions of fertilizer**
• **Installing water and wastewater flow meters** for all developments
• **Using reused and reclaimed water wherever possible**
• **Encouraging industries to your community that use reclaimed wastewater as their source water**
• **Avoiding polluting surface waters** from all sources (point and non-point)

### Facts about …
**Urban Water Use**

- Residential demands account for about three-fourths of the total urban water demand.
- Indoor use accounts for roughly 60 percent of all residential use, and of this, toilets (at 3.5 to 5.0 gallons per flush) use nearly 40 percent.
- Toilets, showers, and faucets combined represent two-thirds of all indoor water use.
- More than 4.8 billion gallons of water is flushed down toilets each day in the United States.
- The average American uses about 9,000 gallons of water to flush 230 gallons of waste down the toilet per year.
- Conventional toilets use 3.5 to 5 gallons or more of water per flush, but low-flush toilets use only 1.6 gallons of water or less. Since low-flush toilets use less water, they also reduce the volume of wastewater produced.
Surface Water Quality Protection

Clean water is just as critical to all life as plentiful water. But what is “good” water quality? To most citizens, water quality may mean “clean” enough to drink, swim, or fish. But to the farmer or manufacturer, “good” water quality may have an entirely different meaning. One of the most important issues concerning defining the quality of water is how that water will be used. Water that may be perfectly fine for irrigation may be unsuitable for drinking, swimming or keeping fish and mussels healthy.

• The Water Cycle

About 25% of the moisture that falls on a natural, undeveloped site is returned to the atmosphere through evapo-transpiration from soil and plants. Approximately 30% filters into the groundwater, and the remaining 45% runs off the land into surface waters. This runoff picks up and carries into surface waters relatively small amounts of soil and vegetation.

On a developed or cleared site, the picture changes. Where vegetation once served to slow runoff and retain soil, allowing part of the precipitation to be absorbed, there is now bare ground. Since less water is able to infiltrate to the groundwater, both the amount and speed of runoff increases. Development often brings increased use of contaminants such as gasoline, oils, fertilizers, pesticides, building materials, and chemicals. Since both the amount and speed of runoff has increased, large concentrations of these contaminants are carried off impervious surfaces and into surface waters. Land disturbing activities that remove vegetation also lead to an increase in sediments carried into surface waters.
• Harmful Effects of Degraded Water Quality

✓ transmission of diseases to man, livestock, fisheries and produce by pathogenic agents such as bacteria and viruses.
✓ transmission of diseases and chronic illnesses by elevated levels of natural agents such as nitrates (as seen with blue baby syndrome).
✓ poisoning and cancers caused by various toxic agents including heavy metals, herbicides, and various inorganic and organic chemicals.
✓ declines in healthy and edible saltwater and freshwater fish, causing declines in food stocks, commercial fishing industries, and recreation and tourism industries.
✓ increased costs of purifying and treating waters for public consumption and use, and increased costs of treating wastewaters for disposal.
✓ declines in the desirability of a region’s environment, quality of life and economic opportunities, leading to negative impacts on economic growth.

• Water Quality Classifications

All fresh and saltwater surface waters in North Carolina have been assigned a “Water Quality Classification” for their “best usage”, be it water supply, recreation or fishing. Specific water quality standards have been adopted by the state based on the expected uses of those waters and the quality of the water necessary to sustain those uses. Table 9-1 shows the ten primary and six supplemental classifications for all surface waters in the state along with a brief summary of the standards and restrictions for their use. This table is meant to be a summary only – consult with the Division of Water Quality for more specific information.
### Table 9-1 Summary of NC Water Quality Classifications and Standards

<table>
<thead>
<tr>
<th>Primary Classifications:</th>
<th>Best Usage</th>
<th>Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshwater –</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Secondary recreation (infrequent contact with water); wildlife, fish and aquatic life survival and propagation; other uses as allowed</td>
<td>Basic standard for all waters. Domestic and industrial discharges not prohibited. Stormwater controls only required for 20 coastal counties.</td>
</tr>
<tr>
<td>B</td>
<td>Primary recreation (frequent human contact with water) and other uses allowed under C</td>
<td>Backup wastewater treatment power may apply.</td>
</tr>
<tr>
<td>WS-I Water Supply</td>
<td>Water supplies in natural and undeveloped watersheds</td>
<td>No point source discharges allowed. Land in public ownership. No stormwater mgmt requirements. No landfills allowed.</td>
</tr>
<tr>
<td>WS-II Water Supply</td>
<td>Water supplies in predominantly undeveloped watersheds</td>
<td>Only general permit discharges allowed. Specific stormwater management requirements depending on proximity to water intake and density of development planned. Most stringent limitations on development density (units per acre or percentage built upon acreage). Stream buffers required. Landfill limitations.</td>
</tr>
<tr>
<td>WS-III Water Supply</td>
<td>Water supplies in low to moderately developed watersheds</td>
<td>General permit discharges allowed. Limitations on placement of individual discharges. Specific stormwater management requirements depending on proximity to water intake and density of development planned. Less stringent limitations on development density (units per acre or percentage built upon acreage) than WS-II. Stream buffers required. Landfill limitations.</td>
</tr>
<tr>
<td>WS-IV Water Supply</td>
<td>Water supplies in moderately to highly developed watersheds</td>
<td>All discharges allowed. Specific stormwater management requirements depending on proximity to water intake and density of development planned. Least stringent limitations on development density (units per acre or percentage built upon acreage). Stream buffers required. Landfill limitations.</td>
</tr>
<tr>
<td>WS-V Water Supply</td>
<td>Former or industrial use water supplies</td>
<td>No restrictions on development or discharges. Other standards may apply.</td>
</tr>
<tr>
<td><strong>Saltwater –</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>Saltwaters protected for all uses as described for C.</td>
<td>All discharges allowed. Specific stormwater management requirements depending on density of development planned.</td>
</tr>
<tr>
<td>SB</td>
<td>Saltwaters protected for all uses described for B</td>
<td>All discharges allowed. Backup wastewater treatment power may apply. Specific stormwater management requirements depending on density of development planned.</td>
</tr>
<tr>
<td>SA</td>
<td>Shellfishing uses and all uses described for B and C.</td>
<td>No domestic discharges. Only non-industrial process discharges. Specific stormwater management requirements depending on density of development planned, except less density allowed than SB or SC.</td>
</tr>
</tbody>
</table>

**Supplemental Classifications:**

| HQW (High Quality Waters) | Waters rated as excellent. Primary Nursery areas. Trout Waters. WS-I and WS-II waters. SA Waters. | Advanced discharge requirements. Specific stormwater management requirements. |
| ORW (Outstanding Resource Waters) | Unique and special waters and having an exceptional state or national ecological or recreational significance and meet other criteria | No new or expanded discharges to freshwater areas. Some discharges may be allowed in coastal areas. Specific stormwater management requirements. Other requirements apply. |
| TR (Trout Waters)         | Protected for natural trout propagation and survival of stocked trout | Discharges allowed with strict requirements. More restrictive toxicant limits. |
| NSW (Nutrient Sensitive Waters) | Waters needing additional nutrient management due to their being subject to excessive growth of vegetation | No increases in nutrients over background levels. All discharges allowed with greater nutrient limitations. |
| SW (Swamp Waters)         | Waters with characteristics different than other waterbodies | Different water quality standards than other waters (lower pH, lower DO and higher organic content). |
| FWS (Future Water Supply) | Waters designated for future water supply use | Acts as “holding zone” for future water supply. Requirements same as for underlying water supply classification. Local government can choose to implement restrictions if desired. |
• Pollutant Sources

Point Sources - This term applies to wastewater and stormwater discharges from a variety of sources that are released into the environment at a measurable, single point. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater systems (referred to as “package treatment plants”) that may serve schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities that serve populations over 100,000 and stormwater associated with certain industrial activities.

Major point source pollutants include:

- Oxygen consuming wastes from wastewater treatment plants and sewer bypasses (called straight-piping)
- Nutrients from municipal wastewater
- Sediment from construction and urban land use activities
- Color in industrial wastewater from textile and pulp and paper mills
- Toxic substances including metals, ammonia, salts and disinfectants (e.g. chlorine) from industrial and municipal discharges
- Fecal coliform bacteria from improperly treated wastewater

Non-Point Sources – These discharges come from many diffuse sources, through stormwater runoff. Non-point source runoff by definition occurs in numerous creeks and streams, and reaches the river or lake at many points.

According to the EPA, non-point source pollution is the nation’s leading threat to water quality, and according to the NC Division of Water Quality, it is the leading cause of impairment in most of the state’s waters.

Major non-point source pollutants include:

- Sediment and silt from improperly managed construction sites and mining activities, disturbed land areas, unpaved roads, streambank erosion, crop and forest lands, livestock grazing lands, uncontrolled urban runoff, timber harvesting, eroding streambanks and removal of vegetative buffers along streams
- Fecal coliform bacteria from failing septic tanks, leaking severs, animal waste, and runoff from livestock operations
- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas

Point source (PS) refers to a discharge that enters surface waters through a pipe, ditch or other well-defined point of discharge. The term applies to wastewater and stormwater discharges from a variety of sources.

Nonpoint source (NPS) pollution, unlike point source pollution, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our surface and aquifer sources of drinking water. Non-point source pollution is widespread because it can occur any time activities disturb the land or water.

On unaltered landscapes, there is little surface runoff except within a few feet of streams. Once the trees are gone and the land is paved, not only are there new pollution sources on the paved surfaces that did not exist before, but there is no area left for infiltration into the soil, so all the water and pollutants end up in the streams and creeks.
- **Nutrients** from fertilizer, animal wastes, leaking sewers and septic tanks, and atmospheric deposition
- **Salt** from irrigation practices and acid drainage from abandoned mines
- **Toxic and synthetic substances** from pesticides, disinfectants (i.e. chlorine), automobile fluids, accidental and illegal spills, and urban stormwater runoff
- **Oil, grease, and toxic chemicals** from urban runoff and energy production
- **Oxygen consuming wastes** from organic matter, leaking sewers, septic tanks and animal waste

NPS pollution comes from land uses such as –

**Agriculture** –
- degrades 60% of impaired rivers and 50% of impaired lakes in country
- third largest source of impairments to estuaries
- polluting activities: confined animal facilities, grazing, plowing, pesticides, irrigation, fertilizing, planting and harvesting

**Urban Runoff** –
- includes roads, rooftops, parking lots, construction sites, failing septic tanks, landfills, and salted winter roads
- comes from large and small urban areas, including rural residential development
- leading source of impairments to estuaries
- third largest source of water quality impacts to lakes

**Forestry** –
- contribute to approx. 9% of the water quality problems in rivers and streams
- polluting activities: removal of streamside vegetation, road construction and use, timber harvesting, mechanical preparation for tree planting

**Impacts from Water Pollutants**

**Sediment**  Clay, silt and other sediments can cause significant impacts through: Streambank erosion and direct damage to wildlife, as well as indirect damage by carrying with it other forms of pollution (nutrients, bacteria and toxic chemicals), through added costs of filtration, and by the filling in (and subsequent reduction in capacity) of water supply reservoirs, necessitating expensive dredging.

**Nutrients**  Nutrients refer to the two main plant nutrients, nitrogen and phosphorus, which are common components of fertilizers, animal and human wastes, vegetation, aquaculture and some industrial processes. Nutrients are beneficial to aquatic life in small amounts. However, when conditions are favorable, excessive nutrients can stimulate the occurrence of algal blooms, which through respiration and decomposition, can deplete the water of dissolved oxygen and can contribute to serious water quality problems (this process is called “eutrophication”). Blooms are aesthetically undesirable, result in unbalanced food web, impair recreational uses of the water, impede fishing, cause fish kills, and pose difficulties for water treatment.

**Toxic Substances**  Toxic substances are defined as having the potential to cause death, disease, deformity, cancer, mutations, abnormalities, or other adverse health effects. Toxic substances frequently encountered in water quality management include chlorine, ammonia, organics (hydrocarbons and pesticides), heavy metals and pH.
**Fecal Coliform**  Fecal coliform bacteria are typically associated with the intestinal tracts of warm blooded animals and can pollute waters through leaking or failing septic tanks, leaking sewer lines, straight-piping, pump station overflows, runoff from livestock operations, wildlife and improperly disinfected wastewater effluent. In addition to being a health risk to man by itself, fecal coliform is used as an indicator for the potential presence of other waterborne pathogens which cause disease, including typhoid fever, dysentery, and cholera.

**Urban Stormwater**  Stormwater runoff from urban, industrial and developing areas can contain significant quantities of pollutants such as heavy metals, herbicides, pesticides, bacteria, and organic compounds such as fuels, waste oil, solvents, lubricants, and grease. Runoff also discharges sediment, which is a pollutant itself and carries other pollutants with it. Urban stormwater can significantly impact the use of water for drinking, in addition to limiting recreation, fisheries, and wildlife uses of the water. Urban runoff can also significantly degrade shellfish areas and nutrient sensitive waters.

**Color**  Color can be found in the effluent of a number of different industries, including pulp and paper mills, textile dyeing and finishing operations, chemical manufacturers, dye manufacturers, to name a few. Color can cause a variety of problems:

- Reducing light penetration of water, thereby decreasing plant growth and disrupting aquatic food chains
- Decreasing oxygen levels in aquatic systems
- Agents that cause color are often toxic to aquatic life
- Decreasing aesthetic value of waterways for recreational uses
- Increasing cost of removing color for downstream water users
Controlling Pollution

Methods used in North Carolina to control pollution from point and non-point sources are very different. **Point source pollution** is controlled using technical and engineering controls that involve chemical and biological processes that remove contaminants from the wastewater. Point source pollutants are relatively easy (but not necessarily cheap) to control through regulations since the wastewater stream is contained in a closed system, incoming pollutant loads can be managed and technological processes have been perfected.

Non-point sources (NPS), however, are not as easy to control since the sources of pollutants often do not lend themselves to easy technical controls. Although engineered solutions are available for controlling some sources of NPS pollutants (e.g. stormwater), preventing NPS pollution usually involves controlling land uses, changing land practices and becoming better stewards of our natural resources.

A 1998 statewide survey revealed that 83% of the state's 100 counties have land use plans. Approximately 70% of the municipalities over 10,000 population and 50% of the towns under 10,000 population have some type of plan. Of those that do have plans, very few local governments incorporate environmental protection and infrastructure planning with their land use planning.

**Water Supply Watershed Protection**

The Water Supply Watershed Protection (WSWS) Rules, effective since 1992, **require all local governments** having land use jurisdiction within surface water supply watersheds to adopt and implement water supply watershed protection ordinances, maps and a management plan. The Water Supply Watershed Act is a state law, not originating from the federal government.

The goals of the program include:

- **protection of surface drinking water supplies** in North Carolina from Non-Point Source and Point Source pollution from urban runoff and wastewater discharges
- **provision of a cooperative program of watershed management and protection** that is administered by local governments consistent with minimum statewide standards.

The State Division of Water Quality manages the program through oversight of local planning ordinances and monitoring of land use activities. The program requires local governments to adopt the following land use controls and limitations based on watershed classifications:
• Limitation of impervious surfaces around water supplies unless stormwater controls are used
• Protection of buffers around perennial streams and lakes
• Limits some land uses
• Limits dischargers (NPDES permits in certain situations)
• Allows the use of clustering and density averaging to meet overall development density limits
• Rules cover entire watersheds (except for WS-IV)

Watersheds that are protected under the WSWS Program have a classification of WS-I through WS-V (see Table 9-1), where WS-I has the most restrictive controls. This table shows a brief summary of land use restrictions for each watershed.

Although less controversial and contentious today than when they first were presented, the Water Supply Watershed Program still may be viewed by some as an unwelcome intrusion of the state into local land use affairs. Unfortunately, watershed boundaries do not respect political ones, and not every community has the same water quality protection goals as its neighbor. The state must act as a regional authority to ensure that drinking waters being used by one community are protected from non-point source pollution generated by the neighboring communities.

Wastewater management

Wastewater management is aimed at restoring the quality of water after citizens and businesses have used it. Although the processes may vary, all wastewater treatment systems are designed to:

- Remove the organic wastes to prevent depletion of oxygen in waters that receive the wastewater (for discharge systems) or to prevent over-nourishment of crops that receive the wastewater through irrigation systems (which prevents seepage of nutrients into ground waters).
- Destroy disease causing microorganisms to prevent disease

Wastewater point source discharges are controlled by National Pollutant Discharge Elimination System (NPDES) regulations, as enforced by the NC Division of Water Quality (DWQ).

Planning Boards and Commissions typically do not get involved with the permitting process, but often discharge points become land use issues when package sewage treatment plants are proposed in areas where no municipal facilities exist.
• Stormwater Management

Changes in land use have a major effect on both the quantity and quality of stormwater runoff. Urbanization and land use development, if not properly planned and managed, can dramatically alter the natural hydrology of an area. Impervious surfaces increase the volume and rate of stormwater runoff. These changes lead to more frequent and severe flooding and also leads to degradation of water quality from the various stormwater pollutants that wash off impervious areas during rain events (e.g. sediments, nutrients, bacteria, organic matter, oil and grease, heavy metals, road salt, and toxicants). As imperviousness increases, the more impacted surface waters become from pollution and flooding. The cumulative effects of stormwater runoff are evident in the frequent correlation between the location of a stream and its water quality, where urban streams overall have poorer water quality than rural streams.

Stormwater is referred to as a point source pollutant if it is discharged from point sources (pipes) to surface waters of the state. Stormwater discharges from point sources in NC are controlled by either National Pollutant Discharge Elimination System (NPDES) regulations or by State Stormwater Regulations. State Stormwater Permits are authorized entirely under state (not federal) laws and only apply to specific circumstances where additional control of point source stormwater discharges is required beyond those mandated under the NPDES program.

Local governments can adopt their own stormwater control regulations that are stricter than state or federal requirements.

Urban stormwater management requires the use of both non-structural and structural controls.

*Non-structural methods* imply limitations on land uses (e.g. prohibiting landfills in certain areas) or limitations on development density by:

- defining a maximum number of residential units per acre, and/or
- defining the maximum amount of built-upon or impervious surface areas allowed for specific types of land uses.
Structural controls are engineered structures designed and constructed to trap and remove pollutants in stormwater runoff. Structural controls include:

- wet detention ponds or basins
- extended detention wetlands
- pocket wetlands
- sand filters
- bioretention areas
- grassed swales
- extended dry retention
- and infiltration devices.

These controls can be designed for one development only and be built on the project site, or they can be designed to trap and treat stormwater from an entire urban watershed, and therefore would be much larger in size and be located and designed to properly drain all upland properties and roads. Structural controls are referred to as "Best Management Practices" (BMPs) by DWQ, and require proper design and maintenance in order to assure adequate stormwater capture and pollutant removal from the intended drainage area under defined storm conditions.

Structural controls are expensive, difficult to design and require regular maintenance for proper function; however, their use is crucially important in areas where water quality could be impaired by urban development, but medium to high urban densities are also desired to implement other community goals, such as curbing urban sprawl, preserving open space, and/or designing development patterns to support regional transit.

The NC Division of Water Quality focuses its urban stormwater management controls first on minimizing impervious surfaces and secondly on BMP’s that treat stormwater from these surfaces. The use of non-structural methods is recommended first because development density and imperviousness are easily measurable, they can be used to estimate cumulative stream impacts, and they can be controlled through land use regulation.

Mandating low density development, however, may encourage urban sprawl, the impacts of which may have their own environmental and community impacts, including:

- increased auto dependence, traffic congestion, fuel consumption and air emissions
- deteriorated air and water quality
- loss of open space, farmlands and rural lands
- declining sense of community
- loss of wildlife habitat and wetlands
- increased costs to local government

North Carolina emphasizes a preventive approach to stormwater management through both the NPDES Stormwater and State Stormwater permitting programs, as described below.
Individual NPDES Stormwater Permits are required for stormwater point source discharges originating from:

- municipalities (incorporated areas with a population of 100,000 or more), and
- selected industrial facilities (that have discharges directly related to manufacturing, processing or raw materials storage areas) that disturb more than 5 acres of land and which have a point source discharge of stormwater.

Individual NPDES Stormwater Permits involve the use of structural and non-structural stormwater controls and are only required if a General NPDES Stormwater Permit is not available.

General NPDES Stormwater Permits are here are required for specific types of industrial activities. There currently are 19 general stormwater permits available across the state. General permits may specify particular controls needed, and monitoring and reporting requirements for both quantitative and qualitative assessment of the stormwater discharge as well as operational inspections of the entire facility, including all stormwater systems.

Both Individual and General NPDES Stormwater Permits require the development and implementation of a Stormwater Pollution Prevention Plan (SPPP). The SPPP requires the permitted facility to develop a comprehensive stormwater management plan. This plan is the basis for evaluating the pollution potential of the site and implementing best management practices (BMPs) to reduce pollutants in runoff from the site.

State Stormwater Permits are required by the Division of Water Quality to extend stormwater management requirements beyond the minimum called for by the federal government under the NPDES Program. A State Stormwater Certification is required for all development in the 20 coastal counties that involves land disturbing activities on more than one acre of land and requires a CAMA Major Permit or a sedimentation/erosion control plan.

SEE MODULE 7. COASTAL AREA PLANNING FOR MORE INFORMATION ON CAMA MAJOR PERMITS.

Development plans showing disturbing activities requiring a sedimentation/erosion control plan (disturbing more than one acre) in the piedmont and mountain areas also require a State Stormwater Certification if the area is within one mile and draining to waters classified as ORW or HQW. Stormwater control requirements (including structural and non-structural controls needed) vary depending on the classification of the waters to which the project drains.

**Sedimentation and Erosion Control**

Erosion and Sedimentation Rules are enforced by the NC Division of Land Resources to control erosion and sedimentation caused by land disturbing activities on one or more acres of land. The State Sedimentation Pollution Control Act states that measures must be planned, designed and constructed to provide protection from the calculated peak rate of runoff from a 10-year storm, except for projects in HQW (High Quality Water) zones, which require control of 25-year storms. **Enforcement of the program is at the state**
level, but can be delegated to local governments (usually counties or large municipalities) with certified erosion control programs.

• Wetland Protection

According to the Environmental Protection Agency, wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water at least part of the year.

For regulatory purposes under the Clean Water Act, the term wetlands means:

"those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Three basic parameters are used for identifying and delineating wetlands:

• the presence of wetland hydrology
• hydrophytic or "water loving" vegetation
• hydric soils.

Wetlands and vegetated riparian areas are valuable because:

• Wetlands are among the most biologically productive natural ecosystems in the world. Wetlands can be compared to tropical rain forests and coral reefs in the diversity of species they support. The U.S. Fish and Wildlife Service estimates that up to 43% of the threatened and endangered species in the U.S. rely directly or indirectly on wetlands for their survival.

• Wetlands protect wildlife and provide natural open spaces. Preserved wetlands and riparian areas provide important corridors of wildlife habitat, and provide both spawning grounds and nursery areas for many commercially and recreationally valuable fish species.

• Wetlands protect water quality in streams, lakes, and estuaries. Acting as natural water quality filters, wetlands and riparian areas improve water quality, including that of drinking water, by intercepting surface runoff and removing or retaining its nutrients, processing organic wastes, and reducing sediment before it reaches open water.

• Wetlands stabilize stream banks and control erosion. Wetland and riparian area plants stabilize shorelines and streambanks by holding soil in place, which reduces erosion and the amount of sediment carried downstream.

• Wetlands prevent flooding damage. Wetland and riparian vegetation slow floodwaters, then function like natural sponges, soaking up and storing floodwater and slowly releasing it. This combined storage and breaking action lowers flood heights and reduces the water's erosion.
According to the EPA, North Carolina has lost 49% of the original 7.8 million acres of wetlands.

In response to these losses, regulatory provisions have been established to prevent indiscriminate destruction of wetlands and riparian areas, the most important being Sections 404 and 401 of the Federal Clean Water Act. **Section 404 regulates discharge of dredge and fill materials into waters of the US**, including wetlands, and is enforced by the U.S. Army Corps of Engineers. **Section 401 requires certification that water quality will not be seriously impacted by a proposed activity**, and is enforced by the NC Division of Water Quality.

Recognizing the value of wetlands and riparian areas, **the North Carolina General Assembly established the North Carolina Wetlands Restoration Program (NCWRP) in 1996**. The purpose of the NCWRP is to restore, enhance, preserve and create wetlands, streams and streamside (riparian) areas throughout North Carolina's seventeen major river basins (G.S. § 143-214.9). To accomplish these goals, the NCWRP has developed Basinwide Wetlands and Riparian Restoration Plans to plan and implement restoration activities within each of the 17 major river basins.

**Nutrient Sensitive Waters**

**Nutrient Sensitive Waters (NSW)** is a supplemental water quality classification (as shown in Table 9-1) assigned to waters with excessive nutrient (nitrogen or phosphorous) levels that cause algal blooms and fish kills. The state Environmental Management Commission (EMC) currently has designated two basins in NC as Nutrient Sensitive - the Neuse River basin and the Tar-Pamlico River basin.

**Neuse NSW Rules** - The 1999 revised Neuse River NSW strategy places stringent nutrient removal requirements on point source dischargers, while also addressing other sources of nutrients, including urban stormwater, agricultural sources and nutrient application management. In addition, the Neuse NSW rules require that 50-feet of existing riparian (wooded) buffer areas be protected and maintained on each side of surface waters (see Figure 9-D). Affected municipalities are required to develop, adopt, and implement stormwater management programs to control nutrients to the Neuse River watershed.

**Tar-Pam NSW Rules** - After two years of implementing a "voluntary" nonpoint source approach (which relied on existing programs to achieve a goal of 30% reduction of non-point source nutrients through better targeting, coordination, and increased effort), the EMC determined, in July 1998, that progress was inadequate, and called for development
of rules to achieve the nonpoint source reduction goals. The State is currently undergoing rulemaking for Tar-Pam NSW rules, which include:

- agricultural best management practices for farmers
- nutrient management requirements for commercial fertilizer applications
- urban stormwater requirements for local governments to achieve the nitrogen and phosphorus loading goals with no net increase in peak stormwater flows.

**What Can Be Done On The Local Level About Water Quality?**

**Practice “Smart” Environmental Growth**

**Watershed-Based Solutions.** Water resource problems are watershed-based problems, often transcending governmental boundaries. This presents difficult problems in water supply development, drainage and flood control, water quality management and environmental protection. **Environmental solutions should therefore be shifted away from individual development sites to the entire ecological “system” for most effective analysis, management and mitigation.** The appropriate system to be focused on should therefore be the watersheds. Successful resolution of these problems, therefore, requires integrated planning approaches, cooperation among regional governments, and shared decision-making within the watershed.

**Comprehensive Environmental Planning.** A Comprehensive Land Use Plan that includes water quality protection, flood control and water supply planning should be prepared for the local government, in coordination with other jurisdictions in the watershed.

**Growth Management.** Local governments should prepare a Growth Management Plan in conjunction with the Comprehensive Land Use Plan that will set forth policies, and long-range goals and objectives relating to growth and development of the local government. The plan should identify general principles and objectives for many areas, including: the rate and timing of growth, the amount and density of growth, the location of growth, the cost of growth, and the quality of growth. The Plan should also set forth a number of implementation strategies designed to achieve these principles and objectives, which should be consistent with the Comprehensive Land Use and Water Resources Plan(s).

**Stormwater Management.** Even if not required by state or federal law, local governments should develop a Comprehensive Stormwater Management Plan in conjunction with the Comprehensive Land Use Plan that addresses long-range land use changes, and is designed to manage both water quantity and quality issues on a drainage-basin scale. Include the use of BMP’s that keep natural drainageways intact (prohibit channelization, piping, minimize crossings and provide adequate sized culverts and bridge openings), and protect vegetative buffers, natural lakes and wetlands so that they can be used to slow and control runoff to avoid flooding while adequately treating stormwater pollutants to prevent water quality degradation.

**Consistency.** Local governments should always require consistency between all plans and ordinances to make sure that its vision and long-range policies for growth are implemented as planned through its day-to-day zoning decisions and the design of its developments.
Land Use & Zoning Controls for Better Water Quality:

- **Use overlay zoning and development performance standards** to control and minimize impacts of development in sensitive areas - stream corridors, significant ecological / habitat areas, and wetlands.
- **Development should be focused on areas that are already disturbed.** Even the most “green” development in the wrong place is not environmentally sound.
- **Adopt policies and zoning controls that prohibit all structures in floodplains** (allowable economic uses may be agriculture, silviculture, park lands, minimal impact recreation, etc.)
- **Use open space preservation tools** to avoid development in sensitive areas.
- **Regulate development intensity using the density of the land use** (i.e. measuring the quantity of development on a site using % built-upon area, sq. ft. of structure, etc.) and not by minimum lot size.
- **Consider using mixed land uses, in-fill and pedestrian-friendly developments,** to reduce automobile dependence and reduce pollution generated by paved surfaces.
- **Design around (and require long-term protection and management of) sensitive watersheds, wetlands, floodplains, and surface waters.**
- **Control development activities based on natural features on each site** (i.e. steep slopes, floodplains, wetlands, significant habitat and vegetation, surface waters, etc.)
- **Restore and enhance environmental functions damaged by prior site activities,** especially damaged wetlands and stream buffers, since they provide the most water quality benefits.
- **Use reclaimed water and integrated pest management** on large landscaped areas.
- **Use and require the use of xeriscape landscapes** (which conserve water by improving soil conditions, using locally adapted plants, irrigating efficiently, limiting amount of turf, using mulches to retain moisture, and are maintained properly)
- **Provide flexible development standards and require / encourage cluster and open space developments** to avoid environmental impacts throughout community.
- **Minimize land disturbance**, including grading, degradation of stream banks, cut & fill and natural vegetation removal to those areas actually needed, through adoption of a tree preservation ordinance.
- **Protect and maintain adequate areas (50 feet) of natural, forested upland buffer areas around each side of all intermittent and perennial streams, lakes and wetlands.**
- **Establish setbacks for all development from drainage channels and streams** to avoid flooding and poor site drainage impacts.
- **Minimize impervious surface cover** on all developments where feasible, and employ engineered stormwater controls that pretreat runoff before it reaches receiving waters and wetlands (where minimizing impervious cover is infeasible)
- **Minimize runoff from development sites** by clustering development on the least porous soils, and by using detention strategies within natural open drainage systems.
- **Design stormwater runoff controls to decrease velocity, spread discharge runoff through vegetative conveyances (not directly into streams), and maintain volumes to pre-development levels.**
- **Design man-made lakes and stormwater ponds for maximum habitat value.**
- **Limit street widths, curbing, and parking** (within NCDOT guidelines) to limit runoff, construction cost and land consumption.
- **Provide information regarding optional pavement materials** that can be used by road builders and developers that can economically replace impervious pavement types so the underlying soil can absorb rainfall and treat pollutants.
- **Provide public labeling of stormwater drains and inlets** to drainage swales to avoid illegal dumping.
Groundwater Protection

The land area where water first enters the ground is called the “groundwater recharge” area. Hazardous or toxic substances that seep into the ground in a recharge area are more likely to contaminate the groundwater, making it unsafe to drink. A groundwater source, once polluted, is very difficult to clean up.

Groundwater is susceptible to pollution from many activities on or below the land surface. As groundwater becomes contaminated, so do public water supplies.

Cleaning up contamination incidents or providing alternative water sources to affected residents can be a costly enterprise. Many communities, when faced with contaminated groundwater supplies, abandon the use of a contaminated aquifer. The community must then find other water supplies, drill new wells farther away from the contaminated area of the aquifer, deepen existing wells, or drill new wells in another aquifer if one is located nearby.

• State Groundwater Management

The Groundwater Section of DWQ, located within DENR, is the lead state agency for groundwater protection. Responsibilities of the Groundwater Section include groundwater pollution prevention, ground water quality classification and standards, review of permits for wastes discharged to the ground waters, developing and implementing ground water cleanup requirements, promoting resource restoration, regulating capacity use areas, regulating underground storage tanks, enforcing well construction rules, controlling underground injection wells, and monitoring ground water quality.

Other agencies involved with groundwater issues –

Division of Environmental Health (DEH) within DENR, enforces standards for public groundwater systems for on-site wastewater permits and subsurface septic tanks and systems. All counties in the state have been given authority (through their health departments) to issue permits for all on-site and subsurface wastewater systems. The only exceptions that require state approval are systems with flows exceeding 3,000 gallons per day or if the system will treat industrial waste.

The Public Water Section of DEH enforces drinking water standards for public water systems, including reviewing permits and site plans for new wells and water distribution systems, monitoring of public water systems and inspecting public water supply facilities.

Division of Waste Management (DWM) within DENR, issues permits and administers regulations for landfills, hazardous waste facilities, and operating and abandoned hazardous waste sites. The Underground Storage Tank (UST) Section of DWM also regulates about 11,000 petroleum underground storage tank facilities to prevent pollution and protect groundwater resources.

These programs may afford some protection to groundwater wells from the most common forms of groundwater pollution – point sources such as chemical manufacturing facilities, Underground Storage Tanks and accidental spills. However, more diffuse and evasive groundwater pollutants from agricultural uses (livestock facilities and chemical application on crops) and urban land uses (over-application of fertilizers and improper use of toxic household chemicals) may not be well managed under these programs.
• Local Groundwater Protection

Health Regulations. The County Board of Health has the authority to adopt rules necessary to protect and promote public health. Rules adopted by the county can be more stringent than those passed by the state.

Local well ordinances have been passed by several North Carolina counties to supplement the N.C. Well Construction Act (N.C.G.S. 87-83 et seq.) and to require inspection of all wells regardless of size. County Health Departments play important roles in regulating the estimated 1.2 million septic tank systems in North Carolina. A state-mandated on-site sewage program requires local governments to uphold minimum requirements and to issue permits for the siting, design, installation, and use of septic tanks and other domestic waste treatment systems. Additionally, 1989 regulations for non-conventional on-site sewage systems require counties to implement programs that meet monitoring and reporting requirements and perform surveillance and performance checks.

County and City Health Departments also provide links between county residents and the DENR in determining the water quality of private wells and the health effects associated with groundwater contamination.

Livestock Management. Although the Swine Farm Siting Act (G.S. 106-800 to 106-803) was added to the NC Planning Statutes in 1995, and although DWQ regulates surface water pollution from livestock operations (see Part Two, above), these rules provide little authority for local governments to protect public ground water from pollutants generated by swine farms. The Swine Farm Act provides only limited setback provisions between swine houses and lagoons and neighboring uses - 1,500-foot setback from occupied residences and 500-foot setback from property boundaries. And, only 50-foot setback is required between spray fields and property lines and streams. These factors do not take into consideration the real setback needs between lagoons and spray fields and water wells, recharge areas or well-head areas to protect groundwater aquifers from being affected by pollutants in swine waste. Additional authority from the state is needed for local governments to protect groundwater and control odors and other intrusive effects of large animal operations.

Well-Head Program. Nearly all ground-water pollution originates at or near the land surface in areas where ground-water systems are replenished, which is referred to as the groundwater recharge area, or well-head area. A well-head protection program is a local government program where cities and counties protect local underground drinking water supplies. The fundamental premise of a wellhead-protection program is that the water withdrawn from a supply well is derived from ground-water recharge on an identifiable area surrounding the well. This area is referred to as the contributing area. The size of the contributing area for any well depends on the pumping rate of the well and on the rate of recharge to the aquifer supplying the water.

Successful application of the wellhead-protection program requires, therefore, both the identification of ground-water recharge areas, estimates of recharge rates, and protection of the recharge areas from contamination by land use activities. Similarly to the land use control strategies used to protect surface water supplies (see the Water Supply Watershed Protection Regulations discussed in Part Two above), various land use control strategies are available to local governments to protect groundwater recharge areas.
Nonregulatory strategies

✓ Purchase or acquire vulnerable land parcels
✓ Purchase or acquire conservation easements
✓ Encourage private donation of land and development rights
✓ Encourage use of voluntary development restrictions (i.e. restrictive covenants)
✓ Encourage testing sites for contamination prior to real estate sales
✓ Conduct household hazardous waste collection programs
✓ Finance and promote public education to -
✓ Promote water conservation
✓ Proper use, storage and disposal of hazardous materials
✓ Proper application of garden and lawn chemicals
✓ Proper design and maintenance of household septic systems
✓ Promote private protection of groundwater resources
✓ Conduct wellhead education efforts aimed at appropriate industries

Regulatory Strategies

✓ Source controls (e.g. regulate the activities and land uses on the site to eliminate hazardous industries or limit the use, storage, or production of substances on the site).
✓ Density standards (limit development density within the wellhead protection areas to 2 dwelling units/acre or 12% impervious surface; and cluster development in less vulnerable areas)
✓ Performance and design standards (e.g. practice safe handling and storage procedures, and require specific construction standards such as requiring double-walled storage tanks)
✓ Site plan review (administrative procedure to make sure strategies 2-4 are followed)

Regulatory Tools

✓ Amend existing or develop new zoning ordinance, adding a wellhead protection overlay zone
✓ Review conditional use and permitted use portions of zoning ordinance to include well-head protection objectives, including limiting development density, prohibiting specific land uses and activities, and requiring clustering of uses on sites to avoid well-head protection areas
✓ Develop a free-standing well-head protection ordinance
✓ Amend existing or develop new subdivision ordinance to include well-head protection objectives, including the use of open space dedication requirements and clustering provisions to restrict development within well-head areas.
✓ Amend building codes to include well-head protection design standards.
Floodprone Area Management

Floodplain Management has become much more important to local governments in NC the last few years, as a result of the tremendous property damage and loss of life caused by hurricanes Fran (1996), Dennis (1999) and Floyd (1999). Although heavy winds and water from storm surges from hurricanes have always caused damage to coastal communities, it has only been recently that inland areas have experienced widespread flooding from hurricanes.

• Lessons from Hurricane Floyd

A few weeks after the flooding from Floyd in September 1999, several hydrogeologists from ECU who had been studying flooding in eastern NC contributed Op-Ed articles to the Raleigh News and Observer, speculating on the real cause of the torrential flooding that destroyed over 50,000 homes and dislocated over 200,000 residents and businesses. Stan Riggs and Richard Spruijl concluded that this “flood of the century” resulted from at least four factors:

• Local rivers were already above flood stage due to Hurricane Dennis by the time Floyd arrived
• Extensive growth and development and urban sprawl in eastern NC converted large areas (both within and outside of floodplains) into large areas of impervious urban surfaces, which significantly increased the amount of stormwater created during storms, which in turn increased the frequency and magnitude of flash flooding in local streams.
• Growth and development also significantly modified natural drainage systems, with resulting channelized streams, drained and ditched wetlands, and expanded road and highway networks in floodplains with minimal culvert and bridge openings.
• With natural absorption within the floodplain weakened, and more impervious surfaces upstream, it took less rain to cause flooding and floodwaters subsequently spread over a larger area.

Riggs and Spruijl state that prior to this period of rapid growth and drainage modification in eastern NC, similar storm events resulted in significantly smaller floods. In fact, larger hurricanes with greater rainfall didn’t even produce record floods. They conclude that land use and development choices and their cumulative environmental impacts on natural drainage systems and floodplains have caused the flooding crisis in eastern NC. And, it can and will happen again, and not in 500 years, but anytime in the near future, if the natural systems are not restored to their natural state, and protected from further development and alteration.

Floodplains are low lands adjoining the channel of a river, stream or watercourse, or ocean, lake or other body of water, which have been or may be inundated by floodwater, and those other areas subject to flooding. In riverine areas, the floodplain usually consists of a regulatory floodway and regulatory floodway fringe. In coastal areas, the floodplain may consist of a single regulatory floodplain area or a regulatory high hazard area and a regulatory low hazard area.

The floodway is the channel of a river or other watercourse and the adjacent land areas that normally carry a base flow. The floodway is intended to carry the deep and fast-moving water at normal flood conditions. The floodway fringe areas are outside the regulatory floodway but still within the designated floodplain.
• Land Use and Flooding

Urbanization, if not properly planned and managed, can dramatically alter the natural hydrology of an area. Increased impervious cover decreases the amount of rainwater that can naturally infiltrate into the soil and increases the volume and rate of stormwater runoff. These changes lead to more frequent and severe flooding and potential damage to public and private property.

Under natural conditions, typically 10% of rainwater falling on a piece of property runs off the land surface into streams, rivers or lakes. The remainder either evaporates into the air or infiltrates into the soil replenishing groundwater supplies. Development increases the percentage of impervious surfaces. As the percentage of impervious surfaces increases, the percentage of runoff increases since there is less vegetated area to soak up the rainwater.

STORMWATER RUNOFF AFFECTS BOTH WATER QUALITY (SEE PREVIOUS SECTION) AND QUANTITY. IMPERVIOUS SURFACES CAUSE BOTH POLLUTION AND FLOODING.

• Flood Insurance

The National Flood Insurance Program (NFIP), which is managed by the Federal Emergency Management Agency (FEMA), was created in the 1960’s in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods. The NFIP makes Federally backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. The NFIP, through partnerships with communities, the insurance industry, and the lending industry, helps reduce flood damage by nearly $800 million a year.

Although the NFIP was intended to be self-supporting for the average historical loss year, which means that operating expenses and flood insurance claims are not paid for by the taxpayer, but through premiums collected for flood insurance policies, recent floods and other disasters needing FEMA assistance show that claims can in fact exceed premiums collected under NFIP. Also, many communities and homeowners do not participate in the NFIP, so lots of damage to local residents during a flood is paid for by citizens, local, state and federal governments. This was seen with Hurricane Floyd, as only 1 in 3 residents affected by flooding in the high hazard floodplain areas possessed NFIP Flood Insurance.

Floodplain management under the NFIP is the operation of an overall program of corrective and preventative measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and floodplain
management regulations, which generally include zoning, subdivision, or building requirements, and special-purpose floodplain ordinances.

**Local Floodplain Management Regulations**

An important element in making flood insurance available to home and businesses owners is a community’s agreement to adopt and enforce floodplain management ordinances, particularly with respect to new construction. It is up to local governments to adopt and enforce ordinances that meet or exceed the minimum floodplain management requirements of NFIP. Local programs **must**:

- prohibit filling in the floodways
- limit construction of buildings in the floodway fringe area, unless an engineer certifies that the bottom floor of the structure is at least one foot above the 100-year flood elevation.

However, because of this provision for allowing raised structures in the floodplain, a substantial amount of development (and potential impacts to water quality and exposure of private property to flooding damage) can and does occur in the floodway fringe area of North Carolina’s floodplains. Construction within floodplains, particularly when riverine wetlands are damaged or destroyed, can lessen the storage capacity of floodplains, contribute to higher flood levels downstream, increase turbidity, and increase erosion problems due to higher streamflow velocities.

**Flood Fringe Protection**

For these reasons, some local governments within NC have enacted stricter floodplain regulations that prohibit most development in the floodplain. For example:

<table>
<thead>
<tr>
<th>Winston Salem / Forsyth County</th>
<th>Floodway: prohibits most development in the floodway</th>
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<tbody>
<tr>
<td></td>
<td>Floodway Fringe: 50% of the area and 50% of the distance between the edge of the floodway and the outer floodplain edge are prohibited from development as if it were floodway.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Durham City / County</th>
<th>Floodway: prohibits most development in the floodway.</th>
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<tbody>
<tr>
<td></td>
<td>Floodway Fringe: Most development is prohibited. Nonresidential development may fill up to 10% of the fringe on a site with the approval of the Development Review Board. Up to 25% of project's required parking may still be placed in the fringe (no fill). Residential development may transfer underlying density credit from the floodway fringe at up to 100% of the underlying zoning; while density credit may be transferred from the floodway at up to 75% of the underlying density.</td>
</tr>
</tbody>
</table>

However, in the wake of Hurricane Floyd, not all local governments in NC (or even in flood-affected areas down east) are taking the extra step of prohibiting all new development from their floodplains. Concerns about private property “takings”, limited cheap land for affordable housing and economic development, and the cultural history of communities (e.g. Princeville) often conflict with efforts to protect floodplains.
Some Exercises:

Situation 1.

Smithville is going through substantial amounts of development pressure, in its location on the fringe of a major metropolitan region. Councilor Jones is pushing for stricter stormwater management rules in Smithville’s local ordinances in excess of that required by the state. He is arguing that the community’s groundwater supply is threatened by stormwater runoff and that the community must get out in front of the issue. Councilor Smith is concerned that the additional regulations are not legal without additional State enabling legislation, and argues that in addition to being an economic development concern, additional regulations like these are ineffective, since stormwater runoff affects streams and lakes and Smithville’s water supply is from a community well. They have referred the item to the Planning Commission for a recommendation.

What should the Planning Commission recommend? What are some of the trade-offs associated with more stringent stormwater requirements? What effect will such regulations have on land use?

Situation 2.

About 2/3 of the town of Mountain Haven’s jurisdiction is located in the watershed for Cove Lake, the water supply for the town of Litchford. This area is designated WS-2 by the State, and is subject to state-wide mandates that localities enact protecting legislation for the watershed area. Mountain Haven’s Board of Commissioners are incensed at the state regulations requiring they restrict development in this part of their municipal jurisdiction to very rural densities, providing no tax benefit to them. The town’s own water supply is supplied through a groundwater well. They inform the State that they will enact rules in this area that allow greater development intensities unless either the State or Litchford contributes financially to the tax debit they must bear to protect Litchford’s water.

Can they do this? Is it reasonable to require this of Mountain Haven? Why or why not. What would you do to make this system work for everybody?

Situation 3.

Willis Level is considering a new Comprehensive Plan. A group of citizens has organized to participate in the plan calling themselves Citizens for Clean Water (CCW) and is arguing for a broad package of water quality initiatives, essentially asking that the town reduce development intensities across the board. They say the only way to protect the waterways is to increase the overall proportion of undeveloped land in the community thereby reducing impervious surfaces.

Should the Planning Board recommend CCW’s strategies to the town board? What are some of the other implications of such a policy? If not, how should the Planning Board address the issue of water quality in their land use plan recommendations?
Other related subjects:

Ask your professional staff to provide you with more training on these issues:

- Planning for Air Quality
- Solid Waste Management
- Protection of Prime Agricultural and Forest Lands
- The State Environmental Policy Act
- Endangered Species / Fish and Wildlife Management
- Open Space / Greenways / Transfer of Development Rights
- Estuarine and Coastal Ecology
- Clean Water Management Trust Fund (CWMTF)
Bibliography, Sources, and Additional Resources

A more complete overview of local and regional environmental issues in North Carolina, including more detailed information on the topics in this module and additional discussion of open space and greenway planning, wildlife management, agricultural / forest protection, solid waste management, air quality planning, and the NC Environmental Policy Act has been prepared by the author and is available by contacting:

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N.C. Department of Environment and Natural Resources, Environmental Permit Information Center (EPIC), Web Site, [http://www.p2pays.org/epic/index.htm](http://www.p2pays.org/epic/index.htm)