Chapter 27
Water Quality Stressors

27.1 Stressor Identification

27.1.1 Introduction and Overview

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired as well as Supporting waters with noted impacts. Identifying stressors is difficult in many cases because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations as well as information from other agencies and the public to identify potential water quality stressors. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address water quality problems.

Stressors to recreation uses include the following pathogen indicators - fecal coliform bacteria, escheria coli, and enterrococci. Stressors to shellfish harvesting are fecal coliform bacteria, and stressors to fish consumption are mercury and any other substance that causes issuance of a fish consumption advisory.

Most stressors to the biological community are complex groupings of many different stressors that individually may not degrade water quality or aquatic habitat but together can severely degrade aquatic life. Sources of stressors are most often associated with land use in a watershed as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor or group of stressors may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered watershed hydrology.

As discussed above, sources of stressors most often come from a watershed where the hydrology is altered enough to allow the stressor to be easily delivered to a stream during a rain event along with unnaturally large amounts of water. DWQ identifies the source of a stressor as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Stressor sources identified in the Cape Fear River basin during this assessment period include urban or impervious surface areas, construction sites, road building, land clearing, agriculture and forestry.

27.1.2 Altered Hydrology as the Ultimate Stressor Source

Aquatic communities (benthic macroinvertebrates and fish) in natural or undisturbed watersheds are impacted only by the most extreme events such as hurricanes or extreme droughts. Even after these events streams in these watersheds are able to recover. As a watershed is altered, more stressors (such as chemicals and bacteria) are found in the watershed and because of the nature of watershed alteration, there are more ways for water to get to streams very rapidly

carrying these new stressors. Once a watershed is severely altered, such as in most urban areas, there are multitudes of stressors in the watershed and many ways for the stressors to affect aquatic life. Also in these watersheds the important habitats are depleted because the natural ground cover is removed and trees are rare. The very high flows in heavily altered watersheds can cause a multitude of instream habitat problems as well. The following stressor discussions are aimed at identification of specific stressors to the various land uses, but the ultimate cause and source of these stressors is the altered watershed hydrology.

27.1.3 Overview of Stressors Identified in the Cape Fear River Basin

The stressors noted below are summarized from all waters and for all use support categories. Figures 30 to 32 identify stressors noted for Impaired waters in the Cape Fear River basin during the most recent assessment period. The stressors noted in these figures may not be the sole reason for an Impaired use support rating. Stressors that are listed because of standards violations may require TMDL development for waters where these stressors are identified. Refer to subbasin chapters for a complete listing of stressors by waterbody. For specific discussions of stressors to Impaired waters refer to the subbasin chapters 1 through 24. There are also 4.7 miles of Atlantic Coastline miles Impaired for recreation where the identified stressor is enterrococcus (not graphed). All waters in the basin are Impaired in the fish consumption category where mercury is the stressor of concern. Stressor definitions and impacts are discussed in the remainder of this chapter.

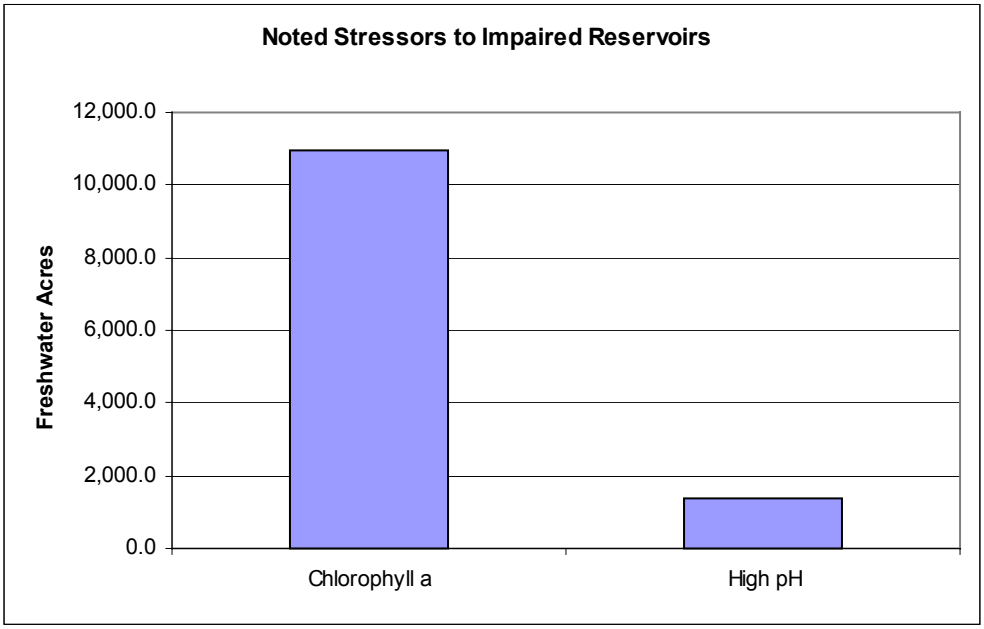


Figure 30 Noted Stressors to Impaired Reservoirs in the Cape Fear River Basin.

Figure 31 Noted Stressors to Impaired Streams in the Cape Fear River Basin.

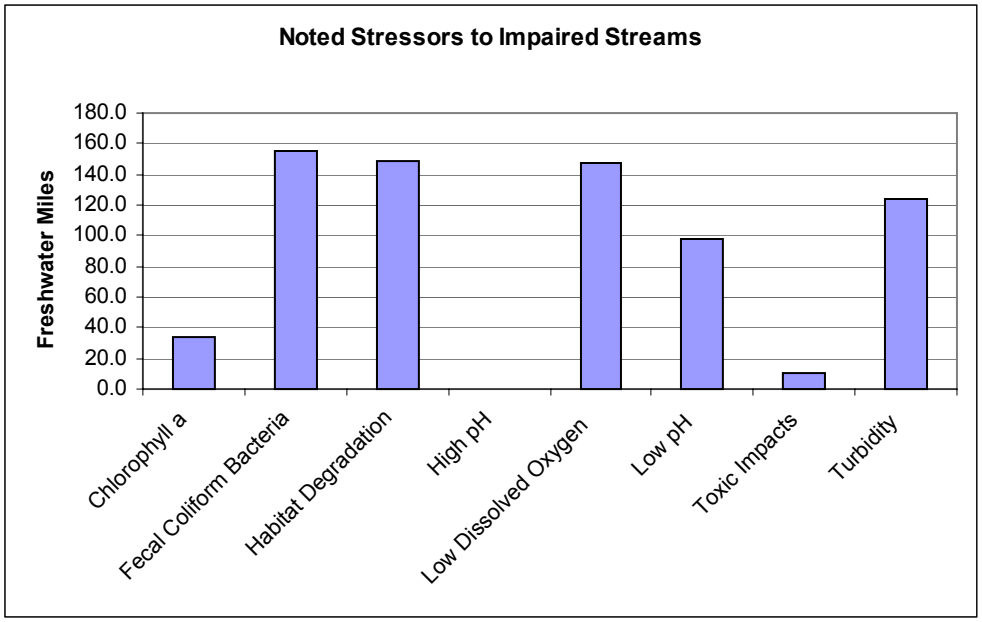
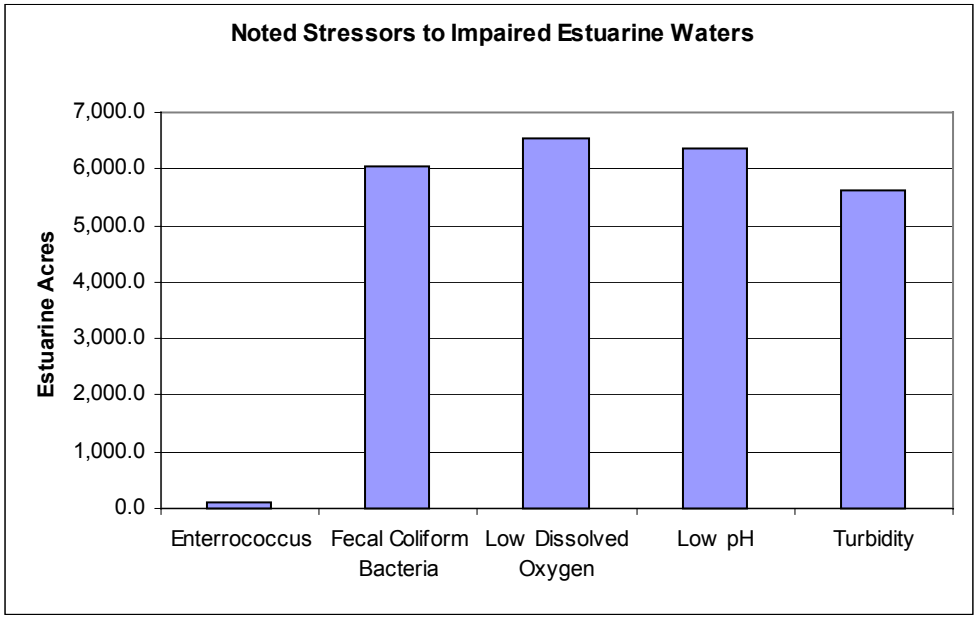


Figure 32 Noted Stressors to Impaired Estuarine Waters in the Cape Fear River Basin.



Figures 33 to 35 identify stressors noted for Impacted waters in the Cape Fear River basin during the most recent assessment period. The stressors noted in these figures did not result in an Impaired use support rating. Refer to subbasin chapters for a complete listing of stressors by waterbody. For specific discussions of stressors to Impacted waters refer to the subbasin chapters 1 through 24. Stressor definitions and impacts are discussed in the remainder of this chapter.

Figure 33 Noted Stressors to Impacted Reservoirs in the Cape Fear River Basin.

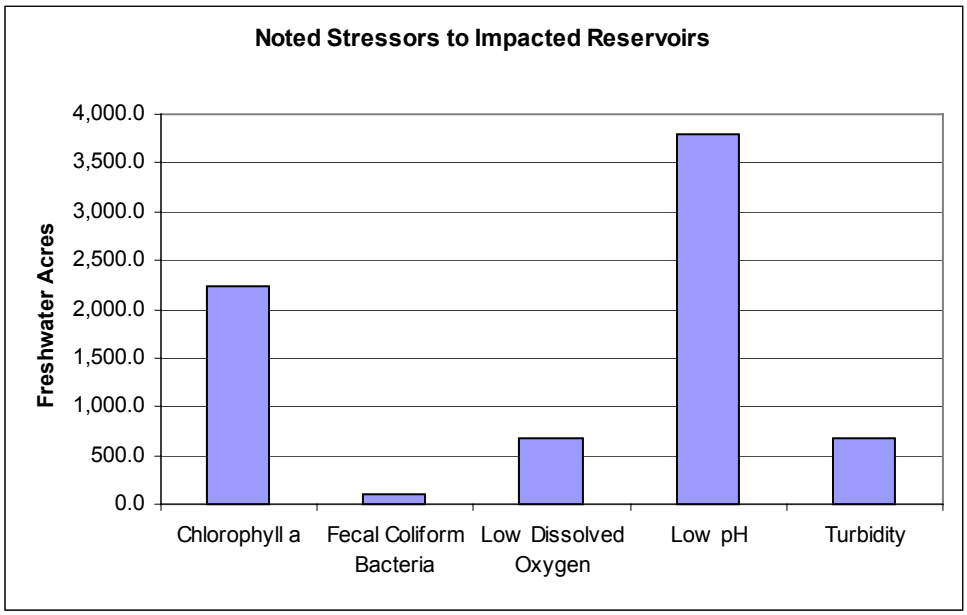


Figure 34 Noted Stressors to Impacted Streams in the Cape Fear River Basin.

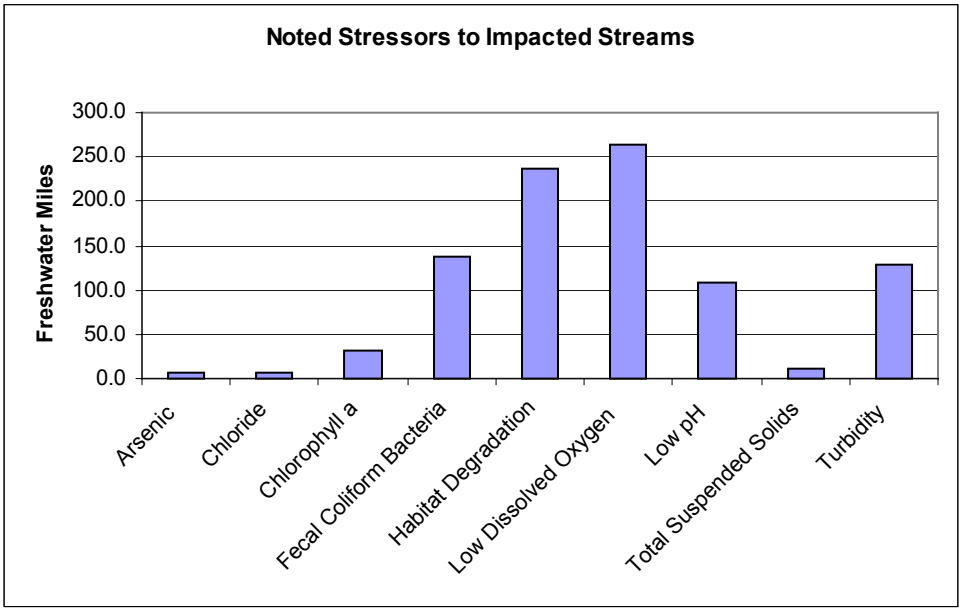
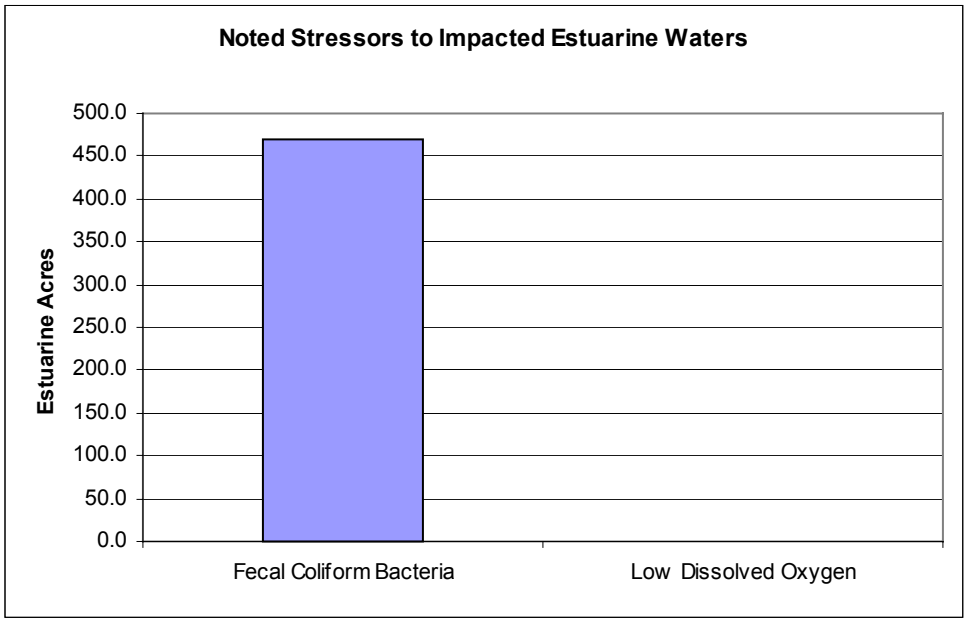


Figure 35 Noted Stressors to Impacted Estuarine Waters in the Cape Fear River Basin.



27.1.4 Overview of Stressor Sources Identified in the Cape Fear River Basin

The sources noted below are summarized from all waters and for all use support categories. Figures 36 to 38 identify sources of stressors noted for waters in the Cape Fear River basin during the most recent assessment period. Refer to subbasin chapters for a complete listing of sources by waterbody. For specific discussions of stressor sources refer to the subbasin chapters 1 through 24. There are also 10.3 miles of Atlantic Coastline where the identified sources of stressors are stormwater outfalls to the beach (not graphed).

WWTP NPDES (wastewater treatment plants) were noted as a potential source to many of the freshwater acres in the Cape Fear River basin. WWTPs contribute nutrients (with other sources) that may increase the potential for algal blooms and cause exceedances of the chlorophyll *a* standard. This can include all discharges upstream of the area of Impairment or noted impacts. WWTPs were noted as a potential source of water quality problems in 105.8 stream miles. Most of these impacts were localized and based on permit violations. Better treatment technology and permit compliance has greatly decreased the number of stream miles locally impacted by WWTPs.

MS4 NPDES (municipal separate storm sewer systems) were noted as sources to many of the freshwater acres for the same reasons as the WWTPs discussed above. MS4 was noted as a potential source when the stream segment was associated with a NPDES permitted municipality. Unlike the WWTPs, MS4s were noted as a potential source of stressors to 375.8 stream miles because of the local impacts of runoff from these urban areas. Impervious surface was noted as a source when field observations indicated that roads and other development not associated with permitted urban areas was the source of stressors to the stream segment. Impervious surface was noted as a source of stressors in 77.2 stream miles. Developed land is the most common source of stressors to water quality in the Cape Fear River basin.

Agriculture was noted as a potential source of water quality stressors when field observations and watershed studies noted agriculture as the predominant land cover. Agriculture was noted as a source of stressors in 91.8 stream miles. Pasture was also noted as a source when field observations indicated that cattle had access to streams or streams ran through pasture areas. Pasture was noted as a potential source of water quality stressors in 36.3 stream miles. Agriculture and pasture impacts and programs are discussed in more detail in Chapter 28.

Land clearing and road construction were noted as potential sources of water quality stressors to less than 70 stream miles. Much of the land clearing and road construction is associated with increased development. Streams where land clearing is a noted source are likely to be more heavily impacted in the future by increased development.

Figure 36 Sources of Stressors to Reservoirs in the Cape Fear River Basin.

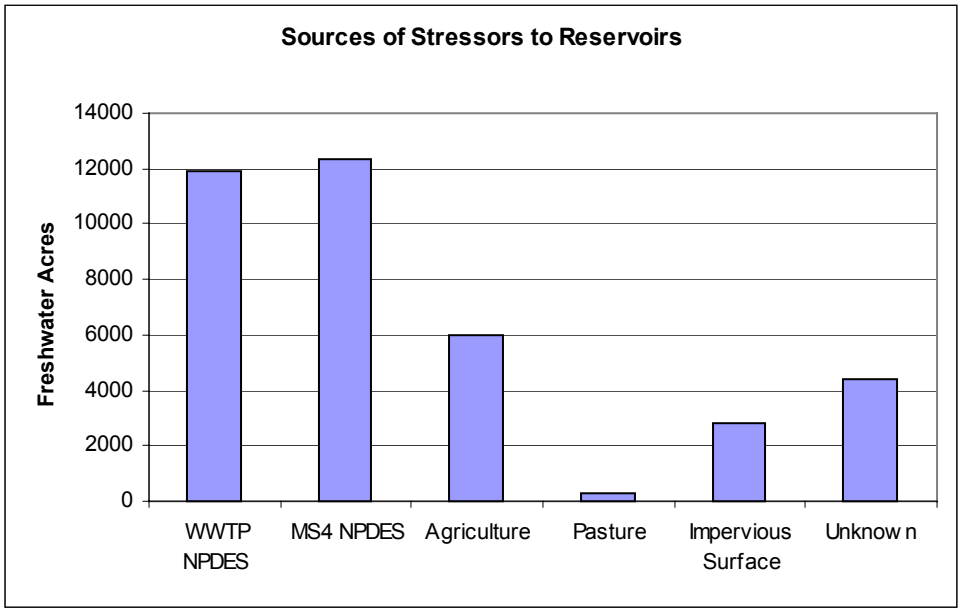


Figure 37 Sources of Stressors to Streams in the Cape Fear River Basin.

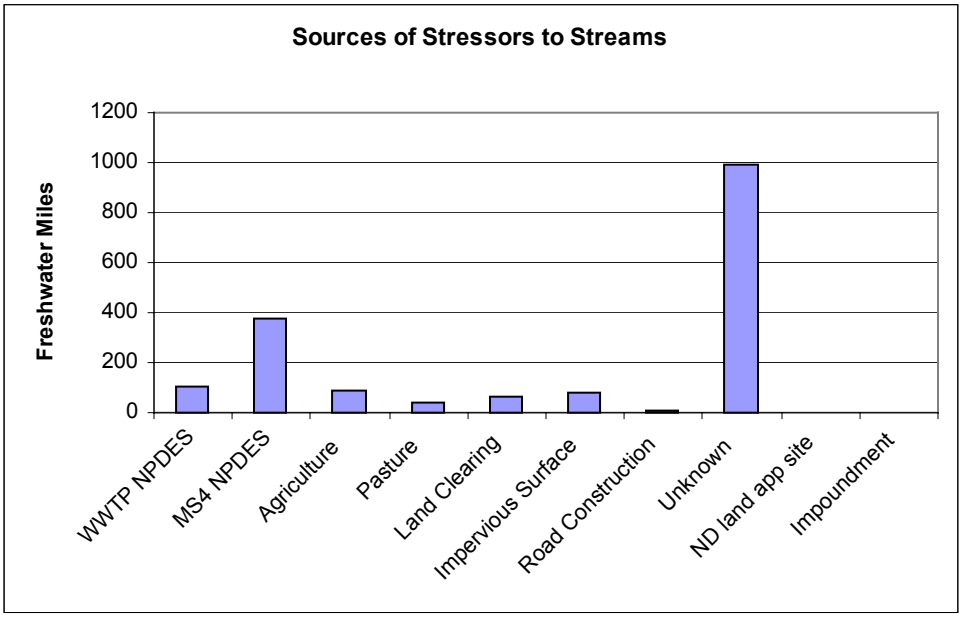
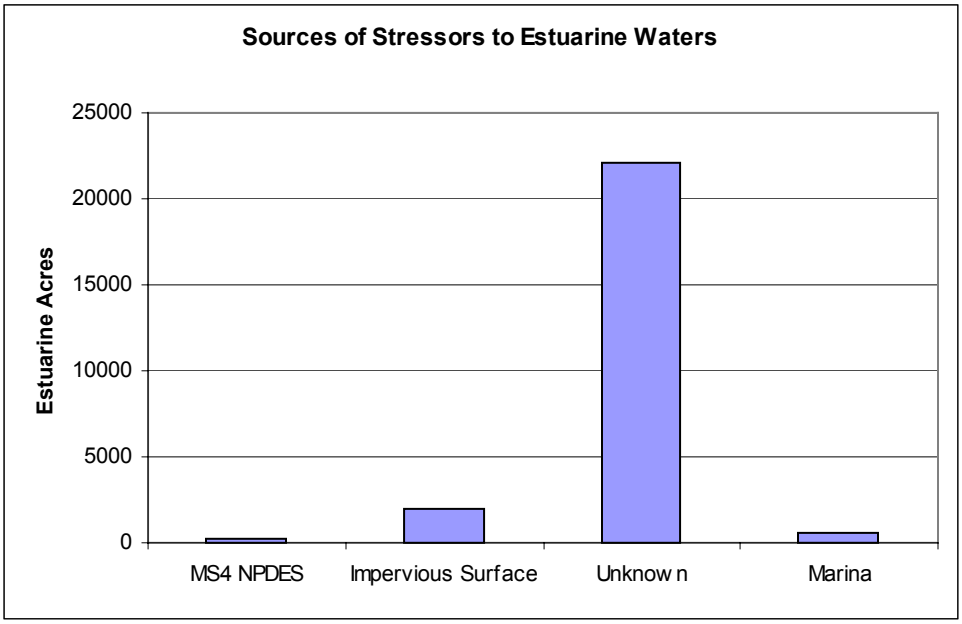


Figure 38 Sources of Stressors to Estuarine Waters in the Cape Fear River Basin.



27.2 Aquatic Life Stressors-Habitat Degradation

27.2.1 Introduction and Overview

Instream habitat degradation is identified as a notable reduction in habitat diversity or a negative change in habitat. This term may include sedimentation, lack of organic (woody and leaf) habitats and channelization. These stressors to aquatic insect and fish communities can be caused by many different land use activities and less often by discharges of treated wastewater into small streams. In the Cape Fear River basin, over 149.2 stream miles are Impaired where at least one form of habitat degradation is the stressor. There are an additional 236.0 stream miles where habitat degradation is impacting water quality. Many of the stressors discussed below are either directly caused by or are a symptom of altered watershed hydrology. The altered hydrology increases both sources of stressors and delivery of stressors to receiving waters. Refer to the subbasin chapters for more information on the types of habitat degradation noted at sample locations and in watershed studies.

Some Best Management Practices

Agriculture

- No till or conservation tillage practices
- Strip cropping and contour farming
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surface area. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well. All of these activities result in altered watershed hydrology.

Quantifying amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and even more resources to restore the stream. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been Impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

27.2.2 Sedimentation

Sedimentation is a natural process that is important to the maintenance of diverse aquatic habitats. Overloading of sediment in the form of sand, silt and clay particles fills pools and

covers or embeds riffles that are vital aquatic insect and fish habitats. A diversity of these habitats is important for maintenance of biological integrity. Suspended sediment can decrease primary productivity (photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory problems, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, 1999). Sediment filling rivers, streams and reservoirs also decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Suspended sediment also increases the cost of treating municipal drinking water. Sediment overloading to many streams has reduced biological diversity to the point of the stream being Impaired for aquatic life.

Sediment comes from land-disturbing activities in a watershed. The cause of this form of sedimentation is erosion of land in the watershed. Land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water.

Streambank erosion, caused by very high stormwater flows after rain events, is another source of sediment overloading. Watersheds with large amounts of impervious surfaces transport water to streams very rapidly and at higher volumes than occurs in watersheds with little impervious surfaces. In many urban areas, stormwater is delivered directly by storm sewers. This high volume and velocity of water after rain events undercuts streambanks causing bank failure and large amounts of sediment to be deposited directly into the stream. Many urban streams are adversely impacted by sediment overloading from the watershed as well as from the streambanks.

Sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. Substantial amounts of erosion can be prevented by planning to minimize the amount and time that land is exposed during land-disturbing activities and by minimizing impervious surface area and direct stormwater outlets to streams. Refer to Chapter 31 for more information on programs designed to reduce sedimentation.

27.2.3 Lack of Organic Aquatic Habitats

During 2002 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Cape Fear River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas. The loss of riparian vegetation and subsequent reduction of organic aquatic habitats is caused by loss of riparian areas, most commonly by land clearing for development, field agriculture, pastureland, forestry and by grazing animals. Instream organic habitat removal has also been caused by de-snagging activities.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks or concrete lining on a bank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher dissolved oxygen levels cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing

streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

Organic microhabitat (leafpacks, sticks and large wood) and edge habitat (root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of benthic macroinvertebrates, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Cape Fear River basin is directly related to the absence of riparian vegetation. Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed.

27.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Channelization is caused by mechanical straightening of channels or by hydraulic overloading during rain events. Often streams in urban areas become channelized as part of the development process in essence using the stream channels as stormwater conveyances. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

Channelization reduces the sinuosity of streams greatly increasing the velocity of water running these streams. Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically in parts of the Cape Fear River basin and continues to occur in some watersheds, especially in small headwater streams.

27.3 Aquatic Life Stressors - Water Quality Standards Violations

27.3.1 Introduction and Overview

In addition to the habitat stressors discussed in the previous section, the stressors discussed below are identified by water quality standards violations. These are usually direct measures of water quality parameters from ambient water quality monitoring stations. The water quality standards are designed to protect aquatic life. As discussed above, altered watershed hydrology greatly increases the sources of these stressors as well as delivery of the stressors to the receiving waters. The following stressors were identified for waters where greater than 10 percent of the observations were above the water quality standard. Refer to the subbasin chapters for more information on the affected waters and the data used to make these assessments.

27.3.2 Arsenic

Arsenic is a metal that is toxic to aquatic life. Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state arsenic standard and at least 10 samples were collected. The arsenic water quality standard for Class C waters is 50 µg/l. In the Cape Fear River basin during this assessment period, there were 6.6 stream miles where arsenic was the identified stressor (see Chapter 8).

27.3.3 Chlorophyll *a* Algal Blooms

Algae are aquatic, microscopic plants, which respond to nutrients, temperature and light, and are an important food source for fish and other aquatic animals. Algae also contain pigments, including chlorophyll, which enable them to photosynthesize and produce oxygen. During summer, algae respond to warm temperatures, high light and nutrients washed into waterways after rain events and from treated wastewater. When temperatures and nutrient concentrations are elevated, algae reproduce to high concentrations ("bloom"). When this occurs at a particular site, chlorophyll *a*, dissolved oxygen (DO) and pH increase. When a site experiences dissolved oxygen concentrations >9 mg/l, DO percent saturation >110%, pH >8, or chlorophyll *a* concentrations exceed the state standard of 40 µg/l, the site is likely experiencing an algal bloom. When these algae die off or respire at night, dissolved oxygen can become very low. Many times low dissolved oxygen caused by algal die off can cause fish kills. Algal blooms have been a problem in lakes, reservoirs and estuaries that are overloaded with nutrients.

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state chlorophyll *a* standard of 40 µg/l and at least 10 samples were collected. In the Cape Fear River basin during this assessment period, there were 10,833.9 freshwater acres and 11.7

stream miles that are Impaired where chlorophyll *a* is a stressor. There were also 2,239.8 freshwater acres and 32.6 stream miles that are impacted where chlorophyll *a* is a stressor.

27.3.4 Low Dissolved Oxygen

Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations including water temperature, depth and turbulence. Additionally, in the Cape Fear River basin, a large floodplain drainage system and flow management from upstream impoundments also influences DO. Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce DO levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters.

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state DO standard and at least 10 samples were collected. The DO water quality standard for Class C waters is not less than a daily average of 5 mg/l with a minimum instantaneous value of not less than 4 mg/l. For Class SC waters the standard is 5 mg/l. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Cape Fear River basin during this assessment period, there were 6,527.4 estuarine acres and 43.9 stream miles that are Impaired where low DO is a stressor. There were also over 667.5 freshwater acres, 264.9 stream miles and 1.0 estuarine acres where low DO is a stressor, although many of these streams are in swampy areas where low DO levels are likely from natural sources.

27.3.5 pH

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state pH standard and at least 10 samples were collected. The pH water quality standard for Class C waters is between 6.0 and 9.0. For Class SC waters the standard is between 6.8 and 8.5. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Cape Fear River basin during this assessment period, there were 97.9 stream miles and 6,360.4 estuarine acres that are Impaired where low pH is a stressor. There were 1,445.5 freshwater acres that are Impaired where high pH is a stressor. There were also 3,799.6 freshwater acres and 107.2 stream miles that are impacted where low pH is a stressor, although many of these streams are in swampy areas where low pH levels are likely from natural sources.

27.3.6 Total Suspended Solids

Total suspended solids (TSS) are noted as a stressor when identified from NPDES compliance reports. Waters are not Impaired due to TSS permit violations. In the Cape Fear River basin during this assessment period, there were 12.4 stream miles impacted where TSS is a stressor.

27.3.7 Toxic Impacts

Toxic impacts are noted as a stressor when identified during biological community monitoring. Waters are not Impaired due to toxic impacts. In the Cape Fear River basin during this assessment period, there were 10.8 stream miles Impaired where toxic impacts are a stressor.

27.3.8 Turbidity

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state turbidity standard and at least 10 samples were collected. The turbidity water quality standard for Class C waters is not to exceed 50 Nephelometric Turbidity Units (NTU). In the Cape Fear River basin during this assessment period, there were 115.4 stream miles and 5,616.7 estuarine acres that are Impaired where turbidity is a stressor. There were also 685.5 freshwater acres and 127.7 stream miles that are impacted where turbidity is a stressor.

27.4 Recreation Stressors - Pathogens

27.4.1 Fecal Coliform Bacteria

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. In the Cape Fear River basin, there are 40.9 stream miles where this standard was exceeded. These waters are Impaired for recreation. In 154.6 stream miles fecal coliform bacteria is a noted stressor because annual screening criteria were exceeded. These waters were not intensively sampled to assess the standard as described above, but had either a geometric above 200 colonies/100ml and/or 20 percent of samples exceeded 400 colonies/100ml over the five-year assessment period. These waters are discussed in the subbasin chapters. A total of 19,339 acres, 1,119.9 stream miles and 48.6 coastline miles were monitored for recreation.

A number of factors beyond the control of any state regulatory agency contribute to elevated levels of disease-causing bacteria. Therefore, the state does not encourage swimming in surface waters. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although fecal coliform standards have been used to indicate the microbiological quality of surface waters for swimming for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes that could make water unsafe for human contact (swimming). Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters. Pathogens associated

with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et *al*., 1996; Sherer et *al*., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

Sources of Fecal Coliform in Surface Waters

- Urban stormwater
- Wild animals and domestic pets
- Improperly designed or managed animal waste facilities
- Livestock with direct access to streams
- Improperly treated discharges of domestic wastewater, including leaking or failing septic systems and straight pipes

Reducing fecal coliform bacteria in wastewater requires a disinfection process, which typically involves the use of chlorine and other disinfectants. Although these materials may kill the fecal coliform bacteria and other pathogenic disease-causing bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, and thereby, endanger the survival of species dependent on those bacteria.

The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

27.4.2 Enterrococcus-Recreational Beach Monitoring

Enterrococcus is the pathogen indicator used by DEH Recreational Water Quality Monitoring Program to assess recreation in coastal waters. DWQ does not directly use enterococcus data to assign use support ratings. Waters are Impaired when swimming advisories are posted for more than 61 days during the five year assessment period. In the Cape Fear River basin 96.6 estuarine acres and 4.7 Atlantic coastline miles are Impaired for recreation because of swimming advisories posted during the assessment period. Enterrococcus is the stressor in these waters.

27.5 Fish Consumption Stressors - Mercury

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway of mercury in the environment is through the atmosphere. Mercury that has been emitted from industrial and municipal stacks into the ambient air can circulate across the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater.

The NC Department of Health and Human Services issues fish consumption advisories and advice for those fish species which have median and/or average methyl mercury levels at 0.4 mg/kg or greater. These fish include shark, swordfish, king mackerel, tilefish, as well as largemouth bass, bowfin (or blackfish) and chain pickerel (or jack) in North Carolina waters south and east of Interstate 85. See *Fish Consumption Advice* below. Refer to Appendix X for more information regarding use support ratings and assessment methodology. DWQ has sampled fish tissue from 13 locations in the Cape Fear River basin. Refer to subbasin chapters for more information on these waters.

For more detailed information, visit EPA's internet site at http://www.epa.gov/waterscience/fish/ or visit http://www.cfsan.fda.gov/seafood1.html or call the FDA's food information line toll-free at 1-888-SAFEFOOD.

For more information and detailed listing of site-specific advisories, visit the NC Department of Health and Human Services website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

27.6 Shellfish Harvesting Stressors - Fecal Coliform Bacteria

DWQ does not directly use DEH Shellfish Sanitation Section (DEH SS) fecal coliform bacteria data to make use support determinations in Class SA waters. DWQ relies on the growing area status of waters in the Cape Fear River basin that are monitored by DEH SS. Class SA waters that are in a DEH SS Approved classification are Supporting in the shellfish harvesting use support category by DWQ. All other DEH SS growing area classifications are considered to be Impaired in the shellfish harvesting category by DWQ. In the Cape Fear River basin, there are 2,654.2 acres of prohibited waters, 94.2 acres of conditionally approved-closed waters, and 3,822.8 acres of conditionally approved-open waters. All of these waters (6,571.2 acres) are Impaired for shellfish harvesting and the stressor is fecal coliform bacteria.