

CHAPTER 9 – WASTEWATER AND WATER QUALITY IMPACTS

Wastewater is used water. It includes substances such as human waste, food scraps, oils, soaps and chemicals from homes, businesses and industries. Effluent is the treated water discharged from wastewater treatment plants or other point source dischargers such as municipalities and manufacturing facilities. In order to protect water quality and aquatic life, wastewater treatment is subject to local, state and federal rules and regulations. This chapter provides an overview of the wastewater treatment process, identifies water quality impacts associated with wastewater discharge and reviews federal and state programs used to manage wastewater throughout the United States.

9.1 WASTEWATER TREATMENT

There are two generally recognized wastewater categories that are not entirely separable – domestic wastewaters and industrial wastewaters. Domestic wastewaters are usually of a predictable quality and quantity and originate from domestic, household activities but will usually include wastewater discharged from commercial and business buildings. Industrial wastewater, however, originates from manufacturing processes that are usually more variable and often more difficult to treat (NYDEC, 1977). Wastewater can be treated close to where it originates (i.e., on-site septic systems or small package plants), or it can be transported long distances by a network of pipes and pump stations to municipal wastewater treatment plants.

9.1.1 MUNICIPAL WASTEWATER TREATMENT PLANTS (PUBLICLY OWNED TREATMENT WORKS)

Domestic wastewater, or sewage, treatment plants remove physical, chemical and biological contaminants from wastewater that is collected from homes, businesses and industries. Typically, wastewater treatment, also known as publicly owned treatment works (POTWs), involves three stages – primary, secondary and tertiary treatment (Figure 9-1). Disinfection and sludge treatment and disposal are also part of most systems. The following provides a brief description of each treatment stage.

Primary Treatment: Equipment used during this stage is designed to remove or reduce the size of large, suspended or floating solids (i.e., pieces of wood, cloth, paper, plastics, garbage, fecal matter, etc.), remove heavy inorganic solids such as sand, gravel, metal and glass and remove excess oils and grease. Many facilities may also have an aeration step, which introduces air, or oxygen, into the system. By agitating the wastewater with air, lighter suspended solids will collect, or flocculate, into heavier masses, which then settle for easy removal. Aeration also helps to separate grease, oils, plastics and soaps from the wastewater stream while wastewater solids create a “scum” on

Physical, Chemical and Biological Wastewater Treatment Methods

Physical

- Screening
- Aeration
- Sedimentation (Clarification)
- Filtration

Chemical

- Chlorination
- Neutralization
- Coagulation
- Adsorption
- Ion Exchange
- Precipitation

Biological

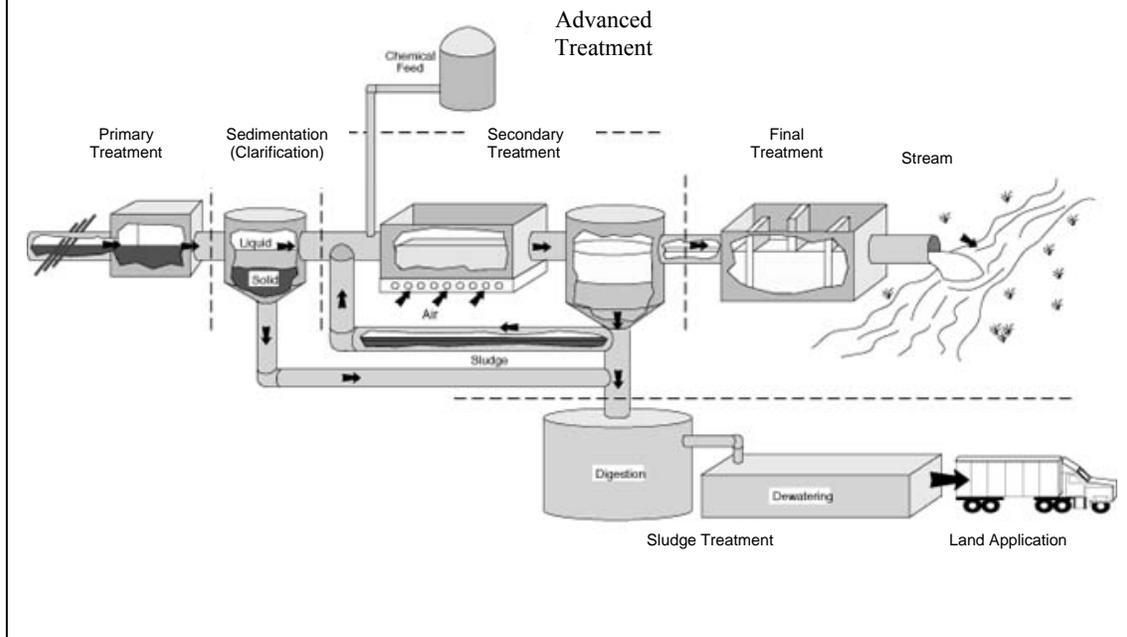
Aerobic

- Activated Sludge Treatment Methods
- Trickling Filtration
- Oxidation Ponds
- Lagoons
- Aerobic Digestion
- Biological Nutrient Removal

Anaerobic

- Anaerobic Digestion
- Septic Tanks
- Lagoons
- Biological Nutrient Removal

Figure 9-1 Typical Process Flow Diagram of a Wastewater Treatment Plant (Jacob and Cordaro, Fall 2000)



top of the settling or aeration tank. Slow-moving rakes then remove the scum from the surface of the tank. The scum and the sludge, or wastewater solids, at the bottom of the tank are collected and kept in large, heated and enclosed tanks called “digesters”. Here, bacteria digest the material which reduces its volume, odor and the number of disease-causing bacteria. The finished product is then sent to landfills, but in some cases, it can be used as compost and applied to land (NYDEC, 1997; USGS, August 2006).

Sedimentation (Clarification): Primary settling tanks, clarifiers or sedimentation tanks or basins is designed to physically remove organic and inorganic solids. Velocity is slowed and wastewater is dispersed which allows for heavy materials to settle to the bottom and lighter materials to float to the top. Sedimentation removes suspended solids from the wastewater stream and produces a homogeneous liquid capable of being treated biologically (secondary treatment) and a sludge that can be treated or processed separately (NYDEC, 1977). Sedimentation removes nearly 60 percent of the suspended solids from the wastewater stream (USGS, 2005).

Secondary Treatment: Secondary treatment depends primarily on aerobic microorganisms to biochemically decompose the organic and inorganic solids that remain in the wastewater after primary treatment. The aerobic microorganisms utilize the colloidal and dissolved organics in the wastewater stream as their food source. They must also have a sufficient amount of oxygen available for survival. Trickling filters, sludge settling tanks, intermittent sand filters and stabilization ponds are all devices used during the secondary treatment process (NYDEC, 1977). Secondary treatment removes nearly 90 percent of the suspended and dissolved solids from the wastewater stream (USGS, 2005).

Tertiary Treatment: Primary and secondary treatment remove the majority of physical, biological and chemical contaminants from the wastewater, but tertiary treatment provides a final stage to increase the quality of the effluent before it is discharged into the receiving stream. It can be defined as “any treatment process in which unit operations are added to the flow scheme following conventional secondary treatment” (NYDEC, 1977). Tertiary treatment can be used to remove additional organic material, dissolved solids and nutrients (i.e., nitrogen and phosphorus) from the effluent.

Disinfection: The purpose of disinfection is to substantially reduce the number of microorganisms (some of which may be pathogenic) from the effluent before it is discharged to the receiving stream. The effectiveness of this step depends on the quality of the water being treated (i.e., pH, cloudiness, etc.), type of disinfection being used, contact time and dose. Chlorination remains the most common form of wastewater disinfection (NYDEC, 1977).

Chlorination may also be used to prevent wastewater decomposition during any stage of treatment. Chlorine controls odors and protects mechanical equipment throughout the treatment process. Chlorine also aids in sedimentation, filtering and activated sludge bulking and reduces or delays biochemical oxygen use (NYDEC, 1977).

Sludge Treatment and Disposal: Wastewater sludge is the mixture of wastewater and settled solids (NYDEC, 1977). In order to insure safe and effective disposal, the sludge is treated to reduce the amount of organic matter and the number of disease-causing microorganisms. The most common treatment options are anaerobic digestion, aerobic digestion and composting. Anaerobic digestion is a bacterial process that is carried out in the absence of oxygen, usually in an enclosed tanks (digestors) that can be heated (Figure 9-1). The type of anaerobic bacteria being used in this process will determine the amount of heat, or temperature, required to properly digest (break down) the sludge. Aerobic digestion is a bacterial process that requires oxygen. Under aerobic condition, bacteria readily consume the organic matter and convert it to carbon dioxide (CO₂). Composting is also an aerobic process but it involves mixing the sludge with a carbon source such as sawdust, straw or wood chips. All three treatment options reduce the volume, odor and the number of disease-causing microorganisms. The finished product is either sent to landfills or, in certain cases, land applied to add nutrients to soil (USGS August 2006).

9.1.2 INDUSTRIAL WASTEWATER TREATMENT

Industrial wastewater varies widely in composition, strength, flow and volume depending on the specific industry or manufacturing establishment in the community. Typical industrial facilities that produce significant volumes of wastewater include paper and fiber plants, steel mills, refining and petrochemical operations, chemical and fertilizer plants, meat packers and poultry processors, food processing and packing operations, power companies and many others. Industrial wastewater may consist of heavy organic material, metals and chemicals that can damage municipal sewer lines and structures. Industrial wastewater may also contain compounds that are resistant to biological degradation.

Because of its potential to damage municipal treatment systems, many industrial facilities are required to pre-treat or partially treat their wastewater before it is discharged to the municipal

sewer. Industrial facilities can employ several mechanical and/or chemical measures (i.e., sedimentation, flocculation, skimming, etc.) to remove solids, oils and greases, organics, acids, metals and toxic substances from the wastewater and must follow state and federal regulations related to water quality and industrial waste. Rules and regulations associated with industrial wastewater that discharges to municipal treatment systems can be found on the US Environmental Protection Agency (EPA) Pretreatment Program Web site (http://cfpub1.epa.gov/npdes/home.cfm?program_id=3). State rules and regulations can be found on the DWQ Pretreatment Emergency Response Collection Systems (PERCS) Unit Web site (<http://h2o.enr.state.nc.us/percs/Pretreatment/PERCSPretreatmentHome.html>). Industrial wastewater can also be directly discharged into surface water. Section 9.3.1 includes information related to permitted activities within the State of North Carolina.

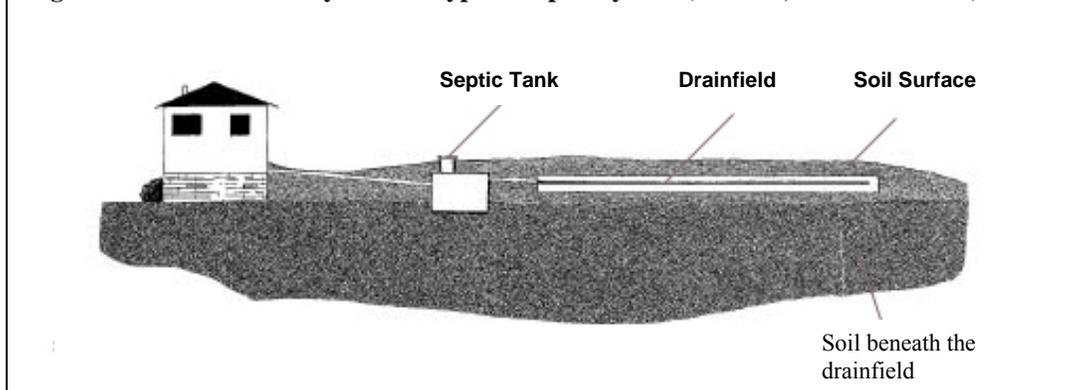
9.1.3 ON-SITE WASTEWATER SYSTEMS (SEPTIC SYSTEMS)

More than 52 percent of all housing units in North Carolina are served by on-site wastewater systems. Most on-site wastewater treatment systems are conventional septic systems that consist of a tank, a distribution box and a series of subsurface absorption lines with perforated pipes laid in a gravel bed. The septic system provides a natural method of treatment and disposal of household wastes for homes that are not part of a municipal sewage treatment system. Septic systems can be a safe and effective method for treating domestic wastewater as long as they are sized, sited and properly maintained. Advanced on-site wastewater systems utilize pre-treatment methods such as filters and aerobic treatment and use improved distribution systems such as pressure dosing on sensitive sites.

In a septic system, household wastewater is separated into solids, liquids and gases by bacteria and sedimentation in a two-chambered septic. The gases exit the system through the plumbing roof vent while the solids float to the surface or settle to the bottom of the first chamber of the tank. It is recommended that the solids be removed, or pumped, from the first chamber once every five years to ensure proper maintenance of the system. The liquid passes through the center of the chamber wall and receives additional sedimentation and bacteriological treatment in the second chamber before passing through a filter at the outlet end of the tank. The treated liquid, or effluent, is then distributed throughout the drainfield through a series of shallow subsurface pipes. Final treatment of the effluent occurs as the soil absorbs and filters the liquid, and microbes break down the remaining waste into harmless organic material (Figure 9-2).

If the tank and/or drainfield are improperly located, poorly constructed or not maintained, nearby wells and surface waters may become contaminated. In some cases, wastewater illegally discharges from homes directly to streams or the land surface through what is known as a “straight pipe”. Straight pipes can carry black water, grey water or both. Black water refers to raw sewage from toilets being discharged directly from homes into streams or the ground. Grey water refers to the water that is used for washing dishes, bathing and laundry. It has a cloudy appearance and often contains bacteria, nutrients, soaps, oils and greases. Straight piping and failing septic systems are considered illegal wastewater discharges.

Figure 9-2 Schematic Layout of a Typical Septic System (NCCES, December 2002).



Many informational brochures related to siting, constructing and maintaining septic systems can be found on the NCDENR Division of Environmental Health On-Site Wastewater Protection Section Web site (http://www.deh.enr.state.nc.us/osww_new//index.htm).

9.2 IMPACTS TO WATER QUALITY

Many of the wastewater treatment processes are designed to mimic the natural treatment processes that occur in the environment. If not overloaded, bacteria in the environment will consume organic contaminants, and the number of disease-causing microorganisms will be reduced by natural conditions (i.e., predation, exposure to UV radiation, temperature, etc.). Consequently, if the receiving environment can provide a high level of dilution, a high degree of wastewater treatment may not be required. Recent studies, however, indicate that very low levels of certain contaminants in wastewater (i.e., human birth control pills, animal husbandry hormones, prescription medications, etc.) can have an unpredictable adverse impact on the natural biota and potentially humans. In the coming decades, rules and regulations may have to account for these medicinal contaminants in wastewater streams.

9.2.1 NUTRIENTS

Nutrients in surface waters come from both point and nonpoint sources including agriculture and urban runoff, wastewater treatment plants, forestry activities, atmospheric deposition and illegal septic system discharges and straight pipes. While nutrients are beneficial to aquatic life in small amounts, excessive levels can stimulate algal blooms and plant growth, depleting dissolved oxygen in the water column. More information on nutrients and management strategies to control them can be found in Chapter 11.

9.2.2 OXYGEN-CONSUMING WASTES – DISSOLVED OXYGEN CONCENTRATIONS

Maintaining adequate dissolved oxygen (DO) concentrations are critical to the survival of aquatic life and to the general health of North Carolina's surface waters. Oxygen-consuming wastes such as decomposing organic matter and some chemicals found in wastewater can reduce dissolved oxygen levels in surface water through chemical reactions or biological activity. Sources of dissolved oxygen-consuming wastes include wastewater treatment plant effluent,

illegal straight pipe discharges, aquaculture waste, the decomposition of organic matter (such as leaves, dead plants and animals) and organic waste that is deposited, washed or discharged into surface waters. Bacterial decomposition of this organic waste can rapidly deplete DO levels, especially if they are not adequately treated at a wastewater treatment plant prior to being discharged into surface waterbodies. The daily average DO standard for most waters in the state, except for those classified as trout (Tr) or swamp (Sw) waters, is 5.0 milligrams per liter (mg/l). Trout waters have a daily average DO standard of 6.0 mg/l. Nonpoint source inputs, which typically occur as a result of rainfall events, are generally a minor source of oxygen-consuming wastes.

Biochemical oxygen demand (BOD) and ammonia nitrogen (NH₃-N) associated with wastewater treatment plants are generally the two oxygen-consuming measurements of greatest concern. BOD is the amount of oxygen required by microorganisms to decompose the organic material found in streams and wastewater effluent. During summertime conditions, when water temperatures are high and streamflow is low, point sources of BOD and NH₃-N have the greatest impact on instream DO concentrations.

Some chemicals also react and bind with DO consequently limiting its availability. Industrial discharges with oxygen-consuming waste, for example, may be extremely resilient and continue to use oxygen for long distances downstream.

The primary water quality impact of oxygen-consuming wastes is similar to that of low DO levels because oxygen-consuming wastes use (or consume) the oxygen that is needed to maintain aquatic life. As the oxygen is used, levels can fall below that which is necessary to sustain life, resulting in a reduction, or even death, to aquatic communities. Low DO levels can also affect the reproduction and growth functions of fish (Alabaster and Lloyd, 1982).

9.2.3 CHLORINATED-ORGANIC COMPOUNDS

Even though disinfection substantially reduce the number of microorganisms from wastewater effluent, chlorination of residual organic material can generate chlorinated-organic compounds that may be carcinogenic or harmful to the environment. Residual chlorine or chloramines may also be capable of chlorinating organic material in the natural aquatic environment to form compounds known as trihalomethanes (THMs). In high concentrations, some THMs are carcinogenic (cancer causing). Many are persistent and can pose a threat to human health for many generations.

9.2.4 TOTAL SUSPENDED SOLIDS

Total suspended solids (TSS) are solids (i.e., sediment, decaying plant and animal material, industrial waste, sewage) that can be filtered out of the water column. High TSS can block light from reaching submerged aquatic vegetation, which slows down the rate of photosynthesis and reduces the amount of dissolved oxygen in the water column. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and die. As plants decompose, bacteria will use up even more oxygen from the water, ultimately leading to fish kills.

High TSS can also increase surface water temperature and decrease water clarity. Surface water temperature increases because the suspended particles absorb heat from sunlight. Because warmer waters hold less dissolved oxygen, dissolved oxygen levels tend to fall even further. The decrease in water clarity caused by TSS can affect the ability of fish to see and catch food. Suspended sediment can also clog fish gills, reduce growth rates, decrease resistance to disease and prevent egg and larval development. When suspended solids settle to the bottom of a waterbody, they can smother fish eggs, as well as suffocate newly hatched insect larvae. Settling sediments can fill in spaces between rocks, reducing habitat availability (Mitchell and Stapp, 1992).

9.2.5 THERMAL POLLUTION

All aquatic species require specific temperature ranges in order to be healthy and reproduce. Thermal pollution is a temperature change in natural waterbodies caused by human influence. The main cause of thermal pollution is the use of water as a coolant to manufacturing or industrial processes or the generation of electricity. Water used as coolant is returned to the natural environment at a higher temperature, which can alter aquatic ecosystems by decreasing the oxygen level and kill fish that are vulnerable to small increases in temperature. In some cases, higher temperatures may also promote plant and algal growth, which in turn will impact primary producers by reducing oxygen levels and reducing light availability.

9.2.6 COLOR

Color is generally associated with industrial wastewater and municipal wastewater treatment plants that receive industrial wastes from textile manufacturers that dye fabrics and pulp and paper mills. Color can affect the aesthetic quality of a waterbody and interfere with sunlight penetration. Submerged aquatic vegetation needs light for photosynthesis. If color blocks out light, photosynthesis will be reduced, thus reducing the production of oxygen needed for the survival of aquatic life. If light levels get too low, photosynthesis may stop altogether, causing algae to die. In addition, fish may not be able to see in waters polluted with color, making it difficult to find food. Color is usually not a toxicological problem. There is no current data showing that colored effluent poses any threats to human health or that it is the sole source of aquatic life impacts.

9.2.7 BACTERIA

No matter what the bacteria or microorganism type (i.e., virus, protozoan parasites), point and nonpoint source pollution contribute to the bacterial numbers in waterbodies. Point source pollution includes illegal household wastewater straight pipes, municipal wastewater treatment plants, sewage spills and permitted discharges. Nonpoint source pollution includes agricultural runoff, animal waste, human waste, leaky sewer lines, failing septic systems, stormwater runoff from developed land including roads, buildings and residential yards and surface or land application of human and/or animal waste. Some of the waterborne pathogenic diseases caused by certain types of microorganisms include ear infections, typhoid fever, viral and bacterial gastroenteritis, cholera and hepatitis A.

Reducing the number of microorganisms in wastewater requires disinfection, which typically involves the use of chlorine and other disinfectant agents. Although these materials may kill bacteria and other disease-causing microbes, the disinfectants also kill other microbes that are essential to the aquatic environment, often endangering the survival of species dependent on these other microbes. Many wastewater treatment facilities have added a dechlorination to the treatment process to remove residual chlorine from effluent before it is discharged to surface waters. The process should protect the surrounding aquatic environment and also achieve the water quality standard for chlorine.

9.3 WASTEWATER RULES AND REGULATIONS

9.3.1 NPDES PERMITTED ACTIVITIES

The Clean Water Act of 1972 initiated strict control of wastewater discharges with responsibility of enforcement given to the EPA. The EPA then created the National Pollutant Discharge Elimination System (NPDES) to track and control point sources of pollution. The primary method of control is the issuance of discharge permits with limitations on wastewater flow and constituents. The EPA delegated permitting authority to the State of North Carolina in 1975. All wastewater discharges to surface waters in the State of North Carolina must receive a permit to control water pollution.

Types of Wastewater Discharges

Major Facilities

Wastewater treatment plants with flows ≥ 1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts to public health and water quality).

Minor Facilities

Facilities not defined as Major.

100% Domestic Waste

Facilities that only treat domestic-type waste (from toilets, sinks, washers).

Municipal Facilities

Public facilities that serve a municipality. Can treat waste from homes and industries.

Nonmunicipal Facilities

Non-public facilities that provide treatment for domestic, industrial or commercial wastewater. This category includes wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation, and other facilities such as schools, subdivisions, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

DWQ's NPDES Permitting and Compliance Program is responsible for administering NPDES for the state. The NPDES Permitting and Compliance Program must determine the quality and quantity of treated wastewater that can be discharged into a receiving stream. An NPDES permit will specify an acceptable level of a pollutant in a discharge (i.e., bacteria, nitrate, ammonia, pH, biochemical oxygen demand, total suspended solids, etc.) in order to protect water quality. Conservative methods are used to calculate the acceptable level, based on the assimilative capacity and designated uses of the receiving stream. The permittee may choose which technologies to use to achieve the level specified in the permit. NPDES permits ensure that both North Carolina's mandatory standards for clean water and federal minimum requirements are met. As a delegated state, North Carolina has the authority to establish state water

quality standards more stringent than the federal standards established by EPA. The following are major components to permitting wastewater activities in the State of North Carolina:

NPDES Permit Review and Processing: NPDES permits are issued in two categories - individual and general. Individual permits are categorized as major or minor. Discharges from treatment systems treating domestic waste with a design flow of 1.0 million gallons per day (mgd) or more or those that have a pretreatment program are classified as major discharges. Minor discharges have a design flow of less than 1.0 mgd. Industrial and commercial discharges are classified based on several factors including flow, waste characteristics and water quality and health impacts.

General permits are developed for certain types of industrial facilities. The permit includes requirements that are appropriate for a typical facility within a specific industrial classification. General wastewater permits currently exist for the following activities: non-contact cooling water discharges, petroleum-based groundwater remediation, sand dredging, seafood packaging and domestic discharges from single family residences.

Wasteload Allocation Modeling: In order to assess the impacts of pollutants on surface water quality, DWQ develops and applies water quality models. A water quality model is a simplified representation of the physical, chemical and biological processes that occur in a waterbody. The type of model that is used is dependent upon the purpose for which it is needed, the amount of information that is available or attainable for its development and the degree of accuracy or reliability that is warranted. In most cases, DWQ develops and applies a given model to predict the response of a natural system to a given set of inputs that reflect various management strategies.

Compliance Monitoring and Enforcement: Facilities should strive to be in compliance with the NPDES permit, water quality standards and any other applicable water quality regulations, rules or statutes. Monitoring is required for facilities that receive an NPDES permit. Each facility must submit its discharge monitoring report (DMRs) no later than 28 days after the end of the reporting period. DWQ regional office staff review the DMRs and determine whether or not there were any permit limit or monitoring violations. Notices of violation and civil penalties are examples of enforcement tools DWQ uses to bring non-compliant facilities into compliance. DWQ can also issue Special Orders by Consent (SOC) and Moratoriums if a facility is non-compliant.

Pretreatment Program: The goal of the pretreatment program is to protect municipal treatment plants and publicly owned treatment works (POTWs), as well as the environment, from receiving hazardous or toxic wastes. The pretreatment program regulates nondomestic (industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA). The program requires businesses and other entities that use or produce toxic wastes to pretreat their wastes prior to discharging wastewater into the sewage collection system of a POTW. Local governments that operate POTWs typically administer state-approved pretreatment programs and address four areas of concern: interference with POTW operations; pass-through of pollutants to a receiving stream; municipal sludge

contamination; and exposure of workers to chemical hazards. Interference refers to a problem with plant operation including physical obstruction and inhibition of biological activity.

DWQ and local governments develop pretreatment limits by determining the maximum amount of each pollutant that a facility can accept at the influent (or headworks) while still protecting the receiving water, the POTW and the POTW's sludge disposal options. More information about the pretreatment can be found on the PERCS Unit Web site (<http://h2o.enr.state.nc.us/percs/Pretreatment/PERCSPretreatmentHome.html>).

Operator Certification and Training: Water pollution control systems must be operated by individuals certified by the North Carolina Water Pollution Control System Operators Certification Commission (WPCSOCC). The level of training and certification that the operator must have is based on the type and complexity of the wastewater treatment system. The Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, subsurface operation, spray irrigation operation, animal waste management and a variety of specialized conditional exams for specific technologies (e.g., oil/water separators).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most efficient treatment system will not function properly. The goal of the WPCSOCC is to train competent and conscientious professionals who will provide the best wastewater treatment, and thus protect the environment and public health. The Technical Assistance and Certification Unit (<http://h2o.enr.state.nc.us/tacu/collect.html>) of DWQ provides staff support to the Commission and assists in organizing operator training. Specialty courses and seminars for operators are also offered by the North Carolina combined section of the Water Environment Association/American Water Works Association (WEA/AWWA).

Non-Discharge and Regional Wastewater Treatment Alternatives: DWQ requires new and expanding NPDES permit applicants to provide documentation that considers alternatives to surface waters. This analysis includes a feasibility study on options such as the connection to a regional wastewater treatment facility or the use of non-discharge options such as spray irrigation, rapid infiltration basins and drip irrigation systems. It also takes into consideration the economic feasibility of the available options. If no other economically feasible option exists, the NPDES application will be forwarded for review and completion. If one or more alternative options are economically feasible, however, it must be reevaluated to determine which option is the best option.

Non-discharge is the preferred wastewater disposal alternative in most instances. Although these systems are operated without a discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is applied to the land at a rate that does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the DWQ Aquifer Protection Section – Land Application Unit (LAU) Web site (<http://h2o.enr.state.nc.us/lau/main.html>).

More information about NPDES can be found on the EPA Web site (<http://cfpub.epa.gov/npdes/index.cfm>) and the DWQ Permitting and Compliance Programs Web site (<http://h2o.enr.state.nc.us/NPDES/NPDESweb.html>).

9.3.2 NON-DISCHARGE PERMITS

DWQ has a non-discharge program that reviews and permits systems using land application as a means of waste disposal. These systems include spray irrigation, animal waste management systems, rapid infiltration basins, drip irrigation systems, land application of residuals programs, wastewater collection systems and beneficial reuse of wastewater systems.

The program, and all associated permits, is regulated by North Carolina General Statutes 143.215.1 and the Administrative Code Section 15A NCAC 2T .0100 - Waste Not Discharged to Surface Waters. These sections not only give DWQ the authority to issue permits; they also provide details on the permitting process and information that must be submitted with a permit application. The [Non-Discharge Permitting Unit \(NDPU\)](#) reviews and approves all systems.

Sanitary sewer collection systems used to collect the wastewater from NPDES discharge wastewater treatment facilities and non-discharge wastewater treatment facilities are both permitted by NDPU. The land application of residuals program and the distribution and marketing program are also permitted by NDPU, as required by EPA's 40 CFR Part 503 rules.

Non-discharge program permits are issued in several categories based on wastewater collection system type. Individual permits exist for gravity sewers, pump stations and force mains, pressure sewers and STEP systems. These applications require a final set of plans and specifications prior to the issuance of a permit.

DWQ also has a fast-track permitting system for gravity sewers. To help with the fast-track system, a list of Minimum Design Criteria was developed that includes the important requirements for the construction of a gravity sewer system.

The fast-track permit requires a four-page application, as well as an engineer seal and signature to insure that the gravity system will be built in accordance with state rules, regulations and the Minimum Design Criteria. Upon project completion, an engineer's certification must be submitted along with record drawings. The fast-track process does not require plans to be submitted prior to permit issuance. This has significantly reduced permitting time.

The non-discharge program also requires wastewater systems that utilize land application for wastewater disposal to be permitted. The program has operational and monitoring requirements similar to those of the NPDES permit.

The primary difference is that treated effluent is not discharged to surface waters. It is usually discharged to a spray irrigation system for land application. Some other options for the land application of effluent include rapid infiltration basins and drip irrigation systems. When compared to spray irrigation, rapid infiltration systems are designed to have a much more intense and higher rate of land application. Most rapid infiltration systems are located in the sandy

regions of the state where soils can handle an increased application volume. Drip irrigation systems, which are typically used for lower effluent volumes, are located statewide.

Every wastewater treatment facility in the State of North Carolina, including large NPDES systems, pretreatment systems and non-discharge systems, produce some form and amount of wastewater residuals. DWQ has a program that requires a permit for the land application of residuals. The program was developed around the EPA rules 40 CFR Part 257 and 40 CFR Part 503. More information about non-discharge permits can be found on the DWQ Non-Discharge Permitting Unit Web site (<http://h2o.enr.state.nc.us/lau/main.html>).

9.3.3 ON-SITE WATER PROTECTION SECTION (OSWPS)

The On-Site Water Protection Section (OSWPS) (http://www.deh.enr.state.nc.us/osww_new//index.htm) of NCDENR Division of Environmental Health (DEH) writes, oversees and enforces the rules and laws regulating the design, installation, repair, operation and maintenance of on-site wells and wastewater treatment systems for the protection of human and environmental health from microbial and chemical contamination. OSWPS provides regulatory and consultative services statewide to local health departments and numerous other clients, including builders, developers, land- and homeowners, system installers, system operators, engineers, soil scientists, geologists and environmental health consultants. However, an authorized environmental health specialist in each county health department conducts the actual implementation of the regulations (i.e., site evaluation, permitting of new systems).

All of the rules and regulations including horizontal setbacks, depth to groundwater, soils requirements, loading rates, etc., are specific to North Carolina and are based on scientific studies of microbial and chemical fate and transport. These rules are constructed to protect groundwater (well water) and surface water from microbial contamination as well as other contaminants. The on-site wastewater treatment regulations are devised to minimize migration of microbes and pathogens to groundwater and surface water. More information related to on-site wastewater management can be found on the DEH OSWPS Web site (www.deh.enr.state.nc.us/osww_new//index.htm).

9.3.4 WASTEWATER DISCHARGE ELIMINATION PROGRAM (WADE)

In North Carolina, the Wastewater Discharge Elimination (WaDE) Program (http://www.deh.enr.state.nc.us/osww_new//WaDE.htm) through OSWPS in DEH was established pursuant to Senate Law 1996-18es2, Section 27.26 (<http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=1995e2&BillID=H53>), to identify and eliminate discharges from straight pipes and failing septic systems to land surfaces and streams. Funds appropriated by the NC General Assembly support a two-member team to address the straight pipe and failing septic system issues in North Carolina. Additional financial support has been secured through grants from the NC Clean Water Management Trust Fund (CWMTF) (<http://www.cwmtf.net/>) and the US Environmental Protection Agency (EPA) 319 Non-point Source Program (<http://www.epa.gov/owow/nps/cwact.html>). Strong collaboration with local and federal agencies as well as the public, the media and environmental groups is the

hallmark of the WaDE program and the key to its successes thus far. More information about the WaDE program can be found on the DEH OSWPS Web site (www.deh.enr.state.nc.us/osww_new//WaDE.htm).

9.4 REDUCING WATER QUALITY IMPACTS

9.4.1 ON-SITE WASTEWATER MANAGEMENT

To protect public health and water quality, best management practices (BMPs) need to be implemented throughout the life cycle of an on-site wastewater disposal (septic) system. Life cycle management problems can be addressed in three phases. The first phase includes system siting, design and installation. The second phase involves the operation of the system and phase three involves maintenance and repair when the system malfunctions or fails.

As BMPs are applied in each life cycle phase, the primary factor for the success of the system is the participation of the local influencing health department and the cooperation of the developer, owner, design engineer, system operator and the state.

The following list is a summary of the current life cycle management practices and penalties utilized in North Carolina to implement the on-site sewage systems program.

Improvement Permit: The developer or property owner meets with a member of the environmental health staff of the local health department to review the proposed project. An application is then submitted to the local health department. The application contains information regarding ownership, plat of the property, site plan, type of facility, estimated sewage flow, proposed method of sewage collection, treatment and disposal. The improvement permit must be issued prior to other construction permits and allows only temporary electrical power to the site.

Construction Authorization: The local health department, with technical assistance from the state (when requested), evaluates the proposed sewage effluent disposal site for several factors, including slope, landscape position, soil morphology, soil drainage, soil depth and space requirements. After evaluating the site characteristics, the local health department assigns a site suitability classification, establishes the design sewage flow and the design-loading rate for the soil disposal system. Specific design requirements are included in the Construction Authorization. The permit includes system components and locations, setbacks and future repair areas and allows construction to begin for the on-site sewage system.

Design Review: The applicant is required to submit plans and specifications prepared by a professional engineer for the sewage collection, treatment and disposal system of complex systems, or for systems exceeding 3,000 gallons per day. Both the OSWPS and local health departments review the design plans. The designer must also include site specifications, installation procedures, phasing schedules, operation and maintenance procedures, monitoring requirements and designate the responsible parties for operation and maintenance.

Legal Document Review: For systems with multiple ownership or off-site disposal, the applicant must prepare and submit to the OSWPS and local health departments the legal review documents applicable to the project.

Operation Permit: An operation permit is issued to the owner of the on-site sewage system by the local health department when it determines that all the requirements in the rules, plans and specifications are met. All conditions on the improvement permit/construction authorization must also be met and, if required, the design engineer for the sewage collection, treatment and disposal system certifies, in writing, that the system has been installed according to the approved plans and specifications. The operation permit may also be conditioned to establish performance requirements and may be issued for a specific period. The operation permit prevents permanent electrical service to the project and prevents occupancy of the facilities until it is issued. The operation permit applies to all on-site wastewater systems.

Surveillance: Once an on-site sewage system is placed into operation, the local health department must make routine inspections at least annually for large systems to determine that the system is performing satisfactorily and not creating a public health nuisance or hazard. Additionally, monitoring reports must be routinely submitted to the local health department as required in the permits. The state provides technical assistance to the local health department and the system operator in assuring adequate performance. While annual inspections are required, frequent performance checks must be made by the local health department.

If the local health department determines that an on-site wastewater system is malfunctioning (i.e., surfacing effluent, discharges to surface or groundwater, sewage backup into buildings), improvement, construction authorization and operation permits are required to pursue the required repairs and/or modifications.

Educational information should also be provided to new septic system owners regarding the maintenance of these systems over time. DWQ has developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. The publication includes a discussion about septic system maintenance and offers other sources of information. To obtain a free copy, call (919) 733-5083. The North Carolina State University Cooperative Extension Service (NCCES) has also put together a homeowner's guide for septic system care entitled *Improving Septic Systems*. The guide can be found on the NCCES Web site (www.soil.ncsu.edu/assist/homeassist/septic/). The following Web site (www.wsg.washington.edu/outreach/mas/water_quality/septicsense/septicmain.html) also offers information about maintaining septic systems in three easy to follow steps.

9.4.2 MONITORING SANITARY SEWERS

Sewer connections can leak or rupture, allowing sewage to flow into surface waterbodies. Common causes of sewer failures and overflows are tree roots growing into sewer lines, excessive rainfall and age. Grease, a by-product of cooking, can also enter sanitary sewers through household and/or restaurant drains. Grease sticks to the inside of sewer pipes, building

up over time. If the entire sewer pipe becomes blocked, sewage can overflow into yards, streets and surface water.

To help prevent bacterial contamination from human and industrial waste, communities should evaluate where sewer lines are in relation to a stream corridor, replace fractured or damaged sewer lines and monitor lines regularly. When evaluating the need for sewer line extensions, communities should keep in mind that extensions to existing water and sewer lines encourage more development, which often results in more impervious surface cover and nonpoint source pollution from cumulative and secondary impacts.

9.4.3 COMMUNITY INVOLVEMENT

Experience has shown that widespread community support is generally necessary to mount an effective campaign that addresses septic system contamination issues, and that this support is unlikely to be forthcoming in the absence of any significant perceived benefits (Herring, 1996). Local governments around the country are finding innovative ways to address improperly installed and/or failing septic systems. For example, in order to protect water quality in the Chesapeake Bay, Arlington County, Virginia has adopted an ordinance requiring all septic tanks be pumped at least once every five years (USEPA, 1993). Stinson Beach, California developed a management program for on-site systems after discovering that malfunctioning systems were threatening public health (Herring, 1996). Homeowners here pay a monthly fee to cover the cost of inspections and testing, in addition to any construction and repair costs (USEPA, 1993). In the Puget Sound area, where a significant shellfish resource has been threatened by fecal coliform contamination from a number of sources, most counties have established revolving loan funds to facilitate the repair of failing systems (Center for Watershed Protection, 1999).

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